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IAALD

International Association of Agricultural Information Specialists – www.iaald.org

From the Editor's Desk

"No Farmers, No Food" is a popular sign stuck on the bumpers of cars driving around Ithaca, NY, which was also the site of IAALD's XIVth World Congress in July 2013. Over 120 attendees came from thirty-three different countries* to Ithaca and Cornell University, no small feat when you consider how far we are from any major metropolitan area (more than one traveler from abroad was dismayed to find out that a taxi ride from NY City's JFK airport to Ithaca is in fact 250 miles/400 kilometers). The Congress' theme was "Emerging Priorities for Scientific & Agricultural Information," and the forty-five papers, eighteen posters and six workshops presented over the course of the four days demonstrated the range of innovative and transformative projects around the globe in this field. "No Librarians, No Food" might be another good way to sum things up.

Presented here are twenty-two papers from the Congress, a sample of the full meal offered by the Congress that should give you a taste of the topics presented as well as the world's agricultural information priorities, circa 2013. While there is plenty of discussion of the potential impact of information technologies like web portals, mobile phones and social media, what struck me in reviewing them was the centrality of *access to information* as a theme in all of these papers. Be they working with extension agents in Uganda, creating a union catalog of Indian agricultural libraries, or providing outreach to University farm staff in Canada, the agricultural librarians and information specialists represented here are all working diligently, by a variety of means, to assure that farmers, extension agents, faculty members and all other agricultural practitioners get the information they need to do their jobs and assure food security both globally and locally. The tools will probably change — and if you're reading this in 2050, you may wonder what Facebook actually was — but the commitment to information access should remain a central and abiding priority.

My thanks to the authors for sharing their papers and making their ideas public, and for IAALD's commitment to publishing AIW as an open access journal — if you are reading this, you're benefiting from their commitment to making information freely available. I hope that the many ideas collected here provide you with "food for thought," as they say in these parts, and that they might just help stir a global conversation on why such topics matter. *No Librarians, No Food* indeed. And finally, if you would like to see full videos of many of these papers presented at the Congress, as well as other presentations not represented here, be sure to check out the IAALD 2013 World Congress site by going to YouTube and typing in IAALD 2013 World Congress.

Jim Morris-Knower
Guest Editor

*Attendees came from Argentina, Australia, Benin, Botswana, Cameroon, Canada, China, Costa Rica, El Salvador, Eritrea, Ethiopia, Fiji, France, Germany, Ghana, India, Indonesia, Israel, Italy, Japan, Kenya, Mexico, Netherlands, Nigeria, Papua New Guinea, Sierra Leone, South Africa, Tanzania, United Republic of, Trinidad and Tobago, Uganda, United Kingdom, United States, and Zimbabwe.

Conference Reflections

Emerging Priorities for Scientific & Agricultural Information was the theme of the XIVth World Congress of the International Association of Agricultural Information Specialists (IAALD) held at Cornell University in the USA from July 21 through 24, 2013. The 120 attendees were treated to some of the most beautiful countryside in the United States. While most people think of New York as a metropolitan area it is also an agricultural state with nearly 25% of its land devoted to farming. Its agricultural products include dairy, corn, cattle, and apples to name a few. The College of Agriculture and Life Sciences at Cornell is one of the most notable in the country and the Mann Library contains a premier research collection of the agricultural literature. It was an excellent opportunity for librarians and information professionals from around the world to interact in a dynamic research environment. The conference provided a venue for information professionals from 45 countries to come together, attend sessions and interact on a social level. This is "social networking" at its highest level with the opportunity to meet face to face with colleagues from around the world both in the professional and the social setting.

The conference planners provided many opportunities to engage both professionally and socially. The speaking venues were numerous and the social functions were enjoyed by all. The welcome receptions at the Johnson Museum gave attendees an opportunity to renew old acquaintances and to make new ones along with enjoying the museum exhibits. The Bar-B-Que Dinner on the Agricultural Quad allowed everyone to experience an American tradition and the farm tours allowed all to see the beautiful rural country side and meet local farmers. Dinner at Dano's Heuriger on Seneca Lake was a relaxing way to end the conference with good fellowship and food.

Presented here you will find the papers from the Conference. For reasons too numerous to go into, we had multiple delays on producing this issue. The publications of these papers are long overdue but we hope you will feel that they were worth the wait.

There were a number of people from Cornell who contributed to the success of the event. Jaron Porciello, conference chair put together an exceptional team. We thank Jaron and her team for their hard work in making this event a success. A special thank you goes out to Jim Morris-Knower from Cornell who edited the papers for this issue.

Toni Greider

Conference attendees enjoy the view of beautiful Seneca Lake in New York, USA.

The State of Information Literacy Policy: A Global Priority

Sharon Weiner, EdD, MLS

This paper is based on a plenary presentation given at the International Association of Agricultural Information Specialists on July 22, 2013.

Abstract: Access to information is important for economic development and community-based solutions to global challenges. However, access to information alone is not sufficient: people need to know how to find, evaluate, manage, analyze, and compile information and communicate the results effectively for the intended audience. This paper presents a global overview of information literacy policy. The paper discusses the meaning of information literacy and its relation to information policy. The paper proposes a role of information literacy in addressing global challenges. It gives national examples of information literacy policy. Finally, the paper identifies challenges in information literacy policy and discusses ways to address them.

Resumé: L'accès à l'information est importante pour le développement économique et les solutions communautaires face aux défis mondiaux. Toutefois, l'accès à l'information ne suffit pas à lui seul : les gens ont besoin de savoir comment trouver, évaluer,gérer, analyser et compiler l'information, et communiquer les résultats efficacement au public visé. Ce document présente un aperçu global de la politique de maîtrise de l'information. Le document aborde la signification de la maîtrise de l'information et son rapport à la politique de l'information. Le document propose un rôle de la maîtrise de l'information face aux défis mondiaux. Il donne des exemples nationaux de politique de maîtrise de l'information. Enfin, le document énumère les défisde la politique d'alphabétisation en information et examine les moyens de les résoudre.

Resumen: El acceso a la información es importante para el desarrollo económico y las soluciones basadas en la comunidad ante los desafíos globales. Sin embargo, el acceso a la información por sí solo no es suficiente: la gente necesita saber cómo encontrar, evaluar, manejar, analizar y compilar información y comunicar los resultados de manera efectiva a las audiencias previstas. Este artículo presenta una visión global de la política de alfabetización informacional. Se analiza el significado de la alfabetización informacional y surelación con la política de información. El documento propone un papel que la alfabetización informacional puede desempeñar para abordar los desafíos globales. Da ejemplos de las políticas de alfabetización informacional de diferentes países. Finalmente, el documento identifica los desafíos que se presentan en la política de alfabetización informacional y analiza la forma de abordarlos.

> *"How well an individual, an organization, and an entire society can harness, access, share, and make use of available information will ultimately decide their ability to generate economic growth and to enhance the quality of life for all."* (Karan, 2011)

Access to information is important for economic development, personal empowerment, participative societies, and community-based solutions to global challenges (The World Bank Group 2012; United Nations 2010; Munyua 2009; Rao and Malhan 2008, p. 177; UN Millenium Project 2005; James 2005). However, access to information alone is not sufficient to achieve these goals: people need to know how to find, evaluate, manage, analyze, synthesize, use, and communicate information in a manner that is effective and appropriate for the intended audience. This can be challenging for many reasons: the sheer amount of available but poorly organized information; gaps in information resources that do not currently exist or are not accessible; the digital divide; and educational, language, and technology barriers. Public policy is a way to address these issues systemically in a society, but to what extent does policy related to information literacy exist internationally? How does it vary among countries? The purpose of this paper is to provide a global overview of information literacy (IL) policy. The paper identifies challenges in information literacy policy and discusses actions that can be taken to address them.

Developing a Common Understanding of Information Literacy

The term, "information literacy," was coined in 1974 as the concept of the "information society" took hold (Zurkowski). The essence of information literacy is the ability to find, evaluate, and communicate information effectively for a specific purpose (ACRL 1989). Information literacy may be considered to be an umbrella term for all other literacies, such as media, digital, health, and financial (Garner 2006, p. 65). The term is synonymous with or closely related to such contextual applications as evidence-based practice, informed or guided learning, knowledge management, problem-solving, and competitive intelligence. An examination of the literature of information literacy and critical thinking shows that they are closely related (Weiner, J. M. 2011). There is general agreement that information literacy contributes to workforce readiness, educational success, and everyday life decision-making (Obama 2009; Perrault 2007; Garner 2006; Beacons 2005; ACRL 1989).

What is information policy?

Information policy is a complex and multi-dimensional area that involves technology, communications, law, government, medicine, education, business and economics. It encompasses laws, regulations, doctrine and other societal positions related to the creation, processing, flow and access to information. Information policies can facilitate access to and use of information or they can restrict it.

There are numerous categorizations of information policy (Ma 2012; p. 60–61; Braman 2006, p. 11–20). Weiner organized the dimensions of information policy into three categories: information infrastructure, information resources and information literacy (see Figure 1). Information infrastructure encompasses the hardware that enables the use of information through technology. The information resources are the knowledge content that technology can facilitate. Some resources are available openly and freely to all, while others are restricted to subscribers or to those who are authorized to use them because of sensitivity of the information, such as corporate proprietary information, health records, or government security information. There are information resources that are not dependent on technology, such as people and print resources. Finally, information literacy involves the competencies to effectively and efficiently find, use and communicate information for specific purposes.

Information policy varies considerably from one nation to another, and even within nations. It may be inconsistent, over-regulated or completely lacking. An example is the U.S., where there is no central coordinating body for information policy. Different organizations, agencies and levels of governmental hierarchy create policies that can be incompatible, redundant or conflicting. One reason for this is that information policy tends to develop as needed or as problems arise, rather than in a coordinated, cohesive manner with all major stakeholders participating. Opinions on who should be responsible for information literacy vary: does this responsibility belong to the government, education, employers, or is it a personal responsibility?

Information Literacy Policy and Global Challenges

The status of policies worldwide relating to information literacy is important because the world is grappling with difficult issues identified by the United Nations (UN):

- The eradication of poverty and hunger
- Universal primary education
- Gender equality
- Child and maternal health
- Combat HIV/AIDS
- Environmental sustainability

Figure 1 – Weiner's Categorization of Information Policy.

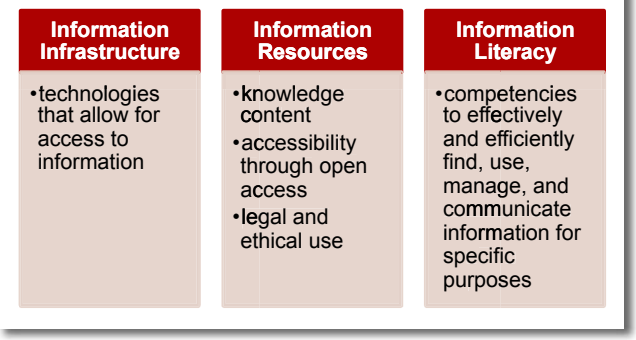

Figure 2 – How to Achieve Solutions to Global Problems.

- Global development partnerships (UN Millennium Development Goals)

The strategies that the UN is pursuing to achieve the Millennium Development Goals are: rural and urban productivity; health, education and gender equality; water and sanitation; environmental sustainability; science, technology, and innovation; and transparent, decentralized governance (UN Millennium Project 2005). For these strategies to be realized, those involved in developing and implementing solutions must have competence in finding and using information. "Inequity in access to information and inadequate training in how to use information worldwide hampers the collective problem-solving that could lead to dynamic, innovative results" (Weiner 2013). In Thailand, executives, managers, and librarians identified the lack of a clear national information policy as a factor that influenced the slow development of the science and technology information sector (Ruenwai and Morris 2008, p. 282). The U.S. President stated, "The ability to seek, find, and decipher information can be applied to countless life decisions, whether financial, medical, educational, or technical" (Obama 2009). Information literacy affects the "ability to access and use available information" (Arnold 2004, p. 206). Figure 2 illustrates that effective long-term solutions develop when stakeholders

have competency with information literacy and collaborate to problem-solve.

Jobs are key to economic growth, which is important for resolving many of the global challenges. In the workplace, whether a metropolitan office building, a rural farm, or a village marketplace, people have three things in common: they use technology for their work; they find and use information; and they work with people. Much of education is based on a didactic model in classrooms that are not conducive to interaction, and the finding and use of information is not embedded throughout formal education. There is a need for educational systems to adapt so that they can prepare people for success in the workplace by teaching the use of technology, optimal ways to find and use information and the ability to collaborate. Since the ability to find and use information develops a capacity for learning independently and throughout life, integrating this throughout the formal education of children and young adults can prepare people for success in the workplace and throughout life.

How Information Literacy Issues Can Become Policy

Issues become policy through various and complex means. Inclusion of an issue on a policy agenda is an important step toward the development and implementation of policy. An issue can be linked with an already accepted policy issue to attain increased visibility and importance. For instance, information literacy has been linked to educational reform, workplace readiness, lifelong learning, an informed citizenry and participative society, and a globally competitive workforce (Moscow Declaration 2012; Obama 2009; Garner 2006; Perrault 2006; Beacons 2005; The Prague 2003; Thompson 2003; ACRL 1989). Factors that can influence policy agendas include current political events, societal problems, government officials, policy professionals and public opinion (Weiner, S. 2011, p. 298). For example, the wife of the Vice President of Ghana, Matilda Nana Manye Amissah-Arthur, is a librarian and past president of the Ghana Library Association. As a prominent political figure, she can influence public opinion and the addressing of societal problems. She is a strong advocate for information literacy (Second Lady 2013). Another example is the Finnish Ministry of Education and Culture, which is promoting media literacy (a type of information literacy) as a means of social inclusion, active citizenship, critical thinking, creativity and self-expression (Good Media Literacy 2013).

Another way that issues can become policy is through policy diffusion (Weiner, S. 2011, p. 303). The National Forum on Information Literacy's "Information Literacy Proclamation Project" is a deliberate strategy to move the issue of information literacy to policy agendas in the U.S. The effort began in 2009 with the successful proclamation by President Barack Obama declaring October as Information Literacy Awareness month. The Forum encourages information literacy advocates in each U.S. state and territory to recommend that their governors issue a similar proclamation to raise awareness at the state level. To date, twenty-three states, the Northern Mariana Islands, and the city of Anchorage, Alaska, had official proclamations (Weiner, Jackman, and Prause 2013).

Information Literacy Policy Challenges

Most countries do not have a coordinated, well-planned strategy involving multiple stakeholders, prioritization and sufficient funding to address information literacy competency. There is more to accomplish so that information literacy competency can become ubiquitous through progressive integration in educational curricula. These are the primary challenges that need to be addressed:

1. Limited understanding of the importance of information literacy. There is a lack of recognition of the importance of information to development (Wopereis-Pura 2009, p. 77; Ayoo 2002, p. 351, 354). Since personnel in policymaking positions change frequently, advocates for information literacy must repeatedly educate newcomers about the importance of information literacy as a societal issue. The importance of the ability to find and use information must be communicated to stakeholders from individuals and communities to policymakers. Advocates should compile and share real-life stories of how information literacy, or the lack of it, affects decisions and problem-solving, building on such a work as *Great Information Disasters* by Horton and Lewis (1991).

Researchers can collect data on the cost of lack of information literacy and communicate it widely. There are data on the cost of lack of health literacy and lack of financial literacy. In fact, one's standard of living is not just related to personal financial resources, but to the level of financial literacy they have (Financial Education 2012; van Rooij, et al. 2012). And lower health literacy means greater difficulty in controlling chronic illnesses, less likelihood of participating in disease prevention programs, more likely to be hospitalized, and greater mortality (Eichler, et al. 2009; Vernon, et al. n.d.; Nielsen-Bohlman 2004; Baker, et al. 1998).

Efforts to educate people about the importance of information can begin through stakeholders groups. In Poland, while there are no policies that include information literacy, the Polish Librarians Association developed a plan for information-gathering and advocacy (Wiorogórska 2011, p. 1). And the European Network on IL, or EnIL (http://enil.ceris.cnr.it/Basili/EnIL/index.php?id=european-observatory-on-il-policies-and-research) posts links to policy information for member countries. EnIL addresses research issues such as policy awareness, higher education policies, and best practices in information literacy (Basili 2011, p. 401).

2. Need for ongoing education in how to find and use information. It is not enough to have an adequate

technology infrastructure and access to information resources. People need to learn how to find and use information (Ballestra 2010, p. 2; Gendina 2010, p. 7; Bertolini, 2004, p. 3; van Dijk 2000, p. 167). UNESCO sponsored workshops to "train the trainers" in information literacy; 761 people from 99 countries attended (Boekhorst and Horton 2009, p. 224). In Wales, a cross-sector group developed the "Information Literacy Framework for Wales" which has a unified approach to embedding information literacy in education, training, and throughout life within the Credit and Qualifications Framework for Wales (Welsh [n.d.]).

3. Need for stakeholder collaboration. Cross-sector and interdisciplinary collaboration is essential for developing information literacy policy (Moscow Declaration 2012; Irving 2011, p. 435; Mokhtar and Majid 2008, p. 10; Ruenwai and Morris 2008, p. 287; Kargbo 2007, p. 327). In Thailand, executives, managers and librarians perceived that a lack of collaboration between institutions and at the national level was one of the reasons for the slower development of the science and technology information sector in Thailand compared to developed countries (Ruenwai and Morris 2008, p. 282). Ponjuan (2010, p. 96) suggested that evaluation of the new Cuban National Information Literacy Program occur following "implementation by many different local communities and many different socio-economic groups."

In a review of information literacy education in schools internationally, Moore (2002) stated that "sound communication between advocates and stakeholders is essential" and that "governments need to establish advisory groups to ensure that:

- There is a clear understanding of what is to be achieved and why it is desirable;
- Coordinated plans for implementation are developed so that top down and grassroots strategies from each sector merge in an effective and timely fashion; and
- Internationally recognized publications…are critically analyzed for those aspects that can be adopted or adapted to local resource conditions and student learning needs as the basis for short, medium and long term planning."

4. Educational systems need change. The need for change in educational systems has been noted for both Italy and Columbia as well. In Italy, Laura Ballestra notes, "teaching style is traditional and problem solving that uses information skills is not valued. Italian students are not requested to write assignments and, as a result, they often miss out on the opportunity to search for information" (Ballestra 2010, p. 2). And in Colombia "…information literacy training is not clearly seen as a key strategy in education, and research libraries" (Tirado and Penagos 2010, p. 18).

Teacher education programs, in particular, must include information literacy training so that teachers can develop in children the skills and habits that foster the ability to find and use information effectively. Libraries must be staffed by librarians who are professionally trained in library science practices and information literacy so that they can advise library users appropriately (Tirado & Penagos 2010, p. 12; Gendina 2010, p. 12; Ruenwai and Morris 2008, p. 287; Kargbo 2007, p. 328). Educational systems must adopt pedagogies that develop lifelong learners (Mokhtar and Majid 2008, p. 9; Garner 2006).

The United Kingdom mapped information literacy to the national curriculum and incorporated information policy functions into a Cabinet Office. Many U.S. educational institutions and accrediting organizations include information literacy as an expected learning outcome or standard (Saunders 2007; Essential learning outcomes n.d.). And the Finland Ministry of Education included information literacy in its 2003–2008 plan for education and research; it is part of the curriculum for the country's Virtual University (Tolonen 2006, p. 3).

Conclusion: Taking Action to Address Challenges

If communities are to participate in sustainable solutions to global challenges, information literacy—the ability to find, evaluate, and communicate information effectively for a specific purpose (ACRL 1989)—should be a priority for societies. There is much to do, but the steps to the solutions are known. Each person, each community and each stakeholder organization can focus on issues most relevant to them and take action on the professional, societal or personal levels. Some ways to influence policy are to:

- Learn about the policy process and identify those who have influence over policy.
- Network with people who have a common interest.
- Consider coupling information literacy with other policy priorities.
- Communicate effectively with policy makers by using argument, persuasion, reasoning, and summarized research findings (Weiner, S. 2011, p. 306–308).

In conclusion, information literacy policy is complex. There is great variation in its occurrence in different societies. Without it, investment in technology and economic development has limited results. Policy making for information literacy requires that individuals and organizations exert influence in their communities, societies, and governments.

References

ACRL. 1989. *Presidential Committee on Information Literacy: Final Report.* http://www.ala.org/acrl/publications/whitepapers/presidential

Arnold A. 2004. "Developing a National Information Policy—Considerations for Developing Countries." *International Information & Library Review* 36:199–207.

Ayoo P, Otike J. 2002. "Factors Hampering the Formulation of a National Information Policy in Kenya." *Library Review* 51(7): 350–7.

Ballestra, Laura. 2010. Italy: Information literacy state-of-the art report. http://www.ifla.org/files/assets/information-literacy/publications/il-report/italy-2010.pdf .

Baker, D.W., et al. 1998. "Health Literacy and the Risk of Hospital Admission." *Journal of General Internal Medicine* 13(12):791–98.

Basili C. 2011. "A Framework for Analyzing and Comparing Information Literacy Policies in European Countries." *Library Trends* 60(2):395–418.

Beacons of the Information Society: The Alexandria Proclamation on Information Literacy and Lifelong Learning, 2005. http://www.ifla.org/publications/beacons-of-the-information-society-the-alexandria-proclamation-on-information-literacy.

Bertolini, Romeo. 2004. *Making Information and Communications Technologies Work for Food Security in Africa*. 2020 Africa Conference Brief 11. Washington, DC: International Food Policy Research Institute. http://www.ifpri.org/sites/default/files/pubs/pubs/ib/ib27.pdf

Boekhorst AK, Horton Jr. FW. 2009. "Training-the-Trainers in Information Literacy (TTT) Workshops Project, Final Report to UNESCO." *International Information and Library Review* 41(4):224–30.

Braman S. 2006. *Change of State: Information, Policy, and Power*. Cambridge, MA: MIT Press.

Eichler K., et al. 2009. "The Costs of Limited Health Literacy: A Systematic Review." *International Journal of Public Health* 54: 313–324.

Essential learning outcomes. [n.d.]. Association of American Colleges and Universities. http://www.aacu.org/leap/vision.cfm

Financial Education in Schools. 2012. International Network on Financial Education. http://www.oecd.org/daf/fin/financial-education/FinEdSchool_web.pdf

Garner S. D. 2006. *High-Level Colloquium on Information Literacy and Lifelong Learning, Bibliotheca Alexandrina, Alexandria, Egypt, November 6–9, 2005: Report of a meeting*. http://www.ifla.org/publications/high-level-colloquium-on-information-literacy-and-lifelong-learning

Gendina, Natalia. 2010. *Information literacy in Russia. Problems of formation of information literacy and information culture of children and youth: A view from Russia*. http://www.ifla.org/files/assets/information-literacy/publications/il-report/russia-2010.pdf

Good Media Literacy; National Policy Guidelines 2013–2016. 2013. Ministry of Education and Culture. http://www.minedu.fi/OPM/Julkaisut/2013/Hyva_medialukutaito.html?lang=en

Horton, Jr., Forest W. and Lewis, Dennis (eds.). 1991. *Great Information Disasters.* London: Aslib

Irving, Christine. 2011. "National Information Literacy Framework (Scotland): Pioneering Work to Influence Policy Making or Tinkering at the Edges?" 60(2):419–39.

James J. 2005. "The Global Digital Divide in the Internet: Developed Countries Constructs and Third World Realities." *Journal of Information Science* 31(2):114–123.

Karan K. 2011. *Information Policies in Asia: Development of Indicators*. Bangkok, Thailand: UNESCO Bangkok. http://www.unesco.org/new/en/communication-and-information/resources/publications-and-communication-materials/publications/full-list/information-policies-in-asia-development-of-indicators/.

Kargbo, John Abdul. 2007. "The Need for a Library and Information Policy in Sierra Leone." *Library Review* 56(4):323–329.

Ma F, Jiang T, Fu Z, Zhao H. 2012. "A study on the Structure of the Chinese Information Policy Domain Framework." *Journal of Information Science* 38(1):52–63.

Mokhtar, Intan Azura and Majid, Shaheen. 2008. "Information Literacy Standards, Guidelines and Their Implementation: An Analysis." *DESIDOC Journal of Library & Information Technology* 28(2):5–12.

Moore, Penny. 2002. *An Analysis of Information Literacy Education Worldwide*. White Paper prepared for UNESCO, the U.S. National Commission on Libraries and Information Science, and the National Forum on Information Literacy, for use at the Information Literacy Meeting of Experts, Prague, The Czech Republic, July. http://portal.unesco.org/ci/fr/file_download.php/33e3dd652a107b3be6d64fd67ae898f5Information%2BLiteracy%2BEducation%2B%28Moore%29.pdf.

The Moscow Declaration on Media and Information Literacy. UNESCO Information for All Programme, IFLA. June 28, 2012. http://www.ifla.org/publications/moscow-declaration-on-media-and-information-liter'acy.

Munyua H, Adera E, Jensen M. 2009. "Emerging ICTs and Their Potential in Revitalizing Small-Scale Agriculture in Africa." *Agricultural Information Worldwide* 2(1):3–9.

Nielsen-Bohlman L. 2004. *Health Literacy: A Prescription to End Confusion*. Washington, DC: National Academies Press. http://www.iom.edu/Reports/2004/Health-Literacy-A-Prescription-to-End-Confusion.aspx.

Obama B. 2009. *National Information Literacy Awareness Month, 2009: A Proclamation*. http://www.whitehouse.gov/the_press_office/Presidential-Proclamation-National-Information-Literacy-Awareness-Month.

Perrault, A. 2007. *American Competitiveness in the Internet Age: Information Literacy Summit, October 16, 2006, Washington, DC*. http://infolit.org/wp-content/uploads/2012/09/Summit16Oct2007B.pdf.

Ponjuan, Gloria. 2010. "Guiding Principles for the Preparation of a National Information Literacy Program." *International Information & Library Review* 42:91–97.

The Prague Declaration: "Towards an Information Literate Society," 2003. http://portal.unesco.org/ci/en/ev.php-URL_ID=19636&URL_DO=DO_TOPIC&URL_SECTION=201.html.

Rao, Shivarama Rao and Malhan, I.V. 2008. "Transforming Indian Farmers to Reach the Next Level of the Green Revolution Through Communication of Strategic Knowledge and Increased Use of ICTs." *International Information & Library Review* 40: 171–178.

Ruenwai, Narumol and Morris, Anne. 2008. "Blueprint for Thailand: S&T Information Resource Sharing." *Library Management* 29(4/5):278–292.

Saunders, Laura. 2007. "Regional Accreditation Organizations' Treatment of Information Literacy: Definitions, Collaboration, and Assessment." *Journal of Academic Librarianship* 33(3):317–26.

Second Lady calls for radical approach to library services in Ghana. *Ghana Business News* May 3, 2013. http://www.ghanabusinessnews.com/2013/05/03/second-lady-calls-for-radical-approach-to-library-services-in-ghana/.

Thompson, S. 2003. *Information Literacy Meeting of Experts, Prague, the Czech Republic, September 20–23, 2003: Report of a Meeting.* http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/themes/info_lit_meeting_prague_2003.pdf.

Tirado, Alejandro Uribe and Leonardo Machett's Penagos. 2010. *Information Literacy in Colombia: Report of the State of the Art.* http://www.ifla.org/files/assets/information-literacy/publications/il-report/colombia-2010-en.pdf.

Tolonen, Eva. 2006; updated 2010 by Leena Toivonen. *Nordic Countries: Finland, Denmark, Norway and Sweden: Information Literacy State-of-the Art Report.* http://www.ifla.org/files/assets/information-literacy/publications/il-report/nordic-countries-2006.pdf.

UN. *Millennium Development Goals.* http://www.un.org/millenniumgoals/.

UN Millennium Project. 2005. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals.* New York: United Nations Development Programme. http://www.unmillenniumproject.org/documents/MainReportComplete-lowres.pdf.

United Nations General Assembly. 2010. Resolution adopted by the General Assembly. Keeping the promise: United to achieve the Millennium Development Goals. Oct. 19. A/RES/65/1. http://www.un.org/en/mdg/summit2010/pdf/outcome_documentN1051260.pdf.

van Dijk, Jan. 2000. "Widening Information Gaps and Policies of Prevention." In *Digital Democracy: Issues of Theory and Practice* edited by Kenneth L. Hacker and Jan van Dijk, 166–83. Thousand Oaks, CA: Sage Publications.

van Rooij, Maarten C.J.; Annamaria Lusardi; and Rob J.M. Alessie. 2012. "Financial Literacy, Retirement Planning and Household Wealth." *Economic Journal* 122(560):449–78.

Vernon J.A.; Antonio Trujillo; Sara Rosenbaum; Barbara DeBuono. [n.d.]. *Low Health Literacy: Implications for National Health Policy.* http://sphhs.gwu.edu/departments/healthpolicy/CHPR/downloads/LowHealthLiteracyReport10_4_07.pdf.

Weiner, John M. 2011. "Is There a Difference Between Critical Thinking and Information Literacy?" *Journal of Information Literacy* 5(2):81–92. https://ojs.lboro.ac.uk/ojs/index.php/JIL/article/view/LLC-V5-I2-2011-2.

Weiner, Sharon A. 2011. "How Information Literacy Becomes Policy: An Analysis Using the Multiple Streams Framework." *Library Trends* 60(2):297–311.

Weiner, Sharon A. 2013. *Overview: The Role of Information Policy in Resolving Global Challenges.* Purdue University Global Policy Research Institute Policy Briefs 1(1), Article 6. http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1005&context=gpripb.

Weiner, Sharon A., Lana W. Jackman, & Emily Prause. 2013. "Strategizing for Public Policy: The Information Literacy State Proclamation Project." *Public Services Quarterly* 9(4):284–99.

Welsh Information Literacy Project. http://librarywales.org/en/information-literacy/ .

Wiorogórska, Zuza. 2011. *Poland: Information Literacy State-of-the-Art Report.* http://www.ifla.org/files/assets/information-literacy/publications/il-report/poland-2011.pdf.

The World Bank Group. 2012. ICT for greater development impact: World Bank Group strategy for information and communication technology 2012–2015. *http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/WBG_ICT_Strategy-2012.pdf* .

Wopereis-Pura, Myra. 2009. "Sub-Saharan Africa: RAILS." *Agricultural Information Worldwide* 2(2):76–79.

Zurkowski, Paul G. 1974. *The Information Service Environment: Relationships and Priorities.* Washington, DC: National Commission on Library and Information Science. http://www.eric.ed.gov/PDFS/ED100391.pdf.

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Framing of Climate Change News in Four National Daily Newspapers in Southern Nigeria

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Paper originally presented at the International Conference on Climate Change Effects: Impacts World 2013, Potsdam, Germany, 27–30 May 2013.

Abstract: **The underlying theoretical assumption of this study is that understanding how the climate issues are framed by journalists is of vital importance to how the general public and policy makers will respond to lifestyle changes necessary to mitigate and adapt to climate predictions. The study examined the framing of climate change news in four national daily newspapers in southern Nigeria namely: Guardian, ThisDay, Vanguard and Daily Sun. The results showed that the majority of the articles used a negative tone in reporting the headlines, and that the two most common frames for climate change were "blame" and "action." The study therefore recommends that media organizations should re-allocate some of their time and energy to explaining more of the specifics behind the mitigation and adaptive solutions to deal with global climate change, especially, as it relates to agriculture, rather than devoting most of their time explaining the science behind global climate change.**

Resumé: **L'hypothèse théorique sous-jacente de cette étude est: comprendre comment les questions climatiques sont présentées par les journalistes, a une importance vitale sur la manière de réagir des décideurs politiques et du grand public face aux changements de mode de vie nécessaires pour atténuer les prévisions climatiques et s'y adapter. L'étude a examiné la présentation des infos sur le changement climatique dans quatre quotidiens nationaux dans le sud du Nigéria à savoir : le Guardian, ThisDay, Vanguard et Daily Sun. Les résultats ont montré que la majorité des articles ont utilisé un ton négatif dans les titres à la une des journaux, et que les deux discours les plus courants sur le changement climatique ont été "d'accusation" et "d'action". L'étude recommande donc que les organisations des médias devraient ré-allouer une partie de leur temps et énergie à expliquer plus en détail les mesures derrière les solutions d'atténuation et d'adaptation pour faire face au changement climatique mondial, en particulier en ce qui concerne l'agriculture, plutôt que de consacrer la plupart de leur temps à expliquer la science derrière le changement climatique.**

Resumen: **El supuesto teórico subyacente de este estudio es que el conocer cómo los periodistas enmarcan los temas climáticos es de vital importancia para la forma en que el público en general y los formuladores de políticas responden ante los cambios en estilo de vida que son necesarios para mitigar y adaptarse a las predicciones climáticas. El estudio examinó la enmarcación de noticias sobre el cambio climático en cuatro periódicos de circulación nacional en el sur de Nigeria, a saber: Guardian, ThisDay, Vanguard y Daily Sun. Los resultados mostraron que la mayoría de los artículos utilizan un tono negativo en la redacción de los titulares, y que los dos marcos más comunes para el cambio climático eran "culpa" y "acción". Por lo tanto, el estudio recomienda que las organizaciones de los medios de comunicación reasignen parte de su tiempo y energía para explicar más los detalles específicos detrás de las soluciones de mitigación y adaptación para hacer frente al cambio climático global, sobre todo respecta a la agricultura, en lugar de dedicar la mayor parte de su tiempo explicando la ciencia detrás del cambio climático global.**

Introduction

Global climate change is certainly one of the most pressing concerns of the 21st century. Africa—and more specifically Nigeria—is a place which scientists agree is likely to suffer dire consequences of climate change. According to Chris (2009), gas flares in the Niger-Delta region produce very large halos of lights; this affirms Oyebade's (2009) assertion that Nigeria is not only a victim but also a contributor to global climate change and its consequences. In one of the conferences on planning for climate change planning in Nigeria, some of these consequences were discussed. These include imminent drought and water restrictions and a subsequent greater need for alternative farming practices, the threat of rising sea levels wreaking havoc on coastal tourism and the fishing industry, and the spread of disease causing organisms (Ogbonna, 2009; Awosika and Folorunsho, 2009).

When it comes to media coverage of climate change, there is often a significant acceptance of political and expert voices by the public (McManus, 2000). Studies have shown that the public learns a lot about science through consuming mass media news (Wilson 1995). Moreover, the complex issue of public trust in authority figures may feed back into and influence climate policy decision-making (Lorenzoni and Pidgeon 2006). Carvalho (2007) observed that prominent political actors successfully frame climate risk for their purposes, and align those frames with their interests and perspectives. In other words, different frames highlight different aspects of the options and bring forth different reasons and considerations that influence decision making.

According to Entman (1993) to frame in communication is to select certain aspects of a situation and highlight them in the media in a way that promotes a particular definition, interpretation, evaluation or recommendation. Not only do the media influence the perception of what topics are seen to be important by the public and policy makers, they also influence public opinion by presenting such topics within a certain frame. The way a policy maker or actor frames an issue can determine the success or failure of such issues in being placed in the

public or political agendas. Specifically, frames can be utilized to suggest causes, assign blame, categorize issues, or promote certain solutions by policy makers.

The basis of framing theory is that the media focuses attention on certain events and then places them within a field of meaning. In doing this, the media brings public attention to certain topics and influences peoples' perceptions and feedback through ongoing media practices; these feedbacks in turn shape news framing in subsequent phases, and inform ongoing policies, practices and interactions over time. Thus, framing permeates all facets of interactions between science, policy, media and the public.

It has been observed that journalists report climate change risk as news — that is, they find what is newsworthy in the subject (Cramer, 2008). It is for this reason that climate change is found presented within a certain frame. Therefore, it is believed that knowledge of how climate issue has been understood and framed is of vital importance to establishing how the general public and policy makers will be able to respond to lifestyle changes that will aid climate protection. If the public is not adequately informed about climate change, it will be difficult for them to make demands on government, even when it is in their own interest. But how this information is interpreted and translated into decisions and potential behavioural change is complex, dynamic and contested.

This brings to the fore the importance of this study to determine how climate change issues have been framed in the southern Nigerian newspapers. The specific objectives of the study include:

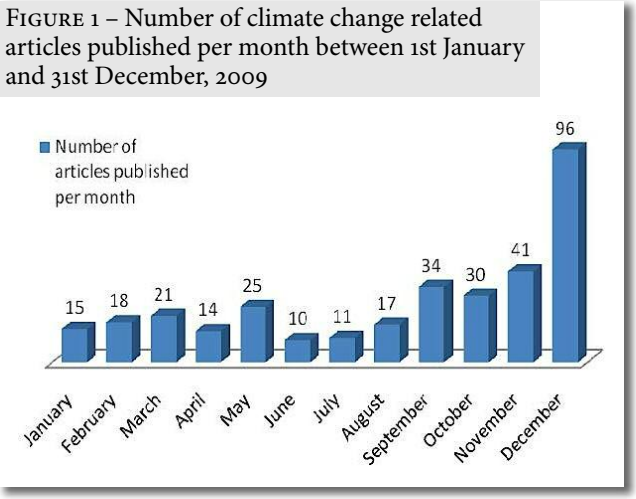
- Determining the number of climate change related articles published in 2009;
- Identifying the overall tone used in reporting climate change issues;
- Identifying the subject matters discussed in the articles analyzed; and
- Determining how climate change issues has been framed in the southern Nigerian newspapers

Methodology

We selected for content analysis four major national daily newspapers in southern Nigeria — *The Guardian, ThisDay, Vanguard* and *The Daily Sun* — because they are considered to be among the country's leading national newspapers. The coverage time was from January 1, 2009 to December 31, 2009, yielding approximately 332 articles for the analysis.

To examine the framing of climate change by print media journalists, we analyzed individual articles using a code sheet, which consisted of categories including the newspaper, the headline, the volume of the articles in word, the month in which the article appeared, the days of the week in which articles appeared, overall tone of the articles, themes and frames used.

Figure 1 – Number of climate change related articles published per month between 1st January and 31st December, 2009



Decisions on the frames used were taken from the perspective of the reader. How would the reader be likely to delimit a story written in a particular way? Would the story result in concluding that climate change is an environmental issue, a political issue, a scientific issue, an agricultural issue, or a health issue, etc.?

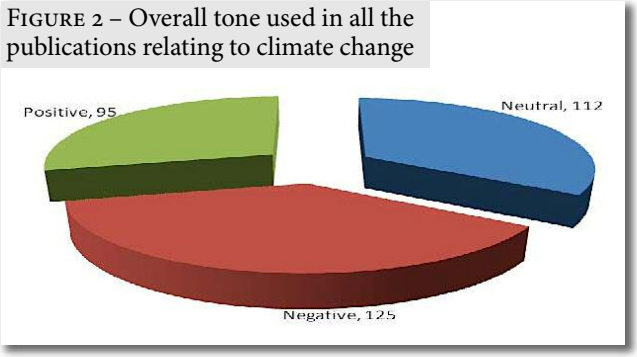
Objective one was achieved by noting the frequency of articles appearing in a particular month of the year. Objective two was achieved by analyzing the manner in which the stories in the articles were portrayed in terms of headlines: neutral, negative or positive. Objective three was achieved by identifying the articles' subject matter and why the articles were written. And objective four was achieved by determining how the southern Nigerian print media framed the climate change issues.

Results and Discussion

Number of climate change related articles published per month – Figure 1 shows that a greater number of climate change articles were published in November and December than in any other month in 2009. This is probably be due to the fact that November 2009 was the month during which environmental ministers gathered in advance of climate discussion and December 2009 was the month the Copenhagen Climate Change Conference took place. The data imply that the release of political and scientific reports during that conference drew media attention to the climate change issue. This corresponds with observations made by McCright and Shwom (2008) who state that political events and the release of scientific reports are the key drivers influencing the amount of media attention climate change receives.

Overall tone of the articles – In all the climate change articles analyzed, it was obvious that a greater portion (125 out of 332) of the articles were presented using negative tones as reflected in the articles' headlines (Figure 2). However, 112 articles were presented using neutral tones, while the remaining 95 articles were captured using positive tones. The greater number of articles with a negative

FIGURE 2 – Overall tone used in all the publications relating to climate change



tone indicates a larger emphasis placed on the negative impacts of climate change on the environment and more specifically on agriculture.

Subject matter discussed in the articles analyzed – As shown in Figure 3, the data indicate that the major issues discussed in all the four newspapers were conferences, report and research, alternate energy source, the effect of climate, new technologies, Copenhagen 2009, and climate action aid. *The Guardian* had a significantly greater number (35) of articles on report and research than the other three newspapers. This probably means that Guardian journalists had a better relationship with scientists, or possibly that they had more interest in report and research. The coverage of Copenhagen 2009 summit across the newspapers (Guardian – 27 articles, ThisDay – 17, Vanguard – 2 articles, and Daily Sun – 2 articles) was probably due to the fact that most of the stories were received from the cable or electronic wireless. Alternate energy sources, such as production of clean natural gas and nuclear power, enjoyed much debate, particularly in *The Guardian* (7 articles). The general effects of climate change (28 articles), and climate change action (27 articles) were widely covered, particularly in *The Guardian*. New technologies were covered in many of the articles (*Guardian* – 23 articles, *ThisDay* – 13, *Vanguard* – 2 articles and *Daily Sun* – 2 articles), particularly in connection with the climate change actions and also with the Copenhagen 2009. Carbon trading received some coverage in *The Guardian* (7 articles) and *ThisDay* (2 articles), along with melting ice caps and the rising sea level (*Guardian* – 7 articles), which were all linked to climate change.

Dominant Frames used in reporting Climate Change News in the Newspapers –

Blame/responsibility frame – A majority (71 articles) of the newspaper articles framed climate change in terms of "blame/responsibility" as shown in Figure 4. This frame focused on the finger-pointing aspect of climate change outbreak. Issues such as who was at fault for the occurrences, why and how it happened, and who was going to take the blame, constituted the major frames. In most of the articles, the developed countries, and industries such as the oil producing companies, were blamed for their high contribution to the emission of greenhouse gases. However, several articles placed the blame on agriculture, primarily deforestation and use of high technologies (inorganic agriculture). Phrases associated with this frame included "the failure of Kyoto protocol agreement," "attempt by the developed world to hoodwink other nations," "China accused for Copenhagen failure," "UN signals delay," and "top 20 major countries that flare gases." The lead from an article in *The Guardian* presented a typical description of this frame as follows:

> It is hard to say how far the conference will be able to go because the United States congress has not agreed on a climate bill, and industrialized nations have not agreed on targets to reduce their carbon emissions or funding to help developing countries limit their discharges. (World Report, 2009).

FIGURE 3 – Subject matter discussed in the articles analyzed

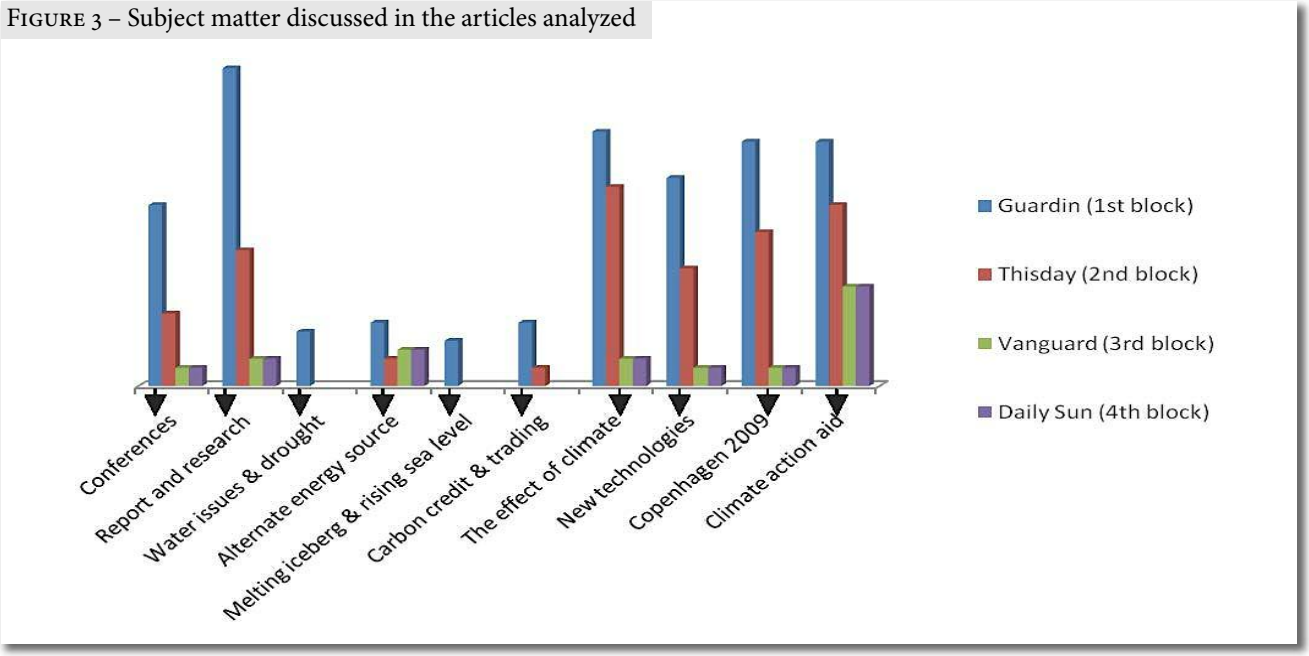
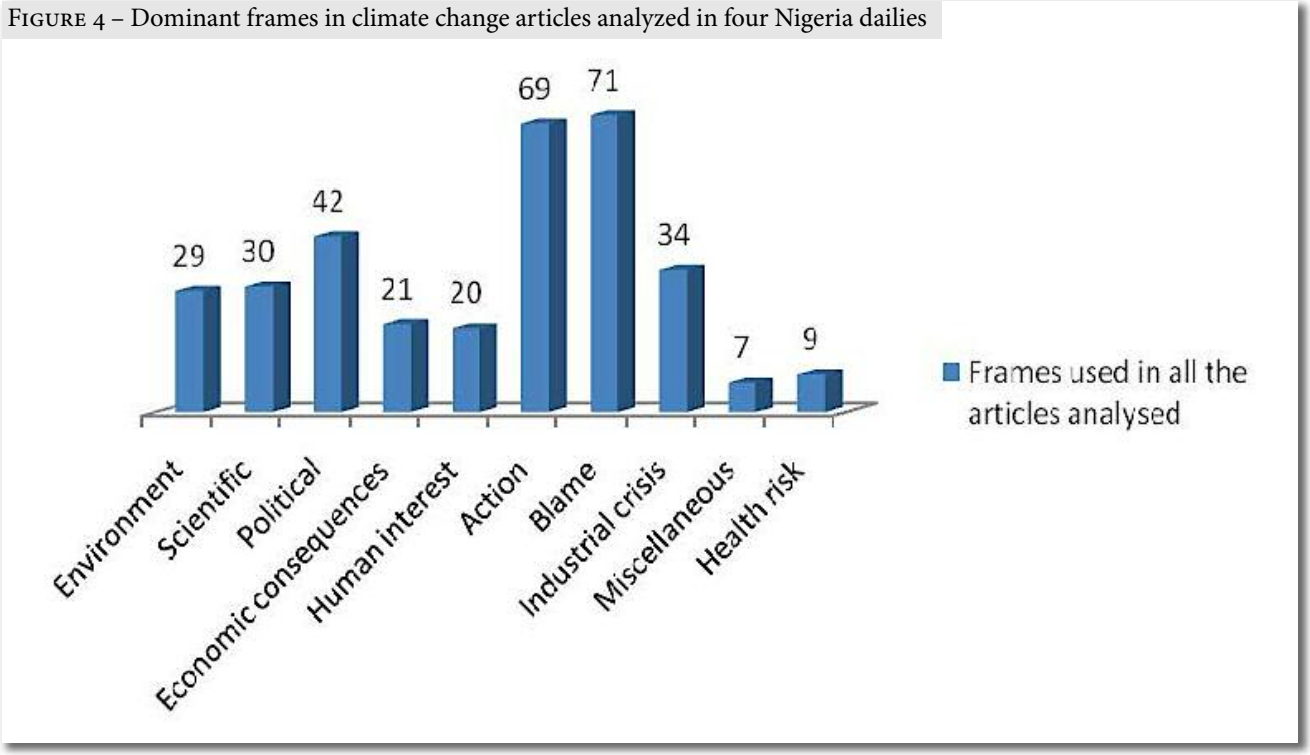


Figure 4 – Dominant frames in climate change articles analyzed in four Nigeria dailies



Action Frame – The "action" frames occupied 69 articles, the second most frequent frame in the stories. This frame mentioned the actions that nations have to perform to mitigate and adapt to climate change effects. Such stories discussed the duties to be performed by the developed nations, developing nations, NGOs or individual citizens. Phrases associated with this frame included "payment of ecological debts," "reduce emissions by 50 per cent," "green campaign," 'it is time to act," "seal a fair agreement," "holistic approach," "plot a survival map," and "determined commitment at the regional level." The following lead from *Vanguard* demonstrates this:

> We must collectively promote an understanding that makes communities change their attitudes towards the environment and mobilize partnership to ensure we all enjoy safe and healthy environment. (Thomas, 2009)

The implication of this frame is that it is the obligation of every individual in the whole world to mitigate the effect of climate change as no country is immune to its effect.

Political Frame – The political frame was active in 42 articles. This frame emphasized the political side, or any issue involving politicians or the government. Words and phrases used to convey this frame included "diplomatic hackles," "side-line negotiating process," "political agreement," "formulate laws," "calls for signatures," and "negotiate tough decisions." The following passage from an article in *The Guardian* is typical of this frame.

> Top members of the Group 77 yesterday walked out of a meeting during climate talks in the Thai capital, Bangkok, saying they would not discuss a future without the Kyoto protocol climate pact. (Africa News, 2009)

This frame implies that while the individuals are empowered to address the environmental issues, greater power for dealing with these problems is often attributed to the government.

Industry Frame – The Industry frame was exposed in 34 articles analyzed. This frame conveyed not only how climate change is devastating to the agricultural sector in Nigeria, but also how it has had negative implications for the agricultural sector internationally. This frame implies that climate change had devastating consequences by communicating the negative aspects of the occurrences, using key phrases like "the embattled crop sectors," "devastating impact," "debt-laden farmers," "poor African farmers are losers," "poor harvest," "species threatened," "farming industries in tail-spin," "catastrophic disruptions" and "pandemonium." The frame was consistently characterized as disaster-causing for the agricultural industries, which produced a negative tone throughout the articles. The implication here is that the framing of this issue potentially could affect perceptions of agriculture in general because the agricultural sector is a large industry, and trust in agricultural yield/ productivity in general could be affected by this frame. Moreover, it has been argued that it is very difficult to get an agricultural issue on the media's agenda and when agricultural issues are reported, they tend to be negative in nature, creating an inaccurate perception of agriculture by the lay public. (Ruth, Eubanks and Telg, 2005)

Scientific Frame – The "Scientific" frame was used in thirty articles analyzed. This frame emanated from scientific research and technical data, with phrases such as "ozone depleting substances," "concentration of aerosol,"

"carbon sink," and "carbon cap." The following lead from the *Vanguard* demonstrates this:

> Turning off carbon dioxide emissions won't stop global warming. It's essentially an irreversible change that will last for more than a thousand years, says climate scientists. (Vanguard, 2009)

Environment Frame – The "environment" frame (29 articles) focused on the predicted effect of climate change on the landscape and possible remedies in Nigeria as well as several other regions. Phrases associated with this frame included "prone to drought, flooding," "environmentally devastating," "flood risk," "loss in landmass," "cataclysmic change," "volcanic eruption," "desertification" "degradation of ecosystem," "environmental threats," and "dramatic impact." The following lead from Vanguard demonstrates this:

> The Niger Delta has been impacted heavily by oil exploration in such a manner that the whole ecology of the area struggles to support life and living. (Vanguard, 2009)

In these articles, climate change was depicted very clearly as being an environmental issue; one potential danger of such depictions is the lack of importance placed on the environment by the average person.

Economic Consequences Frame – The "economic consequences" frame was revealed in twenty one articles. This frame emphasized the impact of climate change on the industries outside the agricultural sector, like transportation, insurance, banks, oil producing companies, and the economies of Nigeria, other African countries, and even the developed countries. This frame presented two perspectives regarding the economy. The first sub-frame presented climate change as offering major development opportunities for Africa. In most cases, this frame mentioned that addressing climate change could be viewed as a major development opportunity for Africa, given the anticipated increase in both alternative energy and carbon sequestration requirements and as growth accelerates (Okonjo-Iwela, 2009). This passage from *The Guardian* portrays this:

> Commonwealth leaders have stressed their conviction that urgent and substantial action to reduce global emissions is needed and have approved "fast tracking funding" focused on the most vulnerable countries… (Badejo, 2009).

The other perspective of the economic impact frame focused on the issues of amplified economic risk which climate change extends. Phrases like "long term financial risk," "depleting our natural capital," "falling wages," and "diminished opportunities" portrayed the impact of climate change on several economies and other industries. The following passage from a 2009 *Vanguard* article was typical of this:

> Nigeria is facing a looming threat of economic losses up to about $100m annually as a result of the debilitating impact of desertification, deforestation; flooding, erosion and coastal sea rise if nothing is done to improve our adaptation capacity. (Onyedika and Okoronkwo, 2009).

Again, incorporating words like "deplete," "falling" and "diminished" portrayed the amplified economic consequences to the readers; the overall tone of the amplified economic risk frame articles was negative and implied that the occurrences could result in serious economic damage if nothing is done.

The two sub-frames from the economic consequences frame also exposed another important aspect from the articles reviewed: because of the very different tones resonating in these articles, it is difficult to determine the overall tone of the articles and this resulted in most of the articles having a neutral tone. A neutral tone emanated as the descriptor when there was both positive and negative information regarding climate change effects within each of the reviewed articles.

Human Impact Frame – "Human impact" frames, revealed in twenty articles, showed the effect climate change has on people. Words and phrases used to convey this frame included "green collar jobs," "funding appeals," "changing lifestyle," "hunger," and "compensation." The lead from an article in *The Guardian* presents a typical description of this frame:

> The host communities in the oil producing area of Niger Delta, who had over the years been at the receiving end of incessant gas flaring, have demanded N 165 billion, as proceeds from the levy slammed on erring oil companies; as their gas flares contributes to global warming, degradation of marine and farming activities in the Niger Delta, as well as health danger to the communities. (Okere, 2009)

Another important aspect of the human impact frames reviewed was that they exposed both the negative and the positive impacts of climate change on human beings; this resulted in different tones resonating from the articles, and led to most of the articles having a neutral tone.

Health Risk Frame and Miscellaneous Frame – The "health risk" frame, with nine articles, was the most infrequently used frame in all the articles analyzed. Words and phrases used to convey this frame included "danger to public health," "health threatening," and "natural disaster related death." The following lead from the *Guardian* demonstrates this:

> The change in climatic conditions account for extreme high and low temperatures and spread of diseases, as it allows for favorable zones for vectors conveying infections disease such as fever and malaria, resulting into 150,000 deaths annually, says the World Health Organization (WHO). (Oyebade, 2009)

Also among the less frequently used frames was the "miscellaneous" frame, which incorporated all other frames and was revealed only in seven out of three hundred and thirty two articles. Some of the more interesting and unlikely stories included a fashion story (where corporate fashions are expected to change to accommodate for warmer temperatures) and musicians' stories about

their fear for the safety of the planets. The following passage from a *Guardian* article is typical of this depiction:

> Nigeria is set to host the maiden edition of Miss Climate Change West Africa, a beauty pageant and TV reality show to be presented by communication outlets. (Akhaime, 2009)

Conclusion and Recommendation

Based on the findings, we conclude that climate change articles are mainly portrayed using accusing or finger pointing scenario (blame) as it relates to the factors responsible for climate change occurrences. Also, the actions/strategies to be implemented were also portrayed in most of the articles. The fact that the scientific frame (twenty five articles) outnumbered the environmental frame (sixteen articles) suggests that climate change can and should no longer be boxed into the environmental frame. Scientific research has portrayed the broadness and urgency of this threat to the world at large, but more specifically to Nigerians and in the agricultural sector. While the environment may be viewed as a softer premise which is relevant to many, climate change is an issue which goes far beyond degraded ecosystems. Water shortages, crop failures and changing weather patterns are issues which will affect all Nigerians in the near future. In other words, climate change is broader than the environment, politics and science. It is very much an economic issue, but above all in a country where poverty is prevalent, climate change is a human interest issue and it is the duty of the media to portray it as such.

Given the fact that climate change coverage tends to be increasingly blame-based, the study therefore recommends that agricultural and media organizations should re-allocate some of their time and energy away from explaining the science behind why global climate change is happening to explaining more of the specifics behind the mitigation and adaptive solutions that would help the general public deal with global climate change and aid climate protection. Agriculture organizations should keep in mind that as they present agriculture climate change-related research findings to the mass print media audience, they should provide many solutions. Otherwise, they risk falling into the trap that agricultural reporting continually fell into a decade and more ago when agricultural events were reported as catastrophic, isolated events that could not be predicted or avoided (Cramer, 2008). Also, agriculture organizations should not be afraid to go into great detail about the policy solutions they are advocating for, explaining thoroughly what makes them good policy solutions. Finally, the media should report farmer-centered climate change stories to make the issue relevant to the public and agriculture sectors in particular.

References

Africa News 2009. "Kagame Pushes Africa's Case for Greater Climate Support." *The Guardian, Nigeria.* (May) 26.

Akhaime, S. 2009. "Nigeria to Host Climate Beauty Pageant." *The Guardian, Nigeria.* (October) 6.

Awosika, L and Folorunsho, R. 2009. "Climate Change, Sea Level Rise and Nigeria's Coastal Resources." *The Guardian, Nigeria.* (December) 52.

Badejo, E. 2009. "Commonwealth Endorses $10b Climate Funding for Vulnerable Countries." *The Guardian, Nigeria.* (December) 23.

Boykoff, M.T. and Roberts, J. T. 2007. "Media Coverage of Climate Change: Current Trends, Strengths, Weaknesses." *Human Development Report 2007/8*. United Nations Development Programme Occasional paper. Human Development Report Office.

Carvalho, A. 2007. "Ideological Cultures and Media Discourses on Scientific Knowledge: Re-reading News on Climate Change." *Public Understanding of Science* 16:223–43.

Chris 2009. "Global Warming: Delta Urged to Intensify Effort." *The Guardian, Nigeria.* (May) 22.

Cramer, C.M. 2008. *The Framing of Climate Change in Three Daily Newspapers in the West Cape Province of South Africa*. Stellenbosch University.

Entman, R. 1993. "Framing: Toward Clarification of a Fractured Paradigm." *Journal of Communication* 43:51–58.

Lorenzoni, I. and Pidgeon, N. 2006. "Public Views on Climate Change: European and USA Perspectives." *Climatic Change* 77(1):73–95.

McCright, A. M. and Shwom, R. L. 2008. "Global Climate Change in the U.S. Mass Media." *In Climate Change and Policy,* edited by Schneider, S. H., Rosencranz, A., and Mastrandrea, M., 18–25. Washington, DC; Island Press.

McManus, P. 2000. "Beyond Kyoto? Media Representation of an Environmental Issue." *Australian Geographical Studies* 38 (3): 306–319.

Ogbonna, R. 2009. "Climate Change: Combating the Enemy Within." *ThisDay, Nigeria.* (August) 24.

Okere, R. 2009. "Host Communities Demand ₦165b for Gas Flaring." *The Guardian, Nigeria.* (January) 15.

Okonjo-Iwela, N. 2009. "Tackling Climate Change Could Earn Africa $1.5 Billion Naira." *Vanguard, Nigeria.* (October) 30.

Onyedika, N., and Okoronkwo, K. 2009. "Nigeria Most Vulnerable to Climate Change, Says Study." *The Guardian, Nigeria.* (March) 31.

Oyebade, W. 2009. "Environment-Led Green Revolution Key to Africa's, Says UNEP." *The Guardian, Nigeria.* (May) 35.

Ruth, A.M., Eubanks, E.E., and Telg, R. 2005. "Framing of Mad Cow Media Coverage." *Journal of Applied Communications* 89 (4). pp. 39–54.

Thomas, L. 2009. "Climate Change: Need for Collective Responsibility." *Vanguard, Nigeria.* (September) 32.

Vanguard 2009. "Climate Change is Essentially Irreversible, Says Study." *Vanguard, Nigeria.* (February) 31.

Weingart, P., Engels, A., and Pansegrau, P. 2000. "Risks of Communication: Discourses on Climate Change in Science, Politics,

and the Mass Media." *Public Understanding of Science* 9(3): 261–283.

Wilson, K. 1995. "Mass Media as Sources of Global Warming Knowledge." *Mass Communication Review* 22(1/2):75–79.

World Report 2009. "Divided Climate Talks End in Copenhagen with Deal." *The Guardian, Nigeria.* (August) 16.

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Access and Use of Information Communication Technologies by Women Staff of Public Extension Service in the North Central Zone of Nigeria

Agwu Ekwe Agwu and Elizabeth Ene Ogbonnah

Abstract: This study determines the access and use of information communication technologies (ICTs) by staff of the Women-in-Agriculture (WIA) sub-programme of the public extension service in North Central Zone of Nigeria. Data were collected from 80 WIA staff randomly selected from three states and the federal capital territory (FCT), Abuja. While a majority of the WIA staff had access to telephone, television and radio, respectively, very few of them had access to digital ICT facilities (computer, internet and printer). Radio, video machine, television and telephone were used by the respondents to a large extent in reaching out to farmers. Lack of training opportunities, insufficient availability of ICT facilities and lack of technical know-how were serious constraints to the use of ICTs. The study recommends establishment of functional ICT centers for WIA staff in all states to help build their competency in the use of ICT tools for disseminating agricultural information to rural farmers.

Resumé: Cette étude détermine l'accès et l'utilisation des technologies de l'information et de la communication (TIC) par le personnel féminin du sous-programme du service public de vulgarisation Femmes-en-agriculture (WIA) en zone centrale nord du Nigéria. Les données ont été recueillies auprès de 80 employées WIA, sélectionnées de façon aléatoire dans trois états et le territoire de la capitale fédérale (FCT), Abuja. Tandis que la majorité des employées WIA avaient accès au téléphone, à la télévision et radio, respectivement, très peu d'entre elles ont accès aux installations TIC numériques (ordinateur, internet et imprimante). La radio, vidéo, télévision et le téléphone ont été utilisés dans une large mesure par les répondantes pour atteindre les agriculteurs. La disponibilité insuffisante de formation et des équipements TIC, et le manque de savoir-faire technique sont de graves contraintes à l'utilisation des TIC. L'étude recommande l'établissement de centres TIC fonctionnels pour le personnel WIA dans tous les états, pour les aider à développer leurs compétences dans l'utilisation des outils TIC pour diffuser l'information agricole aux agriculteurs des zones rurales.

Resumen: Este estudio determina el acceso y uso de las tecnologías de la información y la comunicación (TIC) por parte del personal del subprograma Mujeres en la Agricultura (WIA, sus siglas en inglés) del servicio de extensión público en la zona norte-central de Nigeria. Se recogieron datos de 80 funcionarias del WIA seleccionadas al azar de tres estados y el territorio capital federal, Abuja. Mientras que la mayoría del personal de WIA tenía acceso a teléfono, televisión y radio, muy pocas tenían acceso a herramientas de TIC digital (computador, Internet, impresora). En su trabajo con los agricultores, las encuestadas utilizaron mayormente la radio, equipo de vídeo, televisión y teléfono. La falta de oportunidades de capacitación, la insuficiente disponibilidad de recursos TIC y la falta de conocimientos técnicos eran serias limitaciones para el uso de las TIC. El estudio recomienda el establecimiento de centros operativos de TIC para el personal de WIA en todos los estados para ayudarlas a fortalecer su competencia en el uso de herramientas TIC para diseminar información agrícola a los agricultores en zonas rurales.

Introduction

The sustainable production of food is the first pillar of food security, and millions of women work as farmers, farm workers and natural resource managers. In doing so, they contribute to national agricultural output, maintenance of the environment and family food security (Onyemobi, 2000). Agricultural extension personnel are also very important in the development of agriculture because they utilize vital agricultural information for the individual and general improvement of the farmers and homemakers (Agumagu, Adesope, Mathews-Njoku and Nwaogwugwu, 2008).

Over the past two or three decades, considerable research has been done on gender-related issues in Nigerian agriculture. This has had some impact on policy formulation and programming, including the creation of Women-in-Agriculture (WIA) units in the Agricultural Development Programmes (ADPs) in Nigeria. It is difficult, however, to gauge how effective this has been, especially in terms of moving agriculture forward (Adekanye, Otitolaiye and Opaluwa, 2009).

According to Onyibe (2001), the ADP in Nigeria has in the different states of the federation made important advances in incorporating gender in agricultural extension by modifying the ADP system midstream to provide for women farmers through the creation of WIA programmes in the department of extension services of the ADPs with a gender focus. Women-in-Agriculture is a sub-component in the extension unit of the ADPs and it focuses on improving agricultural production, processing and marketing by rural women.

Agricultural extension depends largely on information exchange between and among farmers and a broad range of other actors. It then means that the importance of information and communication technologies (ICTs) cannot be over emphasized among the WIA sub-programme in the ADPs (Omotayo 2005).

There is a wide range of definitions given to ICTs by different authors. According to the Technical Center for

Agriculture and Rural Cooperation (CTA, 2003) as cited by Arokoyo (2005), ICTs can be interpreted broadly as technologies that facilitate communication and the processing and transmission of information by electronic means, a definition which encompasses the full range of ICTs from radio and television to telephones (fixed and mobile); computers and the internet.

According to Madukwe (2006), the promise of ICTs in agricultural extension is that they can energize the collection, processing and transmission of data, resulting in faster extension of quality information to more farmers in a bottom-up and interactive channel of communication. Also, increasing the use of ICTs in agricultural extension will narrow the gender disparities in terms of access to agricultural information. It is expected that this study will expose different areas of use of ICTs which will motivate the ADPs and other agricultural organizations/ agencies to adjust and reorganize programmes in favour of ICT utilization by women in agriculture.

Objectives of the Study – Specifically, the study sought to:

- Identify the various ICT facilities that WIA staff had access to;
- Determine the level of ICT utilization among WIA sub-component in the ADPs;
- Ascertain the WIA activities in which ICTs were used; and
- Ascertain the perceived constraints to the use of various ICT tools among staff of WIA sub-component of the ADPs.

Methodology

The study was conducted in North Central Nigeria. The zone comprises six states (Benue, Kogi, Kwara, Nassarawa, Niger and Plateau) as well as the Federal Capital Territory (FCT), Abuja. The state ADPs pilot most of the agricultural extension activities in each of the respective states.

All staff of the WIA sub-component of the ADPs in the North Central zone of Nigeria constituted the population for this study. Three states out of the six states, and the Federal Capital Territory, were randomly selected using a simple random sampling technique known as a multi-stage sampling procedure. In each of the states, all WIA staff in ADP state headquarters (The Director and the Deputy Director) were used, giving a total of eight WIA administrative staff. There are three zones in each state and each zone has a WIA subject matter specialist (SMS) in the zonal headquarters. Each of these SMSs was also sampled, making a total of twelve SMSs. Fifteen blocks were randomly selected from each state and a block extension agent (BEA) covers each block as a WIA staff making a total of fifteen BEAs per state. This brought the total to sixty BEAs that were used. The overall sample size is therefore eighty WIA staff (Table 1).

Data for the study were collected from the respondents through the use of a structured interview schedule.

Table 1 – Sampling procedure

Respondents	No.	Total
WIA Director	1×4	4
Deputy Director	1×4	4
SMS WIA	3×4	12
BEA	15×4	60
Total	80	80

To identify the ICTs available to WIA staff, two lists of ICTs were provided for the staff to indicate the ICTs available in their offices and the ones they personally owned. Examples of such ICTs were radios, televisions, video machines, telephones, computers, scanners and internet services. To identify the ICTs accessible to WIA, a list of ICT facilities were provided and the respondents were required to indicate generally those ICTs they had access to.

To determine the level of utilization of ICTs among WIA, respondents were required to indicate the extent to which they could operate such ICTs using a 4-point Likert-type scale of (a) *to a very great extent* (TVGE) - 4; (b) *to a great extent* (TGE) - 3; (c) *to a little extent* (TLE) - 2; and (d) *to no extent* (TNE) - 1. The cut-off of the mean scores was 2.5. ICT tools with mean scores above 2.5 indicating they had been utilized by respondents to a great extent. They were also required to state if they accessed the internet and how often they did so.

To ascertain the perceived constraints mitigating against effective use of ICTs by WIA, the respondents were asked questions on a number of constraints and also to state the extent to which such constraints impede effective discharge of extension duties using a 3-point Likert-type scale of (a) *very serious* (VS) - 3, (b) *serious* (S) - 2 and (c) *not serious* (NS) - 1 with the cut-off of the mean scores being 2. Constraints with mean scores above 2 were perceived by respondents to be very serious.

Frequency count and percentage were used to analyze objectives one and two, while objectives three and four were analyzed using frequency, percentage and mean scores.

Results and Discussion

Available ICT Tools in Respondents' Offices – Data in Table 2 show that some (40.0% and 33.8%) of the respondents had telephone and radio respectively in their offices. Also, 27.5% and 22.5% of them had televisions and video machines, respectively, in their offices. A few (21.2%, 18.8% and 12.5%) of them had computers, duplicating machines and calculators, respectively. None of the respondents had fax machines or GIS, or official E-mail addresses in their offices. This scanty availability or total absence of ICT tools in respondents' working places is a disadvantage to any efforts towards harnessing agricultural extension and ICT for an increased effectiveness of

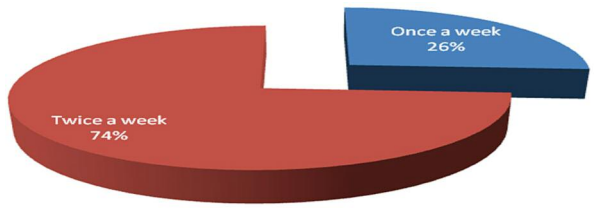
Table 2 – Distribution of respondents according to ICT tools available in their offices (N=80)

ICT tools	Frequency	Percentage
Radio	27	33.8
Video machine	18	22.5
Television	22	27.5
Telephone	32	40.0
Printer	11	13.8
Scanner	8	10.0
Calculator	10	12.5
Computer	17	21.2
Fax Machine	0	0.0
CD-ROM	8	10.0
Official E-mail addresses	0	0.0
GIS	0	0.0
Internet website	4	5.0
Duplicating machine	15	18.8
Digital camera	1	1.2

Table 3 – Distribution of respondents according to their access to ICTs (N=80)

ICT tools	Frequency	Percentage
Radio	64	80.0
Video machine	46	57.5
Television	68	85.0
Telephone	70	87.0
Printer	7	8.8
Scanner	7	8.8
Calculator	46	57.5
Computer	26	32.5
Fax Machine	2	2.5
E-mail	10	12.5
CD-ROM	7	8.8
GIS	2	2.5
Internet website	23	28.8
Photocopier	15	18.8

Figure 1 – Respondents' frequency of use of the internet



extension work as stated by Richardson (2006). Additionally, Saravanan (2010) argues that the ICT-enabled extension systems are acting as a key agent for changing agrarian situations and farmers' lives by improving access to information and sharing knowledge, and that ICT-based agricultural extension brings incredible opportunities and has the potential to enable the empowerment of farming communities. However, such opportunities cannot be harnessed if the ICT tools are lacking in the work environment.

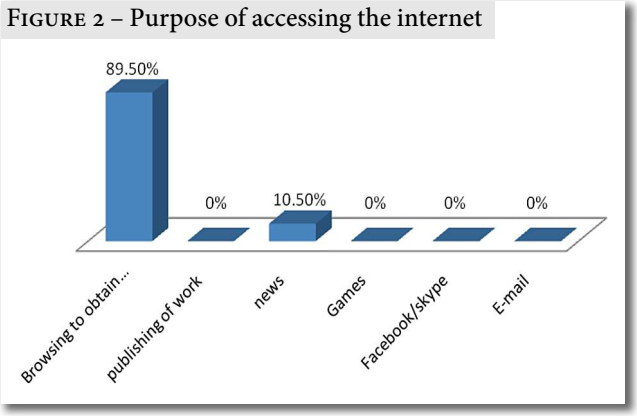
Respondents' Personal Access to ICT tools – A majority (87.0%, 85.0% and 80.0%) of the respondents had personal access to telephone, television and radio respectively (Table 3). Also 57.5% each of the respondents had access to a video machine and calculator, respectively. This implies that the respondents could put such ICTs to use in the discharge of their extension duties. This is in agreement with the opinions of Agwu and Chah (2007) that a majority of agricultural extension staff have access to modern ICTs and if well motivated could apply them in extension work. At the same time, 33.0% of the respondents had access to a computer and 28.8% of them had access to internet facilities, which means that only a few of the respondents had access to the internet. However, Agwu and Chah (2007) reveal that many (57.75%) of the extension staff in the Benue ADP had access to the internet. It is also contrary to the views in Micro LINKS Wiki (2010) which states that internet access is becoming easier and cheaper to extend to previously un-served areas using new technical approaches such as wireless connectivity, and business models geared toward individuals with low cash flows, such as pay-as-you-go applications.

Only 18.8% and 12.5% of the respondents had access to photocopier and e-mail services respectively, while 8.8% each could access a printer, scanner and CD-ROM, respectively. This implies that many of these ICTs would not be put into use for their official functions. However, in Wikipedia (2009) it is stated that any system applied for getting information and knowledge for making decisions in any industry (agricultural extension inclusive) should deliver accurate, complete, concise information in time or on time; and that the information provided by the system must be in user-friendly form, easy to access and cost-effective. Such delivery is not realizable where ICTs are not readily accessible.

Utilization of ICT Tools –

Respondents' Frequency of Use of the Internet – Data in Figure 1 indicate that 73.7% of the twenty three respondents who accessed the internet did so twice a week, while 26.3% accessed the internet only once in a month. This implies that most of these respondents were

Figure 2 – Purpose of accessing the internet



using the internet frequently enough and would be acquainted with it and possibly use it for extension services. Mahtab and Mokhtarnia (2009) assert that the internet is one of the most fascinating phenomena that powers our access to information, offers new ways of communicating and serves many on-line services.

Purpose of Accessing the Internet – Figure 2 shows that a majority (89.5%) of the respondents who accessed the internet did so for browsing, while 10.5% accessed it to get news. They did not use the internet for publishing of work, games and communicating through Facebook/Skype. This indicates that the respondents could browse and download relevant information for their job. This agrees with Obijiofor, Inayatulla and Stevenson (2009) who concluded that ICTs were seen to enhance efficiency in the workplace.

Respondents' Extent of Utilization of ICT Tools – Table 4 reveals the mean scores of the extent of the utilization of ICTs by respondents. The data show that radio (M = 3.70), video machine (M = 3.58), television (M = 3.14) and telephone (M = 3.49) were used by the respondents to a large extent. This implies that communication among staff and between staff and farmers was made easier and probably more effective. This is in accordance with the views of Micro LINKS (2010) (particularly on the use of telephones) which states that cell phones can strengthen horizontal or vertical links by enabling reliable and rapid communication. On the other hand, computer (M = 2.38), printer (M = 1.40), scanner (M = 1.40), calculator (M = 1.14), fax machine (M = 1.10), e-mail (M = 1.10), GIS (M = 1.15), internet (M = 1.22), Facebook (M = 1.28), Skype (M = 1.28), digital camera (M = 1.06), projector (M = 1.14) and duplicating machine (M = 1.14) were not used by the respondents to an appreciable extent. The result further shows that all the standard deviations of the mean scores were less than 1.0 with the exception of computer (SD = 1.08). This signifies that all the respondents' individual scores related to their utilization of ICTs did not vary much from the mean scores.

The inability of the respondents to utilize most of these modern ICTs is in accordance with the observations of Macueve, Mandlate, Ginge and Mocom (2009) that not all women can effectively benefit from some

Table 4 – Mean distribution of extent of utilization of ICTs by respondents (N = 80)

ICT tools	Mean scores (M)	Std. Deviation
Radio	3.78*	0.59
Video machine	3.58*	0.81
Television	3.14*	0.87
Telephone	3.49*	0.75
Printer	1.40	0.77
Scanner	1.40	0.77
Calculator	1.14	0.41
Computer	2.38	1.08
Fax Machine	1.10	0.34
E-mail	1.10	0.34
GIS	1.15	0.39
Internet website	1.22	0.55
Facebook	1.28	0.78
Skype	1.28	0.78
Digital camera	1.06	0.24
Projector	1.14	0.44
Photocopier	1.14	0.35

ICTs even if access does not constitute a constraint. A number of gender studies (Johnson 2003; Payton et al. 2007) have shown that the main users of ICTs—especially computers, internet, and e-mail—are young males, and that women are marginal users.

WIA Activities in Which ICTs Were Used – A majority (62.5% and 56.2%) of the respondents used telephone and radio respectively for root and tuber processing work (Table 5). For fruit and vegetable processing work, 62.5%, 56.2% and 12.5% of the respondents used telephone, radio and flash drive, respectively. A majority (52.5%) of the respondents used a telephone for food fortification activities. Only 17.5% and 11.2% of them used radio and television. For HIV and AIDS awareness campaign, only 20.0%, 18.8%, 12.5%, and 12.5% of the respondents used telephone, radio, television, and digital camera, respectively. Also, in the formation of women groups, a majority (50.0%) of the respondents use radio, while only 20.0%, 8.8% and 7.5% of them used telephone, television and calculator, respectively for their work. Just a few (17.5% each and 6.3%) of the respondents used radio, telephone and duplicating machine, respectively, for organizing meetings with women groups. The fact that the more commonly used ICTs were telephone, radio and television implies that the WIA staff were not familiar with the other digital ICTs like computer, printer, scanner and flash drive, probably because of non-availability or lack of access.

This finding is in line with the views of Arokoyo in 2003 on ICT utilization. He stated that the major ICTs

Table 5 – Percentage distribution of respondents according to their WIA activities in which ICT tools were used

ICT tools	Root and tuber processing	Fruit and vegetable processing	Food fortification	HIV and AIDS awareness campaign	Women group formation	Meeting with women groups
	%					
Radio	56.2	56.2	17.5	18.8	50.0	17.5
Telephone	62.5	62.5	52.5	20.0	20.0	17.5
Television	20.0	10.0	11.2	12.5	8.8	—
Printer	—	—	—	—	—	—
Calculator	—	—	—	—	7.5	—
Computer	6.3	6.3	3.8	1.2	—	—
Fax Machine	—	—	—	—	—	—
E-mail	—	—	—	—	—	—
CD-Rom	—	—	—	—	—	—
GIS	—	—	—	—	—	—
Internet	—	—	—	—	—	—
Duplication Machine	—	—	—	—	—	6.3
Digital camera	—	—	—	12.5	—	—
Flash drive	12.5	12.5	2.5	—	—	—

Table 6 – Mean distribution on constraints to their use of ICTs (N = 80)

Constraints	(M)	Deviation
Poor education	1.74	0.92
Lack of technical know-how	2.05*	0.75
Poor network service	1.52	0.64
No available ICT tools	1.44	0.67
Lack of access to ICT tools	1.71	0.68
Lack of electricity power supply/ power failure	1.44	0.67
Insufficient availability of ICT facilities	2.06*	0.82
Mismanagement of ICT facilities	1.71	0.68
Financial difficulties	1.96	0.85
Corruption	1.79	0.84
ICTs too complicated	1.71	0.68
ICTs not in useable state	1.40	0.69
Lack of interest	1.40	0.69
Lack of time	1.39	0.74
Lack of training opportunity	2.25*	0.77
Age/poor eyesight	1.39	0.74
Fear and lack of confidence	1.08	0.38
High cost of ICT facilities	1.96	0.84
Cultural beliefs	1.08	0.38

*Serious constraints

used in agricultural extension delivery had been radio and television, though since the establishment of the Nigerian Communication Commission (NCC) in 1992 digital communication through the use of cell phones, computers and internet services had become available. However, none of the respondents used fax, e-mail, CD-Roms, GIS, or the Internet for their work probably because of their complexity, inaccessibility or cost.

Perceived Constraints to the Use of ICTs by WIA Staff – The lack of training opportunities (M = 2.25), insufficient availability of ICT facilities (M = 2.06) and a lack of technical know-how (M = 2.05) were perceived by the respondents to be serious constraints to the use of ICTs, as shown in Table 6. On the other hand, variables not perceived as serious constraints included the high cost of ICTs (M = 1.96), financial difficulties (M = 1.96), corruption (M = 1.79), poor education (M = 1.74), mismanagement (M = 1.71) and lack of access (M = 1.71). Others included poor network service (M = 1.52), lack of power supply (M = 1.44), ICTs not available (M = 1.44) and ICTs not in a useable state (M = 1.40). All the standard deviations were less than 1.0, which suggests that all the respondents' individual mean scores regarding their opinions on the seriousness of the constraints to the use of ICTs did not differ much from the mean scores. This, in turn, implies that the WIA staff did not utilize ICTs effectively in their official activities possibly because most of these ICT facilities are complicated and require some level of training in order to be technically competent. Obijiofor *et al* (2009) identified lack of training and staff development as serious barriers to their use. Also, Arokoyo, in Salau and Saingbe (2008) argued that a higher the level

of educational computer literacy was correlated to a greater tendency to adopt and use ICTs. Amy (2008) affirmed that until ICT information and training is distributed directly and efficiently, agriculturalists may remain impoverished. He states that ICT programmes require a basic understanding of computers and software, but many agriculturalists do not know how to operate a computer.

Conclusion – On the basis of the major findings of this study the following conclusions were drawn:

- Most of the respondents had access to radio, television, video machines, telephones and calculators, but had highly limited access to such modern ICTs as computers, printers, scanners, fax machines, e-mail, GIS, photocopiers and the internet. This will limit the functions of the WIA staff within the agencies to those ICTs they can access and operate.
- A majority of the respondents that accessed the internet did so mainly for browsing to obtain information. Thus, if WIA staff can be given more access to the internet, they can obtain useful and relevant information for the rural dwellers.
- Lack of training opportunity, insufficient availability of ICT facilities and lack of technical knowhow were perceived by the respondents to be the most serious constraints to the use of ICTs for official functions. The existence of these constraints are stumbling blocks to the effective performance of WIA as extension workers within the ADPs.

Recommendations – As a result of the findings of this research study, the following recommendations are derived and made:

- Efforts should be made by all ADPs to establish functional ICT centres with departments for WIA in all the states. This will create more awareness, better accessibility and higher usage of ICT tools by the WIA staff.
- Efforts should also be made to facilitate ownership of modern ICTs by WIA staff through loans and hire purchase procedures from their offices. This will spur their excitement and speed of ICT adoption through which they can experiment with relevant and innovative ICT initiatives.
- ADP management bodies and government should set up projects that will make ICT trainers and training materials available for WIA to meet their training needs and usage of ICT facilities.

References

Adekanye, T, Otitolaiye, J. and Opaluwa, H. 2009. "Food and Agricultural Production in Nigeria: Some Empirical Considerations for Engendering Economic Policy for Africa." A paper prepared for presentation at the IAFFE conference on feminist economics, Boston, Massachusetts, USA. http://editorialexptress.com — accessed 26th June 2009.

Agumagu, A.C.,Adesope, O.M.,Mathews-Njoku, E.C. and Nwoagwugwu, O.N. 2008. "Availability, Access and Frequency of Information Usage and Communication Technology Among Extension Managers in the Delta Area of Nigeria." *NJRS* 8(2):9–16.

Agwu, A. E. and Chah, J. M. 2007. "Access and Utilization of Modern Information Communication Technologies among Extension Personnel in Benue State of Nigeria" In *Agricultural Extension and the Challenges of the Millennium Development Goals (MDGS). Proceedings, 12th Annual National Conference.* AESON. 7–21.

Arokoyo, T. 2003. "ICTs in the Transformation of Agricultural Extension: The Case of Nigeria." *Paper presented at the 6th Consultative Expert Meeting of CTA's Observatory on ICTs.* Wageningen, Netherlands, September 23–25. 6.

Arokoyo, T. 2005. "ICTs Application in Agricultural Extension Service Delivery." In *Agricultural Extension in Nigeria,* edited by Adedoyin F. S., 245–250. Illorin, Nigeria: AESON.

CTA 2003. Sixth Consultative Expert Meeting of its Observatory on ICTs. http://www.cta.int/observatory.

Madukwe, M. C. 2006. Delivery of Agricultural Extension Services to Farmers in Developing Countries." http://www.communit.com/redirect.cgi. — accessed 15 July 2009. [current URL: http://knowledge.cta.int/Dossiers/S-T-Policy/Participatory-approaches-in-ARD/Feature-articles/Delivery-of-Agricultural-Extension-Services-to-Farmers-in-Developing-Countries — accessed 23 May 2014]

Mahtab, P. and Mokatarnia, M. 2009. "Investigating Factors Influencing Use of Internet by Agricultural Faculty Members for Educational and Research Activities." Department of Agricultural Extension and Education, Faculty of Agricultural and Development, University of Tehran, Karaj, Iran. http://www.1.org/aejaes/jaes5_(3)/15.pdf — accessed 21 February 2011. [current URL: http://www.idosi.org/aejaes/jaes5(3)/15.pdf — accessed 27 May 2014.]

Micro LINKS 2010. Information and Communication Technology." Retrieved on 25th August, 2010 from "http://apps.develebridge.net/amap/index.php/Information_and_Communications_Technology".

Omotayo, O. M. 2005. I C T and Agricultural Extension: Emergency Issues in Transferring Agricultural Technology in Developing Countries. In: *Agricultural Extension in Nigeria,* edited by Adedoyin, F. S., 145–148. Illorin, Nigeria. AESON.

Onyemobi, F.I 2000. *Towards Agricultural Revolution and Rural development.* Enugu Nigeria, Falude publishers.

Onyibe, J.E 2001. Technology Dissemination through Women Groups .*A quarterly newsletter of the Nigeria Agricultural Question and Answer Service (NAQAS)* vo1 2.

Richardson, D. 2006. "How Can Agricultural Extension Best Harness ICTs To Improve Rural Livelihoods in Developing Countries?" http://developments:agi.huji.ac.il/economies/gelp-haw-ii.pdf — accessed 5 September 2009. [current URL: http://departments.agri.huji.ac.il/economics/gelb-how-11.pdf—accessed 27 May 2014.]

Salau, E. S. and Saingbe, N. D. 2008. "Access and Utilization of Information and Communication Technologies (ICTs) among Agricultural Researchers and Extension Workers in Selected Institutions in Nasarawa State of Nigeria." www.patnsukjurnal.com/current issue. — accessed 29 January 2010. [current URL: http://www.patnsukjournal.net/Vol4No2/p1.pdf — accessed 27 May 2014.]

Saravanan. R. 2010. "ICT for Agricultural Extension: Global Experiments' Innovations and Experiences." http://Saravananraj.blospot.com.2010/icts_for_agricultural_extension_global.htlm — accessed 29 January 2010. [current URL: http://saravananraj.blogspot.com/2010/01/icts-for-agricultural-extension-global.html — accessed 27 May 2014]

Wikipedia 2009. "ICT in Agriculture. http:/en.wikipedia.org/wiki/ict-n-agriculture — accessed 8 July 2009.

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Providing User Preferred Information Resources for a New Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Nigeria

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Abstract: Nnamdi Azikiwe University in Awka, Nigeria was established as a federal government financed university on August 1992. Because the university was unprepared to start any agriculture program at that time, there were limited provisions for agricultural information services. However, in 2010 the University established a Faculty of Agriculture; to prepare the university library to serve this group, a survey was carried out to ascertain the faculty's library literacy status as well as their information needs. The result showed that, among other things, members of the new Faculty preferred hybrid (electronic and print) library services and were open to innovative social media-driven library services. However, they were not very knowledgeable in the use of electronic resources and social media tools, which could hinder their acceptance of electronic and social media-driven services. To assure effective services, the library must provide both traditional and newer, social media-driven library resources.

Resume: L'université Nnamdi Azikiwe d'Awka au Nigéria a été créée en août 1992 en tant qu'université financée par le gouvernement fédéral. Parce que l'université n'était pas prête à démarrer n'importe quel programme d'agriculture à l'époque, il y avait très peu de services d'information agricole. Toutefois, en 2010, l'université a créé une faculté d'agriculture ; et pour préparer la bibliothèque de l'université à servir ce groupe, une enquête a été menée pour déterminer l'état de maîtrise de la bibliothèque pour servir la faculté, ainsi que leurs besoins en matière d'information. Le résultat a montré que, entre autres choses, les membres de la nouvelle faculté préféraient des services de bibliothèque hybrides (électroniques & imprimés) et étaient ouverts aux services de bibliothèque innovateurs basés sur les médias sociaux. Toutefois, ils n'étaient pas très au courant de l'utilisation de ces ressources électroniques et outils de médias sociaux, ce qui pouvaient les empêcher d'accepter ces services électronique basés sur les médias sociaux. Pour assurer des services efficaces, la bibliothèque doit fournir des ressources de bibliothèque à la fois traditionnelles et nouvelles, basés sur les médias sociaux.

Resumen: La Universidad Nnamdi Azikiwe en Awka, Nigeria, se estableció como una universidad financiada por el gobierno federal en agosto de 1992. Debido a que la universidad no estaba preparada para iniciar un programa de agricultura en ese momento, los fondos para servicios de información agrícola eran limitados. Sin embargo, en el 2010 la Universidad abrió una Facultad de Agricultura. Para preparar la biblioteca de la Universidad para atender a este grupo, se realizó una encuesta entre los miembros de la Facultad para determinar su nivel de alfabetización bibliotecaria, así como sus necesidades de información. El resultado mostró que, entre otras cosas, los miembros de la nueva Facultad preferían servicios bibliotecarios híbridos (electrónicos e impresos) y estaban abiertos a servicios bibliotecarios innovadores a través de las redes sociales. Sin embargo, no eran muy conocedores sobre cómo usar los recursos electrónicos y las herramientas de las redes sociales, lo que podría obstaculizar su aceptación de servicios promovidos por medios de comunicación electrónicos y redes sociales. Para asegurar la eficacia de los servicios, la biblioteca debe proporcionar recursos bibliotecarios tanto tradicionales como los más nuevos a través de las redes sociales.

Introduction

The university academic environment has continued to evolve and change as a result of evolving programs, introduction of new courses of study, pedagogical changes, advancement in information and communication technological, as well as other global changes. In spite of these evolutionary transformations, the focus of the university remains the same: teaching, learning, research and social/recreational responsibilities. Libraries, whose role is to source, acquire, process and disseminate information resources needed to achieve the desired state-of-the-art university responsibilities, also face challenges in taking up their pivotal position as it relates to its revolutionary operations and services. Furthermore, the transformation engendered by changes in scholarly communication and users' approaches to information sourcing and preferences has brought enormous challenges to academic libraries.

In their recent article "User Satisfaction with Library Resources and Services in Nigerian Agricultural Research Institution," L.O. Ezeala and E.O. Yusuff (2011) argue that library services to institutions should not be restricted to the acquisition, processing, storage and dissemination of print resources but should also emphasize what users prefer in terms of the way and manner information is provided. Hence, the changing users' preference and behavior from print to electronic resources demands close attention be paid to new and old library services, with a view to ensuring proper guidance on the use of preferred resources (Zha, Li and Yan 2012).

Information services have been recognized to be user-dependent, which differ from one library to another (Osigwe 2004). Thus, a different user implies a different preference and hence a different approach to information provision. Consequently, a new faculty necessitates a new approach to library and information provision. This is achievable when the user's previous library experiences,

their present needs and future expectations are ascertained. This study was carried out to determine those experiences, needs and expectations.

Faculty of Agriculture, Nnamdi Azikiwe University, Awka

The Faculty of Agriculture, Nnamdi Azikiwe University, Awka was established in 2010 with a focus on the production of graduates or experts with broad-based practical and functional training in various course programs designed to mobilize resources and provide opportunities for improved performance and profit in agriculture by developing appropriate technology and manpower needs. Based on this vision of its new faculty, the university was located in a predominantly agricultural-based community — Ifite Ogwarri, in the Western part of Awka, the capital city of Anambra state, Nigeria. It is envisaged that the seven departments of the faculty (Agricultural Economics and Extension, Animal Science and Technology, Crop Science and Horticulture, Fisheries and Aquaculture Technology, Food Science and Technology, Forestry and Wildlife Management and Soil Science and Land Resources Management) will serve as the corner stone for economic transformation of the local community in particular and Nigeria in general, as well as poverty alleviation, a stable civil government with good governance, and a natural and food-rich society (Azih, 2008). The Faculty is expected to achieve the latter through the production of:

- Manpower with scientific knowledge and technological skills in various disciplines of agriculture;
- Graduates with adequate theoretical and practical training in agriculture to carry out research towards improving agricultural production;
- Graduate farmers who should be relevant to themselves, the industry and society and who will be able to contribute effectively to the national development goals through agriculture.

The university library's responsibility is to provide the university faculty and students with specific library/information services. Even though information resources needed by the new faculty are readily available in the university library, the interdisciplinary nature of agriculture — which cuts across biology, medicine, chemistry, engineering, environmental sciences, and economics — requires that the specific needs of the members of the new faculty be ascertained (Lancester and Beeche 1981). It is also vital to determine the previous library use by the new faculty, as they come from different library/information backgrounds.

This study is also measures the use of very important online databases such as TEEAL (The Essential Electronic Agricultural Library), AGORA (Access to Global Online Research in Agriculture), OARE (Online Access to Research in the Environment), ARDI (Access to Research for Development Initiative), the University's Digital Library and various Web 2.0 services provided to the university community which the library intends to extend to the new faculty. Hence, the study serves as a stepping stone to providing the needed library and information services, especially in this era of technology-driven library operations and services.

Study Objectives

This study was carried out to determine the information resources and service preferences of the members of the new Faculty of Agriculture, Nnamdi Azikiwe University, Awka with a view to designing effective and efficient library services for them. Specifically, the study was aimed to:

- Determine the types of libraries previously used by students and faculty members;
- Ascertain the type of resources previously used;
- Identify the type of resources needed; and
- Determine the mode of services needed by the students and members of the faculty.

Review of Literature

Library user surveys are an age long endeavor, first used in 1948 to determine users' information seeking behavior as presented at the Royal Society Information Conference (Wilson 1981). User surveys have become common in academic libraries during the past twenty years (Hiller, 2001), which is closely tied to changes in teaching, learning, research and advances in ICT (information and communications technology) adoption for information delivery, all of which engenders changes in the "method of teaching, learning and research as well as the growing information technology and library users' active engagement and participation in the information chain." (Musoke 2008, p533)

This has all led to changes in research methods, increased ICT literacy, new study programs and methods, and updated curriculum development. A need has therefore arisen for innovative libraries to meet these changes with new initiatives, networks and collaborations. In addition to these justifications for the study of users by academic librarians, the usefulness of user surveys has been established to include the collecting data to help libraries re-assess or re-direct its collections and services, identifying effects of these changes on the use of services, determining users' perceptions of current resources and services, projecting the future needs of library users and providing opportunities for users' input and support for considered changes (Khan, 2012; Inskip, Butterworth and Macfarlane, 2008; Crist, Daub and Mac Adam 1994). Libraries utilize such results to modify operations, collections and services according to user preferences (Majid, Anwar and Eisenschitz 2000). Numerous libraries, including those engaged in agricultural services, are conducting

user surveys due to its benefits for effective library service delivery. Hiller (2001) reports that the University of Washington libraries have conducted triennial faculty and student library surveys, all aimed at determining the present and potential users, how and why they use them, what sources used, and how satisfied they feel, with a view to improving library services. And a series of user surveys have been carried out by the Association of Academic Research Library in 1981, 1984 and 1991. Van House, Wail and McClure (1990) carried out similar research.

Other general library user survey are found in studies by Hiller (2001), Zha, Li and Yan (2012), Khan (2012), Choukhande and Kuman (2004), Eager and Oppenheim (1996), Fidzani (1998), Inskip, Butterworth and MacFarlane (2008), Clougherty, et al (1998), Perley, Gentry, Fleming and Sen (2007). User survey in agricultural libraries, faculties and programs are not uncommon. Kuruppy and Gruber (2006) studied the information needs of academic scholars in agricultural and biological sciences. Palmer (1991) and Brown (1999) studied the information behavior of scientist including, agricultural scientists, using different platforms and templates. Pelzer, Wiese and Leysen (1998) updated the study carried out in 1988 on information seeking behavior of veterinary medical students. Majid, Anwar and Eisenschitz (2000) studied the information needs of agricultural scientists in Malaysia.

Studies have been carried out in Africa and Nigeria with reference to information needs of agricultural researchers and faculties. Uganneya, Ape and Ugbagir (2012) carried out a survey on information services provision and user satisfaction in agricultural libraries in Nigeria. Udekwe (2007) studied the services provided by agriculture libraries in Nigeria as well as user satisfaction. Oladele (2010) also studied information sources used by agricultural researchers in South Western Nigeria. Ezeala and Yusuff (2011) also worked on user satisfaction with library resources and services in Nigerian agricultural research institutes. In the southern part of Africa, Mokotjo and Kalusopa (2010) evaluated the agricultural information services provided to farmers in Lesotho. A majority of these studies adopted qualitative research methods with focus groups involving participatory observation as well as interviews (Inskip, Butterworth and MacFarlane 2008; Nicholas 2000, Meltzer, Maughan and Fry 1995). All studies in Nigeria employed quantitative research methods with questionnaires.

Though the present study is also focused on students as well as agricultural scientists, the objective and the environment varies from the already conducted research. The intention is to find out what has been, what is already and what will be needed as regards library resources and services provided to staff and students of the new faculty of agriculture in Nnamdi Azikiwe University, Awka.

Method

The study adopted a quantitative research method, using questionnaires to elicit information from lecturers and students of the new Faculty of Agriculture in Nnamdi Azikiwe University, Awka. An Interview was held with the Dean of the Faculty to find out the best approach in gathering data needed for the research. Considering the frequency of the lecturers' visits for lectures and the dispersed nature of the seven departments, it was finally agreed that questionnaires would be used to collect the needed data. It was also agreed with the Dean of the Faculty that due to the various backgrounds which the lecturers come from (they were recruited from various establishments, including universities, colleges of education, research institutes, etc.), it was necessary to find out their library literacy background. The picture was also the same with the students who were coming from rural and urban areas where library services may have been absent or underdeveloped during their secondary school days. Based on the discussion with the Dean, two sets of questionnaires were designed for lecturers and students respectively. These questionnaires covered students' and staffs' library literacy, which was derived from the libraries and resources they had used, their present information needs and the modes of service delivery needed.

Since it is a new faculty, there were only 193 students and 37 lecturers in the six departments that are fully engaged. The respondents were purposively sampled based on the ability to reach them. The populations and samples are presented in Table 1.

Results

The results were categorized in order to portray the respondents' library literacy with reference to library

Table 1 – Population and sample of lecturers and students of the new faculty of Agriculture

	Lecturers		Students	
Department	**Population**	**Sample**	**Population**	**Sample**
Agriculture Economics Extension	9	4	14	8
Animal Science & Technology	3	3	48	44
Crop Science & Technology	4	4	31	11
Fisheries& Aquaculture	2	2	36	30
Food Science & Technology	5	5	55	32
Wild Life & Forestry	2	2	9	5
Soil Science	– Yet to Start Academic Activities –			
Total	25	20	193	130

services and resources used before, the type of resources needed and the mode of services needed.

Library and Resources Previously Used by Staff and Students of the Faculty – The survey revealed that 93.07% (121) of the students had used a library before. The question on staff use of library was considered unnecessary since having undertaken university education; they must have been exposed to at least a well developed university library. Table 2 shows that 69% of the students had used an academic library, while only 15% and 31% had ever used the public and special libraries, respectively. Furthermore, 70% of lecturers were familiar with traditional library services through the library desk. None of the lecturers had used OPAC services before, while 50% of them had used databases, with particular reference to TEEAL.

Table 2 – Type of library and services used previously by students and staff of the faculty of Agriculture

Respondents	Category of Response	Items	Frequency	%
Students n=129	Library Used	Academic	90	69
		Public	20	15
		Special/Research	5	3
Staff n=20	Services Used	Traditional services through library desk	14	70
		OPAC services	0	0
		Internet services	5	25
		Offline database (TEEAL)	10	50

Table 3 – Resources used by the students and their reasons for use

Category	Items	Frequency n=129	%
Resources Used	Books	122	94
	Journals	88	68
	Magazines	74	5
	Newspapers	77	59
	Dictionaries/Encyclopedia	97	75
	Maps	55	42
	Photographs	35	27
	Slides	19	15
	CD-Rom	26	20
	Directories	33	25
	Calendars/Almanac	32	24
	E-books	47	36
	E-Journals	70	54
Reason for Use	Carry out assignment	90	69
	Exam revision	73	56
	Borrow resources	56	43
	Read magazines and newspapers	45	35
	Leisure reading	75	58

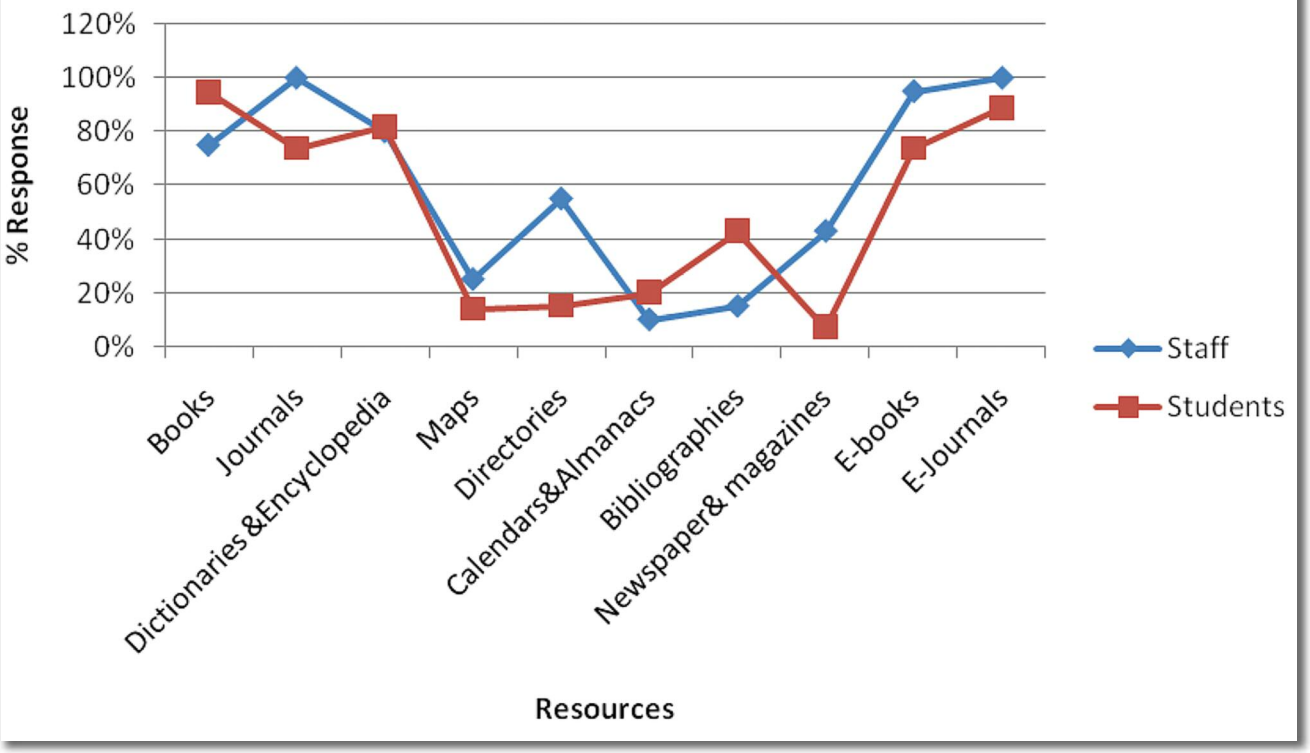
Students were also asked about the type of resources used and the reason for using the libraries. The results as presented in Table 3 shows that above 50% of the students had used almost all the traditional resources of the library except maps, photographs, directories, calendars and almanacs which had low response rates of 42.30%, 26.92%, 25.38%, 20% and 24.61%, respectively. Incidentally, 53.84% had used electronic journals, in contrast to low use of other ICT-based resources. This shows that the students are familiar with all the basic traditional library resources. The Table also shows that the students' pervious use of the library was necessitated by their need to read either for an assignment, examination or leisure. Only 43% and 34% of the students were interested in borrowing library resources or reading magazines and newspapers. This question was not necessary for lecturers who may have used these resources in the course of their university education.

Preferred Resources – To ensure that the initial resources provided at the new faculty library would satisfy the needs of the staff, students and the faculty, users were required to indicate the resource format and services they would want to be served with. The result, in Figure 1, shows that both staff and students preferred journals, encyclopedia, books and dictionaries, all of which had responses above 60%. However, while the staff need newspapers among their top three preferred resources, only 34.61% of the students considered newspaper a prime resource. Other resources are not of primary importance to the majority of the students.

The staff and students also preferred hybrid resources (a mixture of print and electronic) to electronic only or print only, as show in Figure 2.

Preferred Library Services – Since the library has introduced both print and electronic services through the local area network as well as the internet using social

FIGURE 1 – Preferred resources for staff and students' academic work



media platforms, there was a need to find out which services they preferred to use at the present and in the future. Hence, they were required to indicate their preferences for services and access mode. Figure 3 reveals that staff and students are still interested in the traditional access mode (card catalogue), use of Online Public Access Catalogue and use of search engines. Though the University Library is providing services using social media platform, the students and lecturers have yet to embrace such services.

Further inquiry was made on the social media they have been using, as the use of social networking sites and blog is very common in the university, especially with students. The library has also identified social media as an acceptable platform which they can explore as a service provision. Hence, students were required to indicate the use made of social media tools to help the library decide to either consolidate already provided social media services or to review it. Eighty-eighty percent (88%) of the students were aware of social media while 90% of the staff were aware of

FIGURE 2 – Resource format preference of staff and students

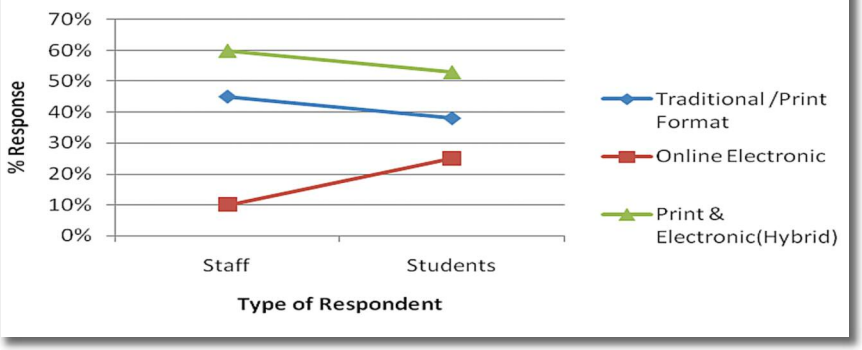


FIGURE 3 – Preferred access mode for library resources

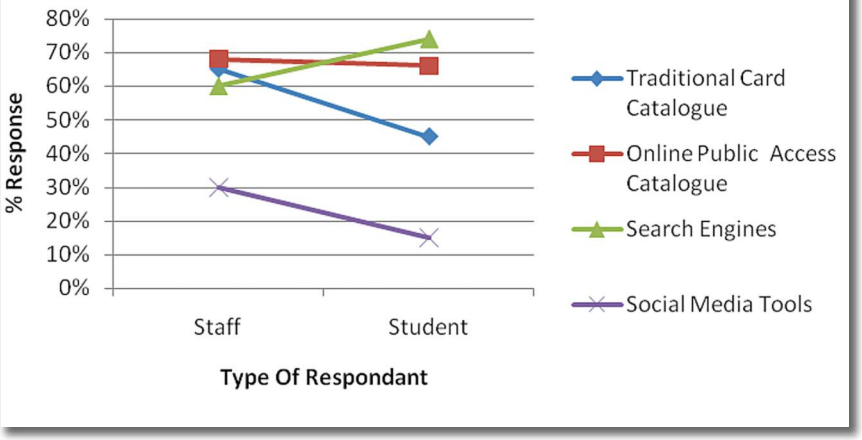
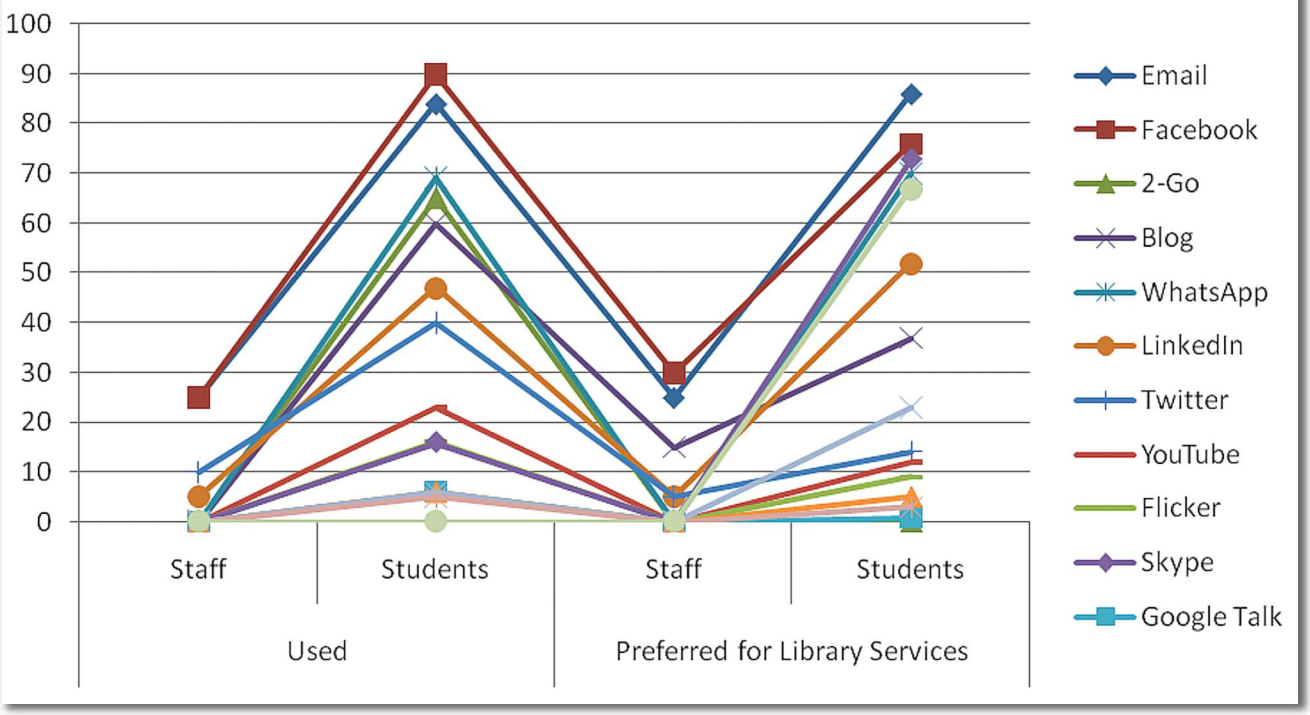


Figure 4 – Social media tools used and preferred for library services by staff and students of the faculty



the social media tools. Their responses on their uses of various social media are presented in Figure 4. Students used all the social media listed, and the percentage that has used them ranged from 90% and 84% for Facebook and E-mail through 69%, 65%, and 60% for WhatsApp, 2-Go and blog to 47% and 40% for LinkedIn and Twitter respectively. Less than 40% of the students have used other social media tools. Contrary to the responses by the students, only 25% of the staff has used E-mail and Facebook. The use of LinkedIn and Twitter was made by 5% and 10% of the staff, respectively. Other social media tools have not been used by the staff.

Responses on preferred social media tools for library services (Figure 4) continued to emphasize the low use of these tools by the staff. Many of the staff could not claim preference for what they have not used before, hence only Facebook, email, blogs, Twitter and LinkedIn elicited 30%, 25%, 15%, and 5% positive responses, respectively.

Though the students have used a majority of the social media tools, their preference for Facebook, E-mail, Skype, LinkedIn, Moodle and WhatsApp was revealed by the positive responses of above 50% for each of them. The major reasons why some staff and students have not used social media include lack of knowledge on how to use them (100% of staff and 94% of students) as well as not being aware of what these social media are used for (98% of staff and 94% of students).

Reason for Preferred Social Media Services – The staff and students' responses on why they use social media show that 88%, 25% and 50% used them for ease of access, 25% and 50% of them indicated that social media are highly interactive. Other reasons included ease of use, and social media brought from elicited responses were below 50% from both staff and students.

Summary of Findings

- Majority of the students have used a library before, of which academic libraries are the most used and special libraries least used.
- Apart from the use of offline databases like TEEAL, the majority of the staff were familiar with only the traditional print services through the library help desk.
- The students demonstrated their greater familiarity with traditional print resources than electronic resources, though 50% of them have used e-journals in addition to the print resources.
- The resources needed by both staff and students of the faculty still remain the traditional library resources which include journals, books and other reference materials as well as newspapers of which format should be hybrid (print and electronic).
- On the access and mode of services delivery, both staff and students are willing to have the resources delivered through the online catalogue and the internet. A majority of the staff are still interested in the traditional access mode using the card catalogue.
- Despite the low acceptance of social media mode of service delivery by the staff and students, a majority are aware of social media tools. However, only a few of the staff have put e-mail, Facebook, LinkedIn and twitter to use while majority of the students have used e-mail, Facebook, LinkedIn, blogs, WhatsApp and 2-Go.

- The reason for non–use of the social media tools was attributed to lack of knowledge and skill on how to use them by staff and students.
- Students are open to Facebook, e-mail, Skype, LinkedIn, Moodle and WhatsApp for library services. Not many of the staff could indicate their interest since they have limited use of the social media tools.
- A majority of staff and students who know and use social media prefer it for library services because they are easily accessible and highly interactive.

Discussion of Findings

The survey to determine the information resources and service preferences of staff and students of the new Faculty of Agriculture revealed that a majority of the students and staff have used academic libraries before, an indication that a new library that will be established will not elicit apprehension on the stakeholders. It is a suggestion that they are not ignorant of what and how of a typical academic library works and which services will be extended to them. Their familiarity with mainly traditional print services and only offline databases like the TEEAL is contrary to majority of the twentieth century findings in studies by Choukhande and Kuman (2004), Meltzer, Manghan and Fry (1995); Oladele (2010), Martell (2008) and the situation in IITA(2013) where library users enjoy offline and online electronic services more than the traditional print services. This also suggests the nature of library services prevalent in many academic libraries in Nigeria, as found by Ugannaya, Ape and Ugbajir (2012). It is not surprising that the university library in Nnamdi Azikiwe University is still offering primarily traditional print services and only TEEAL as the available electronic database with some innovative electronic services which the respondents may not have been aware of.

The low use of electronic resources against the use of print resources which include books, journals and reference resources has continued to suggest low adoption of ICT for library services in Nigerian academic libraries. This also confirms the findings of Anunobi, Nwakwuo, Oga and Bernard (2011) that use of ICT for library services is low in South East Nigerian academic libraries. Hence, it is expected that the respondents will prefer print journals, books and reference materials which they are familiar with. Furthermore, the desire to have a hybrid collection, including print and electronic resources, confirms the findings of Zha, Li and Yan (2012). It also suggests that the respondents derive some value from the offline databases (TEEAL) which they have been exposed to and also provides a window for the establishment of hybrid library services to be in conformity with global trends as Martell (2008) noted , where an increase in electronic network resources is dwindling the physical/print libraries. Another indication of the acceptance of electronic services is their preference for resources delivered through the OPAC, which supports the findings of Hiller (2001) and Tomney and Buton (1998) that users prefer remote access to resources through the OPAC. Hence the new library will be maximally used if the catalogue should become electronic.

It is not amazing that the staff and students of the University are aware of these electronic resources but not using social media tools effectively. These tools are discussed in every nook and cranny of the University and they are also available in some of the mobile phones used by these respondents thus, confirming the assertion of Musoke (2008) that these tools have affected the way and manner of life of information users. That the low use stems primarily from a lack of knowledge and skills may not serve as a hindrance to their adoption for library services; rather, it suggests that training should be provided to these stakeholders as recommended by Zha, Li and Yan (2012) that librarians should pay more attention to the new patrons and should guide them on how to use electronic resources.

Low use of social media tools also suggests why a majority of the innovative library services provided to the university community are not effectively utilized. This should not serve as a deterrent, as Musoke (2008) still insists that innovative library services which mesh collaboration and networks are essential to drive users' information need in the present day competitive information environment. Preference to a particular social media tool could be a function of use; hence students who have used a majority of the social networking tools indicated their preference for them. This however must not limit library social media-tool-driven library services to those preferred by the students; rather, effort should be made to provide innovative services accompanied by training in their use. Furthermore, the respondents' indication that the social media library services are easily accessible and highly interactive implies that those are the major factors to be considered when decisions should be made on the social media services to be provided to them.

Conclusion and Implication

Academic library services can be effective and efficient when the users' needs are identified and services provided in the way and manner required. Despite the basic services expected of an academic library, the changing academic environment and library user approach to desirable information, as well as the overwhelming global electronic world, suggest a need to bridge the gap between the library and its users. Considering the former, it is evident that members of the new Faculty of Agriculture in Nnamdi Azikiwe University can conveniently use print library resources, will prefer hybrid-(electronic and print) library services , need traditional and electronic library resources relating to agricultural programs, and are open to innovative social media driven library services. However, they are not very knowledgeable in the use of electronic resources and social media tools which is likely to hinder

their acceptance of electronic and social media driven services. Assurance of effective and acceptable library and information services will be attained if traditional library resources are provided with automated remote access services/operations. Social media-driven services should be provided for ease of accessibility and interactivity and there is the need to use information literacy classes to train users on the use of the hybrid services.

References

Anunobi, C.V, O.P. Nwakwuo, M. Oga and I.I. Benard. 2004. "The Adoption of ICT for Library and Information Services." *Nigerian Libraries* 44(1): 89–104.

Azih, I. 2008. "A Background Analysis of the Nigerian Agricultural Sector (1998 TO 2007)." *OXFAM NOVIB Economic Justice Campaign in Agriculture.* http://www.inter-reseaux.org/IMG/pdf_Final_Report_on_Background_Analysis_of_Nigerian_Agric_Sector_Oxfam_Novib_november_2008.pdf — accessed April 12, 2013.

Brown, C.M . 1999. "Information Seeking Behavior of Scientists in the Electronic Information Age: Astronomers, Chemists, Mathematicians, and Physicists." *Journal of the American Society for Information Science* 50(10): 929–943.

Choukhande, V.G and P.S.G. Kumar. 2004. "Analytical Study of Information Needs and Use Pattern of Faculty Members and Research Scholars af Amravati University." *ILA Bulletin* 40(3): 23–31.

Clougherty, L., J. Forys, T. Lyles D. Persson, C. Walters and C. Washington-Hoagland. 1998. "The University of Iowa Library's Undergraduate User Needs Assessment." *College & Research Libraries* 59(6): 571–583.

Crist, M., P. Daub and B. MacAdam. 1994. " User Studies: Reality Check and Future Perfect." *Wilson Library Bulletin* 68(6): 38– 41.

Eager, C. and C. Oppenheim. 1996. Observational Method For Undertaking User Needs Studies. *Journal of Librarianship and Information Studies* 28(1): 15–22.

Ezeala, L.O and E.O. Yusuff. 2011. "User Satisfaction with Library Resources and Services in Nigerian Agricultural Research Institution." *Library Philosophy and Practice.* http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1595&context=libphilprac&sei-redi) accessed March 12,2013.

Fidzani, B. T. 1998. "Information Needs and Information Seeking Behaviour of Graduate Students at the University of Botswana." *Library Review* 47(7): 329–340.

Hiller, S. 2001. "Assessing User Needs Satisfaction and Library Performance at the University of Washington Libraries." *Library Trends* 49(4): 1605–25.

IITA: International Institute for Tropical Agriculture 2008. "The New IITA Library." *The Bulletin* no. 1902. www.iita.org/bulletins —accessed April 20, 2013.

Inskip, C, R. Butterworth and A. MacFarlane. 2008. "A Study of the Information Needs of the Users of a Folk Music Library and the Implications for the Design of a Digital Library System." *Information Processing and Management* 44:647–662.

Khan, A. M. 2012. "Users Perceptions of Library Effectiveness: A Comparative Users Evaluation of Central Libraries of AMU, BHU, ALU and BBRAU." *The International Information and Library Review* 44: 72–85.

Kuruppy, P.U. and A.M. Gruber. 2006. "Understanding the Information Needs of Academic Scholars in Agricultural and Biological Sciences." *The Journal of Academic Librarianship* 32(6): 609–623.

Lancaster, F.W. and J.W. Beecher. 1981. "Agricultural Librarianship and Documentation as a Profession." In *Agricultural Information to Hasten Development* . Proceedings of the 6th World Congress of the International Association of Agricultural Librarians and Documentalists. Los Banos, The Philippines: Agricultural Libraries Association of the Philippines, 197–210.

Majid, S., M.A. Anwar and T.S. Eisenschitz. 2000. "Information Needs and Information Seeking Behavior of Agricultural Scientists in Malaysia." *Library and Information Science Research* 22(2): 145–163.

Martell, C. 2008. "The Absent User: Physical Use of Academic Library Collections and Services Continues To Decline 1995–2006." *The Journal of Academic Librarianship* 34(5): 400–407.

Meltzer, E. P.D. Maughan and T.K. Fry. 1995. "Undergraduate in Focus: Can Student Input Lead to New Directions in Planning Undergraduate Library Services." *Library Trends* 44(2): 400–22.

Mokotjo,W. and T. Kalusopa. 2010. "Evaluation of the Agricultural Information Services (AIS) in Lesotho." *International Journal of Informational Management* 30(10): 350–356.

Musoke, M. G. N. 2008. "Strategies for Addressing the University Library Users' Changing Needs and Practices in Sub-Saharan Africa." *The Journal of Academic Librarianship* 34 (6): 532–538.

Nicholas, D. 2000. *Assessing Information Needs: Tools, Techniques and Concepts for the Internet Age.* London: ASLIB.

Oladele, O. I. 2010. "Information Sources Use Patterns Among Agricultural Researchers in South West Nigeria." *The Journal of International Social Research* 3(12): 322–326.

Osigwe C. 2004. Sustainable Information Management and Services. An Overview. *Quarterly Bulletin of the International Association of Agricultural Information Specialists* 38(3): 205–209.

Palmer, J.B. 1991. "Scientists and Information: Using Cluster Analysis to Identify Information Style." *Journal of Documentation* 47:105–129.

Pelzer, N.L, W.H. Wiese and J.M. Leysen.1998. "Library Use and Information-Seeking Behavior of Veterinary Medical Students Revisited in the Electronic Environment." *Bulletin of the Medical Library Association* 86(3): 346–355.

Perley, C.M., C.A. Gentry, A.S. Fleming and S.M. Sen. 2007. "Conducting a User-Centered Information Needs Assessment: The Via Christi Library's Experience." *Journal of Medical Library Association* 95(2): 173–181.

Tomney,H. and P.F. Burton. 1998. "Electronic Journals: a Study of Usage and Attitudes Among Academics." *Journal of Information Science* 24(6): 419–429. http://dx.doi.org/10. 1177/016555159802400605.

Udekwe, P.U. 2007. "Managing Agricultural Information System in Nigeria: Issues and Challenges." *Lagos Librarian* 21: 6–12.

Uganneya, S., R. Ape, N. Ugbajir. 2012. " Information Services Provision and User Satisfaction in Agricultural Research Libraries in Nigeria." *International Journal of Library and Information Science* 3(6): 88–93.

Van House, N., N. Weil and C. McClure. 1990. *Measuring Academic Library Performance: a Practical Approach*. Chicago, IL: American Library Association.

Watson, M., J.B. Foote, C. Roland and R.C. Person. 1996. "Twenty Years of Undergraduate Libraries: Whence and Whither?" *College and Undergraduate Libraries* 3(2):11–25.

Zha, X., J. Li and Y. Yan. 2012. "Understanding Usage Transfer From Print Resources to Electronic Resources: A Survey of Users of Chinese." *Serials Review* 38: 93–98.

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Diffusion of Scientific Knowledge in Agriculture: The Case for Africa

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Abstract: Diffusion of scientific knowledge in the agriculture sector in Africa, primarily in sub Saharan African (SSA) countries, is dominated by traditional extension service that is slow, linear, hierarchical, and poorly funded. We investigated existing knowledge diffusion models and their limitations, available best practices, and the potential for translational research to augment extension service programs in SSA agricultural practices. Our findings include: public-private partnerships are critical to forging ties between the research and farming communities; researchers and their institutions need to consider the needs and priorities of the farmer first; extension services need to focus more on education, training, and face-to-face interactions; translational research will help bolster the existing knowledge diffusion practice; there is potential for information communication technologies(ICT) use in disseminating new knowledge and creating knowledge networks. We also propose an "Agricultural Knowledge Clearinghouse (AKC)" that will work in tandem with the extension service.

Resumé: La diffusion des connaissances scientifiques dans le secteur agricole en Afrique, principalement dans les pays en Afrique subsaharienne (ASS), est dominée par les services de vulgarisation traditionnelle qui sont lents, linéaires, hiérarchiques, et mal financés. Nous avons enquêté sur les modèles de diffusion des connaissances existants et leurs limitations, les pratiques exemplaires disponibles, et le potentiel de recherche translationnelle pour augmenter les programmes de services de vulgarisation sur les pratiques agricoles en ASS. Nos constatations sont les suivantes : les partenariats public-privé sont essentiels à l'établissement de liens étroits entre la recherche et les communautés agricoles; les chercheurs et leurs institutions doivent d'abord examiner les besoins et les priorités de l'agriculteur; les services de vulgarisation doivent se concentrer davantage sur l'éducation, la formation, et les interactions face-à-face ; la recherche translationnelle aidera à renforcer les pratiques existantes de diffusion des connaissances; il existe un potentiel de technologies de l'information et de la communication (TIC) dans la diffusion des nouvelles connaissances et la création de réseaux de connaissances. Nous proposons également un "Centre de connaissances agricoles (AKC)" qui travaillera en tandem avec le service d'extension.

Resumen: La difusión de conocimientos científicos en el sector agrícola africano, principalmente en los países de África sub-Sahárica, está dominada por el servicio tradicional de extensión que es lento, lineal, jerárquico y mal financiado. Se investigaron los modelos existentes de difusión del conocimiento y sus limitaciones, las mejores prácticas disponibles y el potencial para investigación traslacional para aumentar los programas de servicios de extensión en cuanto a prácticas agrícolas de África sub-Sahárica. Entre los hallazgos están los siguientes: (1) las alianzas público-privadas son fundamentales para el desarrollo de relaciones entre la comunidad de investigación y las comunidades agrícolas; (2) los investigadores y sus instituciones deben considerar primero las necesidades y prioridades del agricultor; (3) los servicios de extensión deben centrarse más en la educación, la capacitación y la interacción cara-a-cara; (4) la investigación traslacional ayudará a reforzar la práctica existente de difusión del conocimiento; (5) existe el potencial para usar tecnologías de la información y la comunicación (TIC) en la difusión de nuevos conocimientos y en la creación de redes de conocimiento. También se propone un Centro de Distribución de Conocimientos Agrícolas (AKC, sus siglas en inglés) que trabajará junto con el servicio de extensión.

Agriculture is the mainstay of the economies of most African countries. Close to 50% of the world's population live in rural areas and most of them (over 83%) are in one way or another dependent on and/or engaged in agriculture (FAO, 2013a). Africa is the continent where the economy's main backbone is agriculture and where the largest percentages of people are poor farmers. About two-thirds of the population in Africa, especially in sub-Saharan Africa, and about 72% of those in East Africa are dependent on agriculture for their livelihoods (Adekunle et al., 2012; FAO, 2012; Webersik and Wilson, 2009). These numbers may not change dramatically in the near future although other sectors of the African economy such as commodities and manufacturing, at least in some countries, have picked up momentum thanks in part to good governance and policies making the continent more attractive to investors, both foreign and domestic. In fact, in 2012, the region with the second fastest-growing economy in the world was Sub-Saharan Africa, with agriculture as one of the sectors contributing to the growth (Sayeh, 2013).

Africa, often beset by poverty, malnutrition, and hunger, is also working hard to achieve food security and reduce chronic hunger. However, there are dangers lurking that could impede its growth and deny achievement of sustainable food security. One of these dangers is climate change which could predictably have adverse effects on agricultural production and, in turn, the economy (Sayeh, 2013). Still, according to the latest edition of the 'State of Food and Agriculture 2013' report (FAO, 2013b), Africa has the world's highest prevalence of malnourished people, at nearly 23% of the population. Agricultural output in Africa has not kept with other regions of the world. Major initiatives such as NEPAD's Comprehensive Africa Agriculture Development Program (CAADP), the Forum for Agricultural Research in Africa

(FARA), and the New Alliance for Food Security and Nutrition between G-8 and African countries are all gearing up to lift tens of millions of people out of poverty over the next decade. In this critical social mission, the role of scientific knowledge and innovation capacity cannot be overstated as agriculture is both knowledge and resource intensive (Ayele and Wield, 2005).

To mitigate the dangers to economic development for African countries where agriculture is the main driver of growth, it is crucial to have continued investments in innovations and research by governments and non-governmental organizations as well as immediate translation/diffusion of the innovations, results, and findings of that research to practice. Extensive literature exists in the area of diffusion of knowledge and innovation in general, and in agricultural sciences in particular (Rogers, 1995, p.157; Rogers, 2004). At the time of publication in 2003 of the 5th edition of Everett Rogers' influential book *Diffusion of Innovations* (first published in 1962), there were about 5000 diffusion related publications (Rogers, 2004). One can trace diffusion research in agriculture back to the work of Ryan and Gross (1943) on the diffusion of hybrid seed corn in two Iowa communities. This seminal work was later followed by Griliches' 1957 highly cited article about hybrid-corn adoption in the U.S. The body of work in this area is largely focused on the investigation of characteristics of innovators, why certain innovations are adopted while certain technologies and ideas fail, the rate and speed of adoption of new ideas, etc. (Wejnert, 2002). According to Rogers (1995, p.5; 2004), a leading authority in diffusion research, diffusion is defined as "the process through which an innovation, defined as an idea perceived as new, is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding."

Given the above definition, it is not difficult to extrapolate the fact that relevant actors such as researchers, extension agents, farmers, traders, policy makers, non-governmental organizations (NGOs), and those in industry and manufacturing all have a stake in agriculture and can be seen as members of the larger 'social system' in agricultural sciences. The second element in the definition concerns the notion of 'communication,' and the idea that "members create and share information with one another in order to reach a mutual understanding;" this, however, is not always reflective of the situation on the ground when one examines the existing communication channels in the field of agriculture in Africa. The existing communication in agriculture in Africa is hierarchical, slow, unidirectional, and lacks the appropriate resources and infrastructure (Bembridge, 1987; Rural Economy and Land Use [RELU], 2007).

As is the case in most regions and countries the world over, scientific knowledge communication is predominantly through professional conferences and scholarly journal publications. Such channels of scholarly communication are not really designed with the farmer in mind because the audience, the language of the research findings, and the format of communication are not compatible with the needs and level of competency of the farmer. This is not to suggest that the results of research findings will not reach the farmer at all. For a long time, driven by the basic-applied research divide, basic science/research remained neutral while applied research addressed problem-solving issues. This was evident from Albert Einstein's appeal in 1931: (cited in World Conference on Science by UNESCO, 2000) "concern for humankind itself and its fate must always form the chief interest of all technical endeavors… .Never forget this in the midst of your diagrams and equations."

Still, scholarly communication practices today largely happen within the circle of researchers and scientists. The research-to-application or knowledge-to-decision pathway tends to be linear in that new findings and ideas flow from the research community to the agricultural community via some intermediary, often extension professionals or personnel at government agricultural institutions such as ministries or departments. It is not that the extension service is not working. Studies have shown that when implemented properly, extension's impact and role are positive, including in advanced economies (Davis, 2008; Marsh, Pannell and Lindner, 2000). The fact remains, however, that in such a linear model of knowledge diffusion, the research community largely operates in isolation and is divorced from the needs and priorities of the farming community. At its core, the communication and interaction between the agricultural research community, extension services and farmers in Africa needs re-conceptualizing to bolster effective diffusion of knowledge and innovation. If any of the research findings are to trickle down to the farm field in a timely and usable manner, much work needs to be done to package, repackage, and synthesize the knowledge into context-rich processes, procedures, and guidelines that can be readily used and acted upon.

Although scientific knowledge, which is the focus of this paper, is largely produced by the research community, there is non-research knowledge that is often communicated to the farmer. For generations, through interactions with the natural environment, the farming community in Africa has been using non-research based knowledge. Thus, any knowledge diffusion framework that is introduced or any research activity that takes place to improve existing agricultural practices needs to start with or factor in the existing local knowledge base, often referred to as indigenous knowledge. Studies have also shown the significance of embedding indigenous knowledge with scientific knowledge to achieve better results (UNEP, 2011).

The agriculture sector and the entire supply chain is a complex system that involves multiple actors such as

agricultural science researchers and scientists, technical universities, NGOs, manufacturing and industry, government ministries, traders, extension professionals, and of course farmers. Knowledge diffusion, as opposed to knowledge transfer (which is unidirectional from provider to seeker), is multidirectional and involves the exchange of ideas, best practices, know-how, information and expertise between the range of actors stated (Manning, 2013). In this study we focus on the diffusion of scientific knowledge from the research and scientific community to the farmer as the end-user. Most importantly, we focus on exploring translational research (TR) as a model/strategy for effectively communicating research findings from scientific and research community to the farming community. Broadly defined, translational research is any research that helps to 'translate' the results of scientific research so it can be put to practical use in improving people's lives. Recently, translational research has gained wider recognition in medicine and clinical settings as a strategy to benefit patients in clinical settings from the knowledge and findings of basic research in bio-medical sciences (see for example, Brekke, Ell and Palinkas, 2007; van der Laan and Boenink, 2012; Vignola-Gagne, 2013; Zerhouni, 2003, 2005). We argue that translational research as a new paradigm can be viewed within the framework of the national systems of innovation that is widely recognized in agriculture.

Against this backdrop, we first review existing agricultural extension services that come in different forms and shapes throughout sub-Saharan African (SSA) countries (see Davis, 2008 for a complete typology of the extension service in SSA) in order to propose a working knowledge diffusion model that has translational research practice at its core. Given that agriculture is a complex multi-stakeholder, multi-disciplinary sector and taking into account the limitations in social, technical, and institutional infrastructure in SSA, we propose a framework that overcomes the limitations and augments existing extension services system and proposes a solution that: (1) engages farmers to understand their needs, concerns, and priorities thereby creating the environment for researchers/scientists to work with the farmers instead of for them; (2) includes in addition to well utilized channels more recent advances in social communication tools and mobile technologies; (3) conceptualizes the role of the extension agent as a knowledge broker; and, most importantly (4) learns from translational research to develop effective knowledge translation programs that bridge the knowledge-to-action gap.

More specifically, as we propose an appropriate model, we aim to find answers to the following three questions:

- What best practices exist to build partnerships between researchers, their institutions, and practice constituencies in the agricultural sector in Africa?
- To what extent can translational research augment existing agricultural knowledge diffusion and extension service in sub-Saharan Africa?
- What is the potential of Information Communication Technologies (ICT) in extension services, learning, and knowledge diffusion efforts in sub-Saharan Africa's agricultural practices?

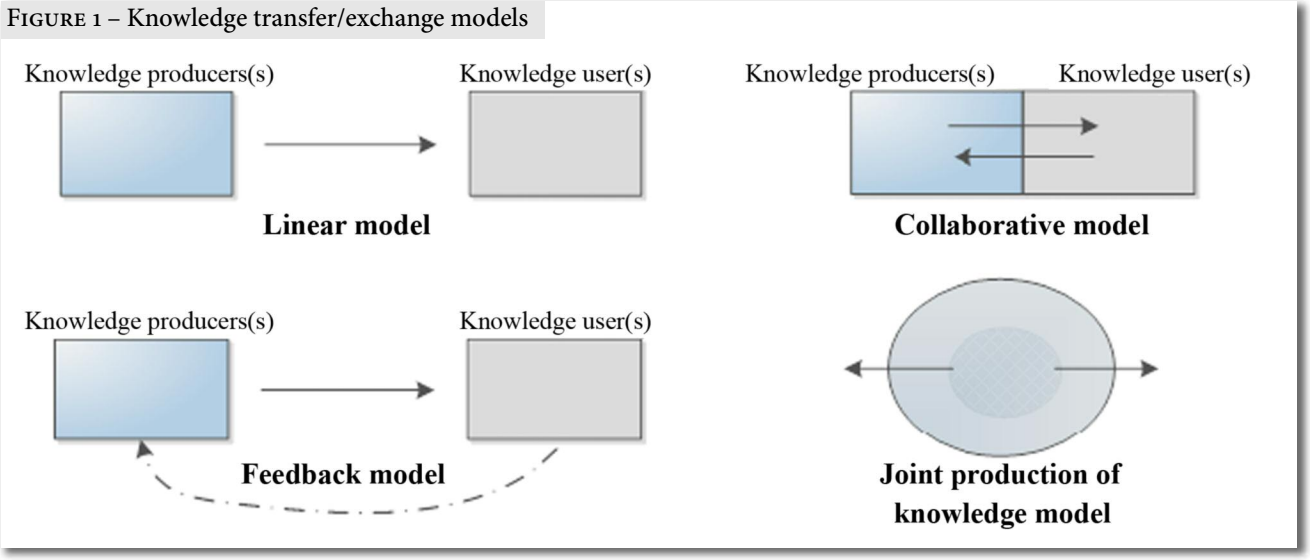
Related Work

Knowledge Diffusion and Innovation Adoption – One would be hard pressed to find a socio-economic activity that does not take in knowledge as an input to produce more and better output, including further knowledge production. Agriculture is no exception in this regard. When relevant and useful knowledge is utilized, it has the power to transform agricultural output. The epistemological and philosophical discussion of knowledge aside, knowledge (internal or external) is continuously internalized and externalized through social interactions, shared experiences, and learning. It is in this context that the discussion of knowledge diffusion and innovation adoption comes to the fore. This section reviews the extant literature about the use of agricultural scientific knowledge in Africa, primarily sub-Saharan Africa (SSA).

Over the years, different approaches, frameworks, and models were developed to explain and guide activities around knowledge diffusion in agricultural practices. In sub-Saharan Africa, a closer analysis of these models reveals that implementation comes down to one of several variations of traditional government-led extension service programs (see, for example, Davis, 2008). More recently, under the general umbrella of a 'national innovation systems approach,' there is an increasing literature that focuses on a new paradigm based on multi-stakeholder, bidirectional, participatory, and collaborative approaches (Ayele, Duncan, Larbi, and Khanh, 2012; Edquist, 1997; Nelson, 1993). Such an innovation systems approach is seen as networks of private and public sector organizations interacting synergistically to create, diffuse, and use knowledge. In addition, we also find related discussions such as scientific and technological capacity building (Ayele and Wield, 2005; Hall, 2005); knowledge networks and social learning (Ingram, 2010); peer-to-peer learning among equals (Topping, 2005); change agent approach (van den Ban and Hawkins, 1996), and learning networks (Riddell, 2001).

The nature of interactions and communication channels employed are equally diverse and include mentoring, one-on-one meetings, demonstrations, community radio, farmer field schools, training, and visits (Davis, 2008; Manning, 2013). It has also been found that face-to-face interactions are significant modes of knowledge exchange (RAND Corporation, 2011). In addition, farmer-to-farmer extension work is regarded as beneficial because both parties communicate the same language and the interaction would be relevant and in-context which ensures availability, accountability, and credibility — and once developed offers an element of sustainability as an ongoing model (Scarborough et al., 1997).

Figure 1 – Knowledge transfer/exchange models



Knowledge diffusion in agriculture is not always about the transfer of scientific knowledge from the research community to farmers as end users. Over generations, farmers accumulate varied practices and ideas that become part of their indigenous knowledge stock. Indigenous knowledge (IK) is the primary resource and social capital that shapes how local farmers engage with the natural environment and develop problem-solving strategies (Lwoga, Ngulube and Stilwell, 2011). As important as it is, IK is usually internal, tacit, unsystematic, and derived from local experiences (Lwoga et al., 2011). Often contrasted with local knowledge, the definition of IK encompasses all forms of knowledge, including technologies, know-how skills, practices and beliefs that enable the community to achieve stable livelihoods in their environment (Manning, 2013). In view of all this, it is apparent that any knowledge diffusion activity needs to start with the community's knowledge base, assess what is and is not working, build on the best practices, and improve on the ones that will not yield desired results (Johnson and Segura-Bonilla, 2001).

The goal of knowledge diffusion is to create a successful environment where end users benefit from the research findings by adopting new ideas and practices in a timely manner. In this regard, learning is an integral part of the end-users embracing innovation and knowledge (Ghadim, Pannell, Burton, 2005). According to Rogers (1995), the rate of adoption, defined as the speed with which new ideas and innovation are embraced by individuals and groups, is predicated on five factors: (1) relative advantage, (2) compatibility, (3) level of competency, (4) trialability, and (5) observability.

Along with the diffusion of research, closely discussed concepts are knowledge transfer, knowledge exchange, and knowledge translation. The Research Council of UK defines knowledge transfer as "the system and processes by which knowledge, expertise and skilled people transfer between the research environment and its user communities in industry, commerce, public and service sectors" (Rural Economy and Land Use [RELU], 2007). Knowledge transfer is often regarded as a one way flow from source to destination without any feedback loop back to the origin. Knowledge exchange, on the other hand, is conceived as a multi-directional flow of all kinds of information that is required as a basis for decision making in the translational research process (RAND Europe, 2011). Four knowledge transfer/exchange models were adapted from RELU (2007). These models (Figure 1) conceptualize the direction of the information/knowledge flow at a higher and broader level and do not tell us much about the role of actors involved in agricultural practices.

More and more, integrated agricultural practices and the innovations systems approach are gaining wider attention. In the African context, the Forum for Agricultural Research in Africa (FARA) is spearheading integrated agricultural research for development (IAR4D), which uses an innovations systems approach to bring together stakeholders as partners (Adekunle et al., 2012). In order to evaluate the usefulness of multiple stakeholder innovation systems approaches to support IAR4D, FARA investigated twenty one case studies from eastern, southern, and western African countries. According to the findings, the successes from the case studies are mixed and dependent on a wide range of facilitating and inhibiting factors, the key elements of which include (Adekunle et al., 2012, p.6–7):

- Building and supporting partnerships
- Strengthening farmer organizations
- Involving the private sector and ensuring use of market driven approaches
- Improving access to information, knowledge, and training
- Scaling up and adding value to country agricultural strategies
- Sustainability

Table 1 – Extension models and agents by country

Country	Current Model(s)
Angola	Rural Development and Extension Programme; FFS
Benin	Participatory management approach; decentralized model; FFS
Burkina Faso	FFS
Cameroon	National Agricultural Extension and Research Program Support Project; FFS
Ethiopia (65,000)	Model based on SG-2000 approach: Participatory Demonstration and Training Extension System; FFS
Ghana	Unified Extension System (modified T&V); pluralistic with NGOs and private companies part of the national extension system; decentralized; FFS
Kenya	Pluralistic system including public, private, NGOs; FFS; stakeholder approach (NALEP): sector-wide, focal area, demand-driven, group based approach
Malawi	Pluralistic, demand-driven, decentralized; "one village one product;" FFS
Mali	Modified T&V; both private and parastatal services for cotton; FFS; SG-2000
Mozambique (1,068)	Government-led pluralistic extension; FFS
Nigeria (5,252)	FFS; participatory; SG-2000
Rwanda (500)	Participative, pluralistic, specialized, bottom-up approach; FFS
Senegal	FFS; government-led demand-driven and pluralistic system; FFS
Tanzania (7,000)	FFS; group-based approach; SG-2000; modified FSRE from Sokoine University of Agriculture's Centre for Sustainable Rural Development; private extension; decentralized Participatory District Extension; pluralism
Uganda	Pluralistic; National Agricultural Advisory Services (NAADS) is demand-driven, client-oriented, and farmer-led; SG-2000; FFS
Zambia	Participatory Extension Approach; FFS

Moreover, diffusion has its own characteristics in that (1) it tends to be adopted over time and it exhibits a wave-like s-shaped pattern, and (2) it has also a spatial dimension in which it tends to concentrate in the geographic region where it started and reaching other areas in outward fashion (Trajtenberg and Yitzhaki; 1989; Wejnert, 2002).

Extension Service and Knowledge Diffusion – The current state of knowledge diffusion in Africa (especially in SSA) is dominated by extension services that are largely coordinated by the ministry of agriculture (and their equivalent institutions) in respective countries. Extension is defined as "the conscious use of communication of information to help people form sound opinions and make good decisions" (van den Ban and Hawkins, 1996). Traditionally, extension was regarded as the delivery of information and technologies to farmers that in turn led to the characterization of agriculture extension as the technology transfer model (Davis, 2008). In agriculture, extension services are key to communicating new knowledge and ideas to farmers, and is often characterized as the conduit between the research community and the farmer (Marsh, Pannell and Lindner, 2000). Extension also plays a significant role in introducing new ideas and innovations to the farmer during initial stages of adoption (Marsh, Pannell and Lindner, 2000).

Extension agents often employ personal interactions, field visits, demonstrations, outreach, workshops, etc. as mechanisms to transfer new knowledge and innovation. The structure and execution of an extension service varies from one country to another. In Africa, where the economy is largely centralized, extension agents are from the government, based mainly in agriculture ministries and departments; they are deployed to execute the plan, supervise instead of teach, and enforce the quantitative attainment of goals instead of the qualitative impact (Blanckenburg, 1982). Davis (2008) reviewed extension services throughout SSA countries and offers three general categories: diffusion or government-driven; participatory or demand-driven; and private or supply driven. Table 1 summarizes extension models, and numbers of agents (also called agent density) in selected SSA countries (Davis, 2008). Farm field schools are noted as FFS.

Extension professionals are often seen as change agents, working closely with the farming community either as an internal or external entity and playing a process-facilitating role (Manning, 2013). To the extent that they are playing a much needed role in driving innovation and providing new knowledge, there are also authors who argue that extension workers are largely engaged in knowledge transfer instead of knowledge exchange because there is no feedback loop in such a change-agent approach that is often characterized as a unidirectional information flow (van den Ban and Hawkins, 1996). Rogers (1995, p.27) describes extension professionals as "opinion leaders" whose mission is to effect behavior change in the target audience, i.e., the farming community. A detailed discussion of extension approaches (guiding the structure, leadership, program, resources), models (schematic account of the system), and methods (such as visits, demonstrations) is given in Ponniah, Puskur, Workneh and Hoekstra (2008).

Increasingly, the literature in this area focuses on how to reform and create a more robust, contextual, and lean extension model that places emphasis on education and engagement. For example, Linder and Dolly (2012) addressed this challenge head-on by offering the following ten ideas to create an effective extension and outreach service in developing countries: (a) be institutionalized, well defined, and well-funded; (b) address important and contemporary issues/problems; (c) be sufficiently nimble and flexible in order to address emerging issues; (d) be a credible and unbiased source for information and education and for solutions and research; (e) understand the needs of its customers; (f) embrace participatory and integrated approaches; (g) recognize that little happens in isolation and create regional/global sustainable partnership/linkages with governments, non-governmental organizations (NGOs), researchers, and educators; (h) be excellent stewards of resources acquired; (i) recognize that return on investment (ROI) from its research and outreach must be well documented; and (j) allow for decentralized decision making and action when warranted.

Worth noting here are the lessons from what is known as "Research into Use – RIU," a program funded by the U.K. Department for International Development (DFID) to help promote results from a suite of research carried out over a period of eleven years from 1995–2006 (Department for International Development [DFID], 2013). Under RIU, six countries from east and west Africa were selected; in each of these countries, a national innovation council was first established, through which relevant actors, stakeholders, scope and intervention strategies were defined. In the six countries involved, the approach was to use the knowledge and innovation capacity developed as a result of the eleven years suite of programmatic activities. After consultation with local and appropriate institutions and agricultural initiatives, specific commodity chains were identified as entry points that came to be known as 'innovation platforms (IP).' Examples include: Cassava and aquaculture IP in Nigeria; poultry IP in Sierra Leone; and Potato IP in Rwanda. The key lesson from such an activity was that by bringing together different actors under specific IPs, success was achieved in building networks that develop trust and build social capital (DFID, 2013). In addition, there was not any single blueprint that worked across the countries, thus supporting the need for contextual, situational, country and culture specific interventions. A similar point was made by Rivera (cited in Linder and Dolly, 2012) that an appropriate extension model or system is situational in context, content, culture, and politics.

Translation science/research – The RAND Corporation Europe (2011) defines translational research as "the new scientific methods and technologies, interdisciplinary approaches, and collaborative institutional arrangements being developed to narrow the gap between basic science and its application to product and process innovation."

The healthcare fields provide a clear example of how these new methods helped bridge the gap between the lab and the community. Here, as the evidence-based medicine (EBM) practice gained momentum, the knowledge-to-action (KTA) or the engagement paradigm became more significant. There were repeated concerns with the existing knowledge transfer paradigm, including the ineffective transfer of knowledge to the intended audience and the failure of researchers to address the most important problems facing clinicians, managers, and decision-makers (Bowen and Graham, 2013). The framework that is often credited with overcoming the limitations of existing knowledge communication in healthcare is the integrated knowledge translation approach, one that engages knowledge users as partners in the research process (Bowen and Graham, 2013; Cargo and Mercer, 2008).

Table 2 shows this same distinction between existing knowledge transfer paradigm and the integrated knowledge translation approach.

Table 2 – Two paradigms in knowledge translation (Bowen and Graham, 2013)

Knowledge Transfer Paradigm	Engagement Paradigm
▪ Evidence-based medicine	▪ Evidence-informed decision-making
▪ Biomedical roots	▪ Social science roots
▪ Researchers do research	▪ Researchers and users select questions
▪ Researchers communicate results effectively	▪ Researchers and users bring different expertise
▪ Recipients use the results	▪ Joint interpretation, application in context
▪ 1-way knowledge transfer by expert	▪ Multidirectional learning
▪ Goal: more use of research	▪ Goal: better quality, relevant research
▪ Communication and dissemination	▪ Genuine partnership mutual respect
▪ Focus on single issue	▪ Focus on change in how business done
▪ Focus on content	▪ Focus on process
▪ Increasing user capacity	▪ Change management
▪ Information sharing	▪ Power sharing

In agriculture, the RAND Corporation in Europe (2011) produced a comprehensive report to promote translational research and knowledge exchange in the U.K. agricultural sector, using wheat production as a test case. The report provided a conceptual framework to guide investigation of the entire value chain in agriculture that spans from what they call "upstream activities" in research to "downstream activities" in application and development (RAND Corporation, 2011). In the long arc of the value chain system depicted by the conceptual framework, the study identified three key actors: knowledge producers, knowledge intermediaries, and knowledge users. In addition, borrowing a significant insight from translational research in healthcare, the report lists the following enablers of translational research and knowledge exchange:

- Targeting of the end-user
- Involvement of key actors
- Multi-disciplinarity
- Fora to facilitate knowledge exchange and translational research
- Policy, legislation, and regulation
- Availability of funding for translational research

The key findings from the RAND Corporation Europe (2011) technical report is that the main impediment to effecting translational research is the lack of synthesized and useful information, communication challenges, and fragmentation of different types of actors across the value chain. Translational research started in healthcare practice as a means to bridge the gap between scientists and clinicians, and there is a growing interest in how it can be used to take advantage of advances made in plant breeding and genomics to improve crop productivity (Delmer, 2005; Reynolds and Tuberosa, 2008). Relevant points that emerge from the discussion of translational research are the ideas of 'knowledge translation' and 'knowledge synthesis.' According to the Canadian Institutes of Health Research (CIHR, 2004), knowledge translation is defined as:

> …the exchange, synthesis and ethically-sound application of research findings within a complex set of interactions among researchers and knowledge users… In other words, knowledge translation can be seen as an acceleration of the knowledge cycle; an acceleration of the natural transformation of knowledge into use. Within the context of health research, KT therefore aims to 'accelerate the capture of the benefits of research…through improved health, more effective services and products, and a strengthened health care system'…

Knowledge synthesis, on the other hand, is:

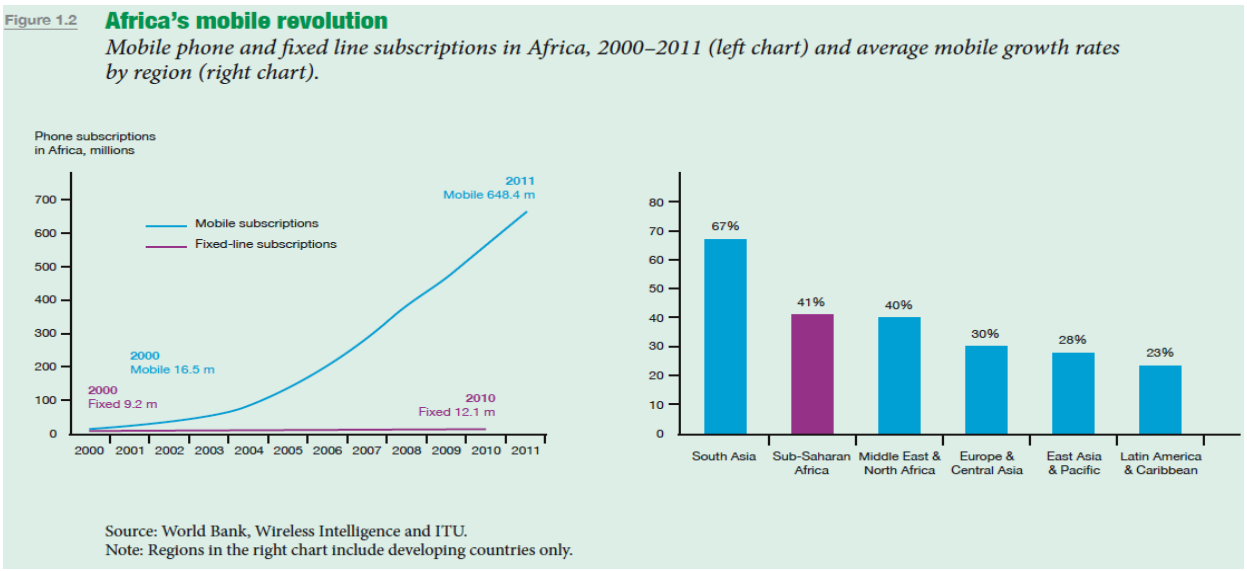
> …the integration of research findings into the larger corpus body of knowledge in a given discipline. A knowledge synthesis must be reproducible and transparent in its methods and use quantitative and/or qualitative methods. It can take the form of a systematic review and follow methods established by the Cochrane Collaboration; or, it can be developed as a result of a consensus conference, expert panel, qualitative or quantitative study. Realist synthesis, narrative synthesis, meta-analysis, meta-syntheses and practice guidelines are all forms of knowledge synthesis (CIHR, 2004).

ICT and Agricultural Knowledge Diffusion in SSA – Information and communication technology (ICT) has the potential to play a significant role in the agricultural innovation effort in Africa. Under the general catchphrase 'ICT for development, ICT4D,' information and communication technology is increasingly used for development activities, including in agriculture sector in Africa. In a time when agricultural innovation is required to be more nimble and adapt to changing local and global situations, the role of ICT to track, analyze, communicate, and follow new developments is enormous. For example, the World Bank is funding a program called "infoDev," through which African countries are receiving support to create technological applications in climate change, mobile technology, and agribusiness entrepreneurship (Ventures Africa, 2013). More examples of innovative use of ICT in African agricultural activities include: the use of an e-voucher system in Zimbabwe; electronic wallets in Nigeria where farmers receive fertilizer and seed support through their mobile phones; or a similar mobile app called 'iCow' that allows dairy farmers in Kenya to track the gestation periods and progress of their cows (Ventures Africa, 2013).

In any knowledge diffusion model, the communication channel plays a central role. Given the that the current paradigm in extension service requires engaging farming communities to understand their needs and priorities, the role of communication technologies such as mobile phones to collect data from the farming community and/or push information back to the farmers is substantial. According to a World Bank report (2012), there were about 650 million mobile phone subscribers in Africa at the beginning of 2012. Figure 2, taken from the same World Bank report, shows the exponential growth of mobile phone penetration in sub-Saharan Africa — the second highest growth in the world, exceeded only by south Asia. Regarding mobile phone utilization, there were several case studies that were documented in this same eTransform Africa report and some of the examples include the mFarmer initiative fund aimed at supporting the development of mobile phone-enabled communications and advisory services in the agricultural value chain; and Africa Scan which documented several success stories of ICT use in multiple SSA countries (World Bank and African Development Bank, 2012).

Although the attempt in this section is to review the potential of ICT for agriculture in SSA, the role of ICT globally in the agriculture sector is vast. For example, a quick scan of the iPhone Apps store or look at resources from major university agricultural extension programs (such as Cornell University Cooperative Extension or Iowa State Extension and Outreach) offer extensive ex-

FIGURE 2 – Exponential growth of Africa's mobile phone subscribers data



amples of technology use in agriculture in areas such as geographic information system, weather forecast, weeds identification, and agricultural price alerts.

Methods

This study is exploratory in nature. We reviewed relevant articles and resources from pertinent sources. We first searched AGRICOLA, Web of Science (WOS) and Science Direct databases using different combinations of terms/phrases: Agriculture, Africa, knowledge — diffusion, transfer, innovation, exchange, translational research, and extension service. In addition, websites and resources from appropriate regional and international organizations were consulted, including the Forum for Agricultural Research in Africa (FARA), Consultative Group on International Agricultural Research (CGIAR), Food and Agricultural Organization (FAO), West Africa Centre for Crop Improvement (WACCI), Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Alliance for a Green Revolution in Africa (AGRA), and African Union–New Partnerships for Africa's Development (AU–NEPAD)'s Comprehensive Africa Agriculture Development Program (CAADP).

As shown in the related works section above, the extant literature is synthesized and categorized into the following areas to help answer the questions put forward in the introduction: (1) scientific knowledge diffusion, exchange, transfer, innovation adoption in agriculture in Africa; (2) extension service in SSA countries; (3) translational research; and (4) ICT use for agriculture in Africa. From the outset, we set out to explore the potential of translational research to bolster knowledge exchange and knowledge diffusion in agricultural practices in Africa as a way to augment existing extension services.

Results and Discussion

Best Practices for Scientific Knowledge Diffusion — in SSA Agriculture – For the translation and diffusion of scientific knowledge to bear fruit and be effective, first and foremost, seamless partnerships between researchers (and their institutions/organizations) and practice constituencies must be built, implemented, nurtured, evaluated, and improved upon. Our first research question is meant to assess the nature of such partnerships in the agricultural sector in Africa and identify best practices.

It is easy to confuse knowledge diffusion, exchange, transfer, translation, synthesis, and integration. However, a closer look into the relevant literature shows that marked differences exist between these concepts. When we consider models and frameworks that are based on participatory, peer-to-peer, and collaborative communication, knowledge diffusion and/or knowledge exchange is the appropriate strategy to pursue. Even in situations where we want to avoid a linear top-down information flow and embrace feedback in the model, knowledge users are usually providing feedback about the outcome rather than the process (RELU, 2007). This calls for participatory and collaborative knowledge production where both the research and farming communities interact from the start on the planning and priorities of the research process. In addition, effective utilization of knowledge with a view to narrowing the gap between knowledge and action requires activities in knowledge synthesis, translation, and integration.

The current understanding and best practices in scientific knowledge diffusion in agricultural practices, therefore, demands a multi-stakeholder, multi-disciplinary, public-private-NGO partnership, and integrated framework (Adekunle et al., 2012; FARA, CGIAR Science Council, 2007). For example, the Integrated Agricultural

Research for Development (IAR4D) concept is aggressively promoted by FARA as a multi-stakeholder and multi-disciplinary participatory approach (CGIAR Science Council, 2007). In this regard, there are already several initiatives that have transformed agriculture in SSA. The effort now needs to focus on integrating all national and regional level activities towards a common shared knowledge base in order to develop a better knowledge diffusion approach. At a more general and abstract level, we envision the current understanding of knowledge diffusion as depicted in Figure 3, spanning activities from upstream (R&D) to downstream (application and use) via an intermediary (information system, or extension service) of some kind. In Figure 3, our goal is to show that R&D activities need not be done in isolation but rather with the end-users at the downstream level. Thus, the arrows entering into the R&D and the arrows coming out of the downstream activities are meant to illustrate the cyclical flow of information. It is to be noted that the double-arrowed line at the top shows the bi-directional flow of information/knowledge in the overall continuum of the model.

Figure 3 – General overview of knowledge diffusion model

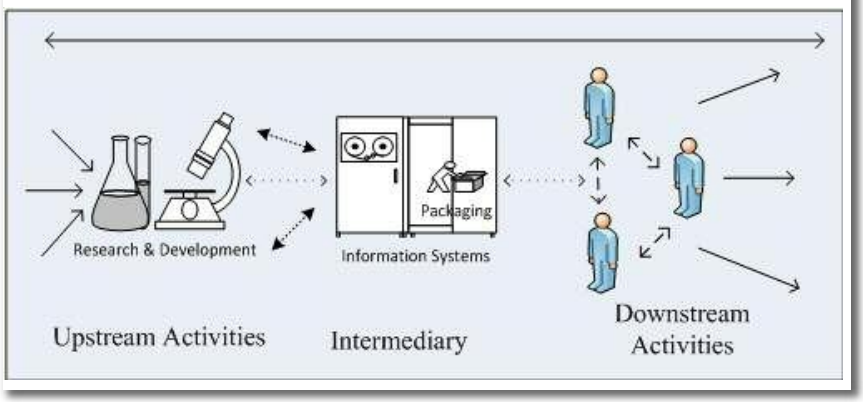
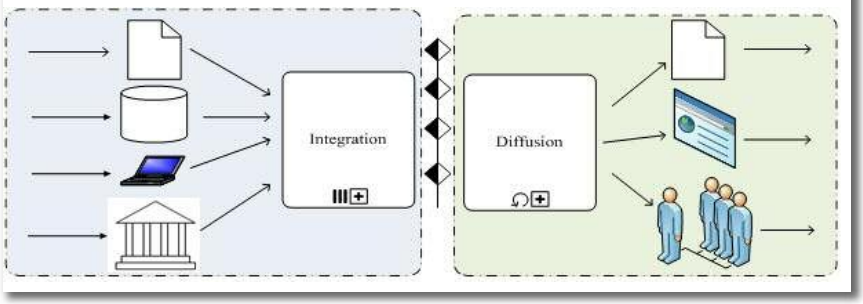


Figure 4 – Knowledge integration and diffusion model



The model is intended to present the results of best practices in scientific knowledge diffusion as reviewed in the extant literature in a form of a diagram, albeit with much of the detail hidden. For example, in the intermediary stage, information systems are used to loosely represent what the extension agent is doing by transferring knowledge and new ideas from the R&D community to the farming community. At the intermediary level, what SSA countries need is a network of national and regional knowledge exchange systems that offer a platform to deposit, manage, package, re-package, mirror, and share new discoveries, insights, and innovations across the agriculture value chain. We present a more specific and detailed model in the discussion section below.

Extension Service in SSA Agriculture – As noted in the literature review, the extension model in SSA is predominantly linear, hierarchical, centralized, poorly funded, and government led. The problems with the existing extension model are widely documented (Bembridge, 1987; Linder and Dolly, 2012; Marsh, Pannell and Lindner, 2004), as are what needs to be done to overcome the bottlenecks (DFID, 2013; Linder and Dolly, 2012). What was attempted under the Research in Use (RIU) program in the six participating African countries was a good example of success in knowledge re-use and knowledge diffusion. The results of eleven years of research work on a whole host of programs on Renewable Natural Resources (RNRRS) were implemented to benefit select African countries. Instead of embarking on new initiatives, the RIU African countries program were given the opportunity to uptake already tested ideas through which countries showed marked success.

We observe that there are a multitude of initiatives and practices that are happening in SSA countries. In the RIU report (DFID, 2013), we find established practices such as farm input promotions (Africa); Learning, Innovation, Knowledge (LINK); national innovation councils; partnerships for agricultural innovation and development (Sierra Leone); national agricultural research systems (Nigeria); crop intensification programs (Rwanda); and many more. While all these initiatives are very encouraging, it is now time to move towards integration of efforts at national and regional levels. We argue that integration is a necessary condition for knowledge diffusion (Figure 4).

In general, the major findings on extension service related to best practices and contemporary understanding include the following:

- Instead of the public and government controlled extension services, the national innovation systems approach is gaining a greater foothold (Adekunle et al., 2012; Ayele et al., 2012; Hall, 2005; Johnson and Segura-Bonilla, 2001; Ponniah et al., 2008).
- Public private partnerships, integrated knowledge exchanges that engage multi-stakeholder and multi-

disciplinary actors, are emphasized across the board (Marsh et al., 2000; Delmer, 2005).

- Training and visit (T&V), farm field schools (FFS) focused on training, mentoring, and education are the preferred methods of reaching farmers (Blanckenburg, 1982; Davis, 2008; Manning, 2013).
- Extension needs to be designed with the farmer but not for the farmer — requiring participation in both research and extension, including the use of technological solutions (Bembridge, 1987; Blanckenburg, 1982).
- When national and regional level knowledge networks and extension services are built, country, culture and politics-specific situational factors need to be taken into account. (Davis, 2008; DFID, 2012; Linder and Dolly, 2012; Ponniah et al., 2008).
- Extension agents/professionals are considered knowledge brokers, linking farmers and researchers and when designed properly extension services play a positive role (Marsh et al, 2000; Marsh et al., 2004; RELU, 2007).
- The educational function of the extension service should be given a greater priority (Blanckenburg, 1982; Navarro, 2006).
- One-on-one consultation, coaching, group advice, peer-to-peer learning, face-to-face extension, learning networks, and the use of community radio are relevant and appropriate methods of contacts (Lwoga, 2010; RAND Corporation, 2011; Riddell, 2001; Scarborough et al., 1997; Topping, 2005).

Translational Research – As noted above, the goal of this paper was to investigate the existing knowledge diffusion model with a view to addressing its inherent limitations by augmenting it from lessons in translational research in healthcare. There are a few studies, especially in biotechnology, genomics, and plant biology, that look into the role of translational science for agriculture (Delmer, 2005; RAND Corporation, 2011; Reynolds and Tuberosa, 2008). The relevance of incorporating translational research in the overall knowledge diffusion activity in agriculture can be seen from the perspective of bridging the gap and speeding the diffusion, use, and impact of scientific knowledge in the entire agricultural value chain. The gulf between what is known in the research labs and what is actually practiced in the field is one reason that gave rise to translational research in medicine. For example, Delmer's (2005) testimony from her personal experience in academia and food security at the Rockefeller Foundation is quite telling: "…there exists a high degree of disconnect between those who work at the lab bench and those who work in the field."

Translational research in healthcare offers significant insights into agricultural practices, including: (1) a methodological approach to translate knowledge and findings from research to application so it can be readily used by the intended audience, the end-users, (2) an awareness across the agricultural value chain of how to package and re-package knowledge, and (3) an opportunity for training in translational research methods for agricultural scientists and extension agents (CIHR, 2004; Davis, Jadad and Perrier, 2003; RAND Corporation, 2011). Driven by evidence-based medicine practices, translational research has given healthcare professionals tools to synthesize knowledge gained through research in order to support their intervention with a certain degree of confidence. Commonly used synthesized knowledge products in evidence-based medicine include practice guidelines, systematic reviews, and the tools and methods used to create such resources include meta-analysis, and other quantitative or qualitative studies (Davis, Jadad and Perrier, 2003; Grol and Grimshaw, 2003).

In order to implement a successful translational program to aid knowledge diffusion in the field of agriculture, it is critical for us to prepare and create the awareness about translational research across relevant stakeholders. One way of achieving this is by sensitizing the whole range of scientists (new to experienced) on the principles and methods of translational research. Technical schools, universities, and research centers, NGOs, government agriculture departments/ministries, and the entire value-chain system should work towards a goal of achieving translational research. In healthcare where translational research is widely used, training on tools such as meta-analysis and systematic reviews are regularly offered. Researchers and scientists are expected to disseminate their knowledge outputs in prescribed outlines and deposit their work in openly accessible repository systems. For example, in a typical systematic review, the ABSTRACT section alone is divided into the following outlines — Background, Objectives, Search methods, Selection criteria, Data collection and analysis, Main results, Author's conclusion. This structure helps to later perform statistical analysis on a body of work in similar topics to understand the evidence better, on aggregate.

ICT and Knowledge Diffusion in African Agriculture – Africa, especially sub-Saharan Africa, is rapidly embracing advances in information and communication technology. With about 650 million subscribers, SSA is registering the second highest growth globally in mobile phone use, exceeded only by south Asia. By September 2011, Africa had already rolled out some 676,739 km of fibre-optic backbone infrastructure under the sea and inland in an effort to connect the entire continent (World Bank and African Development Bank, 2012, p.27). National level innovation councils were established that spearhead new ICT applications in climate change, crop insurance, market information, etc. More and more national, regional, and international funding agencies are creating opportunities for SSA countries to take advantage of the ICT revolution. There is no doubt the literature is indicative of the potential of ICT for development activities, including agriculture. Given the high adult illiteracy rate and shortage of electricity, we believe community information centers tied to the agriculture extension service model would be an appropriate solution. It is

paramount that there be a role for ICT in connecting and exchanging information between and among the national and regional level knowledge clearinghouses as a way of creating an internetwork between independent systems.

Discussion

The implications from the findings reported above are clear. We need to re-conceptualize existing knowledge diffusion practices in the African agricultural sector to create a more dynamic, participatory, collaborative system, one that engages the knowledge end-user in the process. In this effort we propose a framework for developing a national and regional network of agricultural knowledge clearinghouses. It is fitting to restate RAND Corporation's (2011) three key findings that were considered as barriers to the implementation of translational research and knowledge exchange in agriculture: (1) lack of synthesis and useful information, (2) communication challenges, and (3) fragmentation of different types of actors across the value chain.

Closely looking into the most frequently recurring themes in the extant literature that received repeated mention and that have relevance to effective diffusion and utilization of research knowledge, we restate the following: (1) knowledge users must be engaged in prioritization, definition, interpretation, and application of research; (2) starting with indigenous knowledge is significant; (3) there is a critical role for packaging and re-packaging new ideas, findings, and innovation to produce readily-usable guidelines and manuals (knowledge synthesis); (4) there is a need for national and regional integrated knowledge networks, innovation platforms; (5) there should be continuous professional development of the extension agent and re-conceptualizing their role as effective knowledge brokers; (6) users must take advantage of the existing relevant and appropriate information and communication technologies, including mobile and social communication tools; and (7) there is a need to create lean and robust communication infrastructure that serves both vertical and horizontal interactions. In addition, we add to the above synthesis (often overlapping) Linder and Dolly's (2012) ten ideas to create effective extension and outreach services in developing countries. We propose the revitalization of existing extension and knowledge diffusion model by incorporating knowledge integration and translation at its core. Using business processing modeling notation, we offer the following broad framework that incorporates the results of our exploratory investigation thus far (Figure 5).

In the model (Figure 5) we use what is called swim lane diagrams (or cross-functional flowcharts) to show the actors, roles, activities, and interactions within and between the lanes. There are three pools — one for each of the major entities, namely upstream activities, intermediary system, and downstream activities. Within each pool, there are two lanes representing the functions of the major actors in each. For example, upstream activities have 'public-private partnership' and 'Research and Development' lanes. Within each lane, what is shown is a start event (the small blue circle) and a series of activities/tasks (represented by squares) to be executed by the designated actor/entity at the top. The activities/tasks boxes have additional icons to signify the task types (user, service, script, send, receive, and reference). For example, the person icon is for 'user,' the gear icon is for 'service,' etc. Also, some of the boxes have a round pointing arrow to represent a standard loop where the particular task can be executed repeatedly, and the three vertical bars indicate a task that has multiple instances of a loop. While the solid arrow connectors represent a sequence flow within each pool, the dashed connectors between pools are meant to indicate message flow. Models or frameworks (no matter how detailed they may be) always tend to abstract the complex reality. However, given the discussion above, we believe the basic architecture provided in the model captures the idea of participatory, integrated, knowledge diffusion where knowledge translation and synthesis is at its core. Because of this, we believe the proposal to create 'agricultural knowledge clearinghouses (AKC),' at national and regional levels is an idea worth considering.

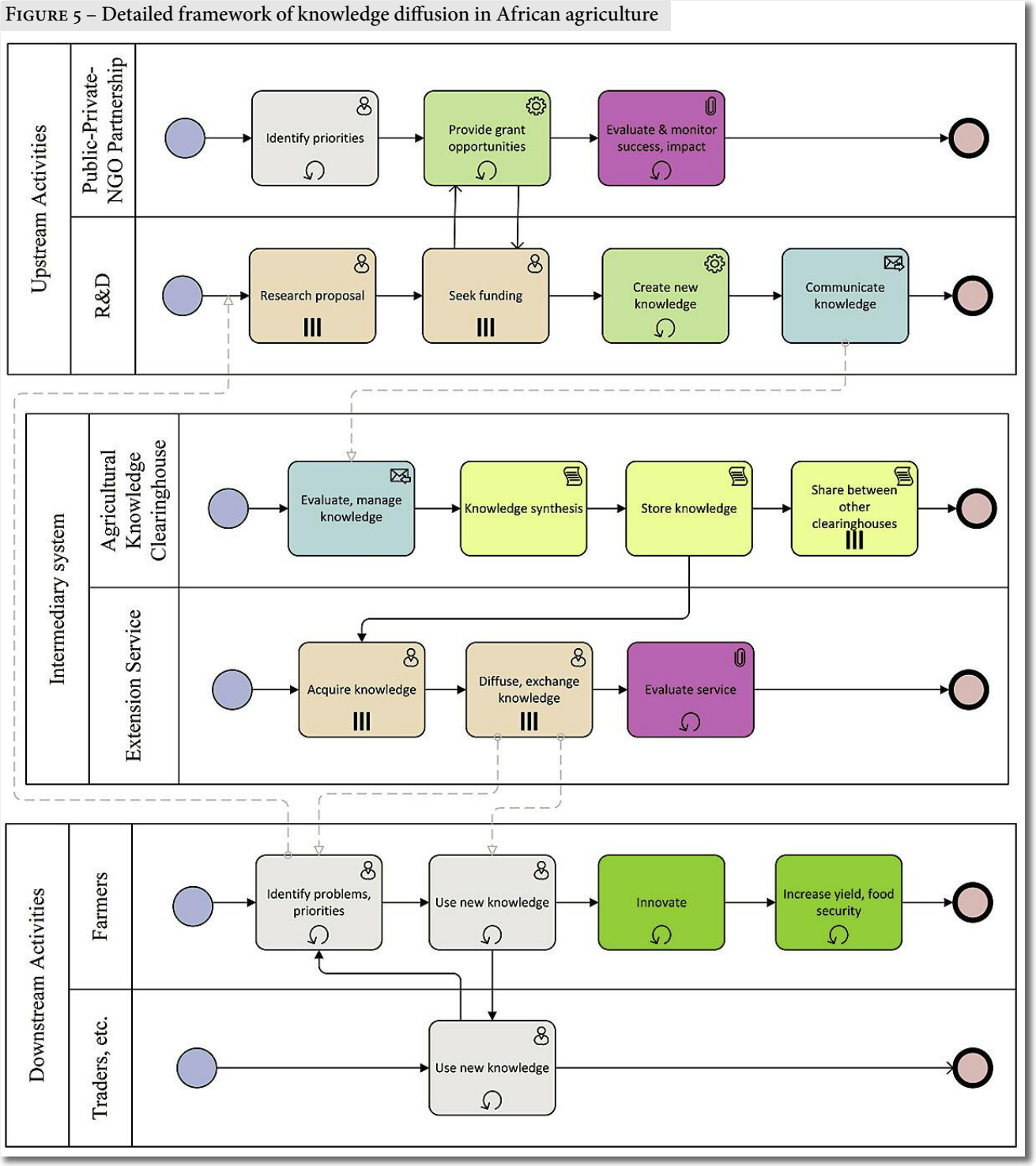
During the initial implementation stage, it would be realistic to start with one regional agricultural knowledge clearinghouse, and then scaling up to other regions based on the regional context. As shown in the framework (Figure 5), the major activities of the AKC involve knowledge work, including: evaluating and managing existing knowledge; synthesizing knowledge to create ready-to-use knowledge packages; and storing and sharing these resources with other regional clearinghouses. Following knowledge products from evidence-based healthcare such as clinical practice guidelines (CPG), systematic reviews, we propose the following knowledge products to come out of the AKC activities:

- Agricultural practice guidelines — e.g., for specific crop or for specific input.
- Farming factsheets — e.g., for pesticide or spray application.
- Expert panel reports — e.g., no-till or tillage.
- Systematic reviews — e.g., literature review of genetically engineered crops.
- Extension demonstration/experiment registries together with the results — e.g., reports from field experiments, tests.
- Systematic documentation of indigenous knowledge — e.g., externalizing or documenting local knowledge.

Conclusion

It is true that tremendous advances have been made in the agriculture sector — spanning crop, livestock, dairy, fruit, vegetable, and organic farming. As a result, knowledge (both indigenous and scientific) is stored in

FIGURE 5 – Detailed framework of knowledge diffusion in African agriculture



knowledge bases globally. We argue that the most important task is not to re-create new knowledge, but to acquire and effectively use existing knowledge to fuel further knowledge creation and spur more innovation. Because of this view and based on what the literature in the field shows, we believe translational research will play a role in strengthening traditional extension service in the effort to disseminate refined, synthesized, and ready-to-use knowledge to the farmer. This not only helps to streamline and standardize processes and agricultural practices, it also repositions the role of the extension agent as an effective knowledge broker, thereby creating trust and long-term sustainability. As indicated above, knowledge translation speeds the knowledge to action/decision gap. In healthcare, where knowledge translation is very active, the knowledge to evidence-based gap is characterized by sub-optimal usage of evidence between what we know and what is done in practice (Davis et al., 2003).

In summary, we believe more effort needs to be expended towards creating national and regional "agricultural

knowledge clearinghouses," where knowledge synthesis and knowledge translation of the existing stock of knowledge form the core of the activities. These clearinghouses can be nested under the current national level innovation councils or knowledge networks that SSA countries are building or have built and may not require much investment other than having designated personnel (research scientists or extension agents) with translational research backgrounds. Another important element to consider is establishing a robust network between national level and regional level clearinghouses as well as between one region (east, west, south, and central) and all the other regions. It is critical to mirror the knowledge repository between one another and avoid duplication of efforts.

References

Abadi Ghadim, A.K., D.J. Pannell and M.P. Burton. 2005. "Risk, Uncertainty and Learning in Adoption of a Crop Innovation." *Agricultural Economics* 33(1): 1–9.

Adekunle, A.A., J. Ellis-Jones, I. Ajibefun, R.A. Nyikal, S. Bangali, O. Fatunbi and A. Ange. 2012. "Agricultural Innovation in Sub-Saharan Africa: Experiences." From *Multiple-Stakeholder Approaches*. Accra, Ghana: Forum for Agricultural Research in Africa.

Ayele, S. and D. Wield. 2005. "Science and Technology Capacity Building and Partnership in African Agriculture: Perspectives on Mali and Egypt." *Journal of International Development* 17(5): 631–646.

Ayele, S., A. Duncan, A. Larbi and T.T. Khanh. 2012. "Enhancing Innovation in Livestock Value Chains Through Networks: Lessons From Fodder Innovation Case Studies in Developing Countries." *Science and Public Policy* 39 (3): 333–346.

Bembridge, T.J. 1987. "Agricultural Extension in the Less Developed Areas of Southern Africa." *Agricultural Administration and Extension* 27(4): 245–265.

Blanckenburg, P.V. 1982. "Basic Concepts of Agricultural Extension in Developing Countries." *Agricultural Administration* 10 (1): 35–43.

Bowen, S.J. and I.D. Graham. 2013. "From Knowledge Translation to Engaged Scholarship: Promoting Research Relevance and Utilization." *Archives of Physical Medicine and Rehabilitation* 94(1): S3–S8.

Brekke, J.S., K. Ell and L.A. Palinkas. 2007. "Translational Science at the National Institute of Mental Health: Can Social Work Take its Rightful Place?" *Research on Social Work Practice* 17(1): 123–133.

Canadian Institutes of Health Research [CIHR]. 2004. *Knowledge Translation Strategy 2004–2009: Innovation in Action*. Ottawa, ON: CIHR.

Cargo, M. and S.L. Mercer. 2008. "The Value and Challenges of Participatory Research: Strengthening its Practice." *Annual Review of Public Health* 29: 325–50.

CGIAR Science Council 2007. *Sub-Saharan Africa Challenge Program External Review.* Rome, Italy: Science Council Secretariat.

Davis, D., A. Jadad and L. Perrier. 2003. "The Case for Knowledge Translation: Shortening the Journey" From Evidence to Effect." *British Medical Journal* 327(7405): 33–35.

Davis, K.E. 2008. "Extension in Sub-Saharan Africa: Overview and Assessment of Past and Current Models, and Future Prospects." *Journal of International Agricultural and Extension Education* 15(3): 15–28.

Delmer, D. P. (2005). "Agriculture in the Developing World: Connecting Innovations in Plant Research to Downstream Applications." *Proceedings of the National Academy of Sciences* 102(44): 15739–15746.

Department for International Development [DFID]. 2013. *Research into Use Program Final Report: July 2006–December 2012*. University of Edinburgh.

FAO. 2013a. *FAO Statistical Yearbook 2013: World Food and Agriculture*. Rome: Food and Agriculture Organization of the United Nations http://www.fao.org/docrep/018/i3107e/i3107e.PDF.

FAO. 2013b. *The State of Food and Agriculture: Food Systems for Better Nutrition*. Rome: Food and Agricultural Organization.

FAO. 2012. *FAO Statistical Yearbook 2012: Africa Food and Agriculture.* Accra: Food and Agriculture Organization of the United Nations Regional Office for Africa http://www.fao.org/docrep/018/i3137e/i3137e.pdf.

Forum for Agricultural Research in Africa [FARA]. 2005. *Synthesis of the Sub-Saharan African Challenge Program Implementation Meeting* Accra, Ghana. — accessed 13–14 January 2005.

Grol, R. and J. Grimshaw. 2003. "From Best Evidence to Best Practice: Effective Implementation of Change in Patients' Care." *Lancet 362*(9391): 1225–1230.

Hall, A. 2005. "Capacity Development for Agricultural Biotechnology in Developing Countries: An Innovation Systems View of What it is and How to Develop it." *Journal of International Development* 2005; 17:611–30.

Hall, A., G. Bockett, S. Taylor, M.V.K. Sivamohan and N. Clark. 2001. "Why Research Partnerships Really Matter: Innovation Theory, Institutional Arrangements and Implications for Developing New Technologies for the Poor." *World Development* 29(5): 783–797.

Ingram, J. 2010. "Technical and Social Dimensions of Farmer Learning: An Analysis of the Emergence of Reduced Tillage Systems in England." *Journal of Sustainable Agriculture* 34(2): 183–201.

Johnson, B. and O. Segura-Bonilla. 2001. "Innovation Systems and Developing Countries: Experiences From the SUDESCA Project." *DRUID Working Paper* No. 01–12.

Linder, J.R. and D. Dolly. 2012. "Extension and Outreach: Not a Question of If, but How." *Journal of International Agricultural and Extension Education* 19(3): 1–9.

Lwoga, E.T. 2010. "Bridging the Agricultural and Information Divide: The Case of Selected Telecenters and Rural Radio in Tanzania." *The Electronic Journal of Information Systems in Developing Countries* 43(6): 1–14.

Lwoga, E.T., P. Ngulube and C. Stilwell. 2011. "Challenges of Managing Indigenous Knowledge with Other Knowledge Systems for Agricultural Growth in Sub-Saharan Africa." *Libri* 61: 226–238.

Lybbert, T.J. and D.A. Sumner. 2012. "Agricultural Technologies for Climate Change in Developing Countries: Policy Options for Innovation and Technology Diffusion." *Food Policy* 37(1): 114–123.

Manning, L. 2013. "A Knowledge Exchange and Diffusion of Innovation (KEDI) Model for Primary Production." *British Food Journal* 115(4): 614 – 631.

Marsh, S.P., D.J. Pannell and R.K. Lindner. 2000. "The Impact of Agricultural Extension on Adoption and Diffusion of Lupins as a New Crop in Western Australia." *Australian Journal of Experimental Agriculture* 40(4): 571–583.

Marsh, S.P., D.J. Pannell and R.K. Lindner. 2004. "Does Agricultural Extension Pay? A Case Study for a New Crop, Lupins, in Western Australia." *Agricultural Economics* 30(1): 17–30.

Navarro, M. 2006. "How Can Agricultural and Extension Educators Contribute to a Successful New Green Revolution?" *Journal of International Agricultural and Extension Education* 12(2): 83–95.

Nelson, R.R. 1993. "National Innovation System: A Comprehensive Analysis." New York: Oxford University Press.

Ponniah, A., R. Puskur, S. Workneh and D. Hoekstra. 2008. *Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book*. Addis Ababa, Ethiopia: International Livestock Research Institute (ILRI). http://www.cida-ecco.org/IPMS/IPMS_SourceBook/IPMS_SourceBook.pdf.

RAND Corporation. 2011. *Translational Research and Knowledge in agriculture and food production: Technical Report*. Santa Monica, CA, USA.

Reynolds, M. and R. Tuberosa. 2008. "Translational Research Impacting on Crop Productivity in Drought-Prone Environments." *Current Opinion in Plant Biology* 11(2): 171–179.

Riddell, I. 2001. *A Farmer's Club Charitable Trust Scholarship Monitor Farms and Farmer Discussion Groups in New Zealand (Summary): Their Role in Improving Physical and Financial Performance Through Collective Learning*. http://www.docstoc.com/docs/28615314/Monitor-Farms-and-Farmer-Discussion-Groups-in-New-Zealand ,

Rogers, E. 2003. *Diffusion of Innovations*. 5th ed. New York: The Free Press.

Rogers, E.M. 1995. *Diffusion of Innovations*. 4th ed. New York: The Free Press.

Rogers, E.M. 2004. "A Prospective and Retrospective Look at the Diffusion Model." *Journal of Health Communication: International Perspectives* 9(1): 13–19.

Roseboom, J. 2004. "Adopting an Agricultural Innovation System Perspective: Implications for ASARECA's Strategy." *ASARECA Strategy Planning Paper* No. 7. Entebbe, Uganda.

Rural Economy and Land Use [RELU]. 2007. "Common knowledge? An exploration of knowledge transfer." *Briefing series* No. 6.

Ryan, B. and N. Gross. 1943. "The Diffusion of Hybrid Seed Corn in Two Iowa Communities." *Rural Sociology* 8: 15–24.

Sayeh, A. M. 2013. "Africa: Second Fastest-Growing Region in the World." *iMFdirect.* http://blog-imfdirect.imf.org/2013/06/10/africa-second-fastest-growing-region-in-the-world. — accessed 10 June, 2013.

Scarborough, V., S. Killough, D.A. Johnson and A. Farrington. 1997, "Farmer-Led Extension." *Concepts and Practices, Intermediate Technology Publications*. London: Overseas Development Institute.

Sussman, S., T.W. Valente, L.A. Rohrbach, S. Skara, A.W. Stacy and M.A. Pentz. 2006. "Translation in Health Behavior Research: Converting Science into Action." *Evaluation and the Health Professions* 29(1): 7–32.

Topping, K.J. 2005. "Trends in Peer Learning Educational." *Psychology* 25(6): 631–45.

UNEP. 2011. *United Nations Environmental Programme: Indigenous Knowledge in Africa*. http://www.unep.org/ik/.

UNESCO. 2000. *World Conference on Science: Science for the Twenty-First Century, A New Commitment*. UNESCO.

UNESCO. 2010. "Education for All Global Monitoring Report 2010: Reaching the Marginalized." *Regional Fact Sheet — Sub-Saharan Africa,* http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/ED/GMR/pdf/gmr2010/gmr2010-fs-ssa.pdf.

Van Den Ban, A.W. and H.S. Hawkins. 1996. *Agricultural Extension*. 2nd ed.London: Blackwell Science.

Ventures Africa 2013. How Innovation is Stimulating Agriculture in Africa. http://www.ventures-africa.com/2013/04/innovation-agriculture-africa/—accessed 29 April, 2013.

Webersik, C. and C. Wilson. 2009. "Achieving Environmental Sustainability and Growth in Africa: the Role of Science, Technology and Innovation." *Sustainable Development* 17: 400–413.

Wejnert, B. 2002. "Integrating Models of Diffusion of Innovations: A Conceptual Framework." *Annual Review of Sociology* 28(1): 297–326.

World Bank and African Development Bank. 2012. *eTransform Africa: the Transformational Use of Information and Communication Technologies in Africa*. Washington, DC: World Bank.

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The Use of Social Media in Agricultural Research Workflows in Ghana and Kenya

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Abstract: The study investigates the usage of social media in agricultural research in Ghana and Kenya. The findings show that in general, the researchers have profiles/accounts on social media; specifically, Facebook is the most actively used social media followed by LinkedIn and Skype. Social media in agricultural research workflows is mainly used in identifying research opportunities and finding potential collaborators for research projects. There is little use of social media in the dissemination of research results. The findings underscore the need for agricultural research organizations to improve their Internet connectivity and to implement policies and strategies that encourage the use of social media tools in the dissemination of research results in addition to the traditional methods of communicating research. Strategic approaches to the use of social media in public agriculture research organizations in Africa could potentially open up research carried out in these organizations.

Resumé: L'étude examine l'utilisation des médias sociaux dans le domaine de la recherche agricole au Ghana et au Kenya. Les résultats montrent qu'en général, les chercheurs ont des profils/comptes sur les médias sociaux; plus précisément, Facebook est le média social le plus activement utilisé suivi de LinkedIn et de Skype. Les médias sociaux lors des opérations de la recherche agricole sont principalement utilisés pour identifier les opportunités de recherche et trouver des collaborateurs potentiels pour des projets de recherche. Les médias sociaux sont très peu utilisés dans la diffusion des résultats de la recherche. Les conclusions soulignent la nécessité pour les organisations de recherche agricole d'améliorer leur connectivité Internet et de mettre en oeuvre des politiques et des stratégies qui encouragent l'utilisation des outils des médias sociaux dans la diffusion des résultats de la recherche, en plus des méthodes traditionnelles de diffusion de la recherche. Des approches stratégiques pour l'utilisation des médias sociaux par les organisations de recherche agricole publiques en Afrique pourraient potentiellement révéler la recherche effectuée dans ces organisations.

Resumen: El estudio investiga el uso de las redes sociales en la investigación agrícola en Ghana y Kenia. Los resultados muestran que, en general, los investigadores tienen perfiles/cuentas en las redes sociales, siendo Facebook la red social más activamente utilizada, seguida por LinkedIn y Skype. En los flujos de trabajo en la investigación agrícola, las redes sociales se utilizan principalmente para identificar oportunidades de investigación y encontrar posibles colaboradores para proyectos de investigación. Hay poco uso de las redes sociales en la difusión de resultados de investigación. Los resultados resaltan la necesidad de que las organizaciones de investigación agrícola mejoren su conectividad a Internet e implementen políticas y estrategias que fomenten el uso de las herramientas de las redes sociales en la difusión de resultados de investigación, además de los métodos tradicionales para comunicar estos resultados. Los enfoques estratégicos para el uso de las redes sociales en las organizaciones de investigación agrícola del sector público en África potencialmente podrían ampliar las investigaciones llevadas a cabo en estas organizaciones.

Researchers in various fields are taking advantage of social media tools and are integrating them in their work (Bik and Goldstein, 2013). For example, Andersen and Söderqvist (2012:6) report that researchers are using blogs to write about their current research work, papers they have read, and other issues relevant to their academic work; they also are using Twitter to share news and survey new ideas and LinkedIn to 'market' their work and career moves.

One aspect of the research process that is benefiting a lot from social media is the communication of research results. Traditionally, researchers disseminate their research results using scientific journals, conferences and posters. Social media is complimenting these methods for communicating research. It is making it possible for researchers to communicate results directly to the public and other key stakeholders.

In Africa, a continent where access to research outputs generated in public research organizations is a challenge, social media has the potential to enhance the search for, distribution and sharing of research results. The widespread availability of mobile telephone networks and improvements in mobile broadband internet on the continent is fueling access to and the use of social media. Mobile phone and social media-based applications are emerging as important channels for interaction among the people, especially the youth. Researchers have to adapt to these new trends, adopt social media tools and apply them in their work to enhance the communication of science to the public. As Small (2011:141) states, the days of scientists communicating only with each other, in the languages of their individual disciplines, and relying on science journalists to translate for the public, are rapidly coming to an end. There is also evidence that using social media to promote/announce scientific articles increases downloads of the articles and citations and could result in increased impact of the research (Eysenbach, 2011; Terra, 2012; Sage 2012).

To date there are a handful of studies exploring the usage of social media in research in Africa. Sokoya, Onifade and Alabi (2012) studied the use of social media by agricultural researchers in Nigeria and reported that they used Facebook to establish connections with their professional colleagues. A citation analysis of publica-

tions in agriculture and biological sciences, by Kousha and Abdoli (2012), also showed that to some extent, researchers in Nigeria are citing different types of social networking sites in their works, an indication that they are also using social media as sources of information for their research activities.

This study explores the use of social media in research workflows in public agricultural research organizations in Ghana and Kenya. We are interested in knowing whether researchers are using social media and in particular in their research work. We are also interested in the types or categories of social media tools used and whether social media is perceived as having any impact on research workflow. Therefore, the guiding questions for this study were as follows:

RQ1. Are the researchers in public agricultural research institutes using social media?

RQ2. Are the researchers using social media in their research workflow?

RQ3. What specific social media tools are they using and at which phases of the research workflow?

RQ4. What is the perceived impact of social media on agricultural research workflow?

Literature Review

What is social media? – Different authors and organizations have defined social media differently. The Research Information Network (RIN) uses the term *social media* to refer to internet services where the users of the services generate the online content (RIN, 2011:7). In its *Social Media Guidelines for Staff*, the European Commission (n.d) describes social media as "online technologies and practices that are used to share content, opinions and information, promote discussion and build relationships." Henderson and Bowley (2010:239) define social media as "collaborative online applications and technologies that enable participation, connectivity, user-generated content, sharing of information, and collaboration amongst a community of users." Kim (n.d) describes social media as "the phenomenon of Community-led information exchange, i.e. users generating and consuming other user-generated content. It is enabling sharing of ideas, co-operating, collaborating, meeting new like-minded people, keeping in touch, strengthening relationships and reaching out to potential customers: both in a personal and professional context." And Kietzmann *et al.,* (2011:241) indicate that social media make use of "mobile and web-based technology to create highly interactive platforms which individuals and communities share, co-create, discuss, and modify user-generated content."

Despite the absence of an agreed upon definition of social media, the general view is that social media is about creating, sharing, adapting and re-using content while engaging in digital dialogue and collaboration, activities that are largely facilitated by web-based and mobile-based technologies. Prominent examples of social media tools include the following:

- ***Blogs*** – "personal Web diaries where users can offer their ideas, experiences and opinions on any topic. A typical blog combines text, images, and links to other blogs, websites or sources. Sound or video can also be added" (Alcatel-Lucent, n.d.). Platforms for creating blogs include Blogger (www.blogger.com) and Wordpress (www.wordpress.org).
- ***Facebook*** (www.facebook.com) – a social networking service (SNS) "where users create personal profiles, add other users as friends and exchange messages, including automatic notifications when they update their own profiles. Additionally, users may join common-interest user groups, organized by common characteristics (e.g. workplace)" (Broughton, *et al*., 2009:7). Facebook users can also chat, share experiences, photos and videos, and send e-mails to each other.
- ***Flickr*** (www.flickr.com) – a platform for managing and sharing and storing photos (Kolbitsch and Maurer, 2006). Flickr account owners can decide whether to keep the photos private or to share them with other users. Users can rate, comment on and rank the photos.
- ***LinkedIn*** (www.linkedin.com) – "a business-related social networking site mainly used for professional networking. Users maintain a list of contact details of people with whom they have some level of relationship, called connections. The lists of connections can be used to build up a contact network, follow different companies and find jobs, people and business opportunities" (Broughton, *et al*., 2009:7).
- ***Twitter*** (twitter.com) – a micro-blogging platform that let users broadcast short messages (called tweets) of up to 140 characters to their followers. Twitter users can also specify which users they want to follow and re-tweet (re-send) the tweets they receive to their followers.
- ***YouTube*** (www.youtube.com) – a video sharing platform. YouTube users can upload, watch and/or download videos, rate and comment on them.
- ***Wikis*** – websites that allow users to freely add, remove, edit, and change content directly from the Web browser. An example of a wiki is Wikipedia (Wikipedia.org), a collaborative web-based encyclopedia project.

Categories of social media – There is no systematic way in which different social media applications can be categorized (Kaplan and Haenlein, 2010: 61). Efforts to classify social media have resulted in several authors, among them Constantinides and Fountain (2008), Mayfield (2008), Convio (2010), Kaplan and Haenlein (2010), and Cavazza (2012) proposing categorizations which in some cases differ in the number of categories, names of the categories, and types of social media tools under each category. Despite this state of affairs, this study focused on the following categories of social media:

- ***Social Networking Services,***
  i.e. Facebook, Google+, LinkedIn, etc.
- ***Voice over Internet (VoIP) Applications,***
  i.e. Google Talk, Skype, etc.
- ***Discussion Forums/Platforms,***
  i.e. Dgroups, Google Groups, etc.
- ***Micro-blogging Applications,***
  i.e. Twitter, FriendFeed, Tumblr, etc.
- ***Cloud Storage Applications,***
  i.e. Dropbox, iDrive, Microsoft SkyDrive, etc.
- ***Online Mapping Tools,***
  i.e. Google Maps, Google Earth, etc.
- ***Online Collaboration Applications,***
  i.e. Google Docs, Wikis, etc.
- ***Video Sharing Applications,***
  i.e. YouTube, Blip.tv, Vimeo, etc.
- ***Presentations,***
  i.e. authorSTREAM, Slidshare, Slidesix, etc.
- ***Photo Sharing Applications,***
  i.e. Flickr, Picasa, etc.
- ***Online Calendars,***
  i.e. Google Calender, Yahoo Calendar, 30 Boxes, etc.
- ***Blogging Applications,***
  i.e. Blogger, Wordpress, TypePad, etc.
- ***Social Bookmarking Applications,***
  i.e. StumbleUpon, Digg, Delicious, etc.
- ***Academic Social Networking Sites,***
  i.e. Mendeley, ResearchGate, MethodSpace, etc.
- ***Audio Sharing Applications,***
  i.e. Podomatic, SoundCloud, etc.

Social media in research – Several studies show that researchers are embracing social media (CIBER, University College London and Emerald Group Publishing Ltd, 2010; Collins and Hide, 2010; Research Information Network, 2010; Van Eperen and Marincola, 2011), Rowlands *et al*., 2011). In their study on how scientists use social media to communicate research, Minocha and Petre (2009) found that even the most conservative researchers were using some Web 2.0 or social software tools. Rowlands *et al*., (2011:183) also reported a change in researchers' attitude towards social media "from outright skepticism, to pockets of skepticism to virtually no skepticism at all," an indication that researchers are accepting social media.

Although most people use social media tools largely for social purposes, available research shows that researchers are using the tools in their research work as well. An exploratory study by CIBER, the University College London and Emerald Group Publishing Ltd. (2010) of researchers from 215 countries who self-reported using social media showed that they are using social media to support every phase of the research life cycle, from identifying research opportunities to disseminating research findings. Researchers are using social media for "communicating their work, including work in progress, for developing and sustaining networks and collaborations, or for finding out about what others are doing" (RIN, 2010:47). Bik and Goldstein (2013:1) highlight various uses of social media by scientists, including sharing journal articles, advertising their thoughts and scientific opinions, posting updates from conferences and meetings, and circulating information about professional opportunities and upcoming events. Rowlands *et al*., (2011) report that researchers are using social media mainly for activities relating to collaborating authoring, conferencing, scheduling and meetings.

Regarding social media used, in general researchers are using more than one type of already established social media tools. According to Van Eperen and Marincola (2011:1), the choice of specific social media tools depends on discipline and the researcher's sentiments. Rowlands *et al*., (2011:185) point out that researchers are using household brands (generic social media tools) and not tools specifically developed for research lifecycle management. Generic social media tools are already popular among social media users, a key factor possibly also contributing to their popularity among scholars (Gruzd, Staves and Wilk, 2012). Proctor *et al*. (2013:4050) also show that in scholarly communication, researchers are rapidly adopting Web 2.0 services that are generic, intuitive, easy to use, available for free with near-zero adoption costs and that offer clear advantages to users, rather than tools developed by publishers and other knowledge intermediaries.

Available literature shows that researchers are using several social media tools, including the following:

- ***Blogs*** (Bonetta, 2007; Edge, 2007; Gruzd, Staves and Wilk, 2012);
- ***Facebook*** (Rowlands *et al*., 2011; Van Eperen and Marincola, 2011; Gruzd, Staves and Wilk, 2012; Sokoya, Onifade and Alabi, 2012);
- ***Wikipedia*** and ***Skype*** (Rowlands *et al*., 2011; Gruzd, Staves and Wilk, 2012);
- ***LinkedIn*** (Rowlands *et al*., 2011); and
- ***Twitter*** (Letierce *et al.*, 2010; Grosseck and Holotescu, 2011; Small, 2011; Van Eperen and Marincola, 2011; Scott, 2013; Winkless, 2013)

Facebook, followed by LinkedIn, are often reported to be the most popular SNS among the social media tools used by researchers (Rowlands *et al*., 2011:185; Sokoya, Onifade and Alabi, 2012:6).

Methodology

The study targeted researchers working at the Council for Scientific and Industrial Research (CSIR) in Ghana and the Kenya Agricultural Research Institute (KARI). At the CSIR, we invited researchers from the following research institutes to take part in the study:

- CSIR – Animal Research Institute (ARI)
- CSIR – Crops Research Institute (CRI)
- CSIR – Forestry Research Institute of Ghana (FORIG)
- CSIR – Food Research Institute (FRI)

- CSIR – Oil Palm Research Institute (OPRI)
- CSIR – Plant Genetic Resources Research Institute (PGRRI)
- CSIR – Savanna Agricultural Research Institute (SARI)
- CSIR – Soil Research Institute (SRI)
- CSIR – Water Research Institute (WRI)

The Food and Agriculture Organization of the United Nations (FAO), in collaboration with partner organizations, is providing support to CSIR and KARI to enhance their management and dissemination of research outputs using several different pathways, including digital technologies. This support is provided within the framework of the Coherence in Agricultural Information Research for Development (CIARD) movement that, among other pathways, recommends the use of social media to communicate research outputs (CIARD 2009).

Working definitions of social media and research workflows – To ensure that the respondents had a clear understanding of what we meant by *social media* and *research workflow*, the electronic mail invitation provided a working definition and examples of social media, and an outline of the phases of the research workflow that we adopted for the study. Based on the literature review, we used *social media* as an umbrella term to refer to mobile and web-based technologies, web platforms and web-based services that facilitate interactions and conversations among users and thus enhance their participation in the generation, distribution, searching and sharing of digital content.

Although research does not follow a strictly sequential process, we adopted the *research workflow* illustrated in Figure 1, which is composed of the following phases:

- Identify research opportunities
- Find collaborators
- Secure support/funding
- Review the literature
- Collect research data
- Analyze research data
- Disseminate/publish research findings
- Manage research process

Data collection and response rate – Data for the study was collected using an online survey questionnaire hosted on the Survey Monkey platform. Prior to data collection, we compiled a list of electronic mail addresses of the target researchers through which the web link to the questionnaire was later distributed. Electronic email invitations were sent to 338 researchers in the two organizations, and seventy-one (21%) researchers agreed to take part in the study. However, the focus of this paper is on the sixty-one (18%) researchers who fully completed the questionnaires. Table 1 shows the distribution of the invitations, the number of responses and the usable responses received from each organization.

The percentage contributions of the two organizations to the usable responses were 55.74% for KARI and 44.26% for the CSIR.

Figure 1 – The research workflow

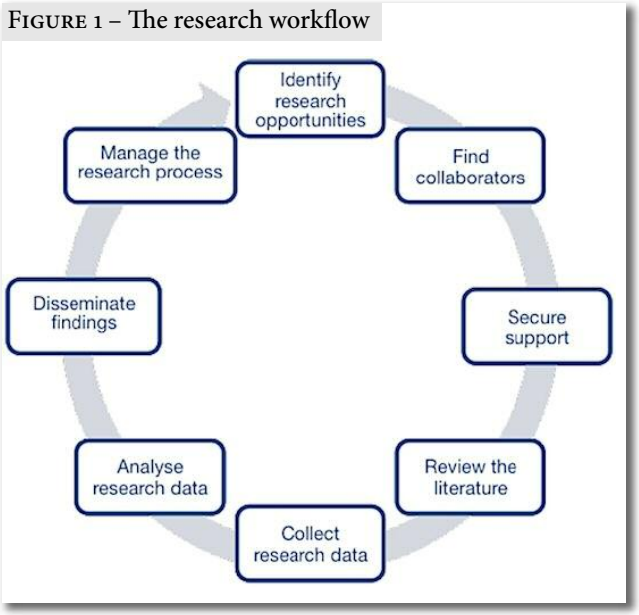


Table 1 – Distribution of invitations and responses

Research Institute	Number of e-mail invitations sent	Responses	Usable responses
Council for Scientific and Industrial Research (Ghana)	109	28	27
Kenya Agricultural Research institute	219	43	34
Totals	338 (100%)	71 (21%)	61 (18%)

Several factors affected negatively on the usable response rate. For example, to encourage the researchers to participate in the survey, completion of the questionnaire was anonymous. This approach made it impossible to make targeted follow-ups to researchers who had not completed the questionnaire, an activity that could have improved the overall response rate.

In addition, we also make the following assumptions regarding the response rate:

- It is possible that in some cases, electronic mail invitations ended up in the junk mail folders and therefore some researchers may not have seen/read the invitation messages.
- The target researchers are based at different research institutes/stations of the two organizations. Internet connectivity at some of these locations is not reliable. This could be one of the reasons the ten respondents who started the survey were unable to complete fully the online questionnaire.
- Although we targeted both users and non-users of social media, it is possible that non-users felt that it was not necessary for them to take part in the survey since they were not using social media.

Table 2 – Age distribution of respondents ($n=54$)

Years	Frequency	Percentage
20–29	1	1.85%
30–39	24	44.44%
40–49	12	22.22%
50–59	15	27.78%
60–above	2	3.70%

Table 3 – Highest academic qualifications ($n=54$)

Qualifications	Frequency	Percentage
Doctoral degree	12	22.22%
Masters degree	37	68.52%
Bachelors degree	5	9.26%

Table 4 – Work experience ($n=54$)

Years in research	Frequency	Percentage
Less than 5 years	7	12.96%
5–10 years	20	34.04%
10–15 years	8	14.81%
15–20 years	6	11.11%
Above 20 years	13	24.07%
Areas of specialization		

Results

Profile of social media users – Out of sixty-one researchers who fully completed the questionnaires, fifty-four (88.52%) indicated using social media. These ($n=54$) were made up of thirty (55.56%) from KARI and twenty-four (44.44%) from the CSIR. Twenty-five (46.30%) were females and twenty-nine (53.70%) males. The earliest reported use of social media was by seven (12.96%) respondents who started using the tools in 2000, and the latest was by one (1.85%) respondent who started in 2013. Most respondents, thirty-one (59.25%), started using social media between 2006 and 2013.

Tables 2, 3 and 4 indicate the age groups, highest academic qualifications and the number of years of experience in research work of the respondents.

The respondents came from more than twenty areas of specialization (Figure 2). They included agronomists, plant breeders, crop protection officers, and biotechnologists, among others.

Main source of funding for research – Twenty-four (44.44%) respondents indicated the main source of funding for their research work was donor agencies, channeling the funds through their research organizations. Fourteen (25.93%) respondents reported receiving research funds from their national governments, while thirteen (24.07%) received funding for research from donor agencies through national governments. Only three (5.55%) indicated private institutions as their main source of funds for research.

Figure 2 – Areas of specialization

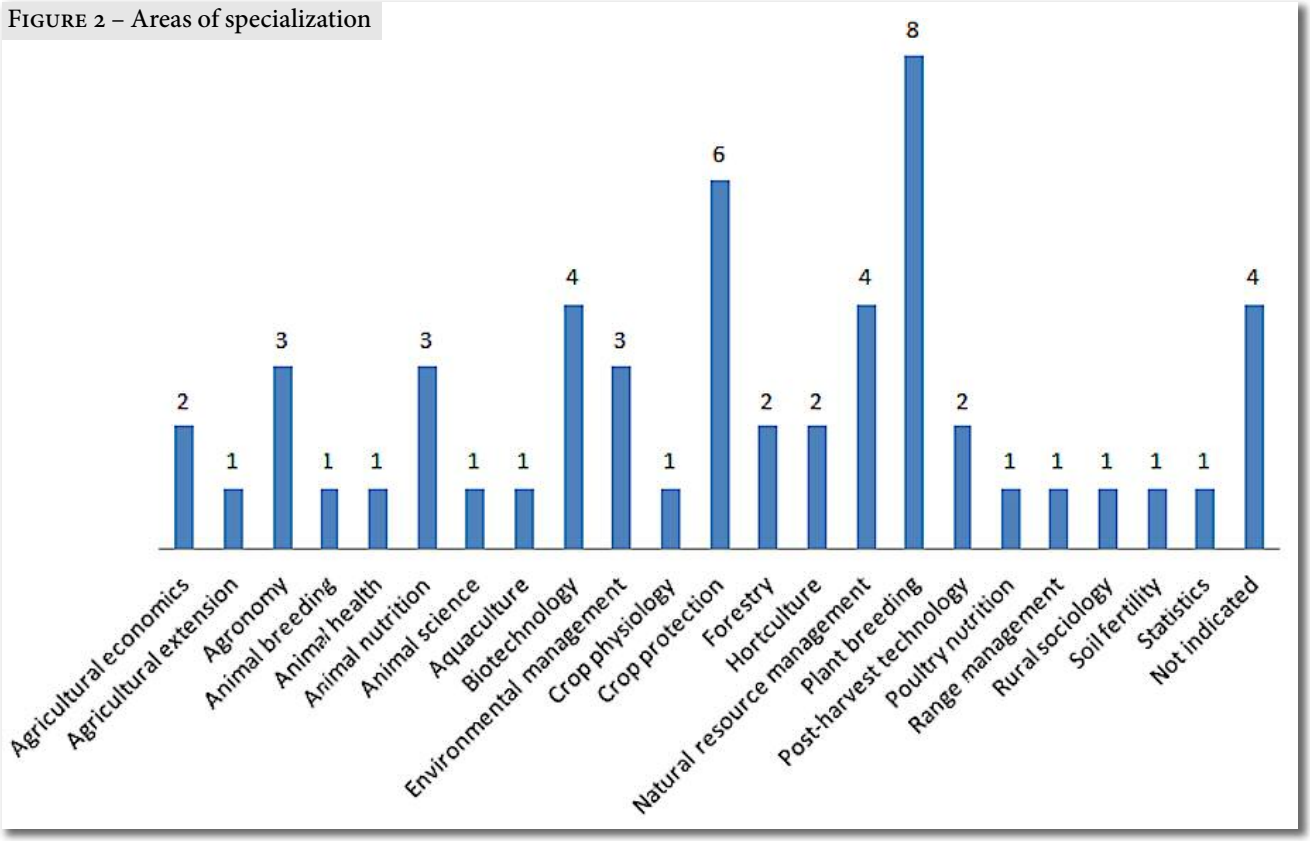


Table 5 – Profiles on social media ($n=54$)

Type of Social Media	Frequency	Percentage
Social Networking Services (i.e. Facebook, Google+, LinkedIn etc.)	47	87.04%
Voice over internet (VoIP) Applications (i.e. Google Talk, Skype, etc.)	26	48.15%
Discussion Forums/Platforms (i.e. Dgroups, Google Groups, etc.)	15	27.78%
Micro-blogging Applications (i.e. Twitter, FriendFeed, Tumblr, etc.)	13	24.07%
Cloud Storage Applications (i.e. Dropbox, iDrive, Microsoft SkyDrive, etc.)	12	22.22%
Online mapping tools (Google Maps, Google Earth, etc.)	9	16.67%
Online Collaboration Applications (i.e. Google Docs, Wikis, etc.)	9	16.67%
Video Sharing Applications (i.e. YouTube, Blip.tv, Vimeo, etc.)	8	14.81%
Presentations (i.e. authorSTREAM, Slidshare, Slidesix, etc)	6	11.11%
Photo Sharing Applications (i.e. Flickr, Picasa, etc.)	5	9.26%
Online Calendars (i.e. Google Calender, Yahoo Calendar, 30 Boxes, etc)	5	9.26%
Blogging Applications (i.e. Blogger, Wordpress, TypePad, etc.)	2	3.70%
Others	2	3.70%
Social Bookmarking Applications (i.e. StumbleUpon, Digg, Delicious, etc.)	1	1.85%
Academic Social Networking Sites (i.e. Mendeley, ResearchGate, MethodSpace, etc)	1	1.85%
Audio Sharing Applications (i.e. Podomatic, SoundCloud, etc.)	0	0.00%

Motivation to use social media – The need to connect with fellow researchers motivated thirteen (24.07%) respondents to adopt social media, while the potential of social media to enhance the researchers' visibility within the research community and outside their countries motivated another thirteen (24.07%) respondents. Eleven (20.37%) adopted social media because they wanted to connect with their family members and relatives. Availability of easy access to broadband internet and mobile information communication and technology (ICT) tools such as laptops, smart phones, tablets, etc., was a key factor in adopting social media for eight (14.81%) respondents. Four (7.41%) respondents adopted social media because they were impressed by what their fellow researchers were doing with the tools, while three (5.56%) adopted social media because using the tools does not require any form of payment. Curiosity on what social media was all about motivated one (1.85%) respondent to adopt the tools, while another (1.85%) researcher was invited by a colleague to use social media.

Profiles on social media services and platforms – We asked the respondents to select from a list of the categories of social media on which they had personal profiles or accounts. Table 5 shows that the majority, forty-seven (87.04%), reported profiles on Social Networking Services which include Facebook, Google+, LinkedIn, and MySpace. This was followed by twenty-six (48.15%) who reported profiles on Voice over Internet (VoIP) applications (i.e. Google Talk, Skype, etc), and fifteen (27.78%) with accounts on Discussion Forums Platforms (i.e. Dgroups, Google Groups, etc).

Access to social media – Easy access to the internet/web and ICT tools such as computers, laptops, tablets and smart phones is essential to accessing and using social media. The survey asked respondents to indicate where and how they accessed social media. Twenty-four (44.44%) reported that they used mobile broadband internet and therefore could access social media almost from anywhere, and fifteen (27.78%) accessed social media from home. Twelve (22.22%) reported accessing social media at their work places and three (5.56%) reported using other means, mainly a combination of home and work.

The majority of the respondents, forty-three (79.63%), used laptops to access social media sites. Six (11.11%), reported using smart phones (i.e. iPhone, Samsung Galaxy III, Blackberry, etc), four (7.41%) used desktop/personal computers, and one (1.85%) used a notebook. None reported using tablets (i.e. iPad, Samsung Galaxy Tab, Blackberry Playbook, etc).

Social media tools that are actively used – The majority of the respondents, forty-four (81.48%), reported actively using Facebook, while twenty-nine (53.70%) each used LinkedIn and Skype. Seventeen (31.48%) researchers reported using Google+ while Twitter was mentioned by thirteen (24.07%) and a mere one (1.85%) each used blogs and Mendeley (Table 6).

Social media in research – The focus of this study was on the use of social media in research. The majority, forty-six (85. 91%), of those who used social media also reported using the tools in their research work. However, less than half, nineteen (41.30%), used social media *very frequently* in their research work. Ten (21.74%) used social media *frequently,* six (13.04%) used the tools *occasionally*, one (2.17%) *rarely* and ten (21.74%) *very rarely*.

Social media in the stages of research workflow – Twenty-five (54.35%) of the respondents reported using

Table 6 – Social media actively used ($n=54$)

Type of Social Media	Frequency	Percentage
Facebook	44	81.48%
LinkedIn	29	53.70%
Skype	29	53.70%
Google+	17	31.48%
Twitter	13	24.14%
Google Maps	9	16.67%
YouTube	7	12.96%
Google Docs	5	9.26%
Picasa	4	7.41%
SlideShare	4	7.41%
iCloud	3	5.56%
Google Calendar	3	5.56%
Wikis	2	3.70%
Yahoo Calendar	2	3.70%
Flickr	1	1.85%
Blogs	1	1.85%
Mendeley	1	1.85%

Table 7 – Social media in research workflow ($n=46$)

Stage(s) of the research workflow	Frequency	Percentage
Identify research opportunities	19	41.30%
Find collaborators	25	54.35%
Secure support/funding	14	30.43%
Review the literature	16	34.78%
Collect research data	9	19.57%
Analyze research data	6	13.04%
Disseminate/publish research findings	12	20.09%
Manage research process	10	21.74%

social media for *finding collaborators* for their research work. In all the other stages of the research cycle (Table 7), less than 50% of the respondents used social media.

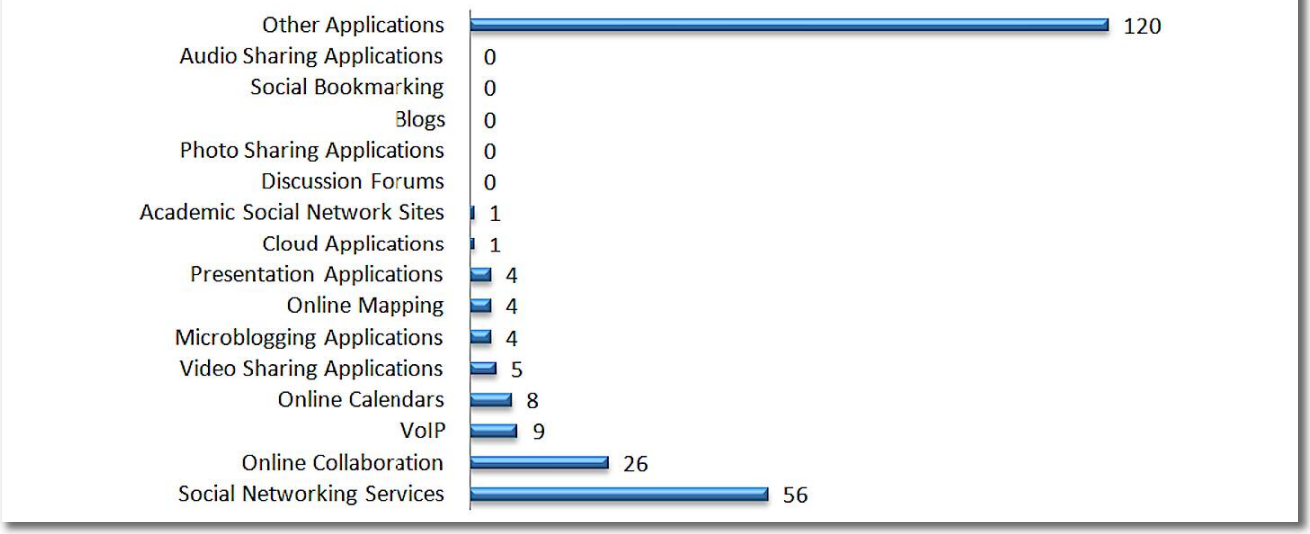
Popular social media categories in research workflow – The data collected showed that the researchers reported using tools from more than one category of social media and in more than one phase of the research cycle. However, across all the phases of the research cycle (Figure 3), applications other than social media tools were the most popular among the respondents, followed by Social Networking Services and online collaboration applications, in that order.

Table 8 shows the specific social media tools that were mentioned by the respondents as being used in their research workflow. The most popular social media tool was LinkedIn (mentioned forty-three times), followed

Table 8 – Social media in research workflow

Social media	Number of indications
Others – Google Search	85
LinkedIn	43
Google Docs	23
Facebook	12
Picasa	9
RSS	9
Skype	9
Yahoo Calendar	8
YouTube	5
Twitter	4
Google Maps	3
SlideShare	3
iCloud	1
Mendeley	1

Figure 3 – Popularity of social media categories in research



by Google Docs (twenty-three times). Facebook received twelve indications across all the phases of the research workflow even though forty-four (81.48%) researchers had indicated that they actively used it.

The Google search engine was the most popular non-social media platform among the researchers. It was mentioned eighty-five times across all the phases of the research workflow.

Impact of social media on research – We asked the respondents to indicate whether social media was having any impact on their research work. The majority, thirty-seven (68.52%), indicated that it was, and the remaining seventeen (31.48%) indicated that this was not the case. The perceived impact of social media is largely on facilitating networking and collaboration with other researchers, and easy access to information. Some of the respondents who indicated no impact were among those who had access to poor internet connection.

Main challenges to using social media – Fourteen (25.93%) respondents cited lack of reliable internet connectivity as the key challenge they faced when using social media in research workflow, while ten (18.52%) indicated lack of skills to make effective use of social media in research. Other notable challenges to using social media were the high cost of mobile broadband internet access (9.26%), unfamiliarity with the benefits of social media in research (7.41%), and difficulty in deciding on what content to share on social media (7.41%).

Non-social media users –

Profile of non-social media users – Only seven (11.48%) of the respondents who fully completed the questionnaire were not using social media. These were five (71.43%) males and two (28.57%) females. Four (57.14%) respondents were from KARI and the remaining three (42.86%) from the CSIR. Their age groups and highest academic qualifications are indicated Tables 9 and 10, respectively.

Research experience – One (14.29%) each have been involved in research for less than five years, 5–10 years, 10–15 years, and 15–20 years. Three (42.86%) respondents have above twenty years research experience.

Source of funding for research – Six (85.71%) respondents indicated donor agencies, through their institutions, as their main source of funding for research, while one (14.29%) indicated donor agencies, through the government, as the main source of funding.

Key reasons for not using social media – While one (14.29%) respondent indicated *lack of time* as key the reason for not using social media, two (28.57%) each mentioned the following as being the reasons why they never used social media:

- Lack of skills to make effective use of social media;
- Unfamiliarity with the benefits of social media in research;
- Lack of reliable internet access.

Table 9 – Age distribution of respondents ($n=7$)

Years	Frequency	Percentage
40–49	4	57.14%
50–59	3	42.86%

Table 10 – Highest academic qualifications ($n=7$)

Qualifications	Frequency	Percentage
Doctoral degree	2	28.57%
Masters degree	5	71.43%

Discussion

The following research questions guided this study:

RQ1. Are the researchers in public agricultural research institutes using social media?

RQ2. Are the researchers using social media in their research workflow?

RQ3. What specific social media tools are they using and at which phases of the research workflow?

RQ4. What is the perceived impact of social media on agricultural research workflow?

The data that we collected and its analysis give answers to the above questions. These are discussed in the followings sections.

Using social media – The study shows that some researchers at the CSIR and KARI are using social media, with Social Networking Services (i.e. Facebook, Google+, LinkedIn, etc) the most popular category of social media. The majority of the researchers have their accounts/profiles on Facebook. This is not surprising, considering that Facebook has more than forty million users in Africa (internet World Stats, 2012) and is the most visited website in most of Africa (Essoungou, 2010; Ndavula and Mberia, 2012). Voice over Internet (VoIP) applications, in particular Skype, are the second most popular category of social media. Skype offers an alternative to the expensive fixed telephone lines and mobile telephone services when it comes to making long distance calls. Its ability to link up to twenty-five individuals in a Skype conference call also makes it very attractive to the researchers.

Using social media in research – Although there is some use of social media in research, the tools are mainly used in the identification of research opportunities and finding collaborators for research projects. In general, the greatest potential for social media is in the dissemination of research findings. The study shows that in the two organizations, there is little use of social media in disseminating/publishing research findings. This could partly be explained by the observations made regarding the provision of support to the two organizations under the CIARD movement. Both the researchers and the organizations place emphasis on traditional means of communicating and sharing research result, and there is little or no institutional support for the use of digital technologies including

social media, publishing in electronic journals and using open archives for sharing research outputs.

Overall, the use of social media across all the phases of the agricultural research workflow is relatively low. Lack of access to reliable internet connection and lack of skills to make effective use of social media in research are the major obstacles to using social media in agricultural research workflow. Although overall internet connectivity has improved on the continent, most publicly funded organizations, such as national agricultural research organizations, lack financial resources to implement and manage reliable broadband internet connections. Skills to use social media effectively are generally lacking and use of these tools is more due to personal initiatives than as part of the organizations' wide social media strategies. As a result, organizations are not investing in capacity development to equip researchers with appropriate skills to enhance their adoption of social media.

Popular social media tools – Although the study established that Facebook was the most popular SNS among the researchers, it was LinkedIn and Google Docs that were the popular social media tools for research workflow. The researchers cited LinkedIn at least twice in all the phases of the research workflow, while Google Docs was also mentioned at least once in each phase of the research workflow, except in managing the research process.

LinkedIn's focus on professionals makes it easier for professionals to consider using that tool in their work, as opposed to Facebook, which started as a tool for connecting friends for social networking purposes. On the continent, Facebook is largely associated with the youth, despite the fact that many users have increasingly started using it for business, marketing and study purposes (Shambare and Mvula, 2011).

Google Docs offers several facilities that attract users who want to collaborate online to create documents, spreadsheets, and presentations and share documents. Easy use of documents created in Microsoft in Google Docs is also a plus for this tool.

Perceived impact of social media on research – Social media is slowly having some impact on the work of researchers, especially on facilitating professional networking and enhancing personal visibility within the research community. However, there seem to be little impact on the dissemination and visibility of research results since there is little use of social media for these purposes.

Conclusion

The study shows that researchers at the CSIR and KARI are using social media and most of them have profiles/accounts on Facebook, LinkedIn and Skype. In research work, LinkedIn and Google Docs are the most popular social media tools. However, the focus of social media usage in agricultural research workflows is on identifying research opportunities and finding collaborators for research projects than on disseminating research results, an activity that could enhance the visibility of research from the two organizations. There is a need to develop and implement social media policies and strategies to enhance the adoption and use of social media in research, and more so in the dissemination of research results.

References

Alcatel-Lucent. [n.d]. "New Communication Behaviours in a Web 2.0 World — Changes, Challenges and Opportunities." *The Era of the Information Revolution: Strategic White Paper*. http://enterprise.alcatel-lucent.com/private/active_docs/Communication%20Behavior%20in%20a%20Web2%200%20World_ALU.pdf — accessed 5 August 2012.

Andersen, N. B. and T. Söderqvist. 2012. *Social Media and Public Health Research*. http://bjerglund.files.wordpress.com/2012/11/final-social-media-and-public-health-research1.pdf. — accessed 15 June 2013.

Bik, H. M. and M.C. Goldstein. 2013. "An Introduction to Social Media for Scientists." *PLoS Biololgy,* 11(4): e1001535.doi:10.1371/journal.pbio.1001535 — accessed 24 May 2013.

Bonetta, L. 2007. "Scientists Enter the Blogospahre." *Cell* 129(3): 443–445.

Broughton, A., T. Higgins, B. Hicks and A. Cox. 2009. "Workplaces and Social Networking: the Implications for Employment Relations." *Brighton: Institute for Employment Studies*. http://www.acas.org.uk/CHttpHandler.ashx?id=3182&p=0. — accessed 8 August 2012.

Cavazza, F. 2012. *Social Media Landscape 2012*. http://www.fredcavazza.net/2012/02/22/social-media-landscape-2012/. — accessed 19 July 2013.

CIARD. 2009. "Using Social Media to Communicate Research Outputs." *Version 0.1. October*. http://www.ciard.net/sites/default/files/CIARD_Pathway_Group_3_Social_Media_0.pdf. — accessed 26 May 2013.

CIBER: University College London and Emerald Group Publishing Ltd. 2010. *Social Media and Research Workflow*. http://www.ucl.ac.uk/infostudies/research/ciber/social-media-report.pdf. — accessed 25 May 2013.

Collins, E. and B. Hide. 2010. "Use and Relevance of Web 2.0 Resources for Researchers. In: Hedlund, T. and Tonta, Y. (eds)." *Publishing in the Networked World: Transforming the Nature of Communication, 14th International Conference on Electronic Publishing. Helsinki.* http://epubl.scix.net/data/works/att/119_elpub2010.content.pdf. — accessed 1 June 2013.

Dresbeck, R. [n.d]. "Communicating with Faculty Using Social Media." http://www.nordp.org/assets/RDConf2012/presentations/nordp-2012-dresbeck.pdf. — accessed 24 May 2013.

Essoungou, A-M. 2010. "A Social Media Boom Begins in Africa." *Africa Renewal* 24(4):3.

European Commission. [n.d]. *Social Media Guidelines for Staff*. http://ec.europa.eu/ipg/docs/guidelines_social_media_en.pdf. — accessed 29 May 2013.

Eysenbach, G. 2011. "Can Tweets Predict Citations? Metrics of Social Impact Based on Twitter and Correlation with Traditional Metrics of Scientific Impact." *Journal of Medical Internet Research* 13(4):e123. http://www.jmir.org/2011/4/e123/. — accessed 6 April 2013.

Grosseck, G. and C. Holotescu. 2011. "Academic Research in 140 Characters or Less." Paper presented at the 7th International Scientific Conference and Software Education, Bucherest, April 28–29, 2011. http://adlunap.ro/eLSE_publications/papers/2011/1590_1.pdf. — accessed 24 May 2013.

Grudz, A., K. Staves and A. Wilk. 2012. "Connected Scholars: Examining the Role of Social Media in Research Practices of Faculty Using AUTAT Model." *Computers in Human Behavior* 28:2340–2350.

Henderson, A. and R. Bowley. 2010. "Authentic Dialogue? The Role of "Friendship" in Social Media Recruitment Campaign." *Journal of Communication Management* 14(3): 237–257.

Internet World Stats. 2012. "Internet Usage Statistics for Africa (Africa Internet Usage and Population Stats)." http://internetworldstats.com/stats1.htm. — accessed 31 July 2012.

Kaplan, A. M and M. Haenlein. 2010. "Users of the World, Unite! The Challenges and Opportunities of Social Media." Business Horizons 53(1): 59–68.

Kietzmann, J. H., K. Hermkens, I. P. McCarthy and B. S. Silvetre. 2011. "Social Media? Get Serious! Understanding the Functional Building Blocks of Social Media." *Business Horizon* 54: 241–251.

Kim, E. [n.d]. *The Impact of Social Media Technologies Upon Academic Researchers and Librarians.* http://concert.stpi.narl.org.tw/Images/upload/CONCERT2011/PPT/Elizabeth_Kim.pdf. — accessed 24 May 2013.

Kousha, K. and M. Abdoli. 2012. "Using Social Networking Sites, Blogs and Online News Contents in the Agriculture Research: A Citation Analysis." Paper presented at the 78th IFLA Conference, 11–17 August 2012, Helsinki, Finland. http://conference.ifla.org/past/ifla78/205-kousha-en.pdf. —accessed 26 May 2013.

Letierce, J., A. Passant, S. Decker and J.G. Breslin. 2010. "Understanding How Twitter is Used to Spread Scientific Messages." *Web of Science Conference, April 26–27.* http://www.johnbreslin.org/files/publications/20100426_webs2010c.pdf. —accessed 24 May 2013.

Minocha, S. and M. Petre. 2009. *Handbook of Social Media for Researchers and Supervisors: Digital Technologies for Research Dialogues.* http://www.vitae.ac.uk/CMS/files/upload/Vitae_Innovate_Open_University_Social_Media_Handbook_2012.pdf. — accessed 24 May 2013.

Ndavula, J. O. and H. K. Mberia. 2012. "Social Networking Sites in Kenya: Trigger for Non-Institutionalized Democratic Participation." *International Journal of Business and Social Science* 3(12):300–306.

RIN. 2010. *If You Build It, Will They Come? How Researchers Perceive and Use Web 2.0.* http://www.rin.ac.uk/system/files/attachments/web_2.0_screen.pdf.—accessed 25 May 2013.

Rowlands, I., D. Nicholas, B. Russell, N. Canty and A. Watkinson. 2011. "Social Media Use in Research Workflow." *Learned Publishing,* 24(3):183–195.

Shambare, R. and A. Mvula. 2011. "South African Students' Perceptions of Facebook: Some Implications for Instructors." *African Journal of Business Management* 5(26):10557–10564.

Sokoya, A. A., F. N. Onifade and A. O. Alabi. 2012. "Establishing Connections and Networking: The Role of Social Media in Agricultural Research in Nigeria." Paper presented at the 78th IFLA Conference, 11–17 August 2012, Helsinki, Finland. http://conference.ifla.org/past/ifla78/205-sokoya-en.pdf. — accessed 26 May 2013.

Terra, M. 2012. "The Verdict: Is Blogging and Tweeting About Research Papers Worth it?" *LSE Blog: Impact of Social Sciences.* http://blogs.lse.ac.uk/impactofsocialsciences/2012/04/19/blog-tweetingpapers-worth-it/. — accessed 15 June 2013.

Sage. 2012. *10 Ways to Increase Usage and Citation of Your Article Using Social Media.* http://www.uk.sagepub.com/journalgateway/usage.htm.— accessed 16 June 2013.

Schenk, N. 2012. *Using Social Media to Support Your Research.* http://www.infotoday.eu/Articles/ReadArticle.aspx?ArticleID=84102. — accessed 19 July 2013.

Scott, S. 2013. "The Researcher of the Future…Makes the Most of Social Media." *Lancet* 381:5–6.

Small, G. 2011. "Time to Tweet." *Nature* 479 (7371):141.

Van Eperen, L. and F. Marincola. 2011. "How Scientists Use Social Media to Communicate Their Research." *Journal of Translational Medicine* 9(199): 1–3.

Winkless, L. 2013. "Science with the #Hashtag." *Materials Today* 16(1/2): 2–3.

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Towards Mobile Agricultural Information Services in Zimbabwean Libraries: Challenges and Opportunities for Small Scale Farmers in Utilizing ICTs for Sustainable Food Production

Collence Takaingenhamo Chisita and Thembani Malapela

Abstract: This paper explores the possibilities of mobile agricultural information services in Zimbabwe with a special focus on libraries and m-services. It analyzes how traditionally experienced smallholder farmers are utilizing mobile technology to access current information relating to the market prices of crops, banking services and weather patterns (agrometeorology). The researchers explore how mobile-phone based services are providing small scale farmers opportunities to access market prices, negotiate better deals with traders and improve the timing of getting their crops to market. It also in vestigates the strategies that libraries are employing to provide e-agricultural library services to small scale farmers in the rural areas. The writers also seek to find out the extent to which Zimbabwe can utilize mobile services to promote access to agricultural information for small-scale farmers.

Resumé: Cet article explore les possibilités de services d'information agricole mobiles au Zimbabwe avec un accent spécial sur les bibliothèques et les m-services. Il analyse comment les petits agriculteurs avec une expérience traditionnelle utilisent la technologie mobile pour accéder aux informations actuelles sur les prix du marché des récoltes, les services bancaires et les conditions météorologiques (l'agro-météorologie). Les chercheurs explorent comment les services de téléphonie mobile permettent aux petits agriculteurs d'accéder aux prix du marché, de négocier de meilleurs accords avec les négociants et d'améliorer la distribution de leurs récoltes sur le marché. Ils examinent également les stratégies que les bibliothèques emploient pour fournir des services de e-bibliothèque agricole aux petits agriculteurs dans les zones rurales. Les auteurs cherchent également à déterminer la mesure dans laquelle le Zimbabwe peut utiliser ces services mobiles pour promouvoir l'accès à l'information agricole pour les petits agriculteurs.

Resumen: Este artículo explora las posibilidades de servicios de información agrícola móviles en Zimbabue con un enfoque especial en bibliotecas y servicios móviles. Analiza cómo pequeños agricultores con experiencia en servicios tradicionales están utilizando tecnología móvil para acceder a información actualizada relativa a precios de mercado de los cultivos, servicios bancarios y patrones climáticos (agrometeorología). Los investigadores exploran cómo los servicios basados en telefonía móvil están ofreciendo oportunidades alos pequeños agricultores para acceder a los precios de mercado, negociar mejores acuerdos con comerciantes y mejorar el tiempo de entrega de sus cultivos a los mercados. También investiga las estrategias que las bibliotecas están empleando para proporcionar servicios bibliotecarios agrícolas electrónicos a los pequeños agricultores en zonas rurales. Los autorestambién tratan de determinar el grado en que Zimbabue puede utilizar los servicios móviles para promover el acceso de los pequeños agricultores a la información agrícola.

Introduction

The Information and communications technology (ICT) revolution has permeated every aspect of life and farmers are already benefitting from mobile communications, even in distant regions of the world. Zimbabwe has an agro-based economy and mobile technologies have come at an opportune time. Silarszky et al. (2008) states that research studies have found mobile phones to have a multi-dimensional positive impact on sustainable poverty reduction and that lack of accessibility to the array of ICTs is stumbling. Fourati (2009) states that lack of access to information and communication can increase poverty in the long run and result in social strife.

The rapid adoption of mobile phones has generated a great deal of speculation and buoyancy regarding its effect on economic development in Africa. The techno-hype transgresses boundaries of age, sex, gender, race as the world drives towards an e-inclusive society. Chisita (2012) quotes Smith and Underwood (2010:374) who view information and knowledge as key factors of production critical in enabling society to find better ways of "*working smarter*" rather than "*working more.*" In the global ICT-driven era, the competitive nature of an institution is dependent upon its ability to generate, access, analyse, evaluate, exchange and exploit information to improve efficiency. The ubiquity of ICTs in developing countries will ultimately enhance opportunities to utilize mobile phones for easier communication locally and internationally thus facilitating access to agricultural information to enhance productivity, markets products, network and create virtual communities of practice. Access to ICTs is also contributing toward the realization of socio-economic and technological outcomes such as increased production, food security, information/digital literacy and enhanced access to information for better communication, health, e-governance and e-inclusion.

Agricultural Information Systems in Africa

Rolling (1988:33) uses a systems approach to describe agricultural information as "…a system in which agricultural information is generated, transformed, consolidated, received and fed back….to underpin knowledge utilization by agricultural producers." Aker and Mbiti (2010) highlight five potential mechanisms in the use of mobile technology for economic benefits in Sub-Saharan Africa, including: improving access to information, use of information and coordination among agents and increasing market efficiency; improving productive efficiency due to improved communication within the supply chain; and the usage of mobile phone-based applications and development projects to facilitate the delivery of e-services in commerce, agriculture, health and education among others. As Rwandan President Paul Kagame stated, "…In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa" Aker and Mbiti (2010).

Durrani (2008:20) states that the information systems that characterize the present day third world have evolved many years in the course of socio struggles such as the wars of liberation and anti-neo-colonial struggles during the twentieth century and after. The author further describes these services as the word of mouth based on oral traditions, the official system created by the colonialists to serve their colonial interests, and post-independence information systems. Durrani further bemoans that there has not been significant qualitative change regarding agricultural information services especially related to quality and relevance of information. Anandajayasekeram et al. (2008) notes that agricultural service delivery in developing countries started with production-oriented limited extension services for export crops but since the second half of the twentieth century, attention was diverted to food production and improved farming techniques.

Durrani also states that third world countries have become tools in the hands of transnational corporations who push technologies in the name of profit and plunder. The author further laments that third world agriculture has become too dependent on transnationalism and vulture capitalism. Leye (2009) and Durrani (2008) challenge the assumption that technologies are value free or independent variables causing change in every domain of human life. The authors further argue that ICTs buttress existing dependencies, and there is therefore a need to thoroughly examine crucial matters of control, cost, selection, and utilization. The World Bank (1998) recommended a systematic approach to the application of ICTs , such as identifying the multi-sectoral information needs of rural communities, determining the type of information needed, determining the gap between what is currently available and what is needed and determining how ICTs can close or bridge these gaps. These recommendations are meant to prevent duplication of effort, ensure proper allocation of resources and effective utilization of resources and overcome the oppression of technology.

Durrani (2008:24) notes how in Africa, prior to independence, agricultural libraries viewed their role in terms of information transmission instead of information communication, which implies a two way exchange of information as reflected by mobile technologies and the use of free open-source software such as FrontlineSMS. The author further notes that there is need for a paradigm shift with agricultural librarians rising above non-communication. ICTs have ushered in a new age of e-inclusivity or *"parabiosis"* whereby everyone is networked. This has been made possible through effective utilization of appropriate innovative technologies to facilitate effective information communication. Modern ICTs such as mobile technologies, social media and blogs enable rural farmers not only to transmit or exchange but also to create agricultural information to increase productivity. Libraries and librarians need to adjust to the challenges of mobile technologies by acquiring the skills to handle digital information and to be efficient creators, collectors, consolidators and communicators of information and to empower users (and especially farmers) with critical literacies with regards to use of mobile technologies in agriculture.

According to the World Bank (2007), most smallholder farming systems are much less productive and profitable because of a lack of access to inputs and credit, the inability to bear risks, and the information and skills gap that constrains the adoption of available technologies and management practices or reduces their technical efficiency. De Silva and Ratnadiwakara (2008) argue that farming has become a more time-critical and information-intense business because of the hypothesis that a drive towards higher productivity will ultimately require an information/knowledge-based decision-making agricultural system. The authors further state that farmers require the right information, at the right time and place, which confirms the view that agricultural information systems should be relevant to the needs of the local people as expressed by Durrani (2008). The agricultural input-output nexus encompasses tangibles like land, labor, financial credit, water supply, pesticides, fertilizers, and infrastructural support (communication network, storage facilities) and intangibles ranging from knowledge production and technological innovations to knowledge dissemination (Africa Capacity Building Report, 2013). De Silva and Ratnadiwakara (2008) further note that research in Sri Lanka discovered that the cost of information from planting decision to selling at the wholesale market amounts to 11% of total production costs.

Aker (2010) notes that in developing countries, agricultural extension systems were conceived of and developed in response to information asymmetries for poor farmers, particularly those with limited access to other sources of information. The author further states that,

while infrastructure investments still remain low in many developing countries, there is a growing interest in mobile phone coverage and adoption. Aker (2011) also argues that mobile phones can improve access to and use of information about agricultural technologies, as well as products potentially improving farmers' learning and livelihood through enhanced production. In many developing countries, Zimbabwe included, agricultural information services have been provided via traditional print and electronic media and agricultural extension services.

Community Informatics

Community informatics is an emerging field that involves the process of using ICTs for community practice in order to improve the socioeconomic well-being of the community. The social informatics perspectives are anchored on the notion that mobile technologies are key components of the mobile agricultural information systems, according to Lamb and Sawyer (2005). Songan et al. (2004) states that social informatics is closely linked to community informatics which is concerned with the processes of using ICTs to improve the socio-economic well-being of communities. This perspective emphasizes more on the social utilitarian aspect of using modern technology. Gurstien (2000) states that community informatics involves the application of ICTs to enable community processes and the attainment of community objectives, for example, turning a digital divide into a digital dividend.

Community informatics aims to ensure that individuals or communities may make use of the opportunities provided by ICTs both where there is a means for direct use of the technology and also where it is not available. The idea of creating or developing rural telecenters and creating shared portals of information amongst libraries, galleries and museums is meant to contribute towards equal and convenient access to information for all. Community informatics is concerned with people centered information systems as proposed by Durrani (2008) .The availability of telecentres and affordability of mobile technologies will empower farmers in both rural and urban areas to access reliable information to increase productivity.

Community informatics goes beyond just providing access to ICTs by empowering users with knowledge and skills to participate in or contribute towards the design of new technology as well as content to ensure equality and equitable access and production of information. Examples of community informatics include the development of community blogs, farming groups on social media and other organisations supporting communities of practice (COP) or Communities of Interest (COI). These are critical information forums for networking which can be networked to libraries. The COPs listed in Figure 1 can be accessed online by farmers, researchers and students through mobile technologies.

Zimbabwe and mobile technology

Crawford and Gorman (1995) noted that technology should be used to improve the lives of communities as reflected by the following law" "Use technology intelligently to enhance services." Mobile services are at work in the field of agriculture, mostly for sharing and obtaining information to increase productivity. The World Summit on Information Society (WSIS) (2003) endorsed e-agriculture as a way to boost agricultural production through effective utilization of the panoply of modern ICTs to create linkages and Fenhance the extension of development services and networks for information and knowledge sharing. The Food and Agricultural Organisation (FAO) (2006) identified agricultural production, community development, research and development media networks in agriculture as key areas in the agricultural sector that could benefit from ICTs.

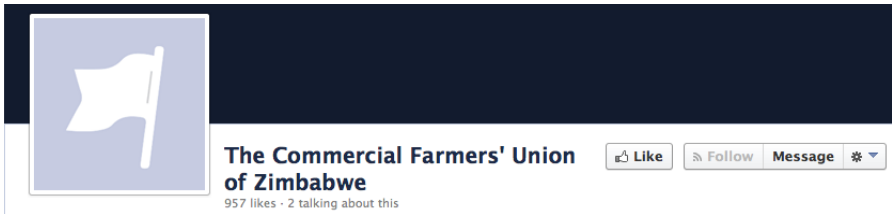
Mobile applications (m-app) refer to either pre-installed or downloadable software programs developed for small low-power handheld devices such as mobile phones or tablets. Gichamba and Lukanda (2012) describe m-Agriculture as the provision of agricultural services and information, using mobile devices such as cell phones, Personal Digital Assistants (PDAs), tablets and other handheld communication or computing devices.

Zimbabwe's leading mobile networks include Econet Wireless Zimbabwe (Econet), state-owned NetOne and Telecel Zimbabwe (Private) Limited (Telecel), according to Mangudhla (2012). Mushawevato (2013) notes that in 2012 the total teledensity rate for both mobile and fixed telephone in Zimbabwe stood at 91% from the 75% that was recorded in December 2011. The Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) noted that teledensity in Zimbabwe rose to 97% in December, 2012 from 89.9% in September of that same year and 67% in 2011; while the combined subscriber base for Econet Wireless Zimbabwe, Telecom Zimbabwe and NetOne has risen to more than ten million as compared to seven million subscribers in 2012.

There are a number of mobile phone-based services providing farmers access to market prices and enabling them to negotiate better deals with traders and improve the timing of getting their crops to market. Mobile-based market information systems and services naturally provide farmers with opportunity to send SMS text messages to a specific number which then gives them wholesale and retail prices of crops. It is argued that mobile phones are significantly less expensive than the equivalent per-search cost of personal travel or a newspaper, yet more expensive than landlines or radio. Landlines are not readily available in resource-starved regions of the developing world, and also radio only provides price information for specific products and markets on a weekly basis; hence the need to adapt mobile services in agricultural production and marketing. Baye, Morgan and Scholten (2007), Aker (2010), Aker and Mbiti (2010) all concur that the reduction in

FIGURE 1 – Farmers Groups Accessible from Social Media Through Mobile Technologies

- **Zimbabwe Farmers Union**
  https://www.facebook.com/ZimbabweFarmersUnion



- **The Commercial Farmers' Union of Zimbabwe**
  https://www.facebook.com/pages/The-Commercial-Farmers-Union-of-Zimbabwe/265040938186

- **National Association of Dairy Farmers Zimbabwe**
  https://www.facebook.com/ZimbabweAssociationOfDairyFarmers/

- **Save Zimbabwe Farmers**
  https://www.facebook.com/groups/25083554492/

- **Zimbabwe Progressive Tobacco Farmers Union**
  https://www.facebook.com/groups/115865545159163/

- **Young Farmers Club Zimbabwe**
  https://www.facebook.com/groups/YOUNGF/

search costs associated with mobile phones could increase farmers' access to information through their private sources, such as members of their social network. Aker (2008) examined the impact of the mobile phone rollout on grain markets in Niger and discovered that mobile phone service had reduced grain price dispersion across markets by a minimum of 6.4% and reduced intra-annual price variation by 10%. In Zimbabwe, m-Technologies have the potential to reduce information gaps and constraints with regards to the development of agricultural. Urban and rural farmers will have an opportunity to receive, analyse, create and exchange agricultural content through m-Technologies.

Information and Development

The common denominator in all the following definitions of development is that there is an element of positive transformation, growth or advancement anchored on access to information/knowledge. Sharif al Nasabi (1996) describes development as the sum total of all "actioning" that drives society towards an organized system of individual and collective living conditions relating to desirable values. The pragmatic nature of actioning is anchored on the provision and equitable access by all to information with reference to agricultural information systems. Abidi (1991) states that in order to ensure effective development there is a need to combine the "*inseparable trinity*" of knowledge/information, communication and development. Development can only be realized through the provision of relevant information/knowledge at the right time and in the right package; galleries, libraries, archives, museums (GLAM) and related institutions play a significant role in leveraging intellectual and cultural assets and building an information/digital literate citizenry to stimulate and sustain development. Aubert and Reiffers (2003) argue that knowledge has always been the source of economic development because economies that perform well are those that make the best use of knowledge and its applications in all aspects of life. And Simmons and Womboh (1999) noted that success in decision making process is dependent upon access to quality information critical for farmers, researchers and policy makers, and that food insecurity may be attributed to wrong agricultural decisions anchored on wrong information. A good example of access to quality information in Zimbabwe is Agromet, which offers current and reliable weather information to farmers with access to mobile technology.

M-technologies and access to information

Across the developing world, there are programs that give farmers access to research and best practices, weather information and market prices via SMS, Interactive Voice Response (IVR) or call centers. Policymakers, newspapers and mobile phone companies have all publicized the poverty-eradicating potential of mobile phones (Corbett, 2008), which can transform agriculture in developing countries by providing mobile marketing and payment systems, micro insurance and lending and trading platforms, systems to manage supplier and distribution networks, and more. Mangena (2011) categorizes Zimbabwean farmers as either commercial, small scale, small scale commercial, the newly resettled who lack adequate access to modern ICTs, and the communal. Access to Libraries and ICTs is skewed in favor of those economically advantaged, like commercial farmers, while the communal farmers have limited or no access to such technologies. Mangena highlights the critical role of ICT's in facilitating access to agricultural information, such as the role of telecentres providing internet, fax, typing, and printing. M-technologies provide farmers with platforms to share agrometereological information, micro insurance schemes and opportunities to send SMS to find out crop prices in distant places. There is, however, a need to incorporate information literacy and a culture of continuous learning at all levels of the educational curriculum from preschool to Higher and Tertiary in order to create a literate generation that will not relapse into techno illiteracy.

Farmers require information at each and every stage of the farming process, including weather forecasts, pest attacks, inputs, cultivation practices, disaster preparedness and mitigation, pest and disease management and prices, among others. Banks (2011) notes that farmers can utilize mobile technologies to communicate agricultural information through SMSs; for example, in Kenya, radio is used to facilitate dialogue through exploiting the potential of SMS text messaging amongst farmers. Another classic example is the iCow platform, a mobile-phone application enabling cattle herders to register each individual cow and to receive individualized text messages on their mobile phones, including advice relating to veterinary care and feeding schedules, a database of experts, and updated market rates on cattle prices. Public libraries should provide links to such platforms since they are strategically situated with regards to easier physical, electronic or virtual access.

There are a multitude of mobile phone-based products, services, and applications working towards enhancing agriculture. The use of free open source software like FrontlineSMS facilitates instantaneous two-way communication on wider scale especially in agriculture. iCow and M-Farm provide useful information to farmers such as how to access the nearest veterinary services. Remote Livestock Marketing System (RLMS) is a blog popular in Zimbabwe that allows techno savvy farmers to market their cattle online and also purchase equipment. This blog can be accessed with following navigable links based on following index-based concepts: narrow terms (NT), broader terms (BT) and relative terms (RT); bull sales (NT); cattle sales (BT); farm equipment; (NT) special sales; upcoming sales; reports; registration. Contacts can be accessed at http://www.rlms.co.zw/

Mushawevato (2013) notes that the number of Zimbabweans with access to a telephone has risen by 16%, according to 2013 figures released by the Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ). The author attributes this significant development to the continually expanding mobile telephone service sector which has increased teledensity in the country. The global telecommunication regulator, the International Telecommunication Union (ITU), defines teledensity as the number of telephone main lines per one hundred inhabitants in a particular country or territory. Aker and Mbiti (2010) note that in sub-Saharan Africa, for example, less than 10% of the population had mobile phone coverage in 1999 but that had increased to over 60 percent of the population in 2008. The International Telecommunications Union ICT Development index (2010) report indicates a rapid increase in teledensity as reflected by high mobile penetration in rural areas, for example in Zimbabwe, stands at 90%.

Other initiatives in Higher Education

Universities have launched e-farming, a technological platform aimed at providing instant agricultural information to farmers through mobile phones. Farmers are required to register with the University so that their details including mobile numbers are captured in the database. It is critical to note that currently, the University boasts rich human, intellectual and structural capital in the form of expertise, database, and information systems providing agricultural information relevant to all Zimbabweans, including information on inputs, market prices, animal and crop diseases and research-based data.

Mataranyika (2006) describes how the University of Zimbabwe library (UZ-library) in collaboration with The Technical Centre for Agricultural Cooperation (CTA) has been offering an indirect reference information service called Question and Answer (QAS) to farmers, especially those distant rural areas and other stakeholders in agriculture. With this service, farmers mail through the post their agricultural information requests to UZ-library. Upon receiving these questions, information searches are carried out in an array of print and electronic resources available at the library and consultations with subject experts from the Faculty of Agriculture are done in an endeavor to address the information need. When found, the information is photocopied, packaged and sent back to the farmer.

The University of Zimbabwe decided to showcase its community engagement projects at the Harare Agricultural Show in August 2011 under the theme "Knowledge based Agro-Solutions." This was an opportunity to market the QAS and conduct a survey as to find out trends in agricultural information requirements as well as explore ways the QAS could be enhanced through the use of m-technologies.

The advent of mobile communication technologies and the increased network coverage in Zimbabwe as well as the existence of Free Open Source short message software (SMS) *www.frontlinesms.com* platforms have all presented an opportunity for UZ-library to trial a modified version of the QAS from a print based to an electronic based service for instant communication or alerts. This SMS platform was exhibited at the Zimbabwe International Trade Fair and the Harare Agricultural Show editions of 2012. EIFL-FOSS, open source software for improving ICT infrastructure in libraries, has been helpful to university libraries in African countries, including Zimbabwe, for those wishing to embark on mobile library projects through experimenting with Free Open Source Software (FOSS) technologies such as MobileCat, which provides access and search facilities to Mobile Public Access Catalogues (MOPAC), circulation details, and links to mobile content; it is a web application providing a mobile interface to one hundred and eleven Web OPACS. Such technologies have the potential to transform agriculture by providing easier access to information through mobile technologies.

Food and Agricultural Organization Emergency Rehabilitation and Coordination Unit

Towards the end of the first decade of the twenty first century, Zimbabwe began to move away from large scale free input distribution programs to market based intervention programs though the Food and Agricultural Organisation's Emergency Rehabilitation and Coordination Unit (ERCU). Voucher systems were launched for agricultural input support which aimed to provide farmers with opportunities to choose the agricultural inputs of their choice, test an alternative method of input assistance, demonstrate the capacity of communal farmers to contribute financially to the inputs received and therefore present an argument to gradually move away from free input distributions, and keep promoting the reestablishment of wholesalers to agro-dealers linkages. This was meant to address the economic opportunities lost during the years of economic decline due to unstable socioeconomic and political conditions coupled with illegal sanctions. The electronic voucher scratch card was piloted in Mashonaland Central while the Electronic Voucher swipe system was launched in Mashonaland West, but the only hurdle was poor mobile communication networks. The Electronic Voucher swipe system is a cost effective method that records all transactions showing quantity and type of inputs purchased, which can be used for monitoring and evaluating in agricultural business. Another program—Rural Agro-dealers Restocking Program (RARP)—was initiated to invigorate links between wholesalers and agro-dealers resulting in the former building a sizeable stock of agricultural inputs for sale to farmers.

The ICT revolution in mobile communications has the potential to transform agriculture and thus benefit

farmers especially in developing countries like Zimbabwe. Mobile services are at work in the field of m-Agriculture, mostly for receiving, sharing and obtaining information. Across the developing world, there are programs that give farmers access to research and best practices, weather information and market prices via SMS, Interactive Voice Response (IVR) or call centers. Knowing the latest market prices allows farmers to avoid unnecessary middlemen and raise their profits, while getting regular weather updates can help them save crops that would have otherwise been destroyed by storms. ICTs are critical in facilitating communication and access to information for agricultural and rural development. In Zimbabwe, just like any other third world country, agriculture is the national priority sector and it is viewed as one of the potentially beneficial areas for the application of ICTs for economic transformation (Qaisar, Ali Khan, and Alam, 2011). As the world moves to the knowledge/wisdom economy whereby success is dependent upon sagacious use of information, the development of networks and use of low-cost ICTs will enhance timely access to accurate and reliable information, and it is prudent to invest a part of the country's limited resources in ICT development in order to secure our place as library and information professionals.

Qaisar, Ali Khan, and Alam (2011), with reference to India, note how the e-Agriculture concept transcends technology to the integration of knowledge and culture and improves communication and learning processes among relevant actors in agriculture locally, regionally and globally. The authors further note how the dissemination of information to farmers became increasingly integrated into ICTs, like rural telecentres as providers of information on education, agricultural and health issues and schools and e-learning centers as promoters of e-literacy.

Appiah (2013) notes that mobile masts or posts could be highly useful for development initiatives; for example, they can be used in filling gaps in rainfall data, providing electricity to refrigerate vaccines and measuring rainfall in areas without rainfall. The author further states that in Zimbabwe, Econet Wireless as part of an EtC project has provided mast-cooled vaccine refrigerators at more than one hundred sites. Overeem, Leijnse, and Uijlenhoet (2012) state that the declining number of rain gauges in Europe, Africa and South America, combined with limited African observation networks, calls for a fundamental rethink or paradigm shift in order to come up with alternative sources of near surface rain information; for example, the use of microwave links from operational cellular telecommunication networks for monitoring rainfall. Di Baldassarre, et al. (2010) argue that monitoring rainfall using cellular telecommunication networks could minimize mortalities and economic loss by improving flood early warning systems as a disaster preparedness and mitigation plan.

Public Libraries are key partners in the provision of agricultural information, as they are strategically positioned to provide information literacy skills to farmers to enable them to manipulate the array of digital technology. This is achieved through capacitating public libraries with ICT infrastructure to create online channels and web portals for exchange and sharing of agricultural information. Public libraries can also invest in m-technologies to connect with users, like a mobile web site that allows patrons to access information pertaining to library operations and services, mobile resources and databases. A good example is the Electronic Information for Libraries Public Libraries Innovation Project (eIFL-PLIP) which has helped transform public libraries into key components of the agricultural information system and significant drivers of agricultural development in Europe, Africa and Latin America.

Conclusion

The advent of mobile technology is providing agriculture with opportunities to extend agricultural services to the disadvantaged and geographically dispersed rural communities. Considering that the future of Africa lies in increased and improved food security and peace, the "great mobile technology leap forward" promises great potential in the drive to maintain and improve production and development. Mobile technology has come at an opportune time when agriculture looms large on Africa's development agenda with regards to ending hunger and ensuring food security. Access to the mobile web has become possible through the proliferation of mobile technologies and wireless broadband. The provision of affordable mobile telephone technology is poised to increase access to agricultural information by previously inaccessible communities via traditional extension services. Since the bulk of farmers are communal and mostly women, access to agricultural information will increase agricultural farming practices and agricultural productivity because of the new "libraries in the pocket."

Libraries and librarians need to adapt to mobile technology to promote agricultural production through enhanced dissemination of information, and they are strategically located to provide rural farmers with access to mobile library websites, social media, mobile reference services and SMS information as well as technology so that they can also go beyond simply receiving information and begin creating and exchanging experiences through technology. Adapting m-technologies into library services will empower the profession to own the future.

References

Abidi,S.A.H. 1991. "Communication, Information and Development in Africa." Kampala, Uganda: Bano Publishers.

Aker, J.C. 2011. *Dial "A" for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries*. CGD Working Paper 269. Washington D.C.: Centre for Global Development. http://www.cgdev.org/publication/dial-agriculture-review-information-and-communication-technologies-agricultural.

Aker, J.C. 2008. Does Digital Divide or Provide? *The Impact of Mobile Phones on Grain Markets in Niger.* CGD Working Paper 154. http://www.cgdev.org/publication/does-digital-divide-or-provide-impact-cell-phones-grain-markets-niger-working-paper-154.

Aker, J.C and I. M. Mbiti. 2010. "Mobile Phones and Economic Development." *The Journal of Economic Perspectives* 24(3): 207–232. Also published as *CDC Working Paper* 211 — http://www.cgdev.org/publication/mobile-phones-and-economic-development-africa-working-paper-211.

Amenyah, I. and K. Puplampu. 2013. *Women in Agriculture: An Assessment of the Current State of Affairs in Africa. ACBF Working Paper* No. 24.

Anandajayasekeram P., R. Puskur, Workneh Sindu, and D. Hoekstra. 2008. *Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book.* Washington, DC: International Food Policy Research Institute); Nairobi, Kenya: International Livestock Research Institute). 275 p.

Andrew, F. and M. Rosenzweig. 1995. "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture." *Journal of Political Economy* 103(6): 1176–1209.

Andrew, F. and M. Rosenzweig. 2010. "Microeconomics of Technology Adoption." *Annual Review of Economics* 2: 395–424.

Appiah, B. 2013. "Mobile Masts Could Help Measure Rain and Chill Vaccines." SciDevNet, (2 March).

Bhavnani, A., R. Won-Wai Chiu, S. Janakiram, and P. Silarszky. 2008. *The Role of Mobile Phones in Sustainable Rural Poverty Reduction*. Washington, DC.: World Bank, ICT Policy Division Global Information and Communications Department. 25 p.

Crawford, W. and M. Gorman. 1995. *Future Libraries: Dreams, Madness and Reality*. Chicago, IL: ALA Publications.

De Silva, Harsha and Dimuthu Ratnadiwakara. 2008. Using ICT to Reduce Transaction Costs in Agriculture Through Better Communication: A Case-Study from Sri Lanka.[n.p.] http://www.lirneasia.net/wp-content/uploads/2008/11/transactioncosts.pdf.

di Baldassarre, G., et al. 2010. "Flood Fatalities in Africa: From Diagnosis to Mitigation for Dairy Farming." *Geophysical Research Letters* Vol. 37, L22402, doi:10.1029/2010GL045467, 2010.

Foster, A.D. and M.R. Rosenweig. 1995. "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture." *Journal of Political Economy* 103(6): 1176–1209.

FAO. 2006. The Internet and Rural and Agricultural Development: An Integrated Approach Food and Agriculture Organisation. Rome: FAO. http://www.fao.org/docrep/w6840e/w6840e05.htm — accessed on 12 May, 2013.

Fourati, K. 2009. "Half Full or Half Empty? The Contribution of Information and Communication Technologies to Development." *Global Governance* 15: 37–42.

Gichamba, A. and I.A. Lukanda. 2012. "A Model for Designing M-Agriculture Applications for Dairy Farming." *African Journal of Information Systems* 4(4) http://digitalcommons.kennesaw.edu/ajis/vol4/iss4/1/.

International Telecommunication Union ITU. 2010. *Measuring the Information Society 2010* Geneva, Switzerland: ITU. 108 p.

Gurstein, M. 2000. "Community Informatics: Enabling Communities with Communication Technologies." Hershey, PA: Idea Group Publishing.

Lamb, R. and S. Sawyer. 2005. "On Extending Social Informatics from a Rich Legacy of Networks and Conceptual Resources." *Information Technology and People* 18(1) 9–20.

Leye, V. 2009. "Information and Communication Technologies for Development: A Critical Perspective." *Global Governance* 15:29–35.

Mangena, G.M. 2011. How Can ICTs beUused to Improve Access to Market for Agricultural Products from Zimbabwe? [n.p.] http://ardyis.cta.int/en/resources/publications/item/87-how-can-icts-be-used-to-improve-access-to-market-for-agricultural-products-from-your-country-or-regional — accessed 21 April, 2013.

Mangudhla, T. 2012. "Zimbabwe Lags Behind in Data Services." *Zimbabwe Independent,* October 12, 2012.

Mushawevato, P. 2013. "Zimbabwe Tele-Density Soars 16 Percent." *Sunday Mail,* 19 February, 2013.p.

Nleya, S.M., T.V. Nyathi and N. Kokera. [n.d.] "Enhancing Crop Production in Zimbabwe Through Use of ICTs." [n.p.] www.appropriatetech.net/…/Enhancing_Crop_Production_in_Zimba. — accessed 23 April, 2013.

Qaisar, M.T., M.M. Ali khan and S. Alam. 2011. "Innovative Agricultural Information Services by ICT Projects in India." *International Journal of Trade, Economics and Finance* 2(4): 276–279.

Overeem, A., H. Leijnse and R. Uijlenhoet. 2012. "Country-Wide Rainfall Maps from Cellular Communication Networks." *PNAS* 110(8): 2741–2745.

Sharif al Nasabi, M. 1996. *Development Process: Guidelines for Rapid Growth*. Tehran: Rasa Institute.

Silarszky, P., A. Bhavnani, R. Won-Wai Chiu and S. Janakiram. 2008. "The Role of Mobile Phones in Sustainable Rural Poverty Reduction." Washington, DC: World Bank, 25 p. http://documents.worldbank.org/curated/en/2008/06/9665086/role-mobile-phones-sustainable-rural-poverty-reduction.

Smith, G.J. and P.G. Underwood. 2010. "374 Times of Crisis: The Need for Knowledge:Management at a National Level." In, *Enhancing Democracy and Good Governance through Effective Information and Knowledge Services*. Proceedings of the 19th Standing Conference of Eastern, Central Southern Africa Library and Information Associations (SCECSAL), Gaborone, Botswana, December 3–9, 2010.

Songan, P., et.al. 2004. "Community Informatics: Challenges in Bridging the Digital Divide." Work with Computing Systems. Kuala Lumpur, Malaysia: Damai Sciences.

"Technical Centre for Agricultural and Rural Cooperation (CTA's) Question and Answer Service (QAS)." http://uzweb.uz.ac.zw/library/cta/. — accessed , 18 June, 2013.

World Bank. 1998. *Knowledge for Development*. Washington, DC; Oxford, England: Oxford University Press, 261 p.

World Summit on the Information Society (WSIS). *Tunis* 2005, Plan of Action Paragraph, 21 http://www.itu.int/wsis/docs2/tunis/off/6rev1.html.

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Agriculture and Natural Resource Scientists' Biodiversity Information Needs: Barriers and Facilitators to Use and Access in the U.S. Southeast

Miriam L.E. Steiner Davis, Carol Tenopir and Suzie Allard

Abstract: In a study funded by the United States Geological Survey, a leading provider of biodiversity information, the University of Tennessee Center for Information and Communication Studies assessed the biodiversity information needs of southeastern US agriculture, natural resource management and other life scientists. Results reveal that 30% of agriculture and resource management scientists describe finding the biodiversity information they need as difficult. In addition, while agriculture and resource management scientists are better than other life scientists at searching for, finding and knowing where to find the biodiversity information they need to do their work, they experience significantly greater difficulty accessing that information. They also value different information source attributes and use information sources differently than do other life scientists. By understanding these and other aspects of agriculture and natural resource scientists' work with biodiversity information, information specialists, librarians, and information and professional organizations can help them maximize their research and practice efforts towards improved environmental outcomes.

Resumé: Dans une étude financée par le Service des études géologique des États-Unis, un des principaux fournisseurs de l'information sur la biodiversité, le Centre d'études en information et en communication de l'université du Tennessee a évalué les besoins en information sur la biodiversité du secteur agricole, des responsables de ressources naturelles et d'autres spécialistes des sciences de la vie du sud-est des Etats-Unis. Les résultats révèlent que 30% des scientifiques en agriculture et en gestion des ressources décrivent trouver difficilement l'information sur la biodiversité dont ils ont besoin. En outre, alors que les scientifiques en agriculture et gestion des ressources sont plus capables que d'autres spécialistes des sciences de la vie, de chercher, trouver et savoir où trouver l'information sur la biodiversité dont ils ont besoin pour faire leur travail, ils ont beaucoup plus de difficulté à obtenir ces informations. Ils ont également évalué différents attributs des sources d'information, et utilisent les sources d'information différemment des autres spécialistes des sciences de la vie. La compréhension de ceci et des autres manières de travailler des scientifiques en agriculture et ressources naturelles avec les informations sur la biodiversité, avec les spécialistes de l'information, les bibliothécaires et organisations professionnelles d'information peut les aider à optimiser leurs travaux de recherche et leurs efforts pratiques pour un meilleur environnement.

Resumen: En un estudio financiado por el Servicio Geológico de los Estados Unidos, un proveedor líder de información sobre biodiversidad, el Centro de Estudios de Información y Comunicación de la Universidad de Tennessee evaluó las necesidades de información sobre biodiversidad de científicos del sureste estadounidense que trabajan en los campos de la agricultura y del manejo de los recursos naturales, al igual que otros científicos de la vida. Los resultados indican que el 30% de los científicos que trabajan en los campos de la agricultura y el manejo de los recursos describen la búsqueda de la información que necesitan sobre biodiversidad como difícil. Además, mientras que los científicos que trabajan en los campos de la agricultura y el manejo de los recursos son mejores que otros científicos de la vida para buscar, encontrar y saber dónde encontrar la información que necesitan sobre biodiversidad para hacer su trabajo, ellos experimentan dificultades significativamente mayores para acceder a dicha información. También valoran diferentes atributos de las fuentes de información y utilizan fuentes de información de manera diferente a como lo hacen otros científicos de la vida. Al conocer estos y otros aspectos del trabajo de estos científicos con la información sobre biodiversidad, los especialistas en información, los bibliotecarios y las organizaciones de información y de profesionales pueden ayudarlos a maximizar sus esfuerzos de investigación y práctica para lograr mejores resultados ambientales.

Introduction

Agriculture and natural resource scientists, and other life scientists, use biodiversity information (information pertaining to plants, animals, habitats and/or ecological communities) as a key input for researching and managing food, fiber, and other biological systems. However, for information science professionals, identifying what kind of biodiversity information is most needed by these different types of scientists and how best to provide access to that information can be a challenge. While much work has focused on biodiversity related data gaps, information seeking, and research and analyses needs, less work has focused on biodiversity information needs related to using that data (Balmford et al. 2005). Scientific research is just one aspect of information needs (Hunt et al. 2007; McNie 2007; Tenopir, Allard, and Davis 2011); additional information needs include formats, parameters, and tools for finding, managing, and describing information. Furthermore, to our knowledge, no attempt has been made to discern the differences between the biodiversity information needs, practices and experiences of agriculture and natural resource scientists and those of other life scientists. While a strict distinction in information needs between these two related subject areas may not be entirely possible, such an assessment would go a long way towards streamlining the provision of research and data services as well as towards improving research, discovery and management.

The southeastern United States is a recognized global biodiversity hotspot for aquatic and amphibious resources.

This makes the biodiversity information needs of its scientists among the most critical to discern. The region's freshwater lakes, rivers, and streams contain the highest levels of diversity and endemism for freshwater mussels, crayfishes and fishes (Abell et al. 2000; Smith et al. 2002). Within specific taxonomic groups, on one or more measures of biodiversity, several southeastern states also rank high. For example, Alabama ranks first in freshwater fish diversity, followed by Tennessee, Georgia, Kentucky and Mississippi. The top four most diverse states in terms of amphibian diversity are North Carolina, Georgia, Virginia and Tennessee (Stein, Kutner, and Adams 2000).

This study, funded by the United States Geological Survey, a leading provider of biodiversity information in the United States, assesses the biodiversity information needs and seeking behavior of Southeast U.S. agriculture and natural resource scientists and other life scientists. The research questions include: 1) What biodiversity information is needed?, 2) What are the barriers and facilitators to finding biodiversity information?, 3) Where do agriculture and natural resources and other life scientists get the biodiversity information they need to do their work?, and 4) What characteristics of biodiversity information sources are valued?

Background

Biodiversity information needs are broader than simply filling particular research needs or data gaps (McNie 2007). For agriculture and natural resource scientists, and other life scientists, it is increasingly common for researchers to integrate diverse data sets and types. This requires information integration tools such as models that link environmental stressors to socio-economic impacts (Hunt et al. 2007; Vaughan et al. 2007), websites that unite information contained in multiple sites and databases (Kagan 2006) and maps that link scientific information specific to certain habitats within the geographies that host them (Theobald et al. 2005). Significant emphasis has also been placed on the utility of Geographic Information Systems (GIS) for data retrieval, organization and analysis (Laihonen et al. 2003; Neelakandan, Mohanan, and Sukumar 2006; Salem 2003). As Laihonen et. al. (2003) state, "biodiversity data or information lacking geographical dimensions have fairly little value from the point of view of end users."

Information integration also requires information from multiple scales. However, biodiversity information which matches the scale at which environmental decisions are made is frequently lacking. One possible result is that information is obscured, as forced scaling up or down is attempted (Cushing and Wilson 2005; Smythe, Bernabo, and Carter 1996; Tribbia and Moser 2008). Metadata is also necessary for both integrating information (Magness, Morton, and Hutton 2010) and identifying available information (Kelling 2006), but the lack of metadata use by scientists remains a concern (Tenopir et al. 2011).

Even when valuable biodiversity information exists, several barriers have been identified which may prevent scientists from finding, or making effective use of, needed information. Researchers must now navigate an often overwhelming "data deluge" (Hey and Trefethen 2003) brought about by recent advances in scientific data capture and storage capabilities (Bracke 2011). Simultaneously, according to Diekmann (2012), "data sets continue to be quickly lost to science and rarely remain accessible, much less usable, to anyone other than the original collector."

Online resources are essential. As one University of Minnesota faculty member states, "If it's not online, it's not visible" (Marcus et al. 2007). Conference literature and gray literature can be particularly difficult to locate. This is especially important for staying current, a major challenge but also viewed by researchers as one of the most important things to do (Marcus et al. 2007). For these reasons, several authors note the need for improved information search skills, training and tools (Cullen, Cottingham, and Doolan 2001; Janse 2006; Szaro et al. 1998; Kagan 2006).

The biodiversity information sources consulted by agriculture and natural resource scientists, and other life scientists, are numerous and varied. A survey of forty three active natural resource managers in mostly U.S. federal resource management agencies conducted by the non-profit organization NatureServe found respondents "regularly visit a diverse array of websites to look up biodiversity information" (Young 2011). Forty four separate websites were mentioned. The most popular in decreasing order were NatureServe Explorer, USDA Plants, various specimen sites (Fishbase, Arctos, GBIF, herbaria, etc.), state heritage program websites, and the United States Fish and Wildlife Services' Environmental Conservation Online System. In a literature review of crop sciences articles, Williams (2012) found 44% of 124 crop sciences articles used a data source other than traditional literature. These included data from other published articles, supplementary files associated with other publications, data from growers, data from weather stations, unpublished data, and GIS spatial data layers. In the United Kingdom, on the other hand, the Research Information Network and British Library's survey of life science researchers concluded they use a limited range of services to discover and gain access to the information they need, mostly web based bibliographic search and retrieval tools, online publications and websites they trust. As a result, researchers relied upon informal advice from colleagues (Research Information Network and the British Library 2009).

Several studies have tried to identify what scientists define as useful attributes of biodiversity information sources. Findings include currency (Laihonen, Kalliola, and Salo 2004; Diekmann 2012; Young 2011), usability (Laihonen, Kalliola, and Salo 2004; Research Information Network and the British Library 2009; Young 2011), and interoperability of systems and software (Research Information Network and the British Library 2009). In addition, the Research Information Network and British

Table 1 – Primary work sectors and subject disciplines

Primary Subject Discipline (n = 169)	%	% of Primary Subject Discipline in Each Work Sector			
		Academic	Government	Not for Profit	For Profit
Life Sciences	67.5	57.9% (66)	21.9% (25)	17.5% (20)	2.6% (3)
Agriculture & Natural Resources	32.5	67.3% (37)	14.5% (8)	16.4% (9)	1.8% (1)
Total	100%	60.9%	19.5%	17.2%	2.4% (4)

Library concluded that U.K. life scientists were less interested in completeness and specificity than accessibility and trustworthiness (2009).

Methods

In the fall of 2010 and early winter of 2011, we invited southeastern U.S. life, agriculture and natural resource and physical scientists to take an internet survey. We developed thirty four survey questions to address the four research questions plus demographics. For this project, the "southeast" was defined as Tennessee, Georgia, North Carolina, South Carolina, Kentucky, Florida, Alabama, and Mississippi. Invitations were e-mailed to attendees of regional topically related conferences, United States Geological Survey (USGS) identified contacts, regional herbaria contacts, university based researchers, and non-profit organization and fish and wildlife agency contacts (n = 8597). Contact information was found by browsing appropriate university, non-profit and agency websites.

The total response (n = 457) represents those southeastern environmental scientists, resource managers and decision-makers involved with and interested in biodiversity information. For this paper, only data associated with respondents who identified their primary subject discipline as "Agriculture and natural resources (forestry, wildlife, plant and soil sciences, etc.)" and "Life Sciences (biology, botany, ecology, zoology, marine biology, etc.)" is analyzed (n = 169). These respondents represent more than three fourths (76%) of all respondents who provided a primary subject discipline.

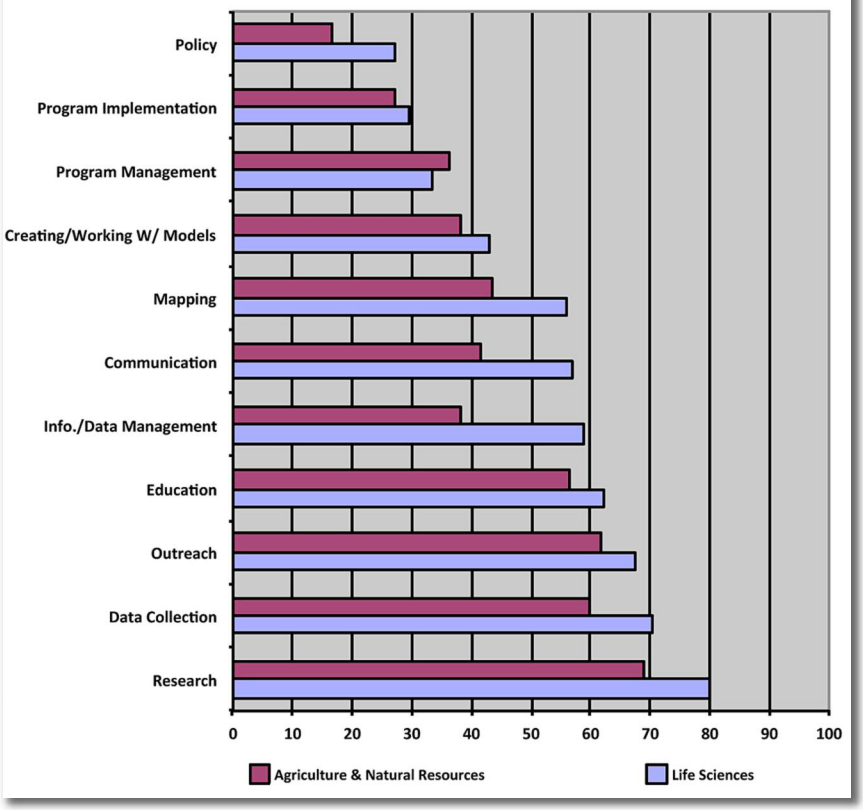
The survey was administered via mrInterview hosted by the University of Tennessee's Statistical Consulting Center's DimensionNet server. The results were analyzed with SPSS 18.0.

Results

More than two-thirds of the sample describe themselves as life scientists, while just over one third categorize themselves as primarily agriculture and natural resource scientists (Table 1). Reflecting the proportions of invitations sent, these respondents come mostly from the academic work sector (60.9% n = 103), with one fifth (19.5%, n = 33), coming from the government sector (Table 1). The majority of the remaining respondents, 17.2% (n = 29) work in the non-profit sector. Life science respondents are more likely than agricultural respondents to work in the government sector (80% federal, 20% state), while agricultural respondents are more likely to be academics.

Most respondents' primary role with respect to their biodiversity work is research (55.6% agriculture and natural resource, 52.6% life sciences), followed by education (16.7% agriculture, 15.8% other life sciences), with biodiversity related program managers and "other" at approximately 11% each. All respondents include a variety of the eleven biodiversity related activities measured in their work (Figure 1). However, life science respondents are more likely than agriculture and natural resource respondents (by 10–20%) to include research, data collec-

Figure 1 – Engagement in biodiversity related work activities



tion, information and/or data management, communication, mapping, and policy. For information and/or data management the difference is significant ($p < .05$). Program management is the only biodiversity related activity in which more agriculture and natural resource respondents than other life science respondents are engaged (Figure 1). Most respondents describe their data as biotic surveys and experiments.

Table 2 – Degree of difficulty in finding needed biodiversity information

	Agriculture & Natural Resources (n = 55)	Life Science (n = 112)	Total (n = 167)
Easy/Extremely Easy	23.6%	26.8%	25.7%
Neither Difficult or Easy	47.3%	50.9%	49.7%
Difficult/Extremely Diff.	29.1%	22.3%	24.6%

What biodiversity information is needed? – On a scale of 1 = None, 3 = Half and 5 = All, the mean amount of biodiversity information respondents need to do their work is 3.64. This amount is significantly less for agriculture and natural resource respondents (mean = 3.39) than for other life science respondents (mean = 3.76, $p < .05$). Proportionately, for more than 80% of all respondents, information specifically related to biodiversity is half or more than half the information they need to do their work. This is also the case for nearly 90% of life scientists (86.7%) and 72% of agriculture and natural resource respondents.

Unfortunately, one-quarter of all respondents say it is difficult or extremely difficult to find the biodiversity information they need (Table 2). The same is essentially true for life scientists. Agriculture and natural resource scientists have even more difficulty. Most respondents, though, say finding the biodiversity information they need is neither difficult nor easy.

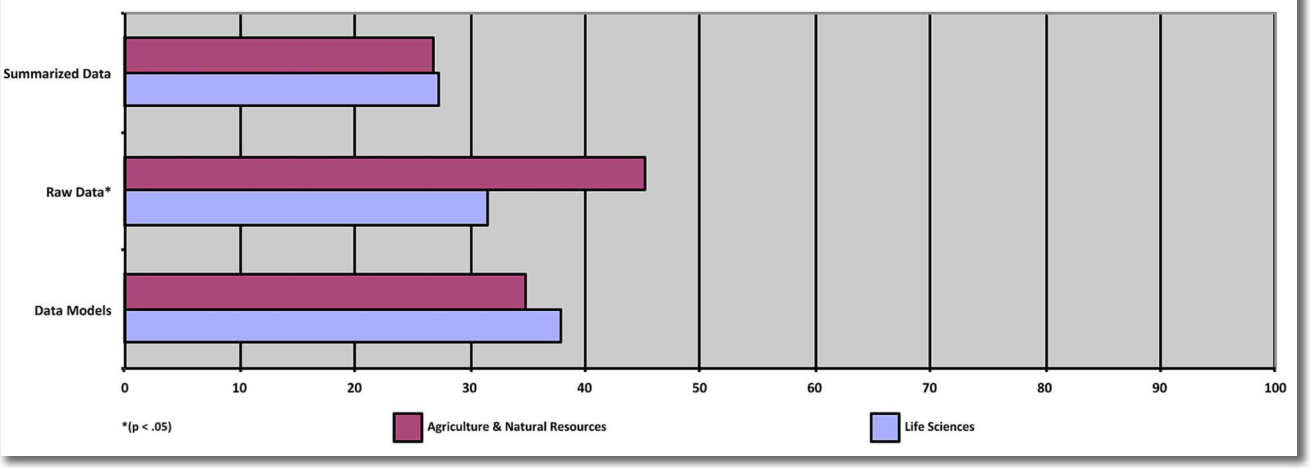
Respondents were also asked what biodiversity information they would like to have but have been unable to find. Most responses reference occurrence, life history, and distribution information, while access to historical literature was also frequently cited. With all responses, several interesting caveats were noted including the importance of easy online access, and that only data that was accurate, current or trustworthy was useful. At least one life science respondent noted that access to a better "roadmap" to find information would be useful.

In terms of different types of biodiversity information, respondents need raw data more (mean = 3.22, same scale as above) than summarized data (mean = 2.99). Life science respondents need significantly more raw data (mean = 3.38) than do agriculture and natural resource respondents (mean = 2.89, $p < .05$), with 80% reporting raw data as at least half the information they need to do their work. Only half the agriculture and natural resource respondents need this much raw data. Agriculture and natural resource respondents are slightly more likely than life science respondents to report summarized data as half or more than half the biodiversity information they need to do their work (69% agriculture compared to 61% life science).

Data models were measured in terms of their importance to respondents' biodiversity work (1 = Not at all important, 2 = somewhat important, 3 = neither important nor unimportant, 4 = important, 5 = essential). Overall, data models are neither important nor unimportant to respondents (mean = 3.14). The same is essentially true for both disciplines (mean agriculture and natural resources = 3.3, mean life sciences = 3.06).

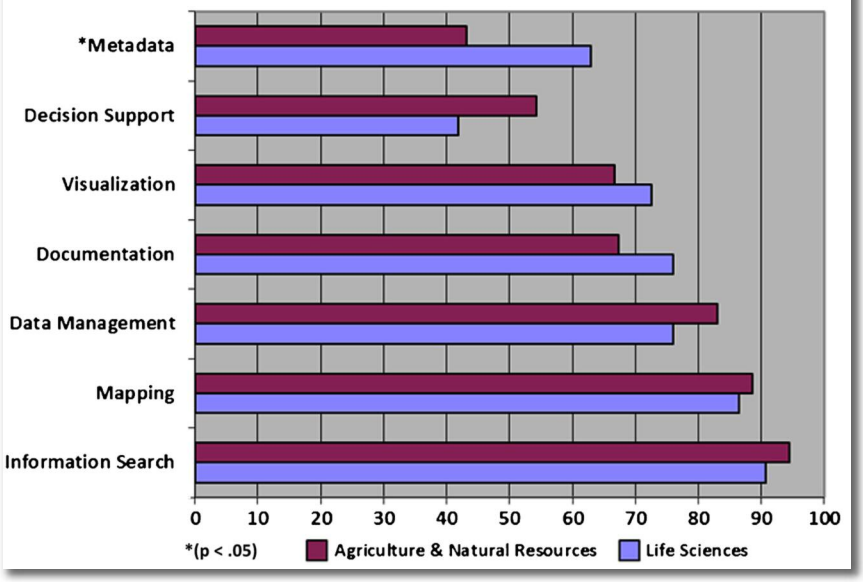
Approximately one-third of all respondents report each data type as difficult or extremely difficult to find. More agriculture respondents report difficulty finding raw data than summarized data or data models, while more life science respondents report difficulty finding data models, followed by raw data and summarized data (Figure 2). No significant differences were found between disciplines or between data types.

Figure 2 – Percent of respondents who say finding three different biodiversity data types is difficult or extremely difficult



In open ended comments, life science respondents described not being able to find reports and literature they know exists. A few mentioned a need for a centralized database of biodiversity related data. In addition, at least one life science respondent noted that without good data description raw data is useless. Another commented that the volume of data is overwhelming. Few agriculture and natural resource respondents provided differing comments on raw data. In terms of summarized data, they require information related to making management decisions.

Figure 3 – Percent of biodiversity information tools rated important or very important



To gauge what biodiversity information tools agriculture and natural resource and other life scientists need, participants were asked how important seven different biodiversity information tools were for doing their biodiversity work (Figure 3). All the tools measured show importance to respondents with means ranging from 3.82 for decision support tools to 4.35 for information search tools with no significant mean differences between disciplines. However, when looking only at the proportion of respondents who rate these tools as important or very important, a significant difference between disciplines in the importance of metadata tools is revealed (Figure 3). Significantly more life science respondents than agriculture and natural resource respondents rate metadata tools as important or very important to their biodiversity related work. Interestingly, slightly more agriculture and natural resource than life science respondents rate data management, mapping and information search tools, all of which at least in part rely upon good metadata, as important or very important to their biodiversity related work. In addition, it is clear that more agriculture and natural resource respondents find decision support tools important than life science respondents.

Biodiversity information tools have been slightly easier for respondents of both disciplines to find than biodiversity information itself. On a five point scale from 1 = Extremely Easy to 5 = Extremely Difficult, the overall mean ease of finding biodiversity tools is 3.11. Means for both disciplines are similar (mean agriculture = 3.08, mean life science = 3.12). Proportionately, only 23.6% of agriculture and natural resource and 16.7% of life science respondents report difficulty or extreme difficulty finding the biodiversity information tools they need to do their work.

Finally, respondents were asked which geographic scale they used most frequently in their biodiversity information work. Smaller, more localized scales are used most often by all respondents (Figure 4). Agriculture and natural resource respondents used state and local

Figure 4 – Geographic scale most frequently used

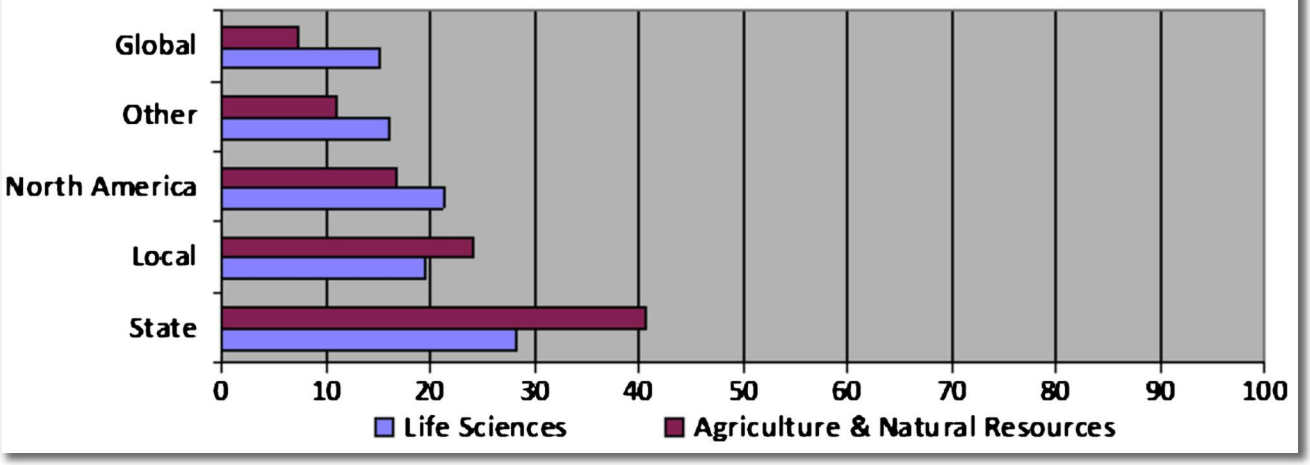
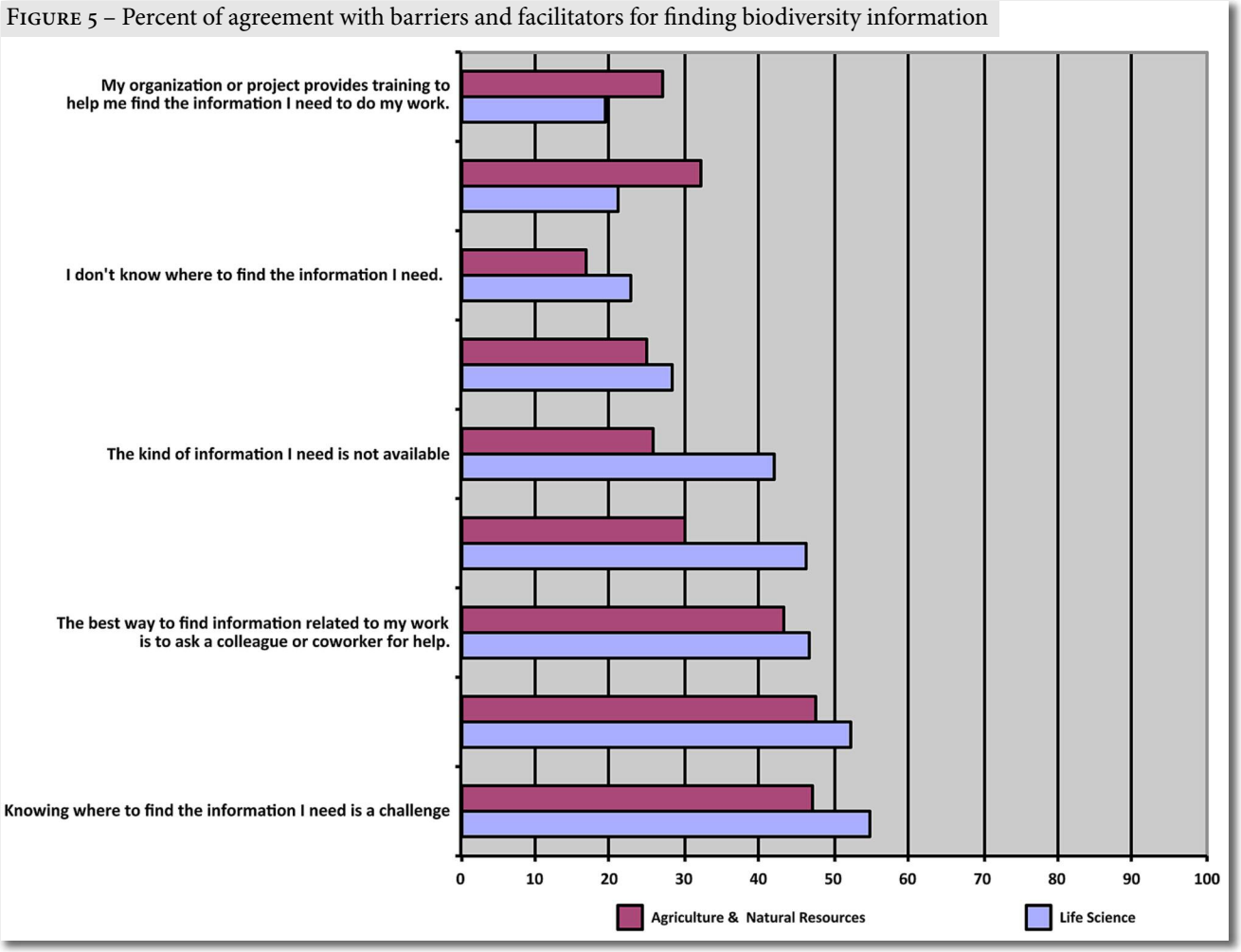


FIGURE 5 – Percent of agreement with barriers and facilitators for finding biodiversity information



scales more often than life science respondents, while the life science scientists more frequently use information at the global or North American scale.

What are the barriers and facilitators to finding and using biodiversity information? – To understand the barriers and facilitators to finding needed biodiversity information, respondents were asked to rate their experiences finding biodiversity information (Figure 5). Response choices ranged from Strongly Disagree (1) to Strongly Agree (5) with Undecided (3) marking the midpoint. On average, respondents are undecided concerning most of these experiences (means = 2.99–3.2). They more clearly tend to disagree that they already have the information they need to do their work (mean = 2.63) or don't know where to find the information they need (mean = 2.59). They also disagree that their organization or project provides training to help them find the information they need (mean = 2.38). No significant mean differences were found between science disciplines.

Despite these neutral to slightly disagreeing mean responses, more than two thirds of all respondents (67.7%) agree that finding the information they need is difficult. For more than half, knowing "where" to find the information they need is a challenge (52.4%). Perhaps for these reasons, and the fact that only 21.8% agree their organizations provide the training they need to find information, nearly half (45.8%) feel asking a colleague or coworker for help in finding information is the best way to go. Another 40% are disappointed with the amount of time it takes to find what they need and nearly that many (36.6%) feel what they need simply is not available.

Life science researchers are more convinced than agricultural and natural resource researchers that the information they need is not available (Figure 5). They are also more likely to agree they spend too long finding the information they need. These differences are substantial, but not quite statistically significant ($p = .047$ and .048 respectively). Agricultural information scientists can also feel good that agricultural researchers are more likely than life scientists to agree their organization provides information search training, and that their agriculture and natural resource colleagues are more likely to feel they already have the information they need to do their work.

When asked to identify what limited them most when looking for the biodiversity information they need to do their work, over one third of respondents, the most for any choice, chose "time" (32.3%) (Table 3). Agriculture and natural resource respondents are less likely to be most limited by a lack of available information and not knowing how to find what they need than life science respondents.

Table 3 – Most limited by . . . (when looking for needed biodiversity information)

	Agriculture & Natural Resources (n = 54)	Life Science (n = 113)	Total (n = 167)
Time	35.2%	31.0%	32.3%
Lack of available information	13.0%	24.8%	21.0%
Lack of appropriate information	17.7%	13.0%	16.2%
Not knowing where to look	15.0%	9.3%	13.2%
*Not being able to access the information that is available	5.3%	16.7%	9.0%
Not knowing how to find what I need	6.2%	13.0%	8.4%

*($p < .05$)

They are significantly less likely than life science respondents to be most limited by not being able to access the information that is available. In other words, agriculture respondents may have better access, or ability to access, the information they need, but they are less likely than life science respondents to know where to find it.

"Time" is also the leading "other" limiting factor in finding needed biodiversity information. Respondents also face limitations from: lack of appropriate information (34.9%), lack of available information (31.4%), not knowing where to look for needed information (31.4%), not being able to access information (27.2%), and not knowing how to find needed information (23.1%). The same patterns between the disciplines noted above are seen among these additional limitations. However, significantly more agriculture and natural resource scientists (45.5%) than life scientists (29.8%) report a lack of appropriate information as an other limiting factor in finding the biodiversity information they need to do their work.

Where do respondents get their biodiversity information? – Respondents consult a wide variety of information sources and systems (Table 4). Most respondents (overall, and in both disciplines assessed) regularly consult 2–5 information sources (58.6%, n = 99), while almost one quarter (23.1%, n = 39) regularly consult six or more. Only 15% are regularly able to consult only one information source. Disciplinary results are similar. In addition, despite being provided with seventeen vetted information

Table 4 – Information sources regularly consulted)

Information Source	Life Science	Agriculture & Natural Resources	Total (n = 169)
	(%)		
*U.S.DA (U.S. Department of Agriculture)	47.4	70.9	55.0
State Environmental or Wildlife Resources Agencies	54.4	49.1	52.7
*NatureServe	42.1	25.5	36.7
*NRCS (Natural Resources Conservation Services)	24.6	49.1	32.5
*NOAA Climate Services	24.6	40.0	29.6
*Other	35.1	18.2	29.6
NCDC (National Climactic Data Center)	15.8	25.5	18.9
LTER (Long-Term Ecological Research Network)	18.4	10.9	16.0
U.S.GS Office of Global Change	14.0	20.0	16.0
Cornell Lab of Ornithology	17.5	9.1	14.8
IPCC (Intergovernmental Panel on Climate Change)	12.3	12.7	12.4
NASA (National Aeronautics and Space Administration, e.g. MODIS or LANDSAT Programs)	11.4	12.7	11.8
U.S. Army Corps of Engineers	8.8	9.1	8.9
NSIP (U.S.GS National Streamflow Information Program)	9.6	7.3	8.9
U.S.A NPN (U.S.A National Phenology Network)	8.8	3.6	7.1
U.S. GCRP (U.S. Global Change Research Program)	4.4	5.5	4.7
NESDIS (National Environmental Satellite, Data and Information Service)	2.6	5.5	3.6
FEMA (Federal Emergency Management Agency)	1.8	5.5	3.0

*($p < .05$)

sources to choose from, one third of respondents regularly consult an "other" information source.

The top five information sources consulted present a mix of federal and state agencies as well as one not-for-profit organization. Not surprisingly, the United States Agriculture Department is the top information source for agriculture and natural resource respondents. However, it is the second most regularly consulted for life science respondents as well. The only information source they are more likely to consult is state agencies. Overall, agriculture and natural resource respondents rely more heavily on the U.S. federal agencies than do the life science respondents. Life science respondents are more likely to consult state, not-for-profit and a variety of other sources. A number of the disciplinary differences seen are large enough to be statistically valid (Table 4).

As any given source of information can also provide more than one information system, respondents were also asked which information systems they regularly consult. Results follow the same general trends as seen with information sources. The full list of information systems polled and their usage rates are summarized in Table 5 to provide a fuller picture of the diversity of respondents' information searching.

What characteristics of biodiversity information sources are most valued? – Southeastern U.S. agriculture and life scientists who responded to this survey have uniformly high standards for the biodiversity information sources they regularly use. Respondents were asked to rate the importance of seven information source attributes on a scale from "not at all important" (1) to "essential" (5): 1) Currency – the information is up to date, 2)

Table 5 –Information systems regularly consulted

Information Source	Life Science	Agriculture & Natural Resources	Total (n = 169)
	(%)		
U.S.DA PLANTS Database	41.2	54.5	45.6
*NatureServe Explorer	31.6	16.4	26.6
Other	25.4	14.5	21.9
National Soil Access System	17.5	29.1	21.3
Birds of North America	23.7	12.7	20.1
Breeding Bird Survey	21.1	16.4	19.5
NOAA's Southern Regional Climate Center	13.2	23.6	16.6
Christmas Bird Count	14.9	9.1	13.0
NBII Portal	13.2	5.5	10.7
AU.S.GS GAP Analysis Portal	8.8	14.5	10.7
*National Weather Service Climate Prediction Center	5.3	20.0	10.1
LTER Data Portal	9.6	7.3	8.9
U.S.FS Climate Change Tree Atlas	7.9	10.9	8.9
Southeast Regional Climate Center's Climate Data	6.1	12.7	8.3
NBII Metadata Clearinghouse	8.8	3.6	7.1
U.S.GS Climate Change Bird Atlas	7.0	5.5	6.5
NAWQA (National Water Quality Assessment) Program	4.4	7.3	5.3
NSIP	6.1	3.6	5.3
U.S.GS Science in Your Backyard	6.1	1.8	4.7
Eastern Brook Trout Survey	3.5	3.6	3.6
U.S. DOE Carbon Dioxide Information Analysis Center	2.6	5.5	3.6
EcoTrends	3.5	1.8	3.0
FEMA Map Service	0.9	5.5	2.4
U.S.FS/LTER CLIMDB/HYDRODB	0.9	5.5	2.4
NOMADS	3.5	0	2.4
Agroclimate	0	5.5	1.8
AcoE Environmental Residue Effects Database	1.8	0	1.2

*($p < .05$)

Completeness – the information is comprehensive, 3) Scale – the information is provided at the geographic or temporal scale needed, 4) Usability – the information is easy to use, 5) Trusted source – the information is authoritative, 6) Provenance – the information is well documented, 7) Navigation – the information is easy to find. Mean importance levels range from 4.5 (Trusted Source) to 3.98 (Navigation). No significant differences in mean importance between the disciplines were found. Proportionately, all the attributes measured are important or essential to more than 75% of all respondents. Few disciplinary differences in the proportion of respondents rating these attributes important or essential are seen except in Completeness. 96.2% of agriculture and natural resource respondents rate completeness as important or essential, while only 81.8% of life science respondents do ($p < .05$). Life science respondents rate provenance, trusted source, and scale as more important than completeness. For agriculture respondents, completeness is second only to trusted source.

Discussion

In many ways, this study confirms previous findings on scientists' biodiversity information needs. The scientists in our sample require large amounts of high quality, appropriately scaled and mappable biodiversity information they can access quickly, easily, and preferably online without assistance. And they are having difficulty getting what they need. However, by focusing more on information needs rather than research needs, and by discerning between related life science disciplines, this study also highlights useful findings for information scientists attempting to facilitate biodiversity information access for agriculture and natural resource scientists and other life scientists. These results can also speak directly to scientists, who are often creating the very information their colleagues struggle to find and use, about data curation practices which would increase findability, accessibility and availability.

Past studies have emphasized the importance of biodiversity information integration and identification tools such as data models (Hunt et al. 2007; Vaughan et al. 2007), information finders (Kagan 2006), maps (Laihonen et al. 2003; Theobald et al. 2000) and metadata (Kelling 2008). Here, data models are important or essential to approximately half the respondents. The importance of mapping tools is second only to information search tools, and the mean importance of metadata tools is 3.94 on a scale of Not at all Important (1) to Extremely Important (5). The importance of online information access, noted in the literature (Marcus et al. 2007), and the need for improved information search skills, training and tools (Cullen, Cottingham, and Doolan 2001; Janse 2006) were also found here in open ended responses and in the overwhelming importance attributed to information search tools (> 90% of respondents rate these important or essential). Like the natural resource managers surveyed by NatureServe (Young 2011), respondents to this survey regularly consult a diverse array of information sources including literature, websites, databases, and government agency systems. Lastly, several of the biodiversity information attributes preferred by respondents in previous studies such as currency and usability are also preferred by respondents in this sample.

This study adds to the literature by revealing specific types of biodiversity information and tools needed, information on respondents' experiences meeting these needs, and disciplinary differences. Overall the mean amount of information needed by life scientists that is specifically biodiversity related is greater than it is for agriculture and natural resource scientists ($p < .05$). However, 72% of agriculture and natural resource scientists still say half or more than half of the information they need to do their work relates specifically to biodiversity. One-third of these, as opposed to just over one-fifth of life scientists, have difficulty finding it. Why agriculture and natural resource respondents should have more difficulty than life science respondents remains unclear. These findings are all the more puzzling when one considers the fact that, at least according to these results, agricultural scientists are slightly more likely to agree that their organizations provide the training in finding the information they need.

In terms of biodiversity information types, raw data is needed more than summarized data overall and significantly more so by life scientists than agricultural scientists. However, it is again the agriculture and natural resource scientists who have a significantly harder time finding the raw data than the life scientists. One possible reason is that since agricultural scientists tend to need slightly more summarized biodiversity information than life scientists, they are somewhat less practiced at looking for raw data than life scientists.

In addition, according to these results, life scientists may be somewhat more data savvy than agriculture and natural resource scientists overall. Life scientist respondents are significantly more likely to include data management in their positions than are agricultural respondents. Metadata tools are also significantly more important to life science respondents than to agriculture respondents, perhaps because they are more familiar with them.

As only 22% of respondents say their organization provides training for finding the biodiversity information they need, these results suggest a need for increased information skills training. And because life science and agriculture and natural resource science are highly related, training possibilities such as joint life and agriculture science trainings, peer to peer training, and embedded information scientists should be considered. Agricultural science can be viewed as one application of life science, and researchers in both areas frequently collaborate and/or conduct interdisciplinary research. While disciplinary differences in biodiversity information needs and

skills reported here are present, they are not stark. Lastly, nearly half of all respondents state that asking a colleague is the best way to find the information they need.

By embedding themselves with scientists, both agricultural and natural resource scientists and other life scientists, information professionals can achieve a deeper level of knowledge concerning biodiversity information needs. This knowledge can then be used proactively and combined with push technologies such as tweeting, listservs, and blogs to provide needed information directly to scientist colleagues. This decreases the burden on scientists to seek out information professionals, their services and/or their trainings. Whether embedded or not, information professionals might also consider coordinating collegial interactions among scientists to capitalize on both the collaborative nature of agriculture and natural resource and life science work as well as the extant processes of relying on colleagues for finding information.

Time was the primary barrier for all respondents, regardless of discipline. While nothing can increase the amount of time scientists have to find the biodiversity information they need, training, usability analysis of information resources and embedded collaborative relationships may improve efficiency. In addition, having further evidence of the barriers to finding biodiversity information, including time, biodiversity information providers may be able to use these results to streamline and enhance usability and accessibility. Those who wish to target agriculture and natural resource scientists should also note that for agricultural respondents in particular, the importance of completeness as a biodiversity information attribute is second only to trusted source. Life science respondents were significantly less concerned with completeness.

Lastly, life and agriculture and natural resource scientists themselves have much to learn from these findings. It is clear that finding and accessing trusted, appropriate, mappable and available biodiversity information that is complete, usable, well described, well documented, and current takes time, skill, and knowledge as well as familiarity with a number of information sources and systems. However, if all those who generate biodiversity information were to invest time up front in documentation, description, deposition, and management, biodiversity information would be easier to find for all who need it. Agriculture and life science information science professionals are one group that can carry these messages.

Literature Cited

Abell, R., D.M. Olson, E. Dinerstein, P. Hurley, J.T. Diggs, W. Eichbaum, S. Walters, W. Wettengel, T. Allnutt, C.J. Louks, and P. Hedao. 2000. *Freshwater Ecoregions of North America: A Conservation Assessment.* Washington, D.C.: Island Press.

Balmford, Andrew, Peter Crane, Andy Dobson, Rhys E Green, and Georgina M Mace. 2005. The 2010 Challenge: Data Availability, Information Needs and Extraterrestrial Insights. *Philosophical Transactions of the Royal Society B: Biological Sciences* 360 (1454):221–228.

Bracke, Marianne Stowell. 2011. Emerging Data Curation Roles for Librarians: A Case Study of Agricultural Data. *Journal of Agricultural & Food Information* 12 (1):65–74.

Cullen, Peter, Peter Cottingham, and Jane Doolan. 2001. Knowledge Seeking Strategies of Natural Resource Professionals. In *Synthesis of a Workshop held in Bungendore, NSW from 5–7th June 2000*. Bungendore, NSW: The Cooperative Research Centre for Freshwater Ecology.

Cushing, Judith, and Tyrone Wilson. 2005. Eco-Informatics for Decision Makers: Advancing a Research Agenda. In *Workshop on Eco-Informatics for Resource Management Decision Makers*. Olympia, Washington: The Evergreen State College.

Diekmann, Florian. 2012. Data Practices of Agricultural Scientists: Results from an Exploratory Study. *Journal of Agricultural & Food Information* 13 (1):14–34.

Hey, Tony, and Anne Trefethen. 2003. The Data Deluge: An E-Science Perspective. In *Grid Computing*: John Wiley & Sons, Ltd.

Hunt, Kathryn, Jeffrey S. Kahl, Jonathan Rubin, and Deirdre M. Mageean. 2007. Assessing the Science-Based Information Needs of Stakeholders: A Case Study on Acid Rain Research and Policy. *Journal of Contemporary Water Research & Education* (136):68–79.

Janse, Gerben. 2006. Information Search Behaviour of European Forest Policy Decision-Makers. *Forest Policy and Economics* 8 (6):579–592.

Kagan, James S. 2006. Biodiversity Informatics: Challenges and Opportunities for Applying Biodiversity Information to Management and Conservation. *Northwestern Naturalist* 87 (1):80–85.

———. 2006. Biodiversity Informatics: Challenges and Opportunities for Applying Biodiversity Information to Management and Conservation. *Northwestern Naturalist* 87 (1):80–85.

Kelling, Steve. 2008. Significance of Organism Observations: Data Discovery and Access in Biodiversity Research. Report for the Global Biodiversity Information Facility, Copenhagen.

Laihonen, Pasi, Risto Kalliola, and Jukka Salo. 2004. The Biodiversity Information Clearing-House Mechanism (Chm) as a Global Effort. *Environmental Science & Policy* 7:99–108.

Laihonen, Pasi, Mia Ronka, Harri Tolvanen, and Risto Kalliola. 2003. Geospatially Structured Biodiversity Information as a Component of a Regional Biodiversity Clearing House. *Biodiversity and Conservation* 12:103–120.

Magness, Dawn Robin, John M. Morton, and J. Hutton. 2010. How Spatial Information Contributes to the Conservation and Management of Biodiversity. In *Spatial Complexity, Informatics and Wildlife Conservation*, edited by S. Cushman and F. Huettman: Springer.

Marcus, Cecily, Stephanie Ball, Leslie Delserone, Amy Hribar, and Wayne Loftus. 2007. Understanding Research Behaviors, Information Resources, and Service Needs of Scientists and Graduate Students: A Study by the University of Minnesota Libraries. University of Minnesota Libraries.

McNie, Elizabeth C. 2007. Reconciling the Supply of Scientific Information with User Demands: An Analysis of the Problem and Review of the Literature. *Environmental Science & Policy* 10:17–38.

Neelakandan, VN, CN Mohanan, and B Sukumar. 2006. Development of a Biogeographical Information System for Conservation Monitoring of Biodiversity. *Current Science* 90 (3):444–450.

Research Information Network and the British Library. 2009. Patterns of Information Use and Exchange: Case Studies of Researchers in the Life Sciences. London: The Research Information Network.

Salem, B. B. 2003. Application of Gis to Biodiversity Monitoring. *Journal of Arid Environments* 54 (1):91–114.

Smith, R.K., P.L. Freeman, J.V. Higgins, K.S. Wheaton, T.W. FitzHugh, K.J. Ernstrom, and A.A. Das. 2002. Priority Areas of Freshwater Conservation Action: A Biodiversity Assessment of the Southeastern United States.: The Nature Conservancy.

Smythe, Katie D., J. Christopher Bernabo, and Thomas B. Carter. 1996. Focusing Biodiversity Research on the Needs of Decision Makers. *Environmental Management* 20 (6):865–872.

Stein, Bruce A., Lynn S. Kutner, and Johnathan S. Adams, eds. 2000. *Precious Heritage: The Status of Biodiversity in the United States*. New York: Oxford University Press.

Szaro, Robert C., Jeri Berc, Scott Cameron, Steve Cordle, Michael Crosby, Lynn Martin, Douglas Norton, Robin O'Malley, and Gregory Ruark. 1998. The Ecosystem Approach: Science and Information Management Issues, Gaps and Needs. *Landscape and Urban Planning* 40 (1-3):89–101.

Tenopir, Carol, Suzie Allard, and Miriam Davis. 2011. Understanding the Data Management Needs and Data Sharing Challenges of Environmental Scientists. In *Environmental Information Management*, edited by M. B. Jones and C. Gries. Santa Barbara, CA: University of California.

Tenopir, Carol, Suzie Allard, Kimberly Douglass, Arsev Umur Aydinoglu, Lei Wu, Eleanor Read, Maribeth Manoff, and Mike Frame. 2011. Data Sharing by Scientists: Practices and Perceptions. *PLoS ONE* (6).

Theobald, David M., N. T. Hobbs, Tammy Bearly, Jim A. Zack, Tanya Shenk, and William E. Riebsame. 2000. Incorporating Biological Information in Local Land-Use Decision Making: Designing a System for Conservation Planning. *Landscape Ecology* 15 (1):35–45.

Theobald, David M., Thomas Spies, Jeff Kline, Bruce Maxwell, N. T. Hobbs, and Virginia H. Dale. 2005. Ecological Support for Rural Land-Use Planning. *Ecological Applications* 15 (6):1906–1914.

Tribbia, John, and Susanne C. Moser. 2008. More Than Information: What Coastal Managers Need to Plan for Climate Change. *Environmental Science & Policy* 11 (4):315–328.

Vaughan, Hague H., Robert B. Waide, J Manuel Maass, and Exequiel Ezcurra. 2007. Developing and Delivering Scientific Information in Response to Emerging Needs. *Frontiers in Ecology and the Environment* 5 (4):w8–w11.

Williams, Sarah C. 2012. Data Practices in the Crop Sciences: A Review of Selected Faculty Publications. *Journal of Agricultural & Food Information* 13 (4):308–325.

Young, Bruce. 2011. Needs Assessment for Species Profiles. Technical Report Prepared by Natureserve for the United States Geological Survey Biological Informatics Program.

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French Agricultural Research Institute Paves the Way to Open Access: Feedback from CIRAD

Marie-Claude Deboin and Cécile Fovet-Rabot

Abstract: CIRAD works with developing countries to generate and pass on new knowledge and support agricultural development. When countries cannot afford to subscribe to expensive scientific journals, one way to help is to make publications freely accessible. For this reason, CIRAD's information policy focuses not only on scientific quality but also on open access. CIRAD's scientific and technical information (STI) service has played an important role in helping define priorities and finding funds to support open access. The first step of the institutional process was to inform researchers and help them publish in open access peer-reviewed journals. Indicators were generated from Agritrop to monitor progress towards open access: from 2009 to 2012, 22.3% of CIRAD articles were published in open access and the new plan aims to increase this percentage. CIRAD is also looking into ways of making its scientific datasets publicly available and accessible worldwide.

Resumé: En partenariat avec les pays du Sud, le CIRAD produit et transmet de nouvelles connaissances pour accompagner le développement agricole et contribuer au débat sur les enjeux mondiaux de l'agronomie. Rendre les publications gratuitement accessibles est une façon de répondre à l'impossibilité financière de certains pays d'acquérir des revues scientifiques coûteuses. Pour cette raison, la politique d'information du CIRAD ne se concentre pas seulement sur la qualité scientifique des publications mais aussi sur leur libre accès. Le service d'information scientifique et technique (IST) du CIRAD joue un rôle clé dans la définition des priorités, l'identification de financements soutenant le libre accès, et l'amélioration de la base de données des publications du CIRAD pour communiquer avec d'autres archives ouvertes, françaises et internationales. La première étape de la démarche institutionnelle a été d'informer les chercheurs et de les aider à publier dans des revues à comité de lecture en libre accès. Deux outils ont été spécialement conçus : une base de données publique « Où publier » permettant d'identifier la revue la plus adaptée à un projet de publication, et un site web public « CoopIST » de production d'informations et de ressources pédagogiques pour la rédaction et la publication scientifiques. Un premier défi a été d'allouer un budget interne et également d'identifier des agences de financement externes qui soutiennent le libre accès. Un autre défi a été d'utiliser les outils appropriés — la base des publications institutionnelle Agritrop et l'archive ouverte nationale HAL — pour rendre les publications du CIRAD à la fois accessibles et évaluables. Des indicateurs ont été produits à partir d'Agritrop pour suivre les progrès vers le libre accès : de 2009 à 2012, 22,3 % des articles d'auteurs CIRAD ont été publiés dans des revues en libre accès total, et l'objectif est d'augmenter ce pourcentage. Le CIRAD étudie également la manière de rendre ses jeux de données scientifiques disponibles publiquement et accessibles par tous.

Resumen: El Centro Francés de Investigación Agrícola para el Desarrollo Internacional (CIRAD, sus siglas en francés) trabaja con países en desarrollo para generar y transmitir nuevos conocimientos y apoyar el desarrollo agrícola. Cuando los países no pueden darse el lujo de suscribirse a revistas científicas costosas, una manera de ayudar es hacer que las publicaciones sean de libre acceso. Por este motivo, la política de información del CIRAD se centra no sólo en la calidad científica, sino también en el acceso abierto. El servicio de información científica y técnica del CIRAD ha desempeñado un papel importante en ayudar a definir prioridades y buscar fondos para apoyar el acceso abierto. El primer paso del proceso institucional fue informar a los investigadores y ayudarlos a publicar en revistas revisadas por pares de acceso abierto. Se generaron indicadores a partir de Agritrop para hacer seguimiento a los avances hacia el acceso abierto. Desde 2009 hasta 2012, el 22,3% de los artículos del CIRAD fueron publicados en revistas de acceso abierto y el nuevo plan tiene como objetivo aumentar este porcentaje. El CIRAD también está investigando maneras de hacer que sus conjuntos de datos científicos estén a disposición del público y accesibles para todo el mundo.

CIRAD (French Agricultural Research Centre for International Development) is a French state-owned agricultural research centre which works with developing countries. It has a staff of 1,800, including 800 researchers, nearly 300 of whom are located outside France and the French overseas departments and territories. Its mandate is to produce high quality scientific knowledge and to make it accessible, understandable, and usable worldwide, particularly by its Southern research partners (CIRAD, 2011, 2013). One of CIRAD's indicators, which endeavours to improve the scientific quality of its publications, is the number of peer-reviewed articles published by CIRAD authors, which increased from 445 in 2005 to 746 in 2012, a growth rate of 68% in eight years. But beyond the quality of research results, ensuring their accessibility has become indispensable for CIRAD, as the growing cost of information (Ware & Mabe, 2012) is an obstacle to wide public access to scientific publications.

To support open access to its scientific knowledge, CIRAD has devised an information policy that matches French, European and international policies and recommendations. This involves creating a set of activities, allocating a specific budget, and designing dedicated tools to help CIRAD researchers and their partners make their publications freely accessible. The role of the CIRAD Scientific and Technical Information (STI) Service is to identify priorities and design sets of actions that are reviewed by the STI steering committee chaired by the Director of Research and Strategy and then to implement the actions that are approved. This paper describes the main activities undertaken by CIRAD to make its publications more accessible, and to measure the results of its efforts, the aim

being to help CIRAD identify the main objectives of its 2013–2016 plan and to track the progress CIRAD is making in achieving its open access strategy.

Challenge 1:

Informing researchers and helping them publish in open access journals – The first challenge for the CIRAD Scientific and Technical Information (STI) Service was to inform researchers about open access and the means available to make their publications freely accessible. For this purpose, two specialized public websites were designed: 'Cooperating in Scientific and Technical Information (CoopIST) and 'Where to publish' (*Où publier*).

The public CoopIST[1] website was launched by CIRAD in 2012. This web site targets French-speaking researchers and information specialists in developing countries. CoopIST provides information resources, tools and guidelines drawn up by CIRAD's editors and information specialists to facilitate access to and management of scientific information. Most of the contents are freely available under the Creative Commons Licence (Attribution-NonCommercial-ShareAlike[2]) to enhance information sharing within the Agricultural and Research for Development (ARD) community. Practical advice produced by CIRAD, such as "Publishing in an open access peer-reviewed journal" (*Publier dans une revue en libre accès*[3]) or "Disseminating your thesis on the Internet" (*Diffuser sa thèse sur Internet*[4]), is posted on the CoopIST website. Some advice on authors' rights is also provided via guidelines such as "Understanding a publisher's authors' rights agreement" (*Savoir lire un contrat d'édition*[5]) or "Protecting your authors' rights" (*Protégez vos droits d'auteurs*[6]).

The journal database "Where to publish" (*Où publier*)[7] was developed in 2012 by the STI Service. Its aim is to help researchers select the most appropriate peer-reviewed journals in which to publish papers in the fields of life sciences, social sciences, and agriculture. The database contains nearly one thousand journals, and for each journal displays its aims and scope, topics, types of content, impact factor, whether or not it is an open access journal, and whether it charges for publication. Via a link to the Sherpa/Romeo[8] and Heloise[9] web services, the database also displays the copyright and self-archiving policies of each journal. After authentication, CIRAD users can view other information including the exact impact factor and the names of CIRAD reviewers of the journal.

Challenge 2:

Identifying institutional, French, European and international funds to support open access publishing – The second challenge for CIRAD was allocating a special publishing budget and identifying existing external funders who support open access.

As a research centre and a publisher itself, CIRAD manages or co-funds three scholarly peer-reviewed open access journals: *Revue d'élevage et de médecine vétérinaire des pays tropicaux*[10], *Oléagineux Corps Gras Lipides* (OCL)[11], and *Cahiers Agricultures*[12]. CIRAD researchers and their partners are invited to publish freely in these full open access journals. *Revue d'élevage et de médecine vétérinaire des pays tropicaux* publishes articles on animal production and health in tropical regions, *Oléagineux Corps Gras Lipides* publishes articles on oilseed production and on the food processing chain, and *Cahiers Agricultures* publishes articles on agricultural research and rural development in general. A special annual budget is also allocated to the STI Service to support external open access journal publishers including BioMedCentral[13] and PLoS[14]. As a supporting member, CIRAD's researchers can publish in any BioMed Central, Chemistry Central or Springer Open journal with a 10–15% discount on the article-processing charge.

External funding programmes of interest to CIRAD's research teams and projects have been identified: for example, the French National Research Agency (ANR)[15] and the Seventh Framework Plan (FP7) of the European Commission[16], which allocates special funds for open access publishing or for depositing articles in an online repository. Depending on the recommendations made by each funding agency on publishing and access, the STI Service helps project leaders design and set up an appropriate communication plan for their research project and outputs.

Challenge 3:

Adapting the institutional database to conform with French and international document repositories – The third challenge facing CIRAD in opening up access to its research results was designing or identifying the right tools to record its scientific publications and make them freely accessible, in accordance with their authors' rights. This was achieved through two document repositories: the CIRAD Agritrop database[17] and the French open access archive HAL[18].

Agritrop is the database in which all CIRAD authors are required to deposit all the scientific documents they produce: books and book chapters, journal articles, conference papers and proceedings, theses and "accreditation to supervise research" *(HDR)* documents, scientific and technical reports. Agritrop provides access to 300,000 references and to 14,000 full text documents which are available online. The STI service has created tables of journals linked to Agritrop to identify and to tag references to articles published in full open access peer-reviewed journals. The website "Publications by CIRAD staff"[19] displays published articles and tags articles published in open access journals. From 2009 to 2012, CIRAD published 690 articles in 139 full open access peer-reviewed journals. The 139 full open access journals represent 16.2% of the 856 peer-reviewed journals in which CIRAD authors published over the 3-year period (Figure 1), and the 690 articles represent 22.3% of

the 3,099 articles published by CIRAD in peer-reviewed journals over the same period (Figure 2).

Of the 139 full open access peer-reviewed journals, sixty-five (47%) have an impact factor (IF)[20] and seventy-nine (57%) have a SCImago Journal Rank (SJR)[21] (Figure 3).

HAL is a multidisciplinary French repository set up and managed by CNRS (French National Centre for Scientific Research), for the deposit and dissemination of all types of scientific research documents. CIRAD has been involved in HAL since 2006 and has developed a special HAL-CIRAD interface[22] to enable CIRAD authors to deposit their own scientific and technical documents. In January 2013, nearly two thousand full text scientific documents from research units linked to CIRAD were accessible via HAL. Through its involvement in the French HAL repository, CIRAD is automatically involved in the European pilot projects, OpenAIRE[23] and DRIVER[24]. OpenAIRE aims to make publications from the Seventh Framework Programme (FP7) or from the European Research Council (ERC) publicly accessible. OpenAIRE is based on the DRIVER infrastructure designed to connect repositories in Europe and make them interoperable, like the French HAL repository.

Discussion and Conclusion

The information policy implemented by CIRAD and the first results obtained show that opening up access to scientific knowledge is a long-term process which implies defining priorities, implementing a set of activities at different levels of the institution, designing dedicated tools to support authors, and measuring and displaying progress. The Scientific and Technical Information service plays a key role in implementing and assessing CIRAD's open access policy.

The information website and journal database, designed to help researchers find out more about open access and choose the right journal

Figure 1 – Number of peer-reviewed journals, including full open access journals, in which CIRAD published from 2009 to 2012.

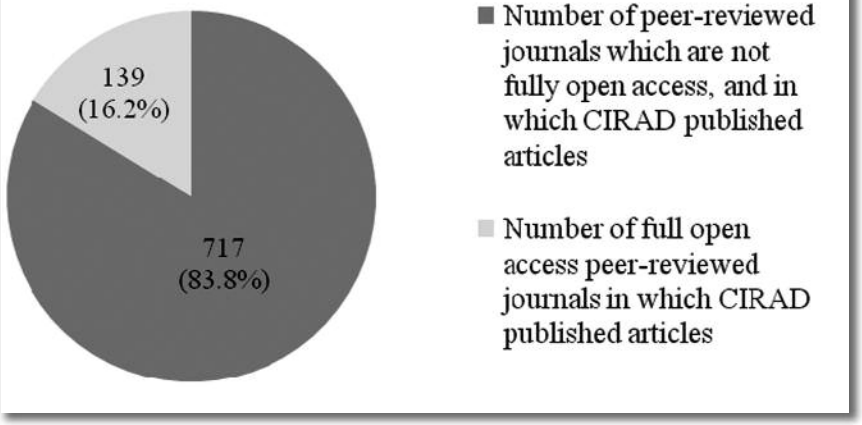


Figure 2 – Number of articles by CIRAD authors published in peer-reviewed journals, including full open access journals, from 2009 to 2012.

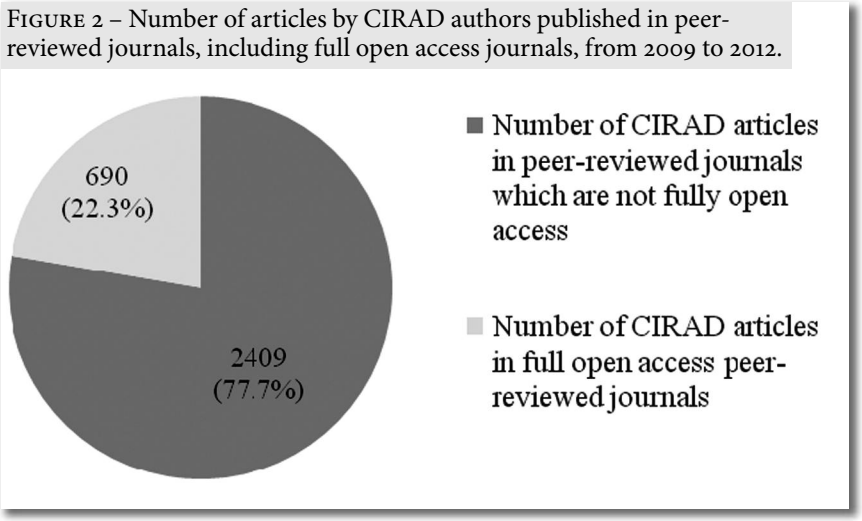
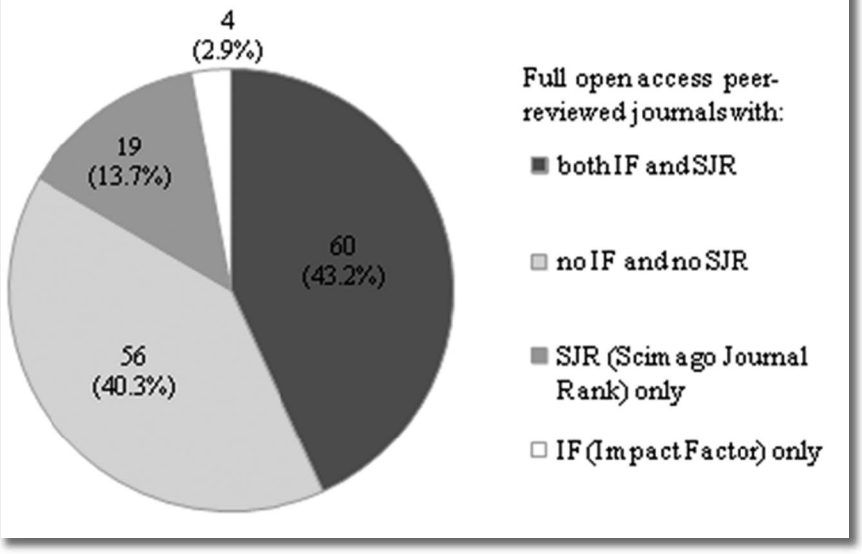


Figure 3 – Number of full open access peer-reviewed journals in which CIRAD published from 2009 to 2012, with or without an impact factor (IF) or a Scimago Journal Rank (SJR).



for their articles, are already successful as they share information on agricultural journals for the benefit of researchers. Finding outside funds and allocating an institutional budget to publish articles in full open access journals is the biggest challenge, as priorities have to be defined and financial means allocated at the institutional level. It will probably still take some years to find the balance between strategic goals, financial means, and indicators related to output. The process of tracking and displaying results through the institutional database is still underway as it means creating and managing special tables.

From 2009 to 2012, 22.3% of CIRAD articles were published in open access journals, and the aim of the 2013–2016 plan is to increase this percentage. In the coming years, CIRAD will continue to inform and train researchers in how to publish open access documents. In 2013, a CIRAD e-learning module (in French) entitled "Write and publish a scientific or technical document" (*Rédiger et publier un document scientifique ou technique*) was issued as part of the FAO IMARK project (Information Management Resource Kit). The CIRAD database Agritrop will become an institutional repository, which will enable authors to deposit their scientific documents and to choose copyright licences and versioning. Agritrop will comply with the European pilots OpenAIRE and Driver, and with the international FAO Agris[25] database. A further challenge for CIRAD is to make its research datasets publicly available and accessible worldwide. This involves collecting, organizing, and describing existing datasets, and ensuring access to them. To achieve this objective, a pilot experiment involving CIRAD scientific teams and Support services, including the STI service, was launched in 2012.

Notes

1. CoopIST: Coopérer en information scientifique et technique (Cooperating in Scientific and Technical Information). (http://coop-ist.cirad.fr/).

2. Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported (CC BY-NC-SA 3.0). (http://creativecommons.org/licenses/by-nc-sa/3.0/).

3. Publier dans une revue en libre accès (Publishing in an Open Access peer-reviewed journal). (http://coop-ist.cirad.fr/aide-a-la-publication/publier-et-diffuser/publier-dans-une-revue-en-libre-acces/1-publiez-en-libre-acces-pour-diffuser-largement-vos-resultats).

4. Diffuser sa thèse sur Internet (Disseminating your PhD thesis on the Internet). (http://coop-ist.cirad.fr/aide-a-la-publication/publier-et-diffuser/diffuser-sa-these-sur-internet/introduction).

5. Savoir lire un contrat d'édition (Reading a publishing contract). (http://coop-ist.cirad.fr/aide-a-la-publication/publier-et-diffuser/savoir-lire-un-contrat-d-edition/1-verifiez-le-contenu-de-votre-manuscrit-et-les-droits-y-afferents).

6. Protéger vos droits d'auteur (Protecting your copyright and related rights). (http://coop-ist.cirad.fr/aide-a-la-publication/publier-et-diffuser/proteger-vos-droits-d-auteurs/1-connaissez-vos-droits-moraux).

7. Où publier: base d'informations sur les revues en sciences du vivant, sciences sociales et sciences de l'ingénieur appliquées à l'agriculture. (http://ou-publier.cirad.fr/).

8. Sherpa/Romeo: Publishers copyrights & self-archiving. (http://www.sherpa.ac.uk/romeo/).

9. Heloise. (http://heloise.ccsd.cnrs.fr/).

10. Revue d'élevage et de médecine vétérinaire des pays tropicaux. (http://remvt.cirad.fr/gb/).

11. Oléagineux Corps Gras Lipides. (http://www.jle.com/en/revues/agro_biotech/ocl/).

12. Cahiers Agricultures. (http://www.jle.com/en/revues/agro_biotech/agr/).

13. BioMed Central: The Open Access Publisher. (http://www.biomedcentral.com/).

14. PLOS: Open for Discovery. (http://www.plos.org/publications/journals/).

15. ANR: The French National Research Agency. (http://www.agence-nationale-recherche.fr/en/project-based-funding-to-advance-french-research/).

16. Open Access in FP7. (http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1300&lang=1).

17. Agritrop: CIRAD's documentary database on agriculture in tropical regions. (http://www.cirad.fr/en/publications-resources/documentary-resources/agritrop).

18. HAL: hyper articles en ligne. (http://hal.archives-ouvertes.fr/index.php?halsid=rdvaojicpevpc7d0i3rfm3s671&action_todo=home).

19. Publications by CIRAD staff. (http://publications.cirad.fr/en/).

20. The Thomson Reuters Impact Factor. (http://thomsonreuters.com/products_services/science/free/essays/impact_factor/).

21. Borja González, Pereira; Vicente P. Guerrero-Bote; Félix Moya-Anegón, 2009. The SJR indicator: A new indicator of journals' scientific prestige (http://arxiv.org/ftp/arxiv/papers/0912/0912.4141.pdf).

22. HAL-CIRAD open archive (http://hal.cirad.fr/).

23. OpenAIRE: OpenAccess Infrastructure for Research in Europe. (http://www.openaire.eu/).

24. DRIVER: Digital Repository Infrastructure Vision for European Research. (http://www.driver-repository.eu/).

25. Agris: International Information System for the Agricultural Sciences and Technology (http://agris.fao.org/).

References

CIRAD, 2013. *Strategic Vision* 2012–2022. (http://www.cirad.fr/en/content/download/7725/82621/version/4/file/StrategicVision_ENG.pdf). Accessed May 20, 2013.

CIRAD, 2011. *Working Together for Tomorrow's Agriculture*, 2012. (http://www.cirad.fr/en/media/documents/qui-sommes-nous/documents-essentiels/cirad-2011). Accessed May 20, 2013.

Ware, Mark and Michael Mabe, 2012. *The stm Report: An Overview of Scientific and Scholarly Journal Publishing.* 3rd edition. The Hague, The Netherlands: International Association of Scientific, Technical, and Medical Publishers. Accessed May 20, 2013.

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Exploring Relevance of Agro Input Dealers in Disseminating and Communicating of Soil Fertility Management Knowledge: The Case of Siaya and Trans Nzoia Counties, Kenya

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Abstract: In most parts of sub Saharan Africa (SSA), a lack of access to necessary agro-inputs contributes to low agricultural productivity and slows the overall economic growth and development. Agro-input dealers make inputs more easily accessible to rural-based smallholder farmers. This study assessed the role played by agro-input dealers in disseminating and communicating integrated soil fertility management (ISFM) practices and information to smallholder farmers in Siaya and Trans Nzoia counties in Kenya, and looked at agro-input dealers' awareness of ISFM practices and communication channels used to access agricultural information. The study underscores the important role played by community based channels of communication in the ISFM knowledge dissemination and suggests a need to improve the provision of extension services to agro-input dealers to enable them effectively communicate information about ISFM technologies to farmers

Resumé: Dans la plupart des régions de l'Afrique subsaharienne (ASS), le manque d'accès aux intrants agronomiques nécessaires contribue à une faible productivité agricole et ralentit la croissance et le développement économiques globaux. Les concessionnaires d'intrants agronomiques rendent les intrants plus facilement accessibles aux petits agriculteurs ruraux. Cette étude a évalué le rôle joué par les concessionnaires d'intrants agronomiques dans la diffusion et la communication de l'information sur les pratiques de gestion intégrée de la fertilité des sols (GIFS) aux petits exploitants agricoles pour les comtés de Siaya et Trans Nzoia au Kenya ; et a étudié la sensibilisation des concessionnaires d'intrants agronomiques aux pratiques de la GIFS et les canaux de communication utilisés pour accéder aux informations agricoles. L'étude souligne le rôle important joué par les canaux de communication fondés sur la communauté dans la diffusion des connaissances de la GIFS et suggère la nécessité d'améliorer la fourniture de services de vulgarisation aux concessionnaires d'intrants agronomiques pour leur permettre de communiquer efficacement les informations sur les technologies de la GIFS aux agriculteurs.

Resumen: En gran parte de África Subsahariana, la falta de acceso a los insumos agrícolas necesarios contribuye a una baja productividad agrícola y retarda el desarrollo y crecimiento económicos en general. Los distribuidores de insumos agrícolas hacen que los insumos sean de más fácil acceso para los pequeños agricultores en zonas rurales. Este estudio evaluó el papel desempeñado por los distribuidores de insumos agrícolas en la difusión y comunicación del prácticas de manejo integrado de la fertilidad del suelo (MIFS) e información a los pequeños agricultores en los condados de Siaya y Trans Nzoia en Kenia, y analizó el conocimiento que tenían los distribuidores de insumos agrícolas acerca de prácticas de MIFS y los canales de comunicación utilizados para acceder a la información agrícola. El estudio resalta el papel importante que desempeñan los canales comunitarios de comunicación en la difusión de conocimientos acerca del MIFS y sugiere la necesidad de mejorar la prestación de los servicios de extensión a los distribuidores de insumos agrícolas para que puedan comunicar de manera efectiva la información sobre tecnologías de MIFS a los agricultores.

Limited access to necessary agro-inputs has been the main cause of low agricultural productivity and the overall poor economic growth and development in most parts of Sub-Saharan Africa (Sanchez and Jama, 2002). Agro-input dealers play a significant role of bringing the inputs close to the farmers (Chianu, 2008). The agro-input dealers play a vital role in guaranteeing that farmers have access to some of the essential agricultural inputs that contribute to boosting the agricultural productivity (Ayieko, 2006). Despite this importance, the strategic role and position of the agro-input dealers has not been fully exploited especially in disseminating and communicating the key agricultural development technologies such as Integrated Soil Fertility Management (ISFM).

In 2006, the plight of African farmers was highlighted when the African policymakers met during the Africa fertilizer summit held in Abuja, Nigeria in June of that year (IFAD[1], 2006; IFDC[2], 2010). The meeting highlighted the gap in agricultural productivity caused by limited use of agricultural inputs. From the meeting and subsequent follow up summits, the role of agro-input dealers and agro-input business started receiving serious attention both in agricultural development discussions and policy-making (COMESA, 2009).

The Alliance for Green Revolution in Africa (AGRA), among other organizations, has been in the forefront in supporting agro-input dealers (AGRA, 2009). Such efforts are also being undertaken by Citizens Network for Foreign Affairs (CNFA) that is working closely with research organizations such as Tropical Soil Biology and Fertility Research institute of the Centre for International Tropical Agriculture (CIAT-TSBF). The International Fertilizer Development (IFDC) and the U.S. Agency for International Development (USAID) are among the other donors supporting agro-input dealers' related projects in Sub-Saharan Africa. Interventions are also

beginning to involve agro-input dealers in the extension of ISFM information to smallholder farmers in various parts of Sub-Saharan Africa. Such efforts are also being explored by the International Plant Nutrition Institute Africa (IPNI) that is working with stakeholders to synthesize information and develop research programs to encourage fertilizer use in ways that are technically efficient, economically viable, and environmentally friendly.

Past research has produced numerous technical know-how and practices, which if adopted by resource poor smallholder farmers could reverse the declining soil fertility and increase crop yields (Scherr, 1999) and thus address the issue of food security in Sub-Saharan Africa. Most documented studies have focused on the role of agro-input dealers in improving farmers' access to fertilizers and seeds, with little contribution to the understanding of the agro-input trade with respect to agrochemicals and farming equipment use (Camara and Heinemann, 2006). Much less effort, however, has gone into understanding the role of agro-input dealers in the dissemination and communication of ISFM knowledge.

This study explores the knowledge among the agro input dealers on various soil fertility management practices and the communication channels used to receive such information. The soil fertility management components that will be looked at in this study include the use of improved seeds and fertilizers in maize production. These inputs are by far the most widely used ISFM practices by farmers for tackling maize productivity problems in Kenya. Maize was chosen because it is the most widely grown and the most important staple crop in Kenya. The other components of integrated soil fertility management practices that were studied include use of inorganic fertilizers, micro dosing or precise fertilization, nitrogen fixations by legumes, biomass transfer, agro-forestry, improved fallow, composting, crop rotation, animal manure, agrochemicals, farm machinery, seed treatment chemicals, pesticides and storage chemicals. The tools that were tested include a maize doctor and soil map.

Objectives – The main objective of the study was to assess the role agro-input dealers play in disseminating and communicating the Integrated Soil Fertility Management (ISFM) practices and agricultural information in Siaya and Trans Nzoia Counties in Kenya.

Specific objectives – The specific objectives were:

1. To assess the awareness of soil fertility management practices by agro-input dealers.
2. To investigate the communication channels that agro-input dealers use to receive agricultural information.

Literature review

Agriculture in sub Saharan Africa (SSA) – Africa remains the only continent that did not fully benefit from the effects of the green revolution experienced in the 1960s in Asia (Adesina, 2009). Food accessibility, affordability and availability are the major concerns for Africa and a primary challenge for human well-being and economic growth (Bationo, 2007). Most Africans (70%) live in rural areas with agriculture as the main source of their livelihood (Asaba et al, 2006). SSA agricultural growth is lagging behind compared to the population growth in the region (FAO, 2008; Vanlauwe et al, 2004). The low and declining productivity can be attributed to Africa's impoverished agricultural resource base, unfavorable socioeconomic and policy environments for investment in agricultural sector development as well as emerging challenges associated with unfavorable weather and climate change (Beets, 1990). Reversing this trend will require improved access to inorganic fertilizers, seeds, pesticides and profitable soil, water and nutrient management technologies by the smallholder farmers in Africa (Bationo, 1998; Nkonya et al, 1997). The slow growth in the use of modern agricultural inputs in the farming systems of SSA has resulted in missed opportunities to increase Africa's agricultural production, productivity, and household incomes and welfare (Chianu et al, 2008).

Even though the majority of the population is fed by smallholder famers, these farmers are faced with many challenges. These include soil fertility as well as crop destruction by pests and diseases—all despite the availability of modern chemicals and tools that would have been useful (Bationo, 2007). At the same time, farming practices have remained the same for a long time despite the advances in technologies and ways of handling the farming practices in other parts of the world (Sanchez, 2002). There are also problems associated with the dissemination and communication of information to farmers (Rege, 2006; Rees, 2000). This has led to a call for strategies to accord farmer education the priority that is needed to spur the use of improved technologies such as fertilizer, improved seed varieties, and pesticides (Oniango, 2001). Additionally, agricultural production needs to grow by 50–70% to cope with a growing world population (Denning and Jeffrey, 2008), and the efficiency of input applications also needs to increase substantially. Climate change is yet another challenge, one that requires farmer education to incorporate strategies for overcoming its effects (Njuguna, 2011).The low adoption of agricultural technologies that would address many of these challenges is attributed to various factors such as the lack of awareness (Ramisch et al, 2006).

Extension Services in Kenya – Extension services play a key role in sharing agricultural knowledge, technologies, information and also linking the farmer to other sectors of the economy (NASEP, 2007). The extension service is one of the critical change agents required for the transformation of subsistence farming to modern and commercial agriculture (NASEP, 2007). This is important in promoting household food security and employment creation and poverty reduction (Agbamu, 2000).

For a long time in Kenya, the extension service was dominated by the public sector. During this period many

new technologies were introduced, due mainly to a well-funded extension service, an elaborate set of farmer incentives including a ready market, subsidized inputs and credit, and relatively good infrastructure (Bouare and Bowen, 1990). However, in the last two decades, several constraints have hindered proper functioning of agricultural extension systems and services. The most critical challenges have been declining human, capital and financial resources for public extension; uncoordinated pluralistic extension service delivery—i.e, many players along the agricultural production value chain are involved in extension services and these efforts are not well coordinated; and poor linkages with extension facilitating factors (Wanga, 1999).

The extension services system is also facing the major challenge of a lack of facilities and resources to provide the essential services to smallholder farmers (Wanga, 1999). The extension services and work traditionally benefited the large scale farmers dealing in cash crops (Agbamu, 1998). The major hindrance to targeting smallholder farmers with the extension services has been the lack of resources to effectively reach the many geographically dispersed farmers, yet the need for extension service is great (Kanyanjua et al, 2000). FAO (1996) argues that most of the research findings exist in complex formats that might not be readily consumable by farmers. At the same time, such information cannot reach the famers on time and in the absence of an effective agricultural extension system.

There have been efforts by donors and NGO's to support the extension system in Kenya. However, the impact of such support has been dismal (Wanga, 1999). IFAD (2006) maintains that greater impact of agricultural extension services can be realized when various stakeholders such as the national agricultural research, extension organization, farmers and farm organizations work together. In addition, making agricultural extension system work for smallholder farmers requires that the various problems be addressed; e.g., structural, organizational, motivational, incentive, resource constraint and communication challenges facing the system (Muyanga et al 2006).

Agro-input dealers role in agricultural production – Agro-input dealers are sellers of agricultural inputs that include seeds, fertilizer, crop protection chemicals, farm equipment and machines, veterinary products and animal feeds. Agro-input dealers play a major role in ensuring that farmers access some of the important agricultural inputs required to improve agricultural productivity in their respective farms (Poulisse, 2007). Nevertheless the contributions of agro-input dealers in agricultural development in Sub Saharan Africa have been largely neglected (IFDC, 2003).

Since 2006, the role of agro-input dealers and agro-input dealer business started receiving some attention as the likely channels for disseminating agricultural information (IFAD, 2006). In Kenya the efforts to tap the potential provided by agro-input dealers has been spearheaded by AGRA and the government through the Kenya Agro dealers strengthening program (KASP). These initiatives have provided training in business management and improved farming methods (AGRA, 2009). Agricultural Market Development Trust (AGMARK), an affiliate of CNFA, has certified over 1,900 agro-input dealers in business management, safe product usage and handling, product knowledge and crop husbandry practices. The training has enabled agro-input dealers to provide inputs and share knowledge on improved production practices with smallholder farmers (CNFA, 2009).

Most of the agro-input dealers, however, still lack business support and hence still encounter various business constraints relating to high transportation costs, low effective demand, lack of appropriate market information, lack of storage facilities and limited skills and knowledge (Isherwood, 2004). The high transportation costs can be attributed to the long distances covered to source the inputs (Chianu et al, 2008).

Information sources and channels in relation to ISFM knowledge – Information and knowledge have been used synonymously even though there is a distinction between the two terms. Information is defined as one or more facts received by a human being and that may be useful or of worth to the recipient (Avelock, 1986). It is any news or facts about something, the flow of messages that play a vital role of reducing uncertainty (Rodgers, 2003). Knowledge, on the other hand, is created and organized by the very flow of information based on the commitment and beliefs of the information holder. Knowledge is the information that has been put together in a given form into a pool of facts and concepts that can be applied. Knowledge can further be defined as processed information (Rasmussen, 2001).

There is also a clear distinction between information sources and channels. Information sources provide the content and the expertise of interest to the information seeker; the key sources of agricultural information include the agricultural research and learning institutions. The channels, on the other hand, are the vehicles through which the information is transferred or received, and can either be disseminative (i.e. uni-directional) or communicative (i.e. multi-directional) (Momodu, 2002). Disseminative channels do not allow for feedback whereas communicative channels allow for feedback from the source and recipient of the information.

Information channels are therefore ways that messages get from a source to a receiver. Such channels can be further categorized broadly into (i) interpersonal (face-to-face) versus mass media (TV, radio, newspaper, etc.) communication and (ii) localite (local) versus cosmopolite (outside the local social system) channels (Rodgers, 2003).

The mass media include television, radio, newspapers and magazines, and generally allow few individuals to reach out to larger audiences (Rodgers, 2003); it is entirely cosmopolite, whereas interpersonal channels can either be cosmopolite or local. Local interpersonal channels are traditional in nature; for instance poems, exchanges

with neighbors, relatives, friends or peers and songs (Dutta, 2009). In these channels the message conveyed is usually over a short distance and within the boundary of the target group or the participating individuals. In a cosmopolite interpersonal channel, the source of information is from outside the system although it involves face-to-face interaction with the participants; they involve community-based channels like workshops, farmer field days, on farm demonstrations, seminars, farm to farm visits, public *barazas,* and agricultural shows.

Besides the mass media and ICT-based channels such as the internet and mobile telephones, there exist many channels through which ISFM information can be shared (Rees et al., 2000). There are print based media, including books, billboards, brochures and posters. There are also development workers and agencies, outreach services, cooperatives, faith-based organizations and other indigenous sources of knowledge (Adolwa et al 2012).

Methodology and Materials

Description of study area – This study was conducted in Siaya and Trans Nzoia counties in western Kenya. Western Kenya is among the most densely populated regions in Sub Saharan Africa (Tittonel et al, 2005). The high population is attributed to the earlier settlements who were drawn by the high agro-ecological potential of the area, making it conducive for crop production and high fertility of the soils in the region (Tittonel et al, 2005). Despite the high potential exhibited by the region, the area has remained highly under-developed. The population faces many challenges including poor infrastructure, high rates of HIV/AIDS epidemics, poor market access, and heavy out-migration of the youth (Ramisch et al, 2006). The region experiences bimodal rainfall and has relatively deep soils, mostly of clay and loam textures which tend to be fertile (Jaetzold and Schmidt, 1993; Jaetzold and Schmidt, 1982).

Siaya county, lies between latitude 0°30′ North and longitude 34°30′ East. The altitude of the area rises from 1141 m to 1400 m above sea level on the shores of Lake Victoria in the south and southwest, to 1400 m above sea level in the North and East. The average annual rainfall is about 800–2000 mm, with annual mean maximum temperature ranging between 27 °C and 30 °C and annual mean minimum temperature ranging between 15 °C and 17 °C (Jaetzold and Schimidt, 1983). The soils are well drained, deep and friable in some places, shallow over petro ferric (with murram) layer. The predominant soil types in the district are mainly the *Nitisols, Orthic ferrralsols* and *Acrisols* (Republic of Kenya, 1997). There are however sections of the county that are drier with poor soils. The administrative map of Siaya County is shown in Figure 1.

FIGURE 1 – Siaya County map

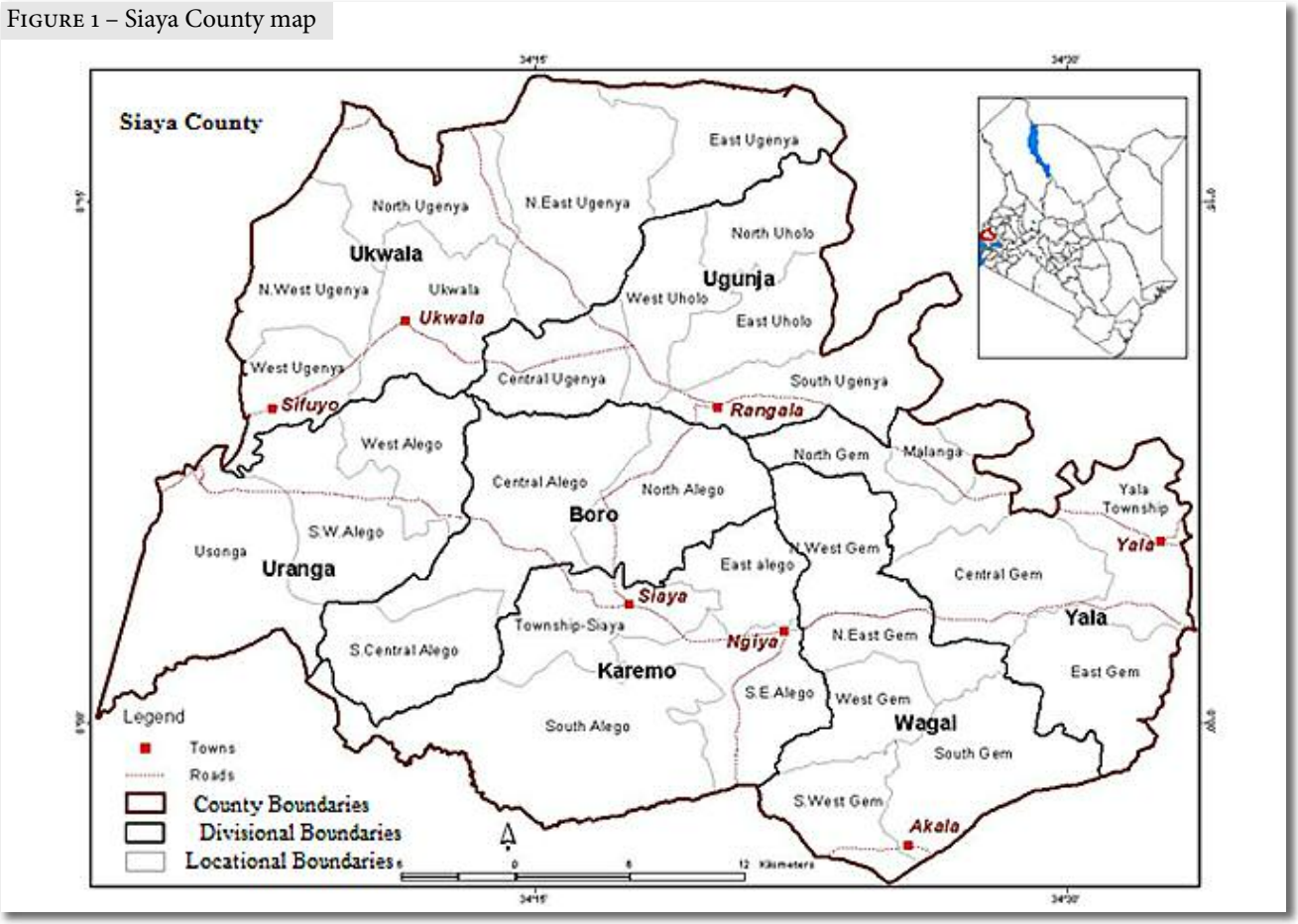
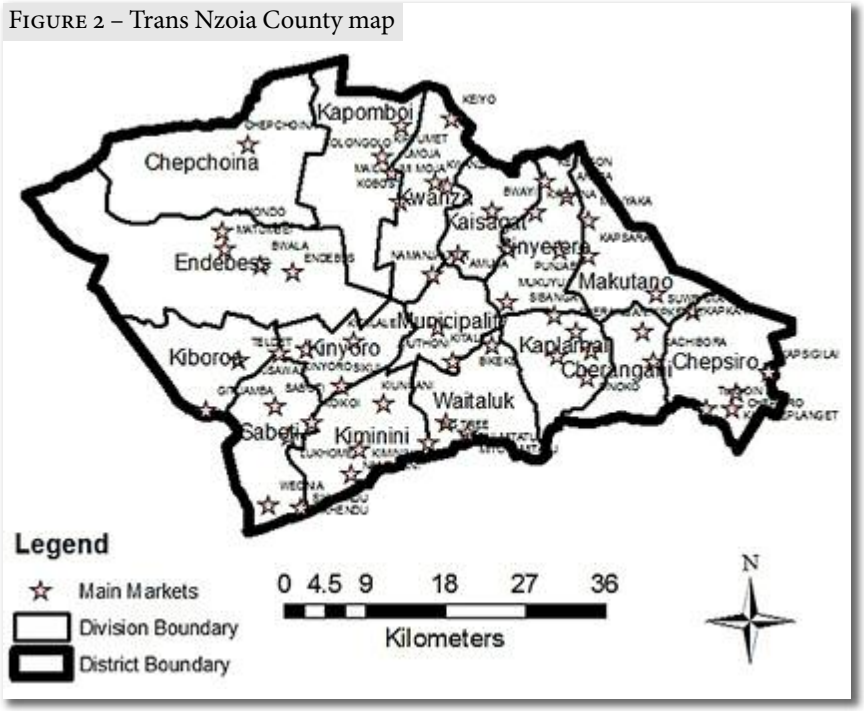


Figure 2 – Trans Nzoia County map



Trans Nzoia County is located between the Nzoia River and Mount Elgon; its center is the town of Kitale and it is the continuation of the fertile Uasin Gishu plateau beyond the Nzoia river. It is the best zone in the country for maize and sunflower production, with an altitude varying between 1800–1900 m above sea level. Major parts of the region consist of a series of uplands of progressively lower altitude towards the west. The eastern boundary is formed by the Cherangani Hills, while on the western boundary the extinct volcanic Mt. Elgon is an outstanding landmark. A scarp in the north marks the watershed between the Lake Turkana drainage basin and the Lake Victoria basin; the latter is contributed to by the Nzoia River, which drains most of the county. Apart from the volcanic rocks of the Mt. Elgon area, the majority of the county is underlain by acid to intermediate rocks of the basement system (Republic of Kenya, 1997). The administrative map of Trans Nzoia County is shown in Figure 2.

The conceptual framework – The focus of this study is to examine the role of agro-input dealers in the dissemination and communication of ISFM knowledge among farmers in Siaya and Trans Nzoia Counties in Kenya. Agro-input dealers can play an important role in the agricultural production sector much like the diagnostic-to-prescription/treatment model applied in the health sector. As in the case of diagnosable illness in the medical sector, the farmers (patients) are distressed about the status of their land's declining food production and land degradation, and are eager to get solutions to these problems. The farmers can then come to the agro-input dealers (doctors) and describe the nature of the problem. The agro-input dealers, having been well equipped with agricultural production knowledge, should then be able to isolate the causes of the problem and recommend solutions in the form of products (inputs) or information on ISFM through the information resources and communication tools developed by researchers and development agencies. Such a working system would then build trust among the farmers and the agro-input dealers and provide a platform for achieving continuous learning and exchange of ISFM knowledge. A similar approach to diagnosis has been demonstrated by Rapport et al (1985) and Rapport and Whitford (1999) in addressing problems of ecosystem degradation.

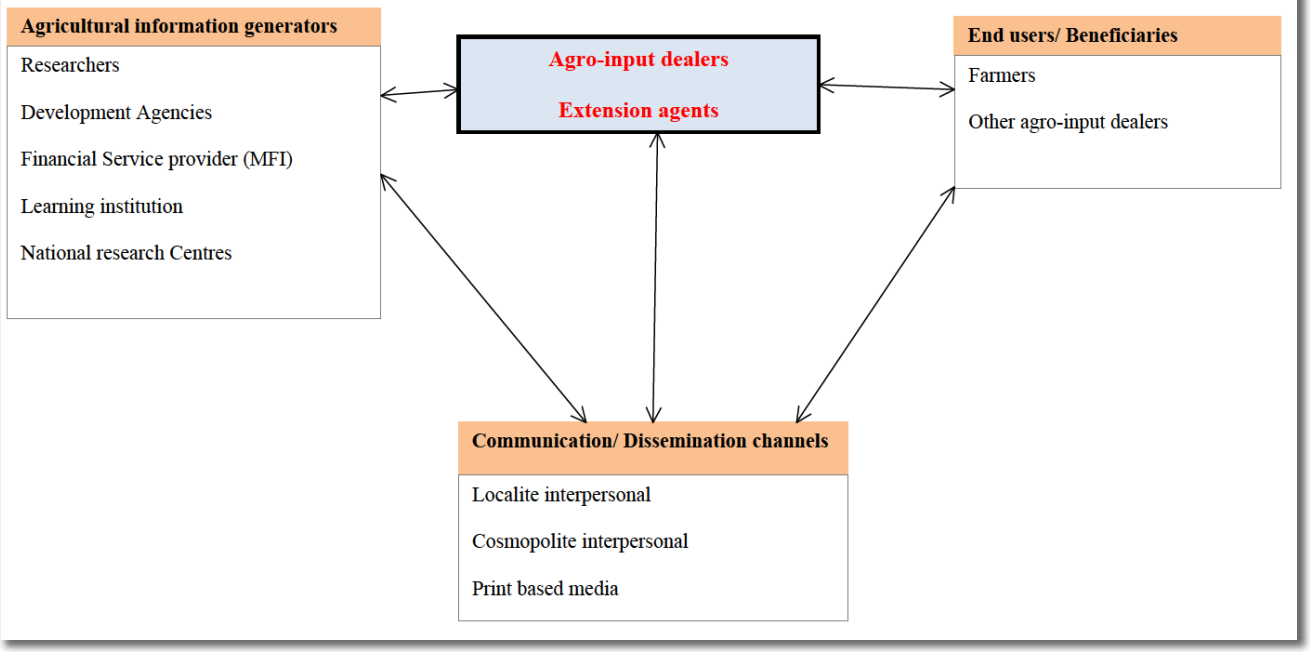
Agro-input dealers who are well equipped with agricultural production knowledge can be very resourceful in addressing the poverty issues in Sub Saharan Africa and can help in the achievement of the African green revolution. Researchers have developed tools and equipment that can be used in testing soil quality and other important parameters in the soil health assessment. Such tools include the digital soil map (Atlas) that is being developed by researchers in Africa Soil information system (AfSIS) with financial support from AGRA and the Bill and Melinda Gates Foundation (BMGF). Others include hand-held spectrometers that researchers at the World Agroforestry Centre are piloting, a "Crop Doctor" system being pioneered by IPNI, CIMMYT and other CGIAR centers, and Cornell University's soil testing kits. These tools can generate knowledge that agro-input dealers need to resolve the challenges that farmers are facing.

The agro-input dealer's knowledge of various aspects of fertilizer usage (ISFM knowledge) will be very essential in providing the farmer with useful information that can be used in improving the farmer's yield. The approach presented in this research will provide an opportunity for the role of farmers and farmer organizations to be able to provide essential feedback on the dissemination and communication of the ISFM technologies and will be especially useful in helping set the priorities and improving the relevance of the program.

Figure 3 presents a schematic presentation of how key stakeholders in agricultural production and productivity can interact effectively. The agro-input dealer plays a pivotal role in linking the various players ranging from information sources and end users using the varied communication channels that can be utilized. The maize doctor and soil map can be useful in strengthening the link between the agro-input dealer and farmer by making the farmer the source of information hitherto obtained only through agricultural extension services.

Sampling and Data Collection – The study involved agro-input dealers as the main respondents. The agro-

FIGURE 3 – ISFM information and communication tools dissemination and communication path (Source: Author; 2012)



input dealers were drawn from the prior participants in the Kenya agro dealers Strengthening Program (KASP) projects. The sampling frame consisted of 288 agro-input dealers who had participated in the KASP project: 140 agro-input dealers in Trans Nzoia and 148 agro-input dealers in Siaya County.

The respondents of the study were drawn from the 288 agro-input dealers through simple random sampling. A total of 144 agro-input dealers were selected. The distribution of the respondents in the two counties is presented in Table 1.

Empirical Methods – This study used a detailed twelve page questionnaire to collect data from 144 agro-input dealers from the two counties covering 33 market centers. The questions covered in the questionnaire were organized into three sections. These included: 1. General characteristics of agro-input dealers (gender, age, years in school, main and secondary occupation, year started agro-input business, etc.); 2. Assessment of ISFM awareness; and 3. Assessment of the channels of communication used by agro-input dealers to receive agricultural information. Following training of enumerators, actual data collection was carried out between November and December 2011. Data entry was done in CSPro, while data cleaning and analysis was carried out using the Statistical Package for Social Sciences (SPSS) and MS Excel.

For the purpose of this research, the following broad categories of communication channels were adopted from Sanginga and Woomer (2009): (i) Mass media, including television, radio, newspapers and magazines; (ii) Local Interpersonal, including other agro-input dealers and songs/poems/skits; (iii) Cosmopolite Interpersonal, including workshops/ seminars, Farmer field days, *Barazas*/public gatherings, and on-farm demonstrations; (iv) Print-based, including books, billboards/ posters, brochures; and (v) ICT based media, including internet, mobile phones, and DVD/CD players.

Data Analysis – Data was analyzed using SPSS version 20. Frequencies, descriptives, correlations and cross-tabulations were generated to derive summary statistics. Regressions (Logistic regressions) and ANOVAs were undertaken to determine causal relationships between variables. Logistic regression was selected due to the fact that the responses are binary, i.e aware or not aware. These methods also allow for a combination of numeric and non-numeric data to compute binary response (Smith et al, 1999).

To address objective 1, on the factors that influenced agro-input dealer awareness of various ISFM technologies, a logistic regression was used (Smith et al. 1999). Following Gujarati (1999), Hardin and Hilbe (2001), the logistic regression model characterizing awareness by the sample agro-input dealer can be specified as:

TABLE 1 – Sampling scheme for agro-input dealers in Siaya and Trans Nzoia Counties

County	Sampling frame	Proportion (%)	Sample agro-input dealers
Siaya	148	50	74
Trans-Nzoia	140	50	70
Total	288	100	144

Source: Author; 2013

$$Pi = F(\alpha + \beta Xi) = \frac{e^{(\alpha+\beta Xi)}}{1+ e^{(\alpha+\beta Xi)}}$$

Where:

Pi is the probability that an individual agro-input dealer is aware of the ISFM technology given *Xi*, and *i* denote *i*-th observation in the sample

Xi is the random variable

$F(.)$ is the accumulative distribution function of the Logit model

e is the base of natural logarithm

α and β are the coefficients associated with each explanatory variable

Awareness is defined as whether the agro input dealer is aware or has heard of the various ISFM components such as inorganic fertilizers, precise fertilization(micro-dosing), nitrogen fixation by legumes, improved germplasm (seeds), biomass transfer, agro-forestry, improved fallow, compositing, crop rotation, animal manure, farm machinery, seed treatment chemicals, pesticides or storage chemicals.

The variables used in the logistic model are gender, age, level of education, experience in agro business, visits by extension agents and researchers, participation in famer field days and education days.

For objective 2 — investigating the communication channels that agro-input dealers use to receive agricultural information — regression analysis was used to help identify factors influencing the use of communication tools used by agro-input dealers to communicate with farmers (Long, 1997). Correlation among the communication channels was also generated. Factor analysis is a data reduction method that allows for discovery of the underlying patterns in the data. Varimax rotation allows for maximum loadings per component. The correlation between factors is set to zero, thus there is no correlation between factors (Long, 1997).

Factor analysis was used to study the relationship among the communication channels, by statistical grouping of the fifteen communication channels into various factors (Bredja et al, 2000) through Varimax rotation. Varimax rotation with Kaiser Normalization was used because it results in a factor pattern that loads highly significant variables into one factor, which was considered to offer a theoretically plausible and acceptable interpretation of the resulting factors.

Results and Discussion

Socio-demographic characteristics of agro-input dealers – The summary statistics of the variables used in this study are presented in Table 2.

Most of the agro-input dealers (65.3%) were men. The age of agro-input dealers ranged from 19 to 68 years, with a mean and standard deviation of 37.3 and 9.68 years, respectively. The number of years that agro-input dealers have been in the agro business ranged from 1 to 16 years (with a mean of 5.5 years and a standard deviation of 3.14 years). 65% of the surveyed agro-input dealers had post-secondary education, 32.6% had secondary education while 2.8% had primary education as the highest level of education attained.

Over 82.6% of the agro-input dealers regarded agro-input business as their main occupation. The rest indicated that they spent 20 to 45% of their time on agro-input business with their main occupation being farmer (13.2%), veterinarian (2.8%) and teacher (1.4%). About 122 of the 144, or 84.7%, of agro-input shops interviewed were specialized agro-input shops. The remaining combined agro-input dealer business with other business lines. The most important of the non-agro-input items sold alongside agro-input dealers were building materials (nails, iron sheets, cement, paint and brush paint), human medicines, bicycle and machinery spare parts, food items (maize products, common bean, flour, sugar, and bread).

Over 92% of agro-input dealers admitted having been visited by an extension staff member. The visits ranged from once to twenty times a year with a mean and standard deviation of 1.98 and 3.712 times respectively in 2010. In 2011, 134 agro-input dealers were visited by extension staff in various occasions which ranged from once to twelve visits a year with a mean and standard deviation of 1.84 and 1.612 times. Some agro-input dealers indicated that they were visited by researchers. Of the 144 surveyed agro-input dealers, 91% were visited by researchers in 2010, while 132 agro-input dealers were visited by researchers in 2011. The interviewed agro-input dealers also indicated that they attended farmer field days and agricultural shows and fares. In 2010, 139 agro-input dealers attended farmer field days while 134 agro-input dealers attended the farmer field days, agricultural shows and fairs in 2011, respectively.

Agro-Input Dealers' Awareness of ISFM Technologies – This study assessed whether the agro-input dealers were aware of ISFM technologies. Awareness was defined as whether the agro-input dealer had ever heard of ISFM technologies such as the use of inorganic fertilizers, precise fertilization or micro dosing, nitrogen fixations by legumes, use of improved seeds or germplasm, biomass transfer, agro-forestry, use of improved fallows, composting, crop rotation, use of animal manure, use of farm machinery, seed treatment chemicals, pesticides and storage chemicals. Results indicate that 57.6% were aware of various ISFM technologies.

Logit Regression of Factors Influencing Awareness of ISFM by Agro-Input Dealers in Siaya and Trans Nzoia Counties – A logistic regression was fitted to assess the effects of variables on ISFM awareness by 144 agro-input dealers; these variables included gender, age, county, level of education, number of years of engagement in agro-input dealer business, visits by extension and researchers, attendance at farmer field days, and primary and secondary occupation (Table 3). Five variables positively influenced agro-input dealer's awareness of ISFM

Table 2 – Socio-demographic characteristics of surveyed agro-input dealers in Trans-Nzioa and Siaya Counties in Kenya

		Frequency	Percentage
Gender	Male	94	65.3
	Female	50	34.7
County	Siaya	73	50.7
	Trans Nzoia	71	49.3
Main occupation	Agro-input dealer	119	82.6
	Farmer	19	13.2
	Veterinary officer	4	2.8
	Teacher	2	1.4
		Gender	
Agro-dealer experience		**Male**	**Female**
Age (years)	Minimum	19.0	20.0
	Maximum	68.0	50.0
	Mean	39.2	33.7
	Std. Deviation	10.34	7.09
Duration in business (years)	Minimum	1.0	2.0
	Maximum	16.0	15.0
	Mean	5.6	5.2
	Std. Deviation	3.18	3.07
		Year	
Agro-dealer-interaction		**2010**	**2011**
Number of times agro-input dealers interacted with extension staff	Minimum	1.0	1.0
	Maximum	20.0	12.0
	Mean	2.0	1.9
	Std. Deviation	3.71	1.61
Number of times agro-input dealers interacted with researchers	Minimum	1.0	1.0
	Maximum	5.0	9.0
	Mean	1.5	1.5
	Std. Deviation	1.08	1.06
Number of field days /shows/fairs attended	Minimum	1.0	1.0
	Maximum	15.0	11.0
	Mean	3.0	2.1
	Std. Deviation	1.92	1.73

Source: Author; 2013

Table 3 – Logit regression of factors influencing awareness of ISFM by agro-dealers in Siaya and Trans Nzoia Counties in Kenya

Variables	Co-efficient	S.E.	P value	Marginal effects
Gender of agro-input dealer	−0.395	0.117	0.001	1.335
Age of agro-input dealer (Years)	0.036	0.007	0.000	37.213
Education level	0.906	0.109	0.000	3.696
Experience in agro business	0.076	0.021	0.000	5.587
Visit by extension	0.569	0.264	0.031	0.931
Visit by researcher	0.038	0.23	0.869	0.916
Farmer field days/shows	−0.442	0.415	0.287	0.991
Engagement in farmer education	0.127	0.287	0.657	0.958
Constant	−4.042	0.669		

Overall percentage predicted correct (86.7%), Model Summary (−2 Log likelihood = 1927.42), Cox & Snell R Square (0.11), Nagelkerke R Square (0.16), N = 142. Source: Author; 2013

technologies significantly: gender, age, educational level, experience in agro business and visits by extension staff.

The agro-input dealers' level of education affected awareness of ISFM technologies. Results from the logistic regression imply that agro-input dealers with basic education were less likely to be aware of some of the ISFM technologies compared to those with secondary or post-secondary education. From the logit regression model, holding other variables constant, an increase in the level of education by one unit such as from primary level to secondary level increases the chances of ISFM awareness by 0.91 ($p = 0.000$). This finding highlights the importance of education in the dissemination and communication of ISFM technologies.

Holding other factors constant, increasing the number of years of engagement in agro businesses increases the chances of agro-input dealer awareness of ISFM technologies by 0.08 ($p = 0.000$). This implies agro-input dealers who have been in business for a longer period are more likely to be aware of ISFM technology that those who have been in agro business for a shorter period. This further means that agro-input dealers who have been in business for a longer period would have had higher chances of learning or interacting with other agro-input dealers and agents who are likely to share about the ISFM technologies.

Age of agro-input dealer is also statistically significant. Holding other factors constant, the model indicates that with increase in the age of agro-input dealer by one year increases the chances of agro-input dealer awareness of ISFM by 0.036 ($p = 0.000$). This means that agro-input dealer awareness of the various ISFM components is determined by the age, thus knowledge intensive technologies will require more time as shared in the previous sections and Table 3.

Gender was also statistically significant; holding other variables constant, female agro-input dealers were significantly less likely to be aware of ISFM technology than male agro-input dealers. This indicates that farmers who will have to rely on male agro-input dealers are more likely to benefit on the awareness advantage they may have of ISFM technologies as compared to farmers who rely on female agro-input dealers as their source of the ISFM technologies.

Visits by extension staff was another variable that affects the agro-input dealer's awareness of ISFM technologies. Holding other things constant, an additional visit by extension staff increases the probability of agro-input dealer being aware of ISFM technology by 0.57% ($p = 0.031$). This indicates that extension service has a role to play in the knowledge of ISFM.

Several variables had no significant influence on the awareness of ISFM technologies by agro-input dealers: visitation by researchers, attending farmer field days and involvement in farmer education were found to have no significant influence on the ISFM awareness.

Based on the above findings, the level of education of the agro-input dealer affects the likelihood of the agro-input dealer's awareness of the ISFM technologies and the results further show that the years of engagement in agro-input business also affects the awareness of the ISFM technologies by agro-input dealers. Therefore the null hypothesis that the level of education of the agro-input dealer has no effect on the awareness of ISFM technologies was rejected. Subsequently, the null hypothesis that the period of engagement in agro-input business has no effect on the awareness of ISFM technologies was also rejected.

Assessment of the Channels Used by Agro-Input Dealers to Receive ISFM Information / Analysis of the accessibility of the channels of communication used by agro-input dealers to get ISFM and agricultural information – Most of agro-input dealers considered farmer field days, on-farm demonstrations, and public gatherings as the most accessible, with 82%, 60% and 49%, respectively, ranking them highly in terms of accessibility (Table 4). Songs/poems and skits were ranked inaccessible with 98% of agro-input dealers ranking the accessibility of this channel low. DVD/CD players and the internet were also considered inaccessible, with 91% and 63% respectively ranking them low.

Cosmopolite interpersonal channels-workshops/seminars, farmer field days, public gatherings/*baraza's* and on farm demonstrations — were considered by agro-input dealers to be more accessible compared to other channels of communication (Figure 4).

Communication Channels Factor Analysis and Agro-Input Dealer Perspectives of Accessibility of Communication Channels – The fifteen communication channels initially analyzed were reduced by factor analysis to seven main components when assessing the accessibility of the communication channels for the ISFM information; these seven components were consequently retained for identification and interpretation (Brejda et al, 2000). Table 5 shows factor loadings and communalities for the reduced components. Large amounts of correlations (loadings) between the parameters and factors ($> \pm 0.5$) were used to group and identify the communication channels (Brejda et al 2000). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.503 which was satisfactory for the factor analysis process and Bartlett's Test for sphericity were significant ($p = .000$) as shown in Table 6.

The first factor, which accounted for 15.019% of the variance, had high positive loadings of on-farm demonstrations (0.736), workshops and seminars (0.6.3) brochures 0.568 and public gatherings (0.555). There was positive and significant correlations between the brochures and Cosmopolite channels of communication as shown in Table 6, and thus the factor was identified as the '*Cosmopolite interpersonal and print based communication channels factor*'. The second factor accounted for 12.993% of the variance and had higher loadings on television (0.795), radio (0.673) and books (0.52), with a significant correlation between the books and Mass media (radio and television) as shown in Table 6 and this factor was identified as '*mass media and print based communication*

Table 4 – Agro-input dealers' assessment of the accessibility of ISFM communication channels (N = 142)

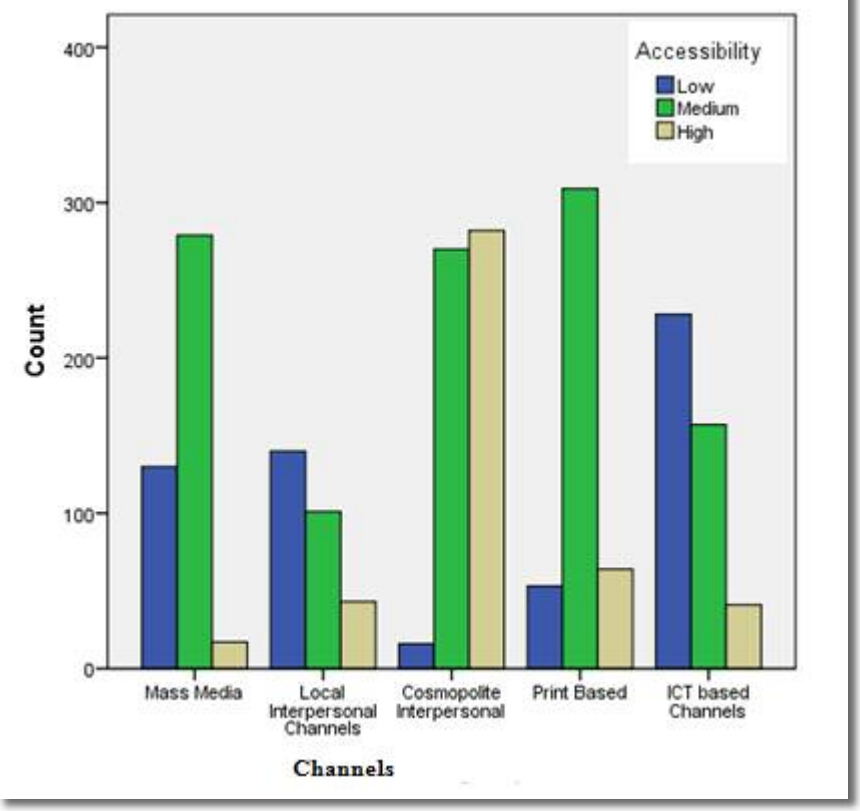
	Accessibility					
	Low		Medium		High	
Communication Channels	Count	%	Count	%	Count	%
Workshops/Seminars	5	4	125	88	12	8
Other agro-input dealers	1	1	98	69	43	30
Billboards/Posters	15	11	121	85	6	4
Internet	90	63	40	28	12	8
Brochures	8	6	111	78	23	16
Newspapers/Magazines	87	61	50	35	5	4
DVD/CD players	129	91	12	8	1	1
Radio	26	18	109	77	7	5
Books	30	21	77	54	35	25
Television	17	12	120	85	5	4
Songs/Poems/Skits	139	98	3	2	0	0
Public gatherings/*baraza*'s	6	4	67	47	69	49
Farmer Field Days	1	1	25	18	116	82
On-farm demonstrations	4	3	53	37	85	60
Mobile phones	9	6	105	74	28	20

Source: Author; 2013

channels factor'. The third factor accounted for 8.737% of the variance and entailed loadings on internet (0.753) and books (0.542) with a significant correlation between internet and books of 0.303 and the factor was identified as '*Print and ICT based communication channels factor'*. The fourth factor had loadings on mobile phones (0.905) and it was identified as '*ICT based communication channel factor'*. The fifth factor was made up of loadings on billboards and posters (0.744) and a negative loading for farmer field days (–0.525) which also indicated a negative correlation between billboards/posters and farmer field days of –0.123 and hence the elimination of the farmer field days from the group; the factor was thus identified as '*Print based communication channels factor'*.

The sixth factor was composed of other agro-input dealers (0.843) and newspapers/magazines (0.503) which had a positive significant correlation of 0.220 and thus was identified as '*Mass media and local interpersonal communication channels factor'*. The seventh factor was highly composed of positive loadings of Songs/poems/skits (0.792) and thus this was identified as '*local interpersonal channels of communication factor'*.

Figure 4 – Agro-input dealers' assessment of the accessibility of communication channel (Source: Author; 2013)



Based on the above results, cosmopolite channels of communication (community based) channels emerged as the most accessible. Farmer fields days ranked highest among the agro-input dealers in all aspects tested. This medium therefore provides agro-input dealers with a

Table 5 – Factor loadings, eigen values and communalities for a seven factor model of the communication channels agro-input dealers use to access ISFM information

	Component							
Accessibility	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Communalities**
On farm demonstrations	0.736	—	—	—	—	—	—	0.721
Workshops /Seminars	0.603		—	—	—	—	—	0.53
Brochures	0.568	—	—	—	—	—	—	0.642
Public gatherings /*baraza's*	0.555	—	—	—	—	—	—	0.692
Television	—	0.795	—	—	—	—	—	0.666
Radio	—	0.673	—	—	—	—	—	0.693
Internet	—	—	0.753	—	—	—	—	0.613
Books	—	0.52	0.542	—	—	—	—	0.763
DVD/ CD players	—	—	—	—	—	—	—	0.57
Mobile phones	—	—	—	0.905	—	—	—	0.831
Billboards/ Posters	—	—	—	—	0.744	—	—	0.585
Farmer Field Days	—	—	—	—	−0.525	—	—	0.617
Other Agro-input dealers	—	—	—	—	—	0.843	—	0.756
Newspapers/ Magazines	—	—	—	—	—	0.503	—	0.625
Songs/ Poems/ Skits	—	—	—	—	—	—	0.792	—
Eigen values	2.3	2.0	1.3	1.3	1.1	1.1	1.0	—
% of Variance	15.019	12.993	8.737	8.377	7.496	7.176	6.699	—
Cumulative %	15.019	28.013	36.750	45.127	52.622	59.798	66.497	—

KMO and Bartlett's Test: KMO Measure of Sampling Adequacy = 0.503; Bartlett's Test of Sphericity: $X^2 = 280.491$, df = 105, Sig. = 0, Cut point for loadings = 0.5. Source: Author; 2012

chance to interact with each other and also other stakeholders. The Community-based channels provide a two-way communication where feedback or clarity can be sought on site and thus allows for feedback between the sender and receiver of the information. Such channels are considered to be effective especially when dealing with knowledge intensive information such as the ISFM technologies (Norrish et al, 2001). The ability to provide feedback reduces the uncertainty and thus explains why the cosmopolite channels were considered more appropriate a by majority of the agro-input dealers.

Mass media was among the least used channels of communication by agro-input dealers to receive information on ISFM technologies. This can be due to the fact that mass media is not as interactive as the community based channels which allow for feedback. Mass media can thus be considered as a channel that allows for dissemination of information but does not allow for feedback since the information reaches out to many audiences. Radio has the potential to reach out to many audiences in rural areas, but may be limited by issues of timing, wrong language and its unsuitability for imparting technical skills to the target audience (Norris 2001). Television and newspapers/magazines are considered relatively expensive for an average agrodealer (Makinen, 2007). Makinen further noted that very few Kenyans are able to buy a newspaper and there is also an impediment of illiteracy and language barriers that deter communication through these channels.

Print based channels — especially the brochures, books and posters — were much better than the mass media, ICTs and local interpersonal channels of communication in terms of accessibility for agro-input dealers. Despite the fact that these channels are disseminative by nature and mostly provided by the agro-input dealer companies, most agro-input dealers acknowledged that they can still provide feedback to the providers of the information. And print based channels are provided for free by the companies that supply the various agro-inputs, and due to competition these companies try to do as much as possible in terms of campaigns and promotion of the products and thus the technologies become familiar with agro-input dealers. Socio-economic factors play a vital role in limiting the full utilization of print based channels; such factors include low income and low levels of education (Bationo et al, 2004, Sanginga and Woomer, 2009). There is also an impediment of difficulty in distribution, minimal impact where the target group is illiterate, susceptibility to wear and tear due to its fragile nature, and the fact that most are impersonal and thus can easily be ignored by those with no interest (Norris, et al,. 2001). This explains the low utilization of print based channels by agro-input dealers for seeking agricultural information.

ICT-based communication channels (DVD/CD players, mobile phones and the internet) showed minimal advantage to agro-input dealers, which may be due to the complex nature of their use and the comparatively high cost of accessing them. The internet was poorly used by agro-input dealers in the two regions and this can be attributed to the disparity in access to ICTs between rural and urban populations (Munyua, 2007, Oguya, 2006). The high cost

and insufficient infrastructure contributed to the low uptake of the ICT-based technologies, especially the use of internet by agro-input dealers.

Mobile phones are commonly used by most agro-input dealers since almost every household in Kenya owns at least one mobile phone handset (Kinyua, 2004). Mobile phones are mostly used by agro-input dealers to communicate with other agro-input dealers, the farmers and suppliers. The use of mobile phones for information seeking has been under-utilized, mostly due to high cost of airtime. Inadequate ICT infrastructure, high cost of ICTs and telecommunications, presence of monopolies, low bandwidth and thus low internet speeds and weak policies on ICT use in Africa are some of the major hindrances to the utilization of ICT channels of communication (Munyua, 2007). There are efforts to address some of these challenges especially the laying of the submarine and terrestrial cables in Africa which is aimed at enhancing speeds and connectivity and thus improving the international communication service since the continent is being connected with other parts of the world (Echezona and Ugwuanyi, 2010).

Conclusions

From the research findings, the following conclusions can be derived from the study. Foremost, the level of education of the agro-input dealer plays a vital role in the agro-input dealer's awareness of the ISFM technologies. The period of engagement in agro-input business has an influence on the agro-input dealer's awareness of the ISFM technologies. The communicative channels of communication are more effective in accessing and sharing ISFM technologies compared to disseminative channels of communication.

The findings of this study suggest the need to improve the provision of extension services to agro-input dealers to enable them effectively communicate information about ISFM technologies to farmers. There is also a need to address the existing

TABLE 6 – Correlations among the communication channels in the context of accessibility of the ISFM Information

Parameters	Workshops/ Seminars	Other agro-input dealers	Billboards/ Posters	Internet	Brochures	Newspapers/ Magazines	DVD/ CD players	Radio	Books	Television	Songs/ Poems/ Skits	Public gatherings/ *baraza*'s	Farmer Field Days	On farm demonstration	Mobile phones
Workshops/Seminars	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other agro-input dealers	-0.047	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Billboards/Posters	0.024	0.065	1	—	—	—	—	—	—	—	—	—	—	—	—
Internet	0.027	0.071	0.117	1	—	—	—	—	—	—	—	—	—	—	—
Brochures	.192*	−.178*	0.039	0.006	1	—	—	—	—	—	—	—	—	—	—
Newspapers/Magazines	0.038	.220**	.159*	.155*	.156*	1	—	—	—	—	—	—	—	—	—
DVD/CD players	−0.044	−0.1	−0.064	−0.113	.170*	0.121	1	—	—	—	—	—	—	—	—
Radio	−0.136	0.084	.152*	−0.105	.167*	.272**	0.041	1	—	—	—	—	—	—	—
Books	−0.099	.166*	0.064	.303**	−0.104	0.128	−0.016	.195**	1	—	—	—	—	—	—
Television	−0.022	0.021	0.108	0.097	.172*	.264**	.182*	.332**	.364**	1	—	—	—	—	—
Songs/Poems/Skits	0.122	−0.092	0.025	0.049	0.073	−0.023	0.107	0.042	0.065	0.032	1	—	—	—	—
Public gatherings/*baraza*'s	.139*	−0.042	−0.065	−0.083	.305**	−0.057	0.03	0.064	−0.076	.169*	−0.028	1	—	—	—
Farmer Field Days	.167*	−0.001	−0.123	−0.075	.145*	−0.079	−0.018	−0.097	−0.078	0.032	0.068	0.059	1	—	—
On farm demon.	.225**	−0.053	−0.063	−0.03	.210**	−.142*	.160*	−0.06	−.415**	−.139*	0.026	.336**	.294**	1	—
Mobile phones	−0.039	−0.049	0.008	0.098	−.220**	−0.026	−.173*	.140*	−0.035	−0.052	−0.04	−0.06	−0.048	.160*	1

*Correlation is significant at the 0.05 level (1-tailed)
**Correlation is significant at the 0.01 level (1-tailed).
List wise N = 142. Source: Author; 2013

knowledge gap among agro-input dealers to enable them to effectively communicate ISFM technologies to farmers. There is a need for all stakeholders to be encouraged to engage in awareness creation and capacity building of the agro-input dealers to effectively equip them with skills and knowledge essential in dissemination and communication of ISFM technology. And finally there is a need for the empowerment of female agro-input dealers to be able to participate in awareness creation of the agricultural technologies being developed; the results indicate the existing systems do not favor them very much.

The government agencies' engagement in training of agro-input dealers has been minimal, and there is a need for more resources in terms of human capital and infrastructure to be invested in national research centers so that agro-input dealers and farmers are able to benefit from basic services like soil analysis and thus be able to effectively know which agronomic practices to adopt for optimum returns.

Community based channels of communication were found to be the most accessible by agro-input dealers, but there was minimal interest especially among the rural agro-input dealers on the use of ICT channels of communication. In Kenya, it is approximated that each household has at least one mobile phone. This means that if exploited as mode of communication, these devices can effectively reach out to many people. Using such a platform for communication has been hindered by the costs of making phone calls or sending SMS (short message service) messages. There is need to develop a platform that is cheaper to use; this will call for all stakeholders engaged in agricultural information generation, packaging and dissemination to work together to develop a cost effective querying system where agro-input dealers' specific needs will be addressed and thus making the initiative worth investing in.

Notes

1. International Fund for Agricultural Development
2. International Fertilizer Development Centre

References

Adesina, A. A. (2009). Africa's food crisis: Conditioning trends and global development policy. Keynote paper presented at the international Association of agricultural economists conference, Beijing, China, 16th August 2009.

Adolwa, I. S., Okoth, P. F., Mulwa, R. M., Esilaba, A. O., Mairura, F. S. and Nambiro, E. (2012). Analysis of Communication and Dissemination Channels Influencing the Adoption of Integrated Soil Fertility Management in Western Kenya, The Journal of Agricultural Education and Extension, 18:1, 71–86.

Agbamu, J.U. (2000). Agricultural research–extension linkage systems: an international perspective: *Agricultural Research & Extension Network* (AGREN) Network paper No.10. ODI London.

Agbamu, J.U. (1998). 'A study on agricultural research–extension linkages: with focus on Nigeria and Japan'. Ph.D. thesis, Tokyo University of Agriculture.

AGRA (2009). *The Agro-Dealer Development Programme,* Alliance for a Green Revolution in Africa, http://www.aec.msu.edu/s2/zambia/tour/AGRA_Agro_Dealer_Development_Programme.pdf [accessed 15 March 2011].

Ayieko, M.W. and Tschirley, D.L. (2006). *Enhancing Access and Utilizationsation of Quality Seed for improved Food Security in Kenya,* Working Paper No 27/2006, Nairobi, Kenya: Tegemeo Institute of Agricultural Policy and Development

Asaba, J.F., Musebe, R., Kimani, M., Day, R., Nkonu, M., Mukhebi, A., Wesonga, A., Mbula, R., Balaba, P., Nakagwa, A. (2006). Bridging the information and knowledge gap between urban and rural communities through rural knowledge centres: case studies from Kenya and Uganda. *Quarterly Bulletin of IAALD*, 51(4):143–151.

Avelock, R.G. (1986). 'Linkage: a key to understanding the knowledge system' in G.M. Beal, W. Dissanayake and S. Konoshima, (eds) *Knowledge Generation, Exchange and Utilisation*. Boulder, Colorado: Westview Press.

Bationo, A., Kihara, J., Vanlauwe, B., Waswa, B., Kimetu, J. (2007). Soil organic carbon dynamics, functions and management in West African agro-ecosystems. *Agricultural Systems* 94: 13–25.

Bationo, A., Kimetu, J., Ikerra, S., Kimani, S., Mugendi, D., Odendo, M., Silver, M., Swift, M.J., Sanginga, N., (2004). The African network for soil biology and fertility: new challenges and opportunities. In: Bationo, A. (Ed.), Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa. Academy Science Publishers, Nairobi, Kenya.

Beets, W.C. (1990). Raising and sustaining productivity of smallholder farming systems in the tropics. Ag Be publishing, Alkmaar. In Andre Bationo, Boaz Waswa, Jeremiah M. Okeyo, Fredah Maina, Job Kihara and Uzo Mokwunye (eds); Fighting poverty in sub Saharan Africa: the multiple roles of legumes in Integrated Soil Fertility Management.

Bouare, D. and Bowen, B. E. (1990). Formal and non-formal instruction delivered to farmers by adult instructors, secondary agriculture teachers, and Extension agents.

Bredja JJ, Moorman TB, Karlen DL, Dao TH (2000). Identification of regional soil quality factors and indicators: I. Central and Southern High Plains. Soil Sci. Soc. Am. J., 64: 2115–2124.

Camara, O, and Heinemann E. (2006). Overview of the fertilizer situation in Africa. Background paper for the Africa fertilizer summit, Abuja, 9–13 June, 2006.

Chianu, J.N., Mairura, F., Ekise, I., and Chianu, J.N. (2008). 'Farm Input Marketing in Western Kenya: Challenges and Opportunities', *African Journal of Agricultural Research* 3(3): 167–173.

CNFA AGMARK Kenya Newsletter 2009 Issue 10.

COMESA (2009). *Getting Fertilizers to Farmers: How to do it? Who should do it? and Why it Should be Done?*, COMESA Africa Agricultural Markets Program (AAMP), http://programmes.comesa.int [accessed 15 March 2011].

Denning, G., and Jeffrey S. (2008). Subsidizing agriculture not enough. The Sunday Times, Features, February 24. Malawi: BNLIFAD (2006) *Africa Fertilizer Summit, Abuja, 9–13 June 2006, Heads of State Session, Statement by Lennart Båge.*

Dutta, R. (2009). Information needs and information-seeking behavior in developing countries: A reviewof the research. *The International Information & Library Review* 41, 44–51.

Echezona, R.I. and. Ugwuanyi, C.F . (2010). African University Libraries and Internet Connectivity: Challenges and the Way Forward *Library Philosophy and Practice.*

FAO (2008). The state of food insecurity in the world 2008. Food and Agricultural Organization of the United nations. Available at: ftp//ftp.fao.org/docrep/fao/011/i1291e/i0291e00.pdf.

Food and Agriculture Organization, FAO (1996).; Sowing the seeds of knowledge. World food summit held in Rome, 13–17 November 1996.

Gujarati, D.N. (1999). Basic Econometrics. New York: McGraw Hill.

Hardin, J. and J. Hilbe (2001). Generalized Linear Models and Extensions. College Station, TX: Stata Press.

IFAD *President,* International Fund for Agricultural Development, http://www.ifad.org/events/op/2006/fertilizer.htm [accessed 15 March 2011].

IFDC, (2003). Input Subsidies and Agricultural Development: Issues and Options for Developing and Transitional Economies. Paper Series P-29. International Fertilizer Development Center, Muscle Shoals, AL.

IFDC, (2010). *Abuja Declaration on Fertilizer for an African Green Revolution,* http://www.ifdc.org/Alliances/Abuja_Declaration [accessed 15 March 2011].

Jaetzold, R. & Smith, H. 1993. Farm Management Handbook of Kenya Vol.II NaturalConditions and Farm Management Information GTZ, Germany.

Jaetzold, R., Schmidt, H. (1982). Farm management handbook of Kenya, vol. II: Natural conditions and farm management information. Part A: West Kenya. Kenya Ministry of Agriculture, Nairobi, Kenya.

Kanyanjua, S.M., Mureithi, J.G., Gachene, C.K.K., Saha, H.M. (2000). Soil fertility management handbook for extension staff and farmers in Kenya. KARI Technical Note series no. 6. KARI and LRNP, Nairobi.

Kinyua, J. (2004). *Towards Achieving Food Security in Kenya*, summary note presented at the conference on Assuring Food and Nutrition Security in Africa by 2020: Prioritizing Action, Strengthening Actors, And Facilitating Partnerships, 1–3 April, Kampala, Uganda: International Food Policy Research Institute

Long, J. S. (1997). *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage.

Makinen, M. (2007). Background study report for the project Mapya? – Social Media and Children in Low Income Communities *Journalism Research and Development Centre, University of Tampere*. Available on-line at http://www.uta.fi/jour/jourtutkimus/mediakenya.pdf (Accessed 18.03.12)

Momodu, M. (2002). Information needs and information seeking behaviour of rural dwellers in Nigeria: a case study of Ekpoma in Esan West local government area of Edo state, Nigeria. *Library Review*, 51(8), 406–410.

Munyua, H. (2007). ICTs and small-scale agriculture: A scoping study. Ottawa: IDRC

Muyanga, M. and T. S. Jayne. (2006). Agricultural Extension in Kenya: Practice and Policy Lessons. Tegemeo Working paper 26/2006. Tegemeo Institute of Agricultural Policy and Development, Egerton University, Nairobi.

National agricultural sector extension policy (NASEP) implementation framework, (2007). National extension task force; Nairobi.

Njuguna, C. (2011). To halt starvation, Kenya must stop fire-fighting approach to food security. The Friday daily Nation, February 18. Kenya: NMG.

Nkonya, E. Schroeder, T. Norman, D. (1997). Factors affecting adoption of improved maize seeds and fertilizers in Northen Tanzania. J. Agric Econ 48(1):1–12.

Norrish, P., Lloyd Morgan, K. and Myers, M. (2001). Improved-communication strategies for renewable natural resource research outputs. *Socioeconomic Methodologies for Natural Resources Research. Best Practice Guidelines.*Chatham, UK: Natural Resources Institute.

Odendo, M., Ojiem, J., Bationo, A. and Mudeheri, M. (2006). On-farm evaluation and scaling-up of soil fertility management technologies in western Kenya. *Nutr Cycl Agroecosyst* 76:369–381.

Oguya, V. (2006). Bridging Africa's digital divide: a case for CD-ROM technology. *Quarterly Bulletin of IAALD* 51(4): 159–165.

Oniango R.K. (2001). The role of Africa's agriculture in poverty alleviation, food security and industrial development. Africa Crop Science Conference proceedings 3:1303–1311.

Poulisse, J.(2007); Increased fertilizer use opportunities and challenges for food security in sub-Saharan Africa. Paper presented at the 13th International Annual conference and Exhibition. Arab Fertilizer Association, Sharm El-Sheikh, 6–8 Feb 2007.

Ramisch, J.J., Misiko, M.T., Ekise, I.E. and Mukalama, J.B. (2006). Strengthening 'folk ecology': community-based learning for integrated soil fertility management, western Kenya international journal of agricultural sustainability 4(2): 154–168.

Rapport, D.J. and Whitford, W. (1999). How ecosystems respond to stress: Common properties of arid and aquatic systems. BioScience 49(3): 193–203.

Rapport, D.J., Regier, H.A. and Hutchinson, T.C. (1985). Ecosystem behavior under stress. The American Naturalist 125: 617–640.

Rasmussen, A.M. (2001). Information and Development: The information effect *Information Development* 17(1): 12–18.

Rees, D., Momanyi, M., Wekundah, J., Ndungu, F., Odondi, J., Oyure, A.O., Andima, D., Kamau, M., Ndubi, J., Musembi, F., Mwaura, L. and Joldersma, R. (2000). Agricultural knowledge and information systems in Kenya – Implications for technology dissemination and development. Agricultural Research & Extension Network (AgREN), *Network Paper No.107*.

Rege, R. (2006). Harnessing institutional alliances and partnerships in agricultural information systems in Kenya. *Quarterly Bulletin of IAALD*, 51(4): 215–222.

Republic of Kenya, (1997). Siaya District Development Plan, (1997–2001): Office of the Vice President, Minister for Planning and National Development. Government Printer, Nairobi, Kenya.

Rogers, E.M. (2003). Diffusion of innovations – 5th ed. Free Press, New York, 551pp.

Sanchez, P.A. (2002). Soil Fertility and Hunger in Africa. *SCIENCE* 295: 219–220.

Sanchez, P.A. and Jama, B.A. (2002). Soil Fertility Replenishment Takes Off in East and Southern Africa. In: Vanlauwe, B., Diels, J., Sanginga, N. and Merckx, R. (Eds) Integrated Plant Nutrient Management in Sub-Saharan Africa: From Concept to Africa. CABI Publishing, New York, pp. 23–45.

Sanginga, N. and Woomer, P.L. (Eds.) (2009). Integrated soil fertility management in Africa: Principles, practices and developmental process. Tropical Soil Biology and Fertility Institute of the International Centre for Tropical agriculture. Nairobi. 263 pp.

Smith, M.D. and P.G. Moffatt (1999). Fisher's information on the correlation coefficient in bivariate logistic models. *Australian & New Zealand Journal of Statistics 41*, 315–330.

Tittonell, P., Vanlauwe, B., Leffelaar, P.A, Shepherd, K.D. and Giller, K.E. (2005). Exploring diversity in soil fertility management of smallholder farms in western Kenya. II. Within-farm variability in resource allocation, nutrient flows and soil fertility status. *Agric Ecosyst Environ* 110:166–184.

Vanlauwe, B. and Giller, K.E. (2006). Popular myths around soil fertility management in sub-Saharan Africa. *Agriculture, Ecosystems and Environment* 116: 34–46.

Vanlauwe, B., (2004). Integrated soil fertility management research at TSBF: the framework, the principles, and their application. In: Bationo, A. (Ed.), *Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa. Academy Science* Publishers, Nairobi, pp. 25–42.

Wanga, E. (1999). Keynote address on new perspectives in rural extension. Regional refresher international course in rural extension (ICIRE) on: Challenges and prospects, Egerton University, 21st Nov.–3rd Dec. 1999.

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Plantwise Knowledge Bank: Building Sustainable Data and Information Processes to Support Plant Clinics in Kenya

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Abstract: Plantwise supports plant health in developing countries through a combination of 'plant clinics' providing plant health advice to farmers, strengthened collaboration between different plant health stakeholders, and the Knowledge Bank database. In addition to providing free open-access tools for plant pest and disease management, the Knowledge Bank supports the plant clinics by providing secure data and information tools for managing and analyzing clinic data, and by working with them to learn to handle clinic data. While analysis of these data provides important insights into clinic performance, there are major challenges to collecting this data. CABI, in conjunction with the Ministry of Agriculture in Kenya, has been running a pilot to establish appropriate and sustainable data; data from all 15 districts running plant clinics are now being analyzed in the Ministry of Agriculture, and the Knowledge Bank team is using these lessons to work with other countries to develop locally-appropriate data and information systems.

Resumé: Plantwise soutient l'état des plantes dans les pays en développement grâce à l'effort combiné des «cliniques des plantes» offrant des conseils sur l'état des plantes aux agriculteurs, d'une collaboration renforcée entre les différents intervenants de la santé des plantes, et de la banque de données Knowledge Bank. En plus de fournir des outils en libre-accès pour la lutte phytosanitaire et la gestion de maladies, la Knowledge Bank soutient les cliniques des plantes en fournissant des données sécurisées et des outils d'information pour gérer et analyser les données cliniques, et en travaillant avec eux pour leur apprendre à gérer des données cliniques. Alors que l'analyse de ces données fournit d'importantes indications sur les performances cliniques, il y a des défis importants pour la collecte de ces données. Le CABI, conjointement avec le Ministère de l'agriculture au Kenya, a exécuté un projet pilote pour établir des données appropriées et durables; les données de tous les 15 districts ayant des cliniques en fonction sont actuellement en cours d'analyse au Ministère de l'agriculture, et l'équipe de la Knowledge Bank utilise ces leçons pour travailler avec d'autres pays pour développer des données et des systèmes d'information appropriés localement

Resumen: "Plantwise" apoya la sanidad vegetal en países en desarrollo mediante la combinación de "clínicas para plantas" que proporcionan asesoría en asuntos fitosanitarios para los agricultores, fortalecimiento de la colaboración entre los diferentes actores del sector de salud vegetal y la base de datos del Banco de Conocimientos. Además de proporcionar herramientas de acceso abierto en forma gratuita para el manejo de plagas y enfermedades en especies de plantas, el Banco de Conocimientos apoya a las clínicas para plantas no solo proporcionando herramientas de información y datos eficaces para el manejo y análisis de datos clínicos, sino también trabajando con las clínicas para que éstas aprendan a manejar datos clínicos. Mientras que el análisis de estos datos proporciona información importante sobre el desempeño clínico, existen grandes retos para la recolección de estos datos. CABI, junto con el Ministerio de Agricultura de Kenia, ha estado realizando un estudio a nivel piloto para establecer datos apropiados y sostenibles. Los datos de cada uno de los 15 distritos en los cuales operan estas clínicas para plantas ahora están siendo analizados por el Ministerio de Agricultura, y el equipo del Banco de Conocimientos está utilizando las lecciones aprendidas para trabajar con otros países para desarrollar sistemas de información y datos que sean localmente apropiadas.

Introduction

There are 870 million undernourished people in the world and yet progress in reducing hunger has slowed up since 2007–8 (FAO, 2012). In the competition for nourishment from crops, however, it is estimated that up to 40% of the food grown worldwide is lost to plant pests and diseases (Oertke, 2006). This problem is exacerbated by international trade, intensified production and climate change altering and accelerating the spread of plant pests. Clearly there is an opportunity to lose less and feed more by improving control of such pest problems, particularly in the developing world.

Plantwise (www.plantwise.org) is a global programme, led by CABI, to support smallholder farmers with accessible, practical knowledge, so they can help themselves to lose less of what they grow and provide more food for their families (Romney et al. 2013). The expected outputs from the programme include:

- innovative linkages established between key actors in a plant health system, including extension, research, regulation and input supply;
- national networks of plant clinics established to provide regular advice to farmers and facilitate pest surveillance through the collection and use of plant clinic data;
- a Knowledge Bank developed according to user needs for pest diagnosis, management and distribution, and available to national advisory services and organisations contributing to plant health systems;
- monitoring and evaluation schemes implemented for continuous learning, improving processes and quantifying outcomes and impact.

A key to the programme's success is the development of partnerships. Plantwise facilitates institutional change through strong partnerships with relevant government ministries and departments, especially those charged with extension and crop protection (often representing the National Plant Protection Organization). With national governments' agreement, Plantwise strengthens national plant health systems by linking in-country stakeholders, such as farmers and community-based organisations, extension services, diagnostic services, research institutions, agro-input suppliers, post-secondary educational institutions, and non-governmental organizations.

Linking Clinics and the Knowledge Bank

The Plantwise plant clinics work in a similar way to human health clinics with trained 'plant doctors' being available, backed up with close links to pharmacies, diagnostic services and laboratories. They are set up where farmers congregate, often at markets, and the plant doctors provide practical advice on how best to treat crop pests and diseases from the samples that farmers bring. At the same time, data is recorded about the farmer, location, problem and the advice given.

The Plantwise Knowledge Bank (http://www.plantwise.org/KnowledgeBank) is a comprehensive online resource developed according to user needs for pest diagnosis and distribution, as well as plant health management. As described elsewhere (Leach and Hobbs, 2013), the Knowledge Bank provides expert information that has been validated and checked and that can then be accessed by all in the plant health system. It delivers country-specific webpages, pest distribution maps, pest alerts, simple diagnostic tools, factsheets and pest management decision guides.

However, in developing the Plantwise programme it was recognized that data coming from the clinics were of high potential value and should also be collected, verified and analysed. As will be outlined in this paper, managing this data provides an entirely separate set of issues and practical problems that need to be resolved.

General Issues of Handling Plant Clinic Data

There are several reasons why collecting and analysing the plant clinic data could be highly beneficial. The information can document the work of the clinics, when they are open and how many farmers they support. It can also monitor quality of advice and provide insight into the improvement of service to farmers. Surveillance also can be made on what crops are grown and where, as well as what pests and diseases are attacking them. This in turn leads to helping predict outbreaks of common pests or identify new and emerging diseases, possibly suggesting where further research is needed. Importantly for all involved in a major programme such as Plantwise, the data can feed into the monitoring and evaluation of the effectiveness of programme activities in generating the desired outputs and outcomes.

However, such data from the field can also be highly sensitive. Trade can be severely impacted if a new quarantine pest is indicated as being present on a commodity crop. Similarly, prices can change if major pest outbreaks are predicted. As Plantwise does not run the clinics on a day-to-day basis, only providing training and start-up funding, the clinic data will belong to the organisations collecting them. The programme would therefore need to negotiate close partnership agreements with those actually collecting the data to be able to help in the process. Furthermore, records collected at the clinics would associate plant doctor names and telephone numbers with other valuable metadata leading to the potential for information abuse. Plantwise had to be able to understand, appreciate and work through these issues. This led to the establishment of cross-programme methodologies, tools and working practices. These were condensed into three Plantwise Policy Statements on Pest Reports, Use of Plant Clinic Data and Personal Data Protection (the link to Plantwise policies is at www.plantwise.org). In addition, a Policy on Intellectual Property Rights in the Plantwise Knowledge Bank was published (http://www.plantwise.org/default.aspx?site=234&page=4363). These policies collectively express how Plantwise would use clinic data in a fair and confidential manner and demonstrate to partners that they can trust sharing clinic data with CABI to allow the organisation to help actively in data management and analysis. To ensure full understanding, and as it was also hoped that countries might share the data widely, both in-country and internationally, data agreement templates were also prepared for signature by CABI and partners to identify how data might be used confidentially and, with permission, how and when these data might be further published in open access. These agreements describe options for partners to share data with the Plantwise Knowledge Bank and are to be signed by both partner and CABI. An example is given at http://www.plantwise.org/default.aspx?site=234&page=4717.

Another area that had to be addressed was that of access to the plant clinic data from the Knowledge Bank. The content in the Knowledge Bank that provides help with diagnosis, treatment and distribution of pests is open access and freely available to all. This content is collected from CABI's repositories, those of content partners and from other open access sources. However, the clinic data, and the associated tools for processing and analysis, needed to be access-controlled so that only those users specifically identified by contributing partners could be allowed viewing rights. This resulted in the creation of an entirely separate access-controlled section of the Knowledge Bank, as illustrated in Figure 1.

Practical Considerations in Handling Plant Clinic Data

Collecting and managing data was clearly going to be a process that would require time and resources. Discussions needed to be held with countries implementing Plantwise

on the importance of the collection of data and the value to them of the information such data would provide. Commitment could therefore be made by the countries to what otherwise might seem to be a difficult and pointless task. Initial talks would build trust but also try to ensure that the incentives for data collection were understood, with CABI providing examples of the sort of analyses that could be undertaken to benefit all stakeholders. Plant doctors might be interested in getting information that would help them prepare their monthly reports, Ministry officials might be interested in what crops were grown where and what pests are attacking them, etc. Once the value of the data was understood, the availability of staff resources, computer skills, hardware and software, etc. could then be taken into account for each country.

It was important in such discussions to have an idea of a workflow that could be understood by all who needed active in its implementation. As highlighted in Figure 2, a theoretical workflow was therefore devised and it was determined what might be needed at each stage.

Figure 1 – Schematic diagram of access controlled and open access sections of the Knowledge Bank

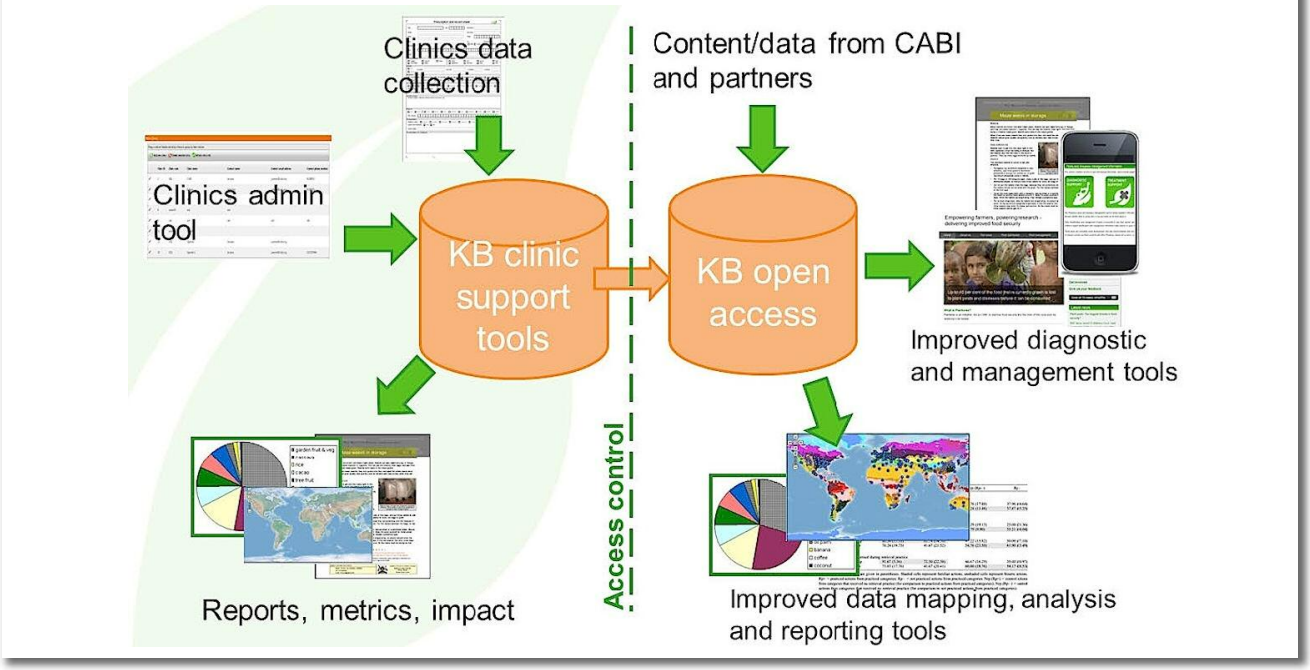
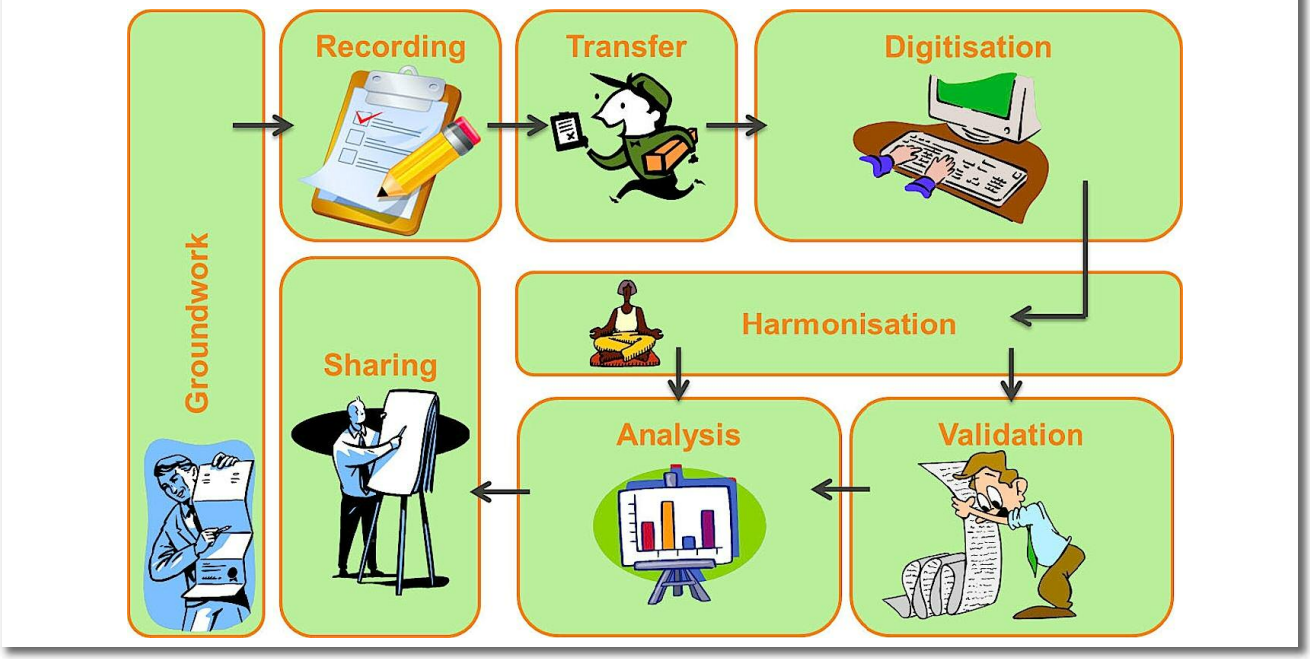


Figure 2 – Stages in a theoretical workflow to process data from plant clinics



Kenya Trial – Testing the Issues and Practicalities

While much thinking had gone into the whole concept of clinic data collection, and that individual ideas and separate workflow stages had been tested with individual countries, there was a need to ensure that an end-to-end solution had been thoroughly tested in practice. CABI has a regional centre based in Kenya and as this was one of the countries initially engaged with the Plantwise programme, it was decided to try to test the concept in its entirety there.

From the beginning, therefore, discussions with the Kenyan Ministry of Agriculture of Plantwise implementation had always involved data and information needs. At the official Kenyan launch of Plantwise, attended by interested parties from all over the country and arranged jointly by the Ministry and CABI, presentations were given on the potential value of clinic data, showing some preliminary analysis of some real clinic data to incentivise all. A Data Agreement was signed by the Ministry and CABI that allowed data to be shared and reviewed by each partner, in part, through the access-controlled section the Knowledge Bank. A staff member, known as the National Data Manager, was allocated by the Ministry to be responsible for the data and a country-wide data plan was then devised by and agreed on by the Ministry and CABI.

The CABI and Kenyan members of the Plantwise team were then able to determine the necessities at each stage of the workflow: what was needed to be done, how it would be done, who would do it, where it would be done, and what was needed in terms of resources (see Table 1). It was then ensured that these necessities were developed and were understood by each of the participants.

To record the information gained and advice given by the plant doctors at the plant clinics, prescription forms were devised, printed and distributed. Thirty-five clinics were organised around fifteen hubs and five hubs were provided with scanning equipment, as it had been decided to try to electronically capture the information on the form as a way of reducing manual input. A central processing office was set up in Nairobi; initially this was in the CABI office, but part of the trial also involved establishing, equipping and training the National Data Manager's office in the Ministry. Training was given across the board, according to each person's place in the workflow. At the same time as this on-the-ground activity was taking place, the CABI Knowledge Bank team was working to build the processes and tools that could effectively handle and analyse high volumes of clinic data. As this was more a trial of logistical issues, it was agreed that the validation and sharing stages would not be tested at this time.

Once this foundation work was in place, the trial started in earnest. After a plant clinic had taken place, completed forms were collected and sent to the local clinic hubs. From here they were consolidated and sent to the central processing office in Nairobi either by courier or through use of the scanner. For the latter, high quality scans of the forms were made and emailed onwards. At the central processing office, data were either entered manually into an Excel spreadsheet or passed through Intelligent Character Recognition (ICR) software that had been purchased.

Guidance from the trial coordinators was given where necessary. For example, initial feedback was given to plant doctors on the legibility of forms and all involved

Table 1 – Essential ingredients and responsibilities for each stage of the data management workflow in Kenya

	What	How	Who	Where	Needs
Groundwork	Supply of clinic prescription forms and training to all involved at each stage	Printing and distribution of forms and training sessions	CABI or in-country staff	In country	Financial support and time from all stakeholders
Recording	Entry of relevant data from farmer interviews	Form which can be scanned by computer or viewed by humans. Follows interview format	Plant Doctors and/or clerks at the clinics	Clinics	Forms, black pen
Transfer	Consolidation of clinic forms, start of entry of data into digital format, and transfer to central database	Forms collected and EITHER scanned and emailed to central processing facility OR sent via courier	Data Transfer Managers	Clinic hub	Power, PC, scanner, email access
Digitisation	Correction of characters recognised by Intelligent Character Recognition soft ware or entered through Excel	Data entry though EITHER ICR software OR manual Excel entry	National Data Manager	Central processing office	Power, PC, good internet access
Harmonisation	Clean up of data and standardisation of terms (e.g. orange, oranges, orange trees)	Access to Knowledge Bank tools or use of Excel processes	National Data Manager	Central processing office	Power, PC, good internet access

in the workflow were regularly helped with any questions or problems. After three months the results of the trial were collected and lessons learned reviewed in order to make recommendations for the future.

These results showed that the prescription form was universally accepted and used by the plant doctors. However, while all clinic hubs could transfer data successfully to the central facility by courier, no forms were flowing from those hubs provided with scanners. The ICR software, it was found, needed forms to be scanned very accurately and in high quality, so much so that the size of the emails containing the scans made them very difficult to send by email. The central processing office was successful in entering the data from the forms manually but where the ICR software was trialled, the complexity of its use made it impossible to use universally. There was also a considerable amount of IT time needed to try to make the ICR work effectively on scanned material. The National Data Manager's office was successfully set up to handle the flow of data through manual entry and so was able to take on full on-going responsibility for the workflow. However, there was recognition of the value that a central facility like the Knowledge Bank could have in proving technical tools for data harmonisation, analysis and reporting. Above all, when initial data started to be analysed, it was shown that while getting the entire system to work was extremely hard work, it was definitely worth it in terms of the information revealed.

Lessons Learned and Recommendations

As a result of this trial, changes were made to the recommended mechanisms for data management for implementation in all Plantwise countries. All CABI staff responsible for initiating Plantwise work in countries were required to begin discussions with the appropriate in-country organisation and work with them to develop data processing plans and partnerships. They would be fully supported by information experts from the central Plantwise Knowledge Bank team. Full consultation with national stakeholders also needed to result in appropriate data agreements being signed. All plant clinics were required to start using the new prescription forms, which were then translated into all necessary languages. In-county printing of forms was to be encouraged. Scanning and emailing of forms was not a recommended transfer method nor was the ICR software recommended as an in-country data entry solution. Instead, a simple data entry template was designed in Excel as a way of speeding up manual data entry and improving its accuracy. This template mimicked the format of the prescription form at data entry but effectively placed all content into appropriate Excel cells. The basic model of manual transfer (e.g. courier) followed by data entry into Excel using this Plantwise data entry template was adopted globally. Validation protocols still needed to be developed and communicated as they were not tested in this trial. This also applied to extensive data sharing. Mechanisms needed to be created for returning data analyses to all stakeholders to keep them incentivised. It was also identified that coordinated training courses and support tools needed to be developed along with improved technical tools for harmonisation (e.g. using Google Refine), which was a very complicated and lengthy manual process. Regular feedback was also required to all involved in the workflow to improve the quality and effectiveness of the process. To make all of this happen, a dedicated data processing project team across Plantwise was set up led by the Knowledge Bank team.

Conclusions and next steps

Work done by Plantwise in Kenya demonstrated to the government not only the value of having trained plant doctors providing pest control advice to farmers but also the value of collecting and analysing the data that could be collected from these consultations. Close collaboration by all partners then showed that the practical difficulties in processing the data could be overcome. In three months' trial, the data from over 400 clinic prescription forms were processed from the thirty-five clinics that are spread out across Kenya.

For Plantwise, the trial provided an ability to modify the concepts of the standard template for data management that it provided to other collaborating countries. Such modifications have now been put in place and include: the requirement of a clustered hub approach to collecting data; no use of ICR technology; a central National Data Manager's office being established with full on-going operational responsibilities; and mechanisms to ensure that offline, as well as online, reports are available from the central Knowledge Bank for circulation to all stakeholders.

While workflows need to be based on simple processes using minimal technology, trying to integrate scanners and ICR software was too complex for overall use in the field. It was noted, however, that many stakeholders and farmers were very familiar with using mobile phones, and it has therefore been decided that as a next step there will be a plan to run a pilot for data collection using mobile devices which will be interfaced closely with the Kenyan government's new e-extension proposals.

A preliminary study of the depth of the information collected on the forms indicated the many different analyses could be undertaken. As hoped for in the planning of the data collection, information was available on pests seen, crops grown, gender of farmers, treatment advice, etc. that gave a survey picture otherwise not available. The potential value was substantial but, recognising that data validation had not been a part of the trial, there was a need for this validation and further professional investigation. This resulted in the Ministry and CABI deciding that a further next step would be to bring together other key stakeholders in the Plant Health System to

study the data carefully in a Data Validation and Analysis Workshop to be held when more data had been acquired. Experts and statisticians from universities, research institutions, the Ministry, pesticide regulating bodies and inspection agencies could then focus on the quality of the data.

This successful trial can be held up to the other countries as a clear example of the ability to overcome difficulties of getting data management and analysis in place and the value of the information to all stakeholder in the national plant health system once data coming from the plant clinics is successfully analysed. The system, with suitable modifications according to local needs, is now being rolled out to all countries implementing Plantwise.

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References

FAO. 2012. *The State of food Insecurity in the World*. http://www.fao.org/publications/sofi/en/.

Leach, M.C. and S.L.A. Hobbs, S.L.A. 2013. "Plantwise Knowledge Bank: Delivering Plant Health Information to Developing Country Users." *Learned Publishing* 26:180–185.

Oerke, E.C. 2006. "Crop Losses to Pests." *Journal of Agricultural Science* 144: 31–43. http://dx.doi.org/10.1017/S0021859605005708.

Romney, D., R. Day, M. Faheem, C. Finegold, J. LaMontagne-Godwin and E. Negussie. 2013. "Plantwise: Putting Innovation Systems Principles Into Practice."*Agriculture for Development* 18: 27–31.

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Innovation in Extension Services for Improved Farmer Access to Agricultural Information in Uganda

Patrick Kasangaki

Abstract: Over 88% of Uganda's population depend on agriculture and the majority live in abject poverty. While the government has adopted policies aiming atreducing poverty to 10% by 2017, problems such as low soil fertility, low incomes and food insecurity persist. A key element in improving agricultural production is the timely provision of relevant and appropriate information to farmers, but the public extension service has not been effective in reaching farmers with timely relevant information. There is an urgent need for approaches that will enhance the delivery of extension services in order to fill the gap. The Rural Empowerment Network, in collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA), implemented a demand driven innovative extension service using a voucher system to meet the end user needs of agricultural information in Uganda. This paper demonstrates how the voucher system allows farmers to receive customized responses to their agricultural problems.

Resumé: Plus de 88 % de la population ougandaise dépendent de l'agriculture et la majorité vit dans une pauvreté abjecte. Alors que le gouvernement a adopté des politiques visant à réduire la pauvreté de 10% d'ici 2017, des problèmes tels que la faible fertilité dessols, de faibles revenus et l'insécurité alimentaire persistent. Un élément clé de l'amélioration de la production agricole est la fourniture en temps opportun d'informations pertinentes et appropriées pour les agriculteurs, mais le service public de vulgarisation n'a pas été efficace pour que les informations pertinentes atteignent les agriculteurs en temps opportun. Il y a un besoin urgent d'approches pour contribuer à l'amélioration de la prestation des services de vulgarisation afin de combler l'écart. Le Réseau d'autonomisation rurale (REN), en collaboration avec le Centre technique de coopération agricole et rurale (CTA), a mis en oeuvre un service de vulgarisation innovant en Ouganda, répondant à la demande grâce à l'aide d'un système de coupons pour satisfaire les besoins en information agricole de l'utilisateur final. Cet article montre comment le système de coupons permet aux agriculteurs de recevoir des réponses adaptées à leurs problèmes agricoles.

Resumen: Más del 88% de la población de Uganda depende de la agricultura y la mayoría vive en pobreza extrema. Si bien el gobierno ha adoptado políticas destinadas a reducir la pobreza hasta en un 10% antes del 2017, persisten problemas como la baja fertilidad del suelo, los bajos ingresos y 3la inseguridad alimentaria. Un elemento clave en elmejoramiento de la producción agrícola es el suministro oportuno de información pertinente y adecuada a los agricultores, pero el servicio de extensión del sector público no ha sido eficaz para llegar a los agricultores con información pertinente y oportuna. Existe la necesidad urgente de enfoques que fomenten la prestación de servicios de extensión con el fin de cerrar la brecha. La Red de Empoderamiento Rural, en colaboración con el Centro Técnico para la Cooperación Agrícola y Rural (CTA, sus siglas en inglés), implementó un innovador servicio de extensión dirigido por la demanda utilizando un sistema de vales para satisfacer las necesidades deusuarios finales de información agrícola en Uganda. Este artículo demuestra cómo el sistema de vales permite a los agricultores recibir respuestas personalizadas a sus problemas agrícolas.

Background

In researching the challenges and choices facing the global community in relation to the future of food and farming, it was found that the application of existing knowledge and technology could increase average food yields two to three-fold in many parts of Africa (GO-Science, 2011).

In common with many African countries, agriculture plays an important role in Uganda's economy. Though agriculture's share in Uganda's gross domestic product (GDP) has steadily declined as the service and manufacturing sectors have grown, agriculture still employs over 80% of the national workforce. Agricultural commodities account for nearly all of Uganda's foreign exchange earnings, with coffee accounting for about 19.9% of exports in 2007 (UBOS, 2008).

Farmers continually seek information from many different sources, but this is still a challenge for them due to factors such as low literacy levels, language barriers and lack of access to relevant information in a timely way. Public sector rural advisory services (RAS) like the National Agricultural Advisory Service (NAADS) are underfunded and underperforming, reaching only a fraction of the farming community. NGOs and the private sector are only partly filling the gap. Farmers, therefore, tend to rely on informal channels of RAS, in particular their peers. There are unexploited opportunities to strengthen the RAS — for example, through appropriate policy advocacy and capacity-development support (Anderson, 2007; World Bank, 2007).

In line with this and as part of its mandate to improve access to agricultural and rural information in Uganda, the Rural Empowerment Network (REN) has been implementing a demand-driven information service to meet the agricultural information needs of end-users through a question-and-answer service (QAS) voucher system (VS) since 2008 with a primary focus on serving farmers and extension agents. This paper examines how this innovative approach came to help fill the gaps left by the national extension and rural advisory services in Uganda.

REN taps into the expertise of the existing National Agricultural Research network of the National Agricultural

Research Organisation (NARO) in order to meet the information needs of end-users through the implementation of this innovative and proactive approach. It leverages its existing relationship with farmer groups and researchers using a simple system that smoothes these information flows. The approach shifts the role of the field agent from providing one-way advice to facilitating dialogue between farmers and a rich reserve of experts.

In this paper, 'extension' refers to all the different activities that provide the information and advisory services that are needed and demanded by farmers and other actors in agri-food systems and rural development (Christoplos, 2010). This term is taken to be synonymous with 'rural advisory services'.

Objectives of the Approach

- To provide timely and accurate responses to farmers' questions on best practices.
- To mobilise existing agricultural expertise in order to improve agricultural productivity, food security and rural livelihoods in Uganda.
- To make research outputs more visible by linking farmers and extension to research scientists.
- To generate online knowledge content and share it widely.
- To build rural agricultural information archives at the community level.
- To catalyse communication among farming communities for purposes of agricultural and rural development.

Geographical Coverage

By June 2009, the service had reached nine hundred farmers in seven districts of Kasese, Kayunga, Kyenjojo, Mityana, Nebbi, Soroti and Wakiso in five different agro-ecological zones. Hundreds more farmers have been reached indirectly through radio broadcasts, local communication, farmer radio listening groups and local information archives. The approach has helped REN contribute to improved agricultural productivity, food security and rural livelihoods in Uganda through timely and accurate responses to farmers' information needs on best agricultural practices.

The QAS VS Process

Vouchers are the means by which information needs of farmers are identified and answers are provided to them. A voucher is the right given to a farmer or group of farmers to seek information and receive a customised response to solve a specific agricultural problem. It entitles them to submit an information request that addresses their problem in a systematic manner and in return receive a customised response from an expert. It is essentially a form capturing the farmer's information need in a systematic and exhaustive way. In other words, the process links farmers to knowledge solutions in the research network. It is a practical, demand-driven way of drawing out and addressing farmers' actual information needs.

To overcome the human-resource challenges faced by a number of extension service providers, the QAS VS uses trained field agents (FAs) with farming backgrounds residing among the farming communities and understanding both English and the local language. They are responsible for distributing vouchers and capturing the farmers' information requests using a standard form. They also take photographs to illustrate the request; at least three photographs are taken and used when the request is published online. The FA submits the farmers' questions to a rural information broker (RIB) in the community with information and communications technology (ICT) skills who publish the farmers' questions in a RIB's journal online.

The answering service (AS), in this case REN in collaboration with the National Agricultural Research Organisation (NARO), identifies an expert through an existing expert database to answer the farmer's question. The AS interacts with the expert to ensure that the answer is provided in a timely way. If required, a representative of the AS will visit the expert to help him or her with the formulation of the answer.

The AS may also use existing library and web resources to supplement the expert's response to the questions if necessary. The AS sends the expert an e-mail with the link to the information request and asks them to respond to the question. Once the answer is provided, the AS publishes it on-line in the AS journal.

When the answer to the question is available, the RIB prints the answer and submits it to the FA. The FA explains the answer in an appropriate language and helps the farmer complete an evaluation questionnaire which is returned to the RIB who will publish it online. Meanwhile the Controlling Agent (CA) follows all the different stages regarding the information request and pays all service providers for the different services rendered once a farmer gives a positive evaluation of the answer provided.

All questions and their answers are published on the RUN website, which was developed by the Information Systems for International Cooperation in Agricultural Research and Rural Development (ISICAD) of the Federal Agency for Agriculture and food of Germany (BLE) with whom REN collaborates. Information on this website is open access and can be accessed by the information society for policy and research purposes.

All questions and their answers have also been compiled into hard copy information archives at suitable locations among the farming communities. These archives are simple files that contain printed versions of the questions and their answers. They are kept at public places (e.g., a community centre) that are easily accessed by farmers. They have proven to be a useful way of improving agricultural information delivery to farming communities as they facilitate learning and information exchange.

Tools Employed

Information request forms or vouchers are used to systematically capture farmer information needs. The QAS VS uses a number of ICTs that enable two-way communication between the research community and the end-users of the research. ICTs can improve and enhance two-way information flows and there is substantial evidence that without two-way information flow, development efforts fail (Zijp, 1994). These include digital cameras used to capture images matching the farmer's problem and computers used to publish the questions and their answers on the Internet. The most frequently asked questions (FAQs) and their answers are selected and radio scripts are produced in English. To help overcome language barriers, these are translated into local languages — in this case *Ateso, Luganda, Luo, Rukonzho and Runyakitara* — which are spoken by farmers in REN's operational areas. They are also broadcast as fifteen minute farmer radio programs to the farming communities; the use of radio as a tool by the QAS VS has facilitated information dissemination to about five million listeners. Copies of the radio programmes are put on compact discs and distributed to farmers and farmer groups to help in the sharing of best farming practices. The programs are also uploaded on the RUN website for purposes of information sharing.

Voucher Distribution

To date a total of nine hundred farmer requests for information have been responded to. In response to the critical role women in low-income countries play in agriculture and its contribution to improving rural livelihoods, more vouchers were distributed to women than men. 54.4% of the vouchers were distributed to female farmers (490 or 54.4%) while 45.6% were distributed to male farmers (Table 1).

Impact

In 2011 with support from BLE of Germany, an impact study was carried out to measure impact the approach achieved. A questionnaire was used to interview 550 randomly sampled farmers to gather data and information on the extent to which the project had improved their farm production. A statistical package SPSS was used for data analysis.

Table 2 gives a detailed analysis of the different information requests by theme. The information requests were diverse, the most popular being crop production (315 requests), followed by animal production (155), with pest control and marketing (20) a distant third.

Table 3 shows the impact the QAS VS approach had on farmer productivity with most farmers realising a 51–75% increase in crop, animal or aquaculture productivity.

Table 4 shows that there was an increase in farmer engagement in marketing, post-harvest processing and pest control, with the major increase reported in the range of 26–50%.

Table 1 – Gender distribution of vouchers issued by site

District	Male	Female	Total
Kasese	45	55	100
Kayunga	97	103	200
Kyenjojo	72	78	150
Mityana	39	61	100
Nebbi	66	84	150
Soroti	42	58	100
Wakiso	49	51	100
Total	***410***	***490***	***900***

Outputs

- The QAS VS was introduced to forty local authorities and nine hundred farmers.
- Fifteen Field Agents were trained.
- Nine hundred different questions and their answers were published online at www.runetwork.org | www.erails.net/UG/ren/qas-2009
- A database of thirty-five subject matter specialists was developed.

Table 2 – Distribution of vouchers by theme

Theme	Kasese	Kayunga	Kyenjojo	Mityana	Nebbi	Soroti	Wakiso	Total
Crop production	33	72	52	37	46	35	40	**315**
Animal production	20	35	22	17	27	22	12	**155**
Pest control	3	2	3	1	6	2	3	**20**
Marketing	2	2	6	2	6	0	2	**20**
Forestry	1	2	2	1	2	1	4	**13**
Post-harvest processing	1	2	2	1	2	1	1	**10**
Aquaculture	1	3	3	1	1	0	0	**9**
Natural resources management	1	2	2	2	1	1	0	**8**
Total	***62***	***120***	***92***	***61***	***91***	***62***	***62***	***550***

Table 3 – Effect on productivity by enterprise

	Increase in productivity (%)							
	< 0	0–25	26–50	51–75	76–99	100	> 100	Total
Crop production	18	55	73	238	92	62	12	550
Animal production	8	36	43	125	51	38	11	312
Aquaculture	0	2	5	12	8	2	0	29

Table 4 – Increased engagement by theme

	Increase in engagement (%)							
Theme	< 0	0–25	26–50	51–75	76–99	100	> 100	Total
Marketing	18	55	220	81	110	55	11	550
Post-harvest processing	15	37	231	48	125	44	50	550
Pest control	12	73	209	117	62	59	18	550

- Existing expertise was mobilised. (>70 people).
- Nine hundred questions and answers are archived at fifteen sites.
- Increased outreach through the broadcasting of seventy-two radio programs.
- 744 radio recordings were distributed to listening groups in the farming communities.

REN, in collaboration with FARA, is currently up-scaling the approach to a new district of Apac in northern Uganda.

Recommendations

The results show that the QAS VS is an effective method of providing information services to farmers. An improvement was reported in farmer productivity, with most farmers realising an increase in crop, animal or aquaculture productivity. Farmers also reported increased engagement in marketing, post-harvest processing and pest control activities. This supports the conclusion that the days when agricultural extension were synonymous with the work of public sector agencies are over (Christoplos, 2010). The QAS VS was developed primarily as an information service and not as a possible approach to extension. Organisations that are not usually categorised as 'extension agencies' are currently providing some of the most innovative extension services (Christoplos, 2010). The QAS VS falls into this category and those involved in providing extension services are urged to consider using it as a possible extension approach. No single method of providing information to farmers or extension approach can meet all of the complex agricultural challenges.

Decisive action is needed, including the QAS VS which has proved to be an effective method of meeting the actual expressed information needs of farmers. To make the service cost-effective, the identified frequently asked questions and best practices documented as answers can be converted into radio programs to reach more farmers.

The QAS VS relies upon and uses existing structures in the communities it serves (e.g., FAs and RIBs), and as such may not be expensive. However, support is needed for staff to provide the service and to cover the cost of producing, translating and airing radio programs on best practices. Different countries are thus urged to consider the QAS VS as one of their approaches to national extension services. Its support should not be left to only development partners as their priorities may not coincide with those of the farming communities who have confirmed that they benefitted from the service.

The QAS VS is a promising and complementary approach to providing extension services with potential for further up-scaling in Uganda and elsewhere. Effective extension services require government commitment and sustainable sources of finance. The injection of project resources to agricultural extension projects can mobilise extension efforts for a short period of time, but their sustainability has generally been poor (Christoplos, 2010).

Accountability and promotion of a farmer-led extension model is an integral part of the QAS VS. Key elements in improving the performance of decentralised agricultural extension systems have been identified as maintenance of transparency and accountability to stakeholders. If decentralisation is to work, agricultural extension workers must be accountable to those who benefit from their services and to the agencies that fund the programs. In other words, a transparent system of accountability is important for shareholders and stakeholders alike in taking ownership of these programs and monitoring the impacts of a decentralised extension system (Swanson and Rajalahti, 2010). Development partners and governments seeking decentralised approaches to providing extension services are thus urged to consider the QAS VS as a viable option. It can be used to improve the evidence base upon which decisions are made for satisfying the needs of the agricultural community and to monitor and assess progress and impact.

Literature cited

Anderson, J.R. 2007. "Agricultural Advisory Services." *Background Paper for the World Development Report 2008*, 44 p. www.g-fras.org/fileadmin/UserFiles/Documents/Background_Information/Agricultural-Advisor-Services_WDR_2008.pdf.

Christoplos, I. 2010. *Mobilizing the Potential of Rural and Agricultural Extension* Food and Agriculture Organization of the United Nations and Global Forum for Rural Advisory Services, Rome, 58 p. http://www.fao.org/docrep/012/i1444e/i1444e.pdf.

Foresight. 2011. "The Future of Food and Farming: Challenges and Choices for Global Sustainability Executive Summary". *Final Project Report*. London: The Government Office for Science, London, 9–37.

Swanson, B.E. and R. Rajalahti. 2010. "Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems". *Agriculture and Rural Development Paper* 45. Washington, DC: World Bank.

Uganda Bureau of Statistics (UBOS). 2008. *National Service Delivery Survey 2008* Kampala: Uganda Bureau of Statistics.

World Bank 2007 *World Development Report 2008: Agriculture for Development.* Washington, DC: World Bank.

Zijp, W. 1994. *Improving the Transfer and Use of Agricultural Information: A Guide To Information Technology* World Bank Discussion Paper 247. Washington, DC: World Bank. 99 p.

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Managing a Web Portal Adapting to New Technologies

Soonho Kim, Kathryn Pace Kincheloe, Yuan Gao and Valdete Berisha

Abstract: This paper presents a study of how new technologies can help manage web content and outreach activities in the context of capacity building in agricultural economics. The Web portal of the African Growth and Development Policy Modeling Consortium (AGRODEP), facilitated by IFPRI, was developed to serve as an online repository to access economic modeling tools, data, documents and events. To achieve these objectives, the Web portal has been adapting technologies including Drupal for content management, Google Analytics for web log analysis, social media for outreach via e-newsletters and bulletins, and Schema.org, which creates better visibility of AGRODEP members in web search engine results. Possible steps to further improve the AGRODEP Web portal include bringing external contents from Linked Open Data and mash-up into the AGRODEP portal as a way to provide more relevant and up-to-date information to AGRODEP members.

Resumé: Cet article présente une étude de la manière dont les nouvelles technologies peuvent aider à gérer des contenus web et des activités de sensibilisation dans le cadre du renforcement des capacités en économie agricole. Le portail web d'AGRODEP (Consortium de modélisation des politiques de croissance et de développement en Afrique) facilité par l'IFPRI, a été développé pour servir de référentiel en ligne pour accéder aux outils de modélisation économique, aux données, documents et événements. Pour atteindre ces objectifs, le portail web a adapté diverses technologies y compris Drupal pour la gestion du contenu, Google Analytics pour l'analyse des données sur le web, les médias sociaux pour la sensibilisation via des lettres d'information et bulletins électroniques, et Schema.org qui crée une meilleure visibilité des membres d'AGRODEP dans les résultats des moteurs de recherche sur le web. Pour améliorer encore le portail web AGRODEP, les mesures à prendre seraient d'importer le contenu externe de Linked Open Data et des applications composites dans le portail AGRODEP, pour obtenir un moyen de fournir de l'information plus pertinente et à jour aux membres d'AGRODEP.

Resumen: Este trabajo presenta un estudio sobre cómo las nuevas tecnologías pueden ayudar a manejar el contenido web y las actividades de divulgación en el contexto de fortalecimiento de capacidades en economía agrícola. El portal web del Consorcio de Modelación de Políticas para el Crecimiento y el Desarrollo Africanos (AGRODEP, sus siglas en inglés), facilitado por el Instituto Internacional de Investigación sobre Políticas Alimentarias (IFPRI, sus siglas en inglés), fue desarrollado para servir como un repositorio en línea para acceder a las herramientas de modelación, datos, documentos y eventos económicos. Para lograr estos objetivos, el portal Web ha ido adaptando tecnologías, incluyendo Drupal para el manejo de contenidos, Google Analytics para el análisis de logísticas Web, redes sociales para difusión mediante boletines electrónicos y comunicados, y Schema.org, lo que otorga una mejor visibilidad de los miembros de AGRODEP en los resultados de motores de búsqueda en la Web. Posibles pasos para mejorar aún más el portal Web de AGRODEP incluyen traer contenidos externos de Linked Open Data y la aplicación web híbrida "mash-up" al portal de AGRODEP como una forma de proporcionar información más relevante y actualizada para los miembros del Consorcio.

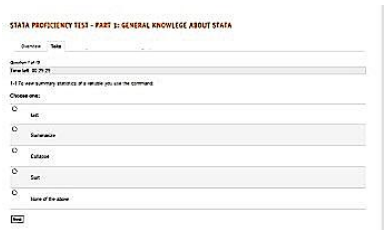
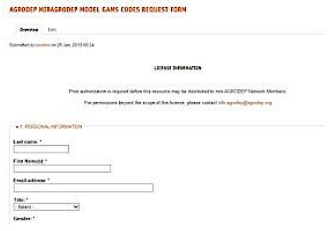
The volume of Web content available on the World Wide Web has increased dramatically over the past decades. Web content management systems are becoming essential for organizations with a significant Web presence as the volume of content continues to increase [McKeever, 2003]. Content management systems (CMS) have evolved rapidly from the basic HTML editors in late 90's to the sophisticated CMSs such as Drupal[1] and WordPress[2] which allow publishing, editing and modifying content as well as maintenance from a centralized Web interface. Such systems of content management provide procedures to manage workflow in a collaborative environment [Eden, 2006].

The African Growth and Development Policy (AGRODEP) Modeling Consortium is an initiative aimed at positioning African experts to take a leadership role in the study of strategic development questions and the broader agricultural growth and policy debate facing African countries. AGRODEP launched its Web portal in October 2011 (http://www.agrodep.org). The web portal provides a membership-based information repository to give access to resources including models, data, publications, events and networks. The AGRODEP web portal serves not only as an information repository but also a collaborative and social network for members through AGRODEP wiki and blogs. AGRODEP members are able to collaborate with other African researchers, share interesting research topics and debates, and create subgroups based on research themes such as impact evaluation under the umbrella of the AGRODEP web portal.

The AGRODEP web portal has been facing different challenges — it has to serve its roles as a repository and as a collaborative and social network while at the same time evolving from the initial launching stage and proving more contents and members. Some of the specific roles/challenges for AGRODEP include:

- Managing massive content including models, data, publications, and event and network activities.
- Maintaining access control to that content on the granular level.

Table 1 – Drupal contributed modules and example pages associated with requirements from the AGRODEP Web portal

Requirements	Modules	Example
Models, data, resource, network, and events	Drupal Core[9]	
Various user roles and access control based on the roles	Content access[10]	
Training workshops and seminar-related features	Webform[11], Quiz[12], Rate[13], and others	
Wiki	Drupal book[14]	
Blog	Drupal Core	
Seamless Multimedia integration	Embedded media field[15]	
Secure source-code download only available to AGRODEP Members	Webform, and Rules[16]	

- Providing up-to-date country data.
- Analyzing web traffic to align with web activities.
- Communicating with target audience in the cost-effective ways.

In this paper, we introduce how the AGRODEP Web portal resolves these challenges by bringing new technologies into the portal, harmonizing them with the existing structure of the portal.

AGRODEP content management

Content management system: Drupal – In terms of market share, Drupal[3] is one of the major open source content management systems (CMS) along with WordPress[4] and Joomla![5] [Shreves, 2011]. It has 15,000 free-community built contributed modules, 1,776 themes, and 27,797 developers throughout the world [Drupal, 2013]. Drupal is a powerful and user-friendly tool for building complex sites by supporting a rich structure of taxonomy, offering well-designed user access roles on each page, and providing free contributed modules such as Webform[6] and Quiz[7].

AGRODEP requirements – The AGRODEP Web portal is a closed membership-based system that allows for different roles for users by providing various access levels of contents in the portal:

- **Models, data, resource, network, and events:** The AGRODEP Web portal mainly consists of five components: model, data, resource (publication), network and events. Each component should be a content type.
- ***V*arious user roles and access control based on the roles:**
  - ***AGRODEP members:*** can access the majority of content in the portal including models, source codes of models, datasets, publications, working papers, technical notes, and training materials, online tests, training-related materials (application forms and evaluations), and their own user profile.
  - ***AGRODEP staff and Web team:*** can create and edit new content.
  - ***AGRODEP Web administrator:*** can manage all content and control accessibility of the Web portals.
  - ***AGRODEP committees:*** can access the AGRODEP governance wiki and content regarding specific committee activities.
  - ***AGRODEP partners:*** can access content associated with their AGRODEP partner activities such as training course pages, training materials, and trainee evaluations.
- **Training workshops and seminar-related features:** AGRODEP hosts training workshops and seminars to support young scientists, upgrade the skills of AGRODEP members, and promote technical and methodological innovation to ensure that the consortium remains a world class entity. It requires participants and instructors to access and complete applications, selections processes, training materials, on-site activities, online testing, and evaluations.
- **Wiki:** AGRODEP model and data libraries require a collaborative document repository so that AGRODEP members are able to ask questions of their peers, share tips, and code files securely.
- **Blog:** AGRODEP members need a dedicated private place to share their research information such as funding opportunities, research questions, and policy debates.
- **Seamless Multimedia integration:** Knowledge products of AGRODEP workshops such as video files images and presentations need to be shared with members who didn't attend the workshops and public users who want to check them out.
- **Secure source-code download only available to AGRODEP members:** AGRODEP provides a variety of customized models to AGRODEP members and those source codes are only available to AGRODEP members. At the same time, we need to have a mechanism to track down who download the source codes for impact evaluation.

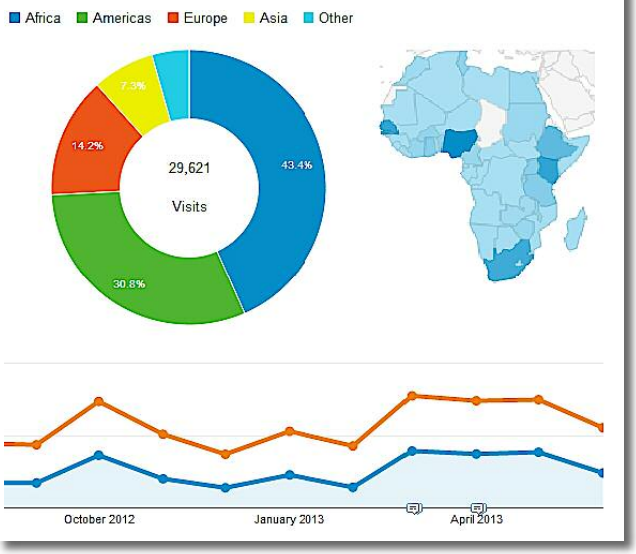
Drupal implementation on the AGRODEP requirements – To implement those requirements using Drupal, the AGRODEP Web portal integrates a variety of contributed modules from the Drupal official Web site[8]. site8. Table 1 lists modules we are currently using in the AGRODEP Web portal.

Google analytics

We use Google Analytics as our primary tool to analyze web traffic patterns. This is a great way for us to monitor our progress because:

- The tools are very easy to use. All of the data we want to monitor is packaged in a user-friendly way and is easily manipulated to suit our needs. Graphics are also very easy to create and are visually attractive (see Figure 1

FIGURE 1 – AGRODEP log analysis



screenshots), allowing us to relay information quickly and efficiently.

- It's comparable, both for our internal use as well as externally. Internally, we can monitor traffic from day to day, month to month, and year to year. Externally, the program is widely used by many different groups, including ifpri.org, and this makes our analyses comparable at a broad level.

In general, we complete analyses on a monthly basis to track overall traffic flow, determine what documents and sections of the websites users tend to be attracted to, examine the primary sources of traffic, and monitor the effectiveness of our use of mass-emails and social media. It is also a great way to quickly find our overall strengths and weaknesses as well as analyze how we address any problems that arise.

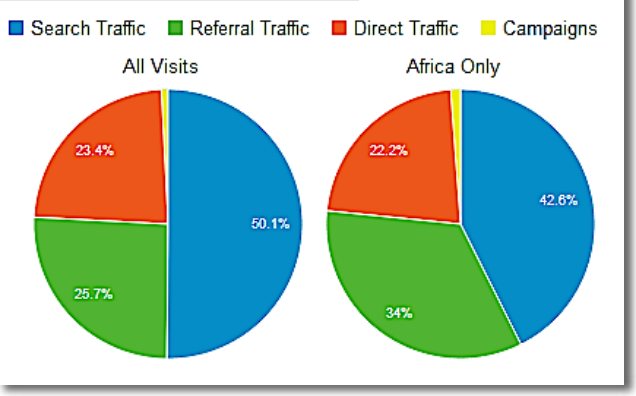
One of the main benefits of using Google Analytics is the ability to break down visitors into subgroups. While we, of course, want to maintain a certain level of total web traffic, our main concern with AGRODEP is reaching users in African countries. Each of the measures and tools in Google Analytics can be reduced into "segments" which can be customized into virtually anything (location, connection speeds, sources, devices, etc.) to suit one's individual analysis needs.

Our most frequently used segment is the continent of Africa. For example, with a couple clicks we can break down the sources of our traffic into "All Visits" and "Africa Only" for a one month period and produce a graphic like Figure 2, pulled directly from Google Analytics.

We can immediately see that referral traffic for our African-based users is more important when compared to global use. From there we can determine which specific referral sources were primarily used and, in turn, focus our outreach and future projects on targeting those specific sources. For African-based users of agrodep.org, email is a huge referral source that has become a priority for maintaining web traffic.

Another benefit of Google Analytics is the ability it gives us to spot problem areas so we can monitor the situation and attempt to find a way to solve it. We can view basic traffic data on several different levels, which gives us the ability to monitor anything from hourly traffic on Tuesdays versus Thursdays to monthly traffic from January 2012 through January 2013. We can use this data to determine the best times to launch grant calls and send newsletters, as well as the importance of consistent outreach.

Figure 2 – Traffic sources from total visits and visits from Africa



Content Mashup

A mashup in the context of AGRODEP Web content management is a web page or part of a page that takes external/internal data from two or more data sources and mixes them together to generate new content in real-time. It provides easy and fast integration of external data sources without saving them in the local server and offers the latest data to AGRODEP users without manual updates. The content mashup was implemented through open Application Programming Interfaces (API) and data sources to produce enriched results that were not necessarily the original reason for producing the raw source data [Ahmet, 2012].

The AGRODEP web portal requires the up-to-date key statistics to display on each country's profile page[17] such as GDP, population, land area, and Global Hunger Index. Given that, AGRODEP looked for appropriate external data for the mashup in the context of AGRODEP requirements:

- Data providers already opened their data and provide machine-readable format of data such as XML or JSON.
- Data providers have the authority to provide those data.
- Data should cover most of African countries and aggregate their value in the country level.

We selected GDP from World Bank, Country land/Agricultural land/Population from FAOSTAT, and Global Hunger Index from IFPRI (Table 2).

Figure 3 illustrates how this API was incorporated into the AGRODEP Country Profiles.

Table 2 – External data sources for content mashup

Data	Data provider	URL	Coverage
GDP	World Bank	http://data.worldbank.org/indicator/NY.GDP.MKTP.CD	Global
Population	FAOSTAT	http://faostat.fao.org/DesktopDefault.aspx?PageID=550&lang=en#ancor	Global
Land Area	FAOSTAT	http://faostat.fao.org/DesktopDefault.aspx?PageID=377&lang=en#ancor	Global
Global Hunger Index	IFPRI	http://data.ifpri.org/lod/ghi	Global

AGRODEP Outreach

AGRODEP communications and outreach activities are targeting policymakers in African countries, regional economic communities (RECs), the international development community, civil society and non-governmental organizations, the media, and the general public. New online technologies, including social media, are being applied by organizations to boost the outreach of online activities [Johnson, 2013][Kelly, 2013]; the AGRODEP web portal has adapted three technologies — social media, an electronic newsletter and bulletin, and Schema.org implementation — in order to meet the following objectives in the context of the AGRODEP web portal:

- Raise awareness about the AGRODEP Modeling Consortium.
- Increase the visibility of AGRODEP members both within and outside Africa.
- Promote/communicate research conducted by AGRODEP members.
- Strengthen partnerships with existing networks in Africa.

FIGURE 3 – Key statistics box in the Sudan Country profile

KEY STATISTICS

GDP: 64,053 (millions of US dollars)
Source: World Bank, Calculated (2011)

Country Area: 250,581 (1000 Ha)
Source:FAOSTAT, Calculated (2009)

Population: 43,552 (1000)
Source:FAOSTAT, Estimated (2010)

Global Hunger Index: 21.5
Source:IFPRI, calculated (2012)

Land deal: 19 investments in Agriculture, Renewable Energy
Source:Land Matrix, estimated (2013)

Social Media – AGRODEP has recently established its presence in several major social media sites including

AGRODEP LinkedIn[18],

AGRODEP facebook[19],

AGRODEP twitter[20], and

AGRODEP YouTube[21], attracting a wide range of audiences and followers. Social media allows AGRODEP to reach its target audience easily. For example, LinkedIn offers a search function of people/groups based on location, type of industry, their interests, and so on. This allows AGRODEP to easily narrow down its target audience and invite that audience into AGRODEP social media groups. Social media also enables AGRODEP members to link with people who are working in civil society (i.e. The African Commission for Policy and Leadership[22]) and non-governmental organizations (i.e. University of Pretoria[23]) or media (i.e. Africa News Network[24]).

Newsletter and AGRODEP Bulletin – AGRODEP has already developed a set of online communication tools which will enable it to become a better known consortium in Africa as well as globally. These online communication tools target a diverse set of audiences and contribute towards the objectives defined earlier in this strategy document.

Newsletter:[25] AGRODEP is broadening the dissemination of its monthly newsletter to include policymakers and the media. This will increase AGRODEP's visibility among local policymakers in Africa and will raise awareness about AGRODEP activities, its members, and policy research that is relevant to African countries.

The Newsletter features AGRODEP members and events, as well as new AGRODEP publications that could be of interest to local policymakers.

AGRODEP Bulletin:[26] AGRODEP has been publishing a four-page bulletin that will feature an editorial on Africa, recent economic data/statistics published on Africa, and information/events in Africa. The bulletin is published every six months and disseminated via email.

Schema.org implementation – Schema.org is an initiative by major search engines including Bing, Google and Yahoo! [Guha, 2011][Macbeth, 2011][Seth, 2011] to create a standard set of vocabularies for structured data that can be used to mark up web content such as events, organizations, people, places and products. Such markup can be recognized by search engines and provide more semantic recognition of given web contents. The vocabulary on schema.org is defined as microformat[27] and RDFa[28] (Resource Description Framework-in-attributes).

We developed a way to incorporate this Schema.org vocabulary by using the themes in Drupal 6 to generate

the html code from the Drupal contents. The user profiles in the portal are created from the views of Drupal, and we updated the view theme of the user profiles by adding the Schema.org vocabulary so that the major search engines can recognize the Schema.org implementation when they crawl our web portal. Figure 4 shows the profile of one of our members as an html page and Figure 5 displays how the Google structured data testing tool[29] extracted the schema.org data that we incorporated from the member's profile.

Figure 4 – An example profile of AGRODEP members in HTML

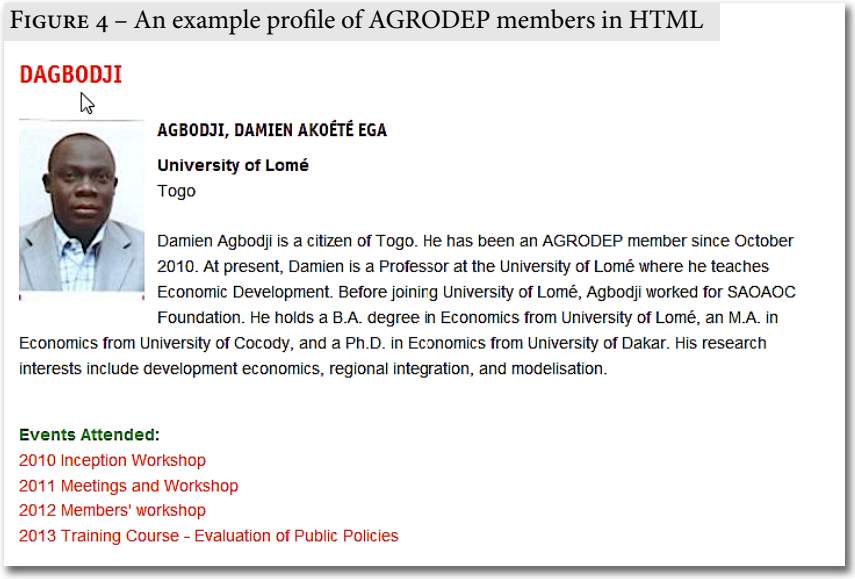
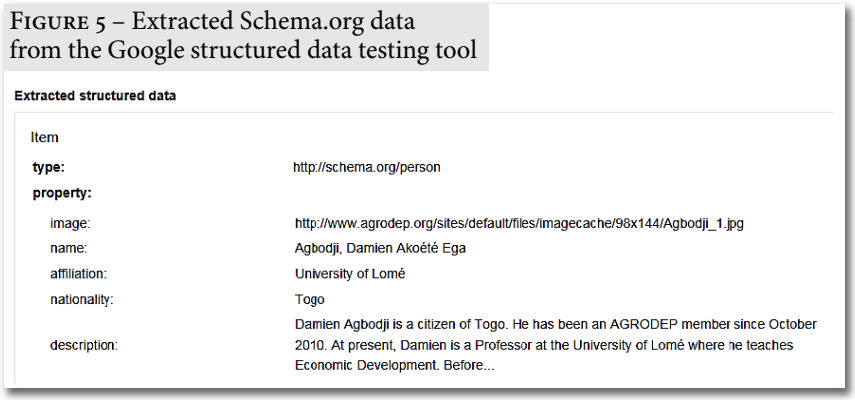


Figure 5 – Extracted Schema.org data from the Google structured data testing tool



Next Steps

This paper highlights how the AGRODEP web portal has been adapting new technologies to improve its content management and reach out to target audiences, including not only AGRODEP members but also policymakers in African countries, regional economic communities, international development community, civil society and non-governmental organizations, media, and the general public. One possible step to further improve the AGRODEP Web portal would be to bring external contents from Open Data and mash-ups into the portal as a way to provide more relevant and up-to-date information to AGRODEP members. We will continue to develop ways for our members to communicate and discuss with other members in the AGRODEP consortium as well as outside the consortium.

Notes

1. http://www.drupal.org
2. http://www.wordpress.org
3. https://drupal.org/
4. http://wordpress.org/
5. http://www.joomla.org/
6. https://drupal.org/project/webform
7. https://drupal.org/project/quiz
8. https://drupal.org/project/modules
9. https://drupal.org/project/drupal
10. https://drupal.org/project/Content_Access
11. https://drupal.org/project/webform
12. https://drupal.org/project/quiz
13. https://drupal.org/project/Rate
14. https://drupal.org/documentation/modules/book
15. https://drupal.org/project/emfield
16. https://drupal.org/project/rules
17. http://www.agrodep.org/country/KEN
18. http://goo.gl/tFP89F
19. http://www.facebook.com/AGRODEP
20. http://twitter.com/#!/AGRODEP
21. http://www.youtube.com/agrodep
22. The African Commission for Policy and Leadership
23. The Alumni of the University of Pretoria in LinkedIn
24. Africa News network in LinkedIn
25. http://www.agrodep.org/newsletter
26. http://www.agrodep.org/newsletter#bulletin
27. http://en.wikipedia.org/wiki/Microformat
28. http://en.wikipedia.org/wiki/RDFa
29. http://www.google.com/webmasters/tools/richsnippets

References

Eden, Bradford Lee. 2006. "Content Management Systems." Library Hi Tech 24:(1): 5–125 and 24(2): 227–272.

Guha, Ramanathan. 2011. "Introducing Schema.org: Search Engines Come Together For A Richer Web. *Google Blog*. http://googleblog.blogspot.com/2011/06/introducing-schemaorg-search-engines.html — accessed July 26, 2013.

Johnson, Nirah. 2013. "Extending the Reach of Hepatitis Coalitions Through Online and Social Media Platforms." *2013 National Conference on Health Communication, Marketing, and Media*. Atlanta, Ga: Center for Disease Control.

Kelly, Brian. "Using Social Media to Enhance Your Research Activities." *Social Media in Social Research 2013 Conference*. London: University of Bath.

Macbeth, Steve. 2011. "Introducing Schema.org: Bing, Google and Yahoo Unite to Build the Web of Objects", *Bing blog*" http://www.bing.com/blogs/site_blogs/b/search/archive/2011/06/02/bing-google-and-yahoo-unite-to-build-the-web-of-objects.aspx — accessed July 26, 2013.

McKeever, Susan. 2013. "Understanding Web Content Management Systems: Evolution, Lifecycle and Market." *Industrial Management & Data Systems* 103(9): 686–692.

Shreves, R. 2011. *2011 Open Source CMS Market Share Report.* Fourth Annual Report on the Industry Leaders. Bali, Indonesia: Water and Stone. http://www.waterandstone.com/downloads/2011OSCMSMarketShareReport.pdf — accessed July 26, 2013

Soylu, A., F. Mödritscher, F.Wild, P. De Causmaecker P. Desmet. 2012. "Mashups by Orchestration and Widget-based Personal Environments: Key Challenges, Solution Strategies, and an Application." *Program: Electronic Library and Information Systems* 46(4): 383–428.

Seth, Shashi. 2011. "Introducing schema.org: A Collaboration on Structured Data, Yahoo blog" http://www.ysearchblog.com/2011/06/02/introducing-schema-org-a-collaboration-on-structured-data/ — accessed July 26, 2013.

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Library Outreach to University Farm Staff

Emily MacKenzie and Natalie Waters

Abstract: This paper explores how an outreach initiative to the campus farm at McGill University enhanced the library's understanding of farm activities, opening avenues for support and collaboration. At McGill's Macdonald Campus Library, liaison librarians reach out to teaching staff, faculty and students of the Faculty of Agricultural and Environmental Sciences, but not at other units, such as the farm. The library and farm missions are similar in that both aim to support the teaching and research needs of the faculty. This, combined with the fact that the farm strives to incorporate innovative agricultural technology and practices into its operations, make them an interesting target for library outreach. From the library's perspective, this outreach has the added benefit that the farm provides a practical model of the future information needs of our students that could inform information literacy skills training contributing to their success after academia.

Resumé: Cet article examine comment une initiative de sensibilisation auprès de la ferme du campus de l'Université McGill a aidé la bibliothèque à mieux comprendre les activités agricoles, et les avenues possibles de collaboration et de soutien. À la bibliothèque du campus Macdonald de McGill, les bibliothécaires de liaison sensibilisent le personnel enseignant, les professeurs et les étudiants de la Faculté des sciences de l'agriculture et de l'environnement, mais pas à d'autres unités, telles que la ferme. Les missions de la bibliothèque et de la ferme sont similaires en ce que les deux visent à soutenir l'enseignement et les besoins de la faculté en matière de recherche. Ceci, combiné avec le fait que la ferme s'efforce d'intégrer des technologies et des pratiques agricoles innovantes dans ses opérations, fait d'eux une cible intéressante pour la sensibilisation de la bibliothèque. Du point de vue de la bibliothèque, ce travail de sensibilisation a l'avantage que la ferme fournit un modèle pratique des besoins en information futurs de nos étudiants, qui pourrait influer sur la formation des capacités d'utilisation de l'information contribuant à leur succès après l'université.

Resumen: Este trabajo explora cómo una iniciativa de extensión en la granja de la Universidad de McGill ha mejorado el conocimiento de la biblioteca acerca de las actividades agrícolas, abriendo caminos para el apoyo y la colaboración. En la biblioteca de la Universidad de McGill en su sede de Macdonald, los bibliotecarios de enlace trabajan con el personal docente, los profesores y los estudiantes de la Facultad de Ciencias Agrícolas y Ambientales, pero no con otras unidades como la granja. Las misiones de la biblioteca y la granja son similares en que ambas buscan apoyar las necesidades de enseñanza e investigación de la Facultad. Esto, junto con el hecho de que la granja se esfuerza por incorporar tecnologías y prácticas agrícolas innovadoras en sus operaciones, hace que sea un objetivo interesante para las actividades de extensión de la biblioteca. Desde la perspectiva de la biblioteca, esta actividad de extensión tiene la ventaja agregada de que la granja ofrece un modelo práctico de las futuras necesidades de información de los estudiantes que puede indicar la capacitación que se requiere en habilidades de alfabetización informacional, lo cual contribuiría a su éxito después de la academia.

McGill University is a large, research intensive institution that resides on two main campuses: the downtown campus located in Montreal, Quebec (Canada), and the Macdonald Campus, located approximately 35 kilometers to the west, in the city of Sainte-Anne-de-Bellevue. The Macdonald Campus houses the Faculty of Agricultural and Environmental Science (FAES) and the School of Dietetics and Human Nutrition and is comprised of approximately 2200 students, faculty and staff. Undergraduate and graduate level programs within this faculty are offered in areas such as natural resource sciences, environment, agriculture, food science, dietetics and human nutrition, agricultural economics, and engineering, as well as the college-level Farm Management and Technology Program.

This community is served by the Macdonald Campus Library, one of ten branch libraries in the McGill Library system. The Macdonald Campus Library is a small branch, consisting of seven staff, including three librarians. The librarians' duties are organized using a liaison librarian model, whereby each librarian is assigned several academic departments within the faculty. Each liaison librarian is responsible for outreach, collection development, and information literacy and support initiatives for their specific departments. While this service model ensures that our academic departments are well taken care of, as Bradley (2009) points out, those units which are not strictly academic may be overlooked.

Providing library outreach and services to non-academic university departments can result in added benefits for the library including: increased visibility of the library (Rockman 2002, Dahl 2007, Bradley 2009), new prospects for partnerships/collaborations (Dahl 2007, Covone and Lamm 2010), an enhanced role of the library within the campus community (Dewey 2004, Bradley 2009), and novel service opportunities (Bradley 2009, Covone and Lamm 2010).

Dahl (2007) proposes that the liaison librarian model, typically geared towards meeting the needs of academic departments as a whole (and already in place at Macdonald Campus Library), provides a relevant framework for outreach to a non-academic audience as well. McGill Library has a history of entering into successful partnerships and collaborative projects with other departments, among them Teaching and Learning Services and the Graduate and Postdoctoral Studies Office. We wondered if there were any units specific to our Macdonald Campus community, falling outside our existing service

model, which could benefit from library outreach or perhaps provide opportunities previously unexplored.

Dahl (2007, 5) also recommends identifying those "service providers who have goals in common with the library." Rockman (2002, 193) echoes this sentiment and suggests recognising those units that "share common values, possess needed expertise, or creatively can enhance and expand library services and programs". Based on these criteria, the Macdonald Campus Farm seemed a likely candidate for outreach. The farm's core mission resonated with us as librarians: "McGill's Macdonald Campus Farm is an experimental and demonstration farm dedicated to teaching and research" (Faculty of Agricultural and Environmental Sciences 2013a). This emphasis on the support of teaching and research aligns well with our library's mission statement:

> "McGill University Library advances teaching, learning, research and community service by providing outstanding collections, access to the world of knowledge, excellence in service and an appropriate library environment, all of which are client-focused and responsive to the needs of the McGill community" (McGill Library 2013).

We sought to identify through the literature what library outreach initiatives were already applied to university experimental farms. Many articles detailed outreach programs developed in response to low use of services and resources in terms of extension programs (Davis 2007, Lee 2004, McKimmie 2003). While interesting, the issues raised such as distance and lack of staff status at the university do not relate to our milieu. Macdonald Campus does not provide or support extension services; these are provided by federal or provincial agencies, for example AgPal offered by Agriculture and Agri-Food Canada (AAFC). Because the staff at the Macdonald Campus farm are on-campus employees of McGill University and as such have access to the services and resources that all staff enjoy, our focus differed from the extension literature. However, articles that detailed approaches for outreach to extension staff were useful; in particular, the first step in Davis' (2007) outline — getting to know one's community and context by reaching out to the administrative staff — echoed our interest in the farm. We arranged a meeting with the Farm Manager, and from that we gained important insights on the various activities undertaken at the farm and were invited to an extensive tour of the facilities a couple of weeks later.

What we learned

About the Farm – Within walking distance of classrooms, residences and departmental offices, the Macdonald Campus Farm supports the teaching and research activities of the FAES community. Students are provided with hands-on experience in research facilities that also produce milk, eggs and forages for sale.

The farm is home to a field unit and the R. Howard Webster Centre, which includes the Donald McQueen Shaver Poultry Complex, the Dairy Complex, the Swine Complex, and the Large Animal Research Unit. The poultry complex has recently purchased an egg grading station certified by the Canadian Food Inspection Agency and now sells eggs to McGill University's dining services and directly to Macdonald Campus staff. The dairy complex is extensively used by students enrolled in production courses and by professors and graduate students who use the cows and facilities to conduct several research projects a year. In addition to research and demonstration, the dairy complex is a milk producer and a member of the Fédération des Producteurs de Lait du Québec *(FPLQ),* the provincial federation that negotiates all sale conditions for milk producers in Quebec. The swine unit offers space for research that includes swine brought in from local farmers, as well as teaching laboratories focusing on reproduction, nutrition, odour control and farm building design, particularly for ventilation and waste management (Macdonald Campus Farm 2013).

Involvement in Student Learning – The farm is an essential venue for applied learning and as a result farm staff are heavily involved in training and demonstration activities enhancing student learning. Lab components are supported across many FAES departments. Examples include:

- Swine and poultry production
- Food science labs in dairy and poultry
- Animal Science labs in animal health and disease, reproduction, calf raising, milk production, and artificial insemination
- Bioresource Engineering labs on building ventilation and design in Dairy, Swine & Poultry complexes and machinery design in field equipment
- Plant Science labs in soil fertility and cropping techniques

The liaison model has successfully integrated library services within many courses on campus; the farm staff, however, have not necessarily received the same level of marketing from the library, if at all, and we felt they could benefit from this as well. For example, the farm manager is listed as the instructor for a course on handling farm animals and animal behaviour. During our talk he was pleased to learn that his list of assigned reading could be assembled into an online course guide, or onto a single linked reading list on the course management system, immediately recognizing that this would reduce his and the students' time spent searching and connecting to the resources through a printed reading list. Armed with a better understanding of the variety and depth of teaching activities occurring at the farm, we realized that this unit must not be overlooked when developing communication strategies for liaison activities.

Community outreach – In 2008 the farm re-opened to the local community, offering organized educational tours to elementary school children. Macdonald Campus

represents the largest green space on the Island of Montreal, which is also Québec's most urbanized area with a population of 2 million, or a quarter of the population of Quebec. Not a petting zoo, the tours were developed in response to the growing disconnect between what we eat and where it comes from. The program has been so popular that it could not meet public demand due to inadequate facilities. (Faculty of Agricultural and Environmental Sciences 2013b). In June 2013, the Macdonald Farm Interpretive Centre project was announced. This type of initiative appeals, very much, to us as librarians, highlighting a potential avenue to offer support in the future.

Information needs and information sources – Library literature and agribusiness literature include many articles and studies on farmers' information needs. These provide evidence regarding the effects of farm characteristics or farmer demographics on information search strategies, both on the sources used — trade publications, professionals, vendor information — and the format of the information — internet, print, personal communication. Diekman, Loibl and Batte (2009) compare thirteen years of studies, from 1988 to 2005, of farmers' information needs in one informative table. Divided into demographic characteristics, such as age and education, and farm characteristics, such as size, and type (crop versus livestock), the table illustrates how studies have found similar results regarding the positive or negative influence of a number of these characteristics.

Though the sources differ depending on any of the above characteristics, several studies, regardless of geographical location or type of farm, found a positive correlation between one's level of education and a search strategy that uses numerous information sources (Gloy, Akridge, and Whipker 2000, Diekmann, Loibl, and Batte 2009, Jensen, English, and Menard 2009).

One's level of education also has a positive correlation with the adoption or use of internet sources. This can be seen in Briggeman and Whitacre's (2010) thorough analysis of six farmer internet adoption studies in the United-States. Based on the variables listed in the studies, they identify the characteristics that significantly influence internet use. It is worth considering that these six studies date from between 2000 to 2006, and therefore do not reflect the substantial growth of internet connectivity and adoption. According to a Pew internet report (Zickuhr and Smith 2012), 47% of American adults were internet users in June 2000, compared to 78% in August 2011. If we apply these findings to the Macdonald Campus Farm, as an academic research institution, we can anticipate that our students and staff are/will likely use multiple sources, both print and online.

While helpful, studies can only explain part of the picture. During our meeting, the farm manager was happy to talk about his information needs and the sources that he uses to do his job. The agribusiness literature examining the information sources of farmers mirrors his preferred sources; for examples, see Gloy, Akridge, and Whipker 2000; Diekmann, Loibl, and Batte 2009; and Jensen, English, and Menard 2009. As the manager of a research farm, and an experienced dairy producer, he uses multiple sources (seller/vendor information, trade publications, and personal communication) in both print and online format. Breed registries and central breeding databases also play a significant role in his daily operations. These exemplify the changing format of information that has permeated all industries and continues to grow in importance. For example, although print registries remain in use, the breeding database is electronic and shared among producers. New births entered by the producers are also updated with each new animal's characteristics. The producers therefore become information providers themselves.

The tour that followed our initial meeting with the farm manager demonstrated to us some of the informed decisions that need to be made throughout the day. While many of our instructional sessions focus on students who will go on to be researchers, many of the undergraduates and FMT students in Macdonald programs will go on to operate farms which, as demonstrated by our own operations manager, requires quite different sources of information that we do not necessarily highlight in classes. The vast majority of the library's subscribed resources will no longer be accessible to them once they have graduated from McGill. We will therefore place a greater focus on free resources and strategies that can help them in their post-graduation and professional life. Most importantly, we must try to highlight the importance of evaluating sources of information that can support knowledgeable decision making. Meeting with the operations manager solidified our understanding of what their needs may be and helped improve our own work.

Conclusion

The Macdonald Campus houses a special and close-knit community within McGill University; it is essential for the Macdonald Campus Library to form connections with other units, to be visible, and to be integrated within this community in order to most effectively provide service in support of the library's overall mission. Though an unusual target for library outreach, reaching out to the farm has proved a valuable and rewarding experience for us as librarians — we have gained a better understanding of the farm and its role within the campus community, as well as the opportunity to develop a more complete picture of the information needs and resources important to best prepare our patrons for their current and future endeavors.

There are many other units on campus that are not part of traditional academic departments and after this first positive experience, we intend to more systematically identify and reach out to those units which may provide us with interesting connections and opportunities throughout campus.

References

Bradley, Cara. 2009. "Campus Disconnect: Academic Libraries and the Information Needs, Skills, and Behaviors of Non-Teaching University Staff". In *ACRL Fourteenth National Conference*. Seattle, WA.

Briggeman, Brian C, and Brian E Whitacre. 2010. "Farming and the Internet: Reasons for Non-Use." *Agricultural & Resource Economics Review* 39 (3): 571–584 http://agecon.okstate.edu/faculty/publications/3482.pdf.

Covone, Nicole, and Mia Lamm. 2010. "Just Be There: Campus, Department, Classroom…and Kitchen?" *Public Services Quarterly* 6 (2–3): 198–207. doi: 10.1080/15228959.2010.498768

Dahl, Candice C. 2007. "Library Liaison with Non-Academic Units: A New Application for a Traditional Model." *Partnership: the Canadian Journal of Library and Information Practice and Research* 2 (1), http://www.criticalimprov.com/index.php/perj/article/viewArticle/242.

Davis, Valrie. 2007. "Challenges of Connecting Off-Campus Agricultural Science Users with Library Services." *Journal of Agricultural & Food Information* 8 (2): 39–47.doi: 10.1300/J108v08n02_05

Dewey, Barbara I. 2004. "The Embedded Librarian: Strategic Campus Collaborations." *Resource Sharing & Information Networks* 17 (1/2): 5–17. doi: 10.1300/J121v17n01_02

Diekmann, Florian, Cäzilia Loibl, and Marvin T Batte. 2009. "The Economics of Agricultural Information: Factors Affecting Commercial Farmers' Information Strategies in Ohio." *Applied Economic Perspectives and Policy* 31 (4): 853–872. doi: 10.1111/j.1467-9353.2009.01470.x

Faculty of Agricultural and Environmental Sciences. 2013. *Macdonald Campus Farm*. McGill University 2013a. http://www.mcgill.ca/macdonald/about/resources/farm.

Faculty of Agricultural and Environmental Sciences. 2013. *Macdonald Farm Interpretive Centre*. McGill University 2013b. http://www.mcgill.ca/macdonald/alumni/priorities/interpretivecentre.

Gloy, Brent A, Jay T Akridge, and Linda D Whipker. 2000. "Sources of Information for Commercial Farms: Usefulness of MediaaAnd Personal Sources." *The International Food and Agribusiness Management Review* 3 (2): 245–260. doi: 10.1016/S1096-7508(01)00046-5

Jensen, Kimberly L, Burton C English, and R Jamey Menard. 2009. "Livestock Farmers' Use of Animal or Herd Health Information Sources." *Journal of Extension* 47 (1): 1–10, http://www.joe.org/joe/2009february/a7.php.

Lee, Deborah. 2004. "Building on a Land-Grant Tradition: Engagement at the Mississippi State University Libraries." *Journal of Agricultural & Food Information* 5 (4):59–67. doi: 10.1300/J108v05n04_06

Macdonald Campus Farm. 2013. *Macdonald Campus Farm*. McGill University 2013. http://www.mcgill.ca/macdonaldfarm/.

McGill Library. 2013. *General Information*. McGill University 2013. http://www.mcgill.ca/library/library-about/general/.

McKimmie, Tim. 2003. "Reaching Out: Land Grant Library Services to Cooperative Extension Offices, Experiment Stations, and Agriculture Science Centers." *Journal of Agricultural & Food Information* 4 (3):29–32. doi: 10.1300/J108v04n03_04

Rockman, Ilene F. 2002. "Establishing Successful Partnerships with University Support Units." *Library Management* 23 (4/5): 192–198. doi: 10.1108/01435120210429925

Zickuhr, Kathryn, and Aaron Smith. 2012. Digital Differences. Washington D.C.: Pew Research Center's Internet & American Life Project. http://www.pewinternet.org/Reports/2012/Digital-differences/Main-Report/Internet-adoption-over-time.aspx

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Enhancing Access to Research in Institutional Repositories through an API

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Authors Note: *We would like to acknowledge the support of the staff at the LandPortal.info for having the interest in IFPRI's research and for their work in incorporating our API into their website, specifically Laura Meggiolaro, Tin Geber and at IFPRI Ruth Meinzen-Dick.*

Abstract: **IFPRI (International Food Policy Research Institute) recently completed a project where we shared IFPRI research papers with a partner organization, the Land Portal (a collaboration of The International Land Coalition (ILC) and Landtenure.info) from our open access repository. The project began when the IFPRI Knowledge Management team was approached by the Land Portal with a request for help finding a way to share a feed for papers from IFPRI related to land and land issues on their website. In this paper, we document our experience using API calls to IFPRI's institutional repository to feed publication metadata records to our partner's website. We used this technique to promote and share the intellectual output of IFPRI with the LandPortal.info and ReSAKSS-Asia project. As a result of this project, we have achieved increased access to IFPRI research, improved reach for our researchers, and enhanced value of the content on our partner's website.**

Resumé: **L'IFPRI (Institut international de recherche sur les politiques alimentaires) a récemment achevé un projet où nous avons partagé des documents de recherche de l'IFPRI provenant de notre centre référentiel en libre-accès, avec une organisation partenaire appelée Land Portal (trad. portail foncier), une collaboration entre la Coalition internationale pour l'accès à la terre (ILC) et la Landtenure.info. Ce projet a commencé lorsque l'équipe de gestion des connaissances de l'IFPRI a été approchée par la Land Portal, avec une demande d'aide pour trouver un moyen d'alimenter et de partager des documents de l'IFPRI liés à la gestion des terres et des questions foncières, sur leur site web. Dans cet article, nous documentons notre expérience utilisant des appels API auprès du centre de références institutionnelles de l'IFPRI pour alimenter la publication des enregistrements de métadonnées sur le site internet de notre partenaire. Nous avons utilisé cette technique pour promouvoir et partager la production intellectuelle de l'IFPRI avec le projet LandPortal.info et ReSAKSS Asie. À la suite de ce projet, nous avons obtenu un accès accru à la recherche de l'IFPRI, une meilleure sensibilisation de nos chercheurs, et une valeur accentuée du contenu sur le site internet de notre partenaire.**

Resumen: **El Instituto Internacional de Investigación sobre Políticas Alimentarias (IFPRI, sus siglas en inglés) recientemente terminó un proyecto en el cual se compartieron los trabajos de investigación del IFPRI del repositorio de acceso abierto del Instituto con uno de sus socios, el Portal de la Tierra, una colaboración entre la Coalición Internacional para el Acceso a la Tierra (ILC, sus siglas en inglés) y Landtenure.info. El proyecto comenzó cuando el equipo de Gestión del Conocimiento del IFPRI fue abordado por Portal de la Tierra con una solicitud de ayuda para encontrar una manera de compartir un grupo de documentos del IFPRI sobre aspectos relacionados con la tierra y tenencia de la tierra en su sitio web. En este trabajo, se documentó la experiencia del IFPRI utilizando registros de una interfaz de programación de aplicaciones (IPA) al repositorio institucional del IFPRI para alimentar registros de metadatos de publicación en la página web de Portal de la Tierra. Se utilizó esta técnica para promover y compartir la producción intelectual del IFPRI con el proyecto LandPortal.info y ReSAKSS-Asia. Como resultado de este proyecto, se ha logrado un mayor acceso a la investigación que hace el IFPRI, un alcance mejorado para los investigadores del IFPRI y valor agregado a los contenidos de la página web del socio del IFPRI.**

Overview

The International Food Policy Research Institute (IFPRI) is a major publisher in the field of international agriculture development research. To support its research, IFPRI has since 2012 maintained a digital institutional repository of its own IFPRI-branded publications, metadata records for material published externally but written by IFPRI authors, metadata records for IFPRI public datasets, as well as several project-specific collections. We sought to develop a repository in order to provide a more stable digital platform for our digital collections and to have the capacity to use advanced tools, like an Application Programming Interface (API), for collaboration and promotion of IFPRI research. We began to migrate our records from our previous OPAC to the repository in 2011 and went live in April 2012, and were very excited when the opportunity came for using the API of our new repository came in the fall of 2012. A repository APIs is a valuable tool for integrating content with partner websites because an API allows for easy customization on the part of the partner, and extends the reach of your content in ways that is measurable without the partner having to host the actual content. The first time we got to use the API was the LandPortal project (http://landportal.info/), but it presented a challenge in that our metadata required some cleaning because it was in large part a legacy from our previous OPAC. With this experience behind us, we hope to find even more opportunities to promote and share IFPRI research using the tools of the repository.

Technologies involved

CONTENTdm for IFPRI repository – We use CONTENTdm as our repository software; it is an OCLC product, and we have chosen to have it cloud-hosted by OCLC. We selected it because it provided a robust and

flexible system that we could set up and run with a minimal staff infrastructure, and it provided an extensive API. (OCLC, 2013)

APIs – The term API stands for the Application Programing Interface, and has become an increasingly common way to exchange information between machines. A key attraction of using an API for this project was that the LandPortal used the available API functions to customize the information drawn from our repository. For example, the API allows for a search query to return XML metadata, and another query for retrieving jpeg files of PDF thumbnails. One of the main benefits of an API for exchanging data between machines is that both the repository and the receiving website retain full discretion over the look and feel of the data on their respective websites.

Other technologies provide some of the services of an API: RSS provides a feed of a subset of items, but it lacks a capacity for flexible customization by a user; OAI harvesting allows for easy transfer of metadata and links back to the full PDF, but the protocol is a little more rigid and requires more processing on the user side.

Partners – The LandPortal is a website run by the International Land Coalition and Landtenure.info to be "an easy access, easy-to-use platform to share land related information, to monitor trends, and identify information gaps to promote effective and sustainable land governance" in developing countries. The material available on site consists of papers, discussions, news, policy guidelines, and web tools." (LandPortal, 2013) The Environment and Production Technology division at IFPRI has worked in collaboration with the Land Coalition since the inception of the LandPortal website.

ReSAKSS-Asia (Regional Strategic Analysis and Knowledge Support System in Asia) is an IFPRI-led initiative that seeks to provide strategic analysis, knowledge management and capacity strengthening to inform strategies for food and nutrition security in Asia (ReSAKSS-Asia, 2013). Their website displays publications, data, blogs and interactive tools related to food and nutrition security for people in the whole of Asia.

Both the LandPortal.info and the ReSAKSS-Asia websites run on Drupal 7.

Land Portal Project

Scenario/Purpose – Members of the LandPortal project at IFPRI approached the knowledge management unit and inquired about a willingness to incorporate IFPRI publications related to land rights into the Land Portal website. We considered a range of solutions including RSS feeds and OAI harvesting, but determined that the API functions of the repository were best suited to the request. We decided on API calls (basically, the programming that allows one software application to talk with another over the Internet) primarily because of the need for highly structured searches of IFPRI's publications, and the way the LandPortal team wanted to display the records on their site. They did not want to provide a long list of everything from IFPRI, but wanted to show small subsets on a series of specific pages and keep the look and feel of their own website. We asked our partners about their plans for the site, including the keywords and topical organization, and then cleaned the relevant records so that they could be extracted directly. We prepared API calls that passed along a query to our repository and returned XML data and they incorporated the XML into their website through the use of a script they wrote and maintained.

Techniques – Our task was to find a way to display relevant documents by country location and by topic that could be displayed to the LandPortal users. We used the keywords and topics that the Land Portal team provided and mapped them to the keywords in our repository. The first round of the project was to display IFPRI publications by country, while round two was to display publications on the topic pages of the LandPortal.

Round One: geography – Matching keywords for countries was straight forward because we use the AGROVOC vocabulary for country location, as does the LandPortal. We developed queries for a general topic, "land", and then they developed scripts to pull out documents for specific country pages based on the country location metadata for each record. We had to clean some of the records so that the country location field conformed to the pattern they needed in their script: country; sub region; region; continent. Using Ghana as an example, we had to enter "Ghana; West Africa; Africa South of Sahara; Africa" or in the case of multiple countries Ghana; India; West Africa; Africa South of Sahara; South Asia; Asia; Africa.

Round two: subject topics – Matching the subject keywords for the LandPortal topic pages was harder because the queries were more involved and we use a variety of keywords, in part AGROVOC (FAO's controlled vocabulary) but also Library of Congress (LOC) and some IFPRI specific terms. The topic pages consisted of: Commercial pressures on land, Environment, Food security, Forest, Gender, Indigenous Peoples, Rangeland Tenure, and Urban Land. Each page had many search terms associated with it, and our challenge was construct a search that would use as many as possible, but also use equivalent terms and avoid terms that we did not use. For example, the LandPortal provided us with the term "land grabbing" while we had used "land grab." In another case, on the Gender page, the LandPortal provided "divorce" and "legal literacy" as keywords, but we did not have any publication tagged with those terms, so we omitted them from the query in our API call. We prepared one API call for each of the main topic pages.

Challenges of inconsistent metadata – We use a separate field for geographic location and subject utilizing standardized vocabularies for each, but before this project could work, we had to normalize some of the records

Table 1 – Examples of the API calls provided

Page:	*COMMERCIAL PRESSURE ON LAND*
Search terms:	*investment OR grab OR acquisition OR conflict AND land*
The API string provided:	
	http://cdm15738.contentdm.oclc.org:81/dmwebservices/index.php?q=dmQuery/p15738coll2/loc^investment^all^or!loc^grab^all^or!loc^acquisitions^all^or!loc^conflict^all^and!loc^land^all^and/title!subtit!date!creato!langua!subjec!loc!url/date!reverse/500/1/1/0/0/0/xml
Page:	*GENDER AND LAND*
Search terms:	*Inheritance* OR right* OR women* OR gender* AND land**
The two API strings provided:	
	http://cdm15738.contentdm.oclc.org:81/dmwebservices/index.php?q=dmQuery/p15738coll2/loc^HIV*^all^or!loc^Inheritance*^all^or!loc^right*^all^or!loc^women*^all^or!loc^gender*^all^and!loc^land*^all^and/title!subtit!date!creato!langua!subjec!loc!url/date!reverse/500/1/1/0/0/0/xml
	tenure AND gender AND land
	http://cdm15738.contentdm.oclc.org:81/dmwebservices/index.php?q=dmQuery/p15738coll2/loc^tenure^all^and!loc^gender^all^and!loc^land^all^and/title!subtit!date!creato!langua!subjec!loc!url/date!reverse/500/1/1/0/0/0/xml

due to errors that accumulated over the years and through data migrations. We had to fill in missing keywords and consolidate related terms. When the metadata was only used by our OPAC, the inconsistencies and problems were less visible and we had less incentive to maintain highly precise metadata, but when the records are used by others, the incentive for precise metadata increased.

API call examples – We prepared API calls specific to their needs. One that returned land related records along with country metadata. They took the country metadata, parsed it, and included those records in the country faceted interface on the website. The second API was an example of the topic-specific queries: Commercial pressure on land, Gender etc. In most cases we do the search with one API call, but for the most complicated one, Gender, we had to do more than one. Table 1 shows examples of the API calls we provided.

ReSAKSS-Asia Project

The knowledge management unit was approached by a project lead at ReSAKSS-Asia with a request for advice on the design for the publications section of their website. When it became clear that they intended to host full-text PDFs of IFPRI material, as well as links to partner gray literature, we recommended using the repository and API instead because of increased efficiency and accuracy of that combination. We recommended that they rely on the existing IFPRI publications repository collection and then create another repository collection with a metadata scheme modeled on the IFPRI publications collection for the partner literation, but containing only metadata records with hyperlinks to the full text hosted by partners. Then using API calls, their web developer could display both types of publications the same way on their site. The technique of drawing on two collections using API calls allowed them to use our existing collection of IFPRI publications, thus avoiding both the introduction of metadata errors and the duplication of PDFs. We recommended the second collection because IFPRI did not have rights to host the full text of the various partner publications, and as these were not IFPRI publications, they could not be included in the main IFPRI publications collection, but we did want the ability to search both.

Results – Based on our recommendations, they changed their website design to work with the API, and created the second collection needed for the partner literature. As one indication of the success of this design, we have seen a five-fold increase in traffic referrals to the IFPRI repository from ReSAKSS-Asia since the start of the year. That reinforces for us that it is in our interest to promote the use of APIs for partners and projects at IFPRI because it contributes to more easily measured usage of publications.

Conclusion

Using a repository API is a flexible way to share and promote research materials. APIs allow partners to use all metadata for filtering of all resources; they allow for extraction of select fields and permit partners to implement the look and feel of their website, while displaying content from another data source. In particular, smaller organizations can experience higher visibility without extensive infrastructure. Sharing through an API allows content creators and owners maintain content and users to rely on creators to update and add new content.

As a result of using the repository API, we were able to reinforce IFPRI's partnership with the LandPortal, lend flexibility and dynamism to an IFPRI project and prepare ourselves for more advanced uses in the future. We have gained a steady source of referral traffic back to the repository from LandPortal and ReSAKSS-Asia. We learned from our experience with the LandPortal which API functions are the most useful, how to formulate queries efficiently and how to educate partners on using the API. We intend to build on this for future efforts with other projects at IFPRI, partners and even our own website redesign, where we expect to see improvements even in the internal publication processes and workflows as each record is created with the intent to make it fully and openly accessible.

References

LandPortal. 2103. http://landportal.info/about —accessed July 19, 2013.

OCLC. 2013. CONTENTdm Online Help version 6. http://contentdm.org/help6/custom/customize2a.asp —accessed July 15, 2013.

ReSAKSS-Asia. 2013. http://resakss-asia.info/about —accessed July 19, 2013

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Building Capacity of Smallholder Farmers in Agribusiness and Entrepreneurship Skills in Northern Uganda

Basil Mugonola and Callistus Baliddawa

Abstract: Northern Uganda is in the process of social, economic and political stabilization after two decades of civil strife that left nearly 1.3 million people internally displaced. This region has fertile and unopened agricultural land with high potential for agriculture based economic development. The Faculty of Agriculture and Environment (FAE), of Gulu University has initiated a number of outreach interventions aimed at improving the livelihoods of smallholder, resource-constrained farmers as well as providing practical hands-on-training to its agricultural graduates. In this comprehensive extension and outreach program, the students are attached to smallholder-farmers within a 5 km radius from the University. Through these attachments improved technologies such as vegetable production, cassava, banana and solar drying of local fruits and vegetables have been disseminated to the farmers. In general, through this intervention, the farmer-student-lecturer linkage has been strengthened as an information model in Gulu and Amuru districts of northern Uganda.

Resumé: La vie sociale, économique et politique du nord de l'Ouganda est dans un processus de stabilisation après deux décennies de guerre civile qui a fait déplacer près de 1,3 million de personnes à l'intérieur du pays. Cette région a des terres agricoles fertiles et non cultivées avec un potentiel élevé pour un développement économique basé sur l'agriculture. La faculté de l'agriculture et de l'environnement (EAF) de l'Université de Gulu a lancé un certain nombre d'interventions visant à améliorer les moyens de subsistance des petits exploitants agricoles aux ressources limitées, ainsi que de fournir des formations pratiques à ses diplômés agricoles. Dans le cadre de ce programme de vulgarisation et de sensibilisation, les élèves sont rattachés à de petites exploitations dans un rayon de 5 km de l'université. Grâce à ces liens, des technologies améliorées telles que la production de légumes, manioc et banane, ainsi que le séchage solaire de fruits et de légumes locaux ont été diffusées aux agriculteurs. En général, grâce à cette intervention, les liens agriculteur-étudiant-instructeur ont été renforcés comme modèle d'information dans les districts de Gulu et d'Amuru, au nord de l'Ouganda.

Resumen: El norte de Uganda está en un proceso de estabilización social, económica y política después de dos décadas de guerra civil que dejaron cerca de 1,3 millones de desplazados al interior del país. Esta región de tierras agrícolas fértiles y sin aprovechar tiene alto potencial para el desarrollo económico basado en la agricultura. La Facultad de Agricultura y Medio Ambiente de la Universidad de Gulu ha iniciado una serie de intervenciones de extensión dirigidas a mejorar los medios de subsistencia de los pequeños agricultores de recursos limitados, así como proporcionar capacitación práctica sobre el terreno a sus graduados en agricultura. En este programa integral de extensión y divulgación, los estudiantes se unen a los pequeños agricultores en un radio de 5 km de la Universidad. A través de estas interacciones, se han difundido a los agricultores tecnologías mejoradas para la producción de hortalizas, yuca y banano y para el secado de frutas y verduras locales al sol. En general, a través de estas intervenciones, se han fortalecido los vínculos entre agricultor-estudiante-profesor como un modelo de información en los distritos Gulu y Amuru del norte de Uganda.

Introduction

As in many Sub Saharan African countries, the agriculture sector is central to Uganda's economy and food security. It provides employment to 73.3% of the working population, accounts for 30% of GDP, and generates 85% of export earnings (MAAIF, 20101; MFPED, 2010). Over 85% of Ugandans, and 96% of the poor, live in rural areas, and this population is growing at approximately 3.2 % per year. About two-thirds of the 3.5 million rural households are mired in unproductive, low-input/low-output farming, and producing food largely for their own consumption with little or no marketable surpluses (Uganda National Human Development report, 2007; UBOS, 2010). Among these farmers, the average land holding is less than two hectares and the basic farm tool is the hand hoe. Low productivity, lack of competitiveness and information asymmetry characterize the entire agricultural value chain, with the majority of the participants hovering on the margins of absolute poverty in many areas.

On the other hand, Uganda is rich in natural resources, has vast arable land, favorable climate and large amounts of fresh water resources for fish farming, as well as micro and macro irrigation projects. If the full production potential is tapped, Uganda has the opportunity to become the food basket in the east African region and other neighboring countries like Democratic Republic of Congo (DRC) and Southern Sudan. Given this eminent potential, the agriculture and agro industry sector can create millions of job opportunities for the youth and women in rural and urban areas along the agricultural value chain. However, Uganda's agricultural productivity is one of the lowest in the world due to lack of efficient and effective extension service; poor access to agricultural inputs like improved seeds, fertilizers and other chemicals; rudimentary farming practices and technologies; limited access to market information and financial services;

lack of proper soil and water management practices; and above all, lack of efficient rural enterprise development and business management programs.

Northern Uganda is in the process of social, economic and political stabilization after the end of over two decades of civil strife that left nearly 1.3 million people internally displaced. Northern Uganda has vast fertile and unopened agricultural land with high potential for rapid and vibrant agriculture-based economic development. However, this can only be realized if development partners and the government follow the right integrated agriculture and market development strategies and also undertake substantial measures to develop rural small and medium scale enterprises along agricultural product value chains. Most of the agricultural development interventions in Uganda and this region in particular have been targeting the agricultural production side (supply side dynamics) and ignoring the agribusiness components, especially the demand side. The result has been that farmers produce and get stuck with their primary produce, having no idea of where to market and/or how to add value to their produce.

Northern Uganda and Gulu in particular is gifted by being on the gateway to southern Sudan, a route that has become a major trading route for both agricultural and industrial commodities. The farming community in Gulu needs to be organized to tap into this emerging market through increased agricultural production, collective marketing techniques, bulking and value addition to their primary products. Gulu University, through the faculty of Agriculture and Environment, has an important role to play in transforming the rural communities from being subsistence producers with barely any significant marketable surplus to market oriented producers, responsive to demand situations. And through its Outreach Program in the Faculty of Agriculture and Environment (FAE) department of Rural Development and Agribusiness, the University is providing agricultural information to the small and medium scale agro-enterprises.

Gulu University

Gulu University is a public institution of higher learning established by a statutory instrument No. 16 of 2003. It is located in northern Uganda, over 350 km from the capital Kampala City. It was born out of the Uganda government's initiatives to target science teacher education, medicine, agriculture and environmental sciences, technology, business management, rural transformation and peace and conflict management studies. It is currently made up of the faculties of Agriculture and Environment, Business and Development Studies, Science Education, Medicine, the Institute of Peace and Conflict Management and the Institute of Graduate Studies and Research.

Gulu University is located in Laroo division in Gulu municipality about four km northeast of Gulu town. It is housed in the premises of the former Gulu District Farm Institute where more structures have been put up to accommodate the increasing student and staff numbers. The surrounding community has put up hostels and restaurants to also benefit from the increased student population. The business opportunities created by the presence of the university are enormous and the impact so far cuts across a wider spectrum and is very visible in the community.

The Faculty of Agriculture and Environment – The Faculty of Agriculture and Environment (FAE) started in 2005. It offers two under graduate programmes: 1. Bachelor of Agriculture (a three year programme) and 2. a four year Bachelor of Bio-system Engineering programme (supported by the World Bank through the Millennium Science Initiative (MSI) project). The current student population has grown to two hundred and thirty-three students, with the number expected to rise further in the succeeding academic years. The faculty has forty full time academic staff out of the required fifty-seven at full capacity, making over 70% recruitment. The departments in the faculty include:

1. Department of Rural Development and Agribusiness
2. Department of Bio-systems Engineering
3. Department of Agronomy
4. Department of Environment
5. Department of Food Science and Technology
6. Department of Animal Science

Outreach Programmes in the Faculty of Agriculture and Environment – The Faculty of Agriculture and Environment (FAE) in Gulu University is strategically situated to contribute to the development of the emerging economy of northern Uganda and in the rebuilding of the agricultural livelihoods. The agricultural outreach programme is at the frontier of achieving the much needed community transformation in northern Uganda and as such, the FAE has initiated a number of outreach interventions aimed at improving the livelihoods of farmers as well as providing practical hands on training to its agricultural graduates. Notable among these interventions are:

1. Comprehensive Extension and Outreach Programme: The students are attached to small scale peri-urban farmers within a five km radius from the University. Through these attachments information on improved technologies such as vegetables production, cassava, banana and solar drying of local fruits and vegetables has been disseminated to the farmers. This intervention has improved household livelihoods in that households have been able to produce sufficient foods for their households and earn income to meet other households' domestic needs from the surplus. The FAE is also implementing the enhanced adoption of orange fleshed sweet potato, a project funded by International potato center through ASARECA with three farmer groups within Gulu and Amuru Districts.

   This outreach programme is limited to farmers within a radius of five km from the university because

of a number of constraints, and yet the bulk of the small-scale farmers who need the interventions most are far away in the villages especially those who have just returned from the Internally Displaced Peoples camps (IDPs). Given more resources, the FAE would strengthen its outreach programmes to target villages far away from the University. More interventions are needed to complement the on-going projects through providing specialized training to farmers on agribusiness and entrepreneurship skills development, product value chain analysis, value addition (processing, solar drying and packaging), business development services (BDS), marketing techniques, etc. to enable them to start up economically viable agribusiness enterprises to supplement their meager household incomes. This will also ensure the continuity of existing university outreach projects and give the farmers a complete package of technological interventions. Besides improving the incomes of household involved, this intervention will also enable the university to achieve its mission of community transformation. It is also envisaged that upon complete transformation, these small-scale farmers will graduate to a semi-commercial and full commercial status and thus will be in position to demand and pay for more specialized services from the university such as consultancies, tractor hire services, and hosting students on their farms — all of which would ensure sustainability of the Outreach programme. In all these outreach and extension programmes, the academic staff remain the subject matter specialists and continue to support the students who carry the message to the end-users (farmers). This effort works with and complements the existing local government extension programmes in the districts.

2. Promoting pro-poor technologies such as Solar drying for fruits and vegetables, wet cassava processing, small scale irrigation, promotion of orange fleshed sweet potato (OFSP) to improve Nutritional security.
3. Training farmers in nursery Management (grafting, budding) Agro-forestry tree selection.
4. Improving Indigenous chicken through breeding and local feeds formulation and management.
5. Offering business consultancy for evaluating the viability and feasibility of small scale businesses.
6. Conducting Business clinics: training of smaller farmer groups in business skills, record keeping, savings including Village Savings and Loan Associations (VSLA) etc.

Objectives

The overall goal of the outreach programme is to put Gulu University at the forefront of community transformation through the provision of information to ensure meaningful sustainable market oriented agricultural production in Northern Uganda.

The outreach programme is guided by the following specific objectives:

1. To build capacity of smallholder farmers in agribusiness and entrepreneurships skills through product chain analysis, value addition and business development services (BDSs).
2. To enable students to interface with farmers, acquiring facilitation and adult training skills.
3. To strengthen the linkage between the farmers and the University as an action platform for initiating innovative approaches to unlocking the potential of small scale agricultural producers in northern Uganda.

Methodology/Target Group

The Faculty of Agriculture and Environment outreach programme targets active resource-poor small farmers within a radius of five km from the University. The farmers have to express interest by registering with the University through the outreach programme either as individuals or within their groups. At the time of registration, the farmers also are asked to identify the areas where they would want the university to intervene. The University outreach coordinator then visits the farmers on a fact-finding mission to ascertain and verify the information given at registration. Then second year students are selected and allocated to specific farmers within the group to work on specific enterprises during their recess term which normally takes place between June and September, every year. The students closely work with farmers and a university lecturer as supervisor. At the end of the attachment, the students are expected to produce a report which is graded and they are awarded marks.

The selected farmers benefit from this student-lecturer-farmer interaction by tapping knowledge from the students and lecturers, as well as from direct full extension services rendered by the FAE through this same outreach programme. Many technologies are extended to the farmers within their communities; for example, depending on the interest of the farmers' group, technologies like solar drying of fruits (pineapples) and vegetables, improved local chicken management, water harvesting and small-scale irrigation technology, among others, are demonstrated.

Results

While the outreach programme is still limited to farmers within a radius of only five km, there are already tangible results that can be documented. These are:

- A number of farmers have adopted growing of bananas, pineapples and vegetables that were hither to not part of their farming systems.
- Solar dried and packaged fruits are now available on the shelves and many supermarkets in Gulu. A price differential exists between the dry and fresh pineapple products, indicating that value has been enhanced.

- Adoption of orange fleshed sweet potato (OFSP) varieties in the production system. Many products have also been developed from OFSP and are available on the shelves. For examples, farmers have developed "twin cakes," pan cakes, and potato flour, among others, as a way of diversifying the product menu from sweet potato.
- Availability of planting materials from nurseries, cassava cuttings, potato vines, banana suckers, pineapple suckers etc. Many farmers' groups have been given planting materials to plant in their own mother gardens from which to multiply these improved crop varieties for further dissemination.
- Enhancement of business skills within the communities through trainings and business clinics.
- Improved relationship between the community and the University. The community's perception of the University has been greatly enhanced, as it is now seen as a partner in development.

Challenges

As the faculty implements the outreach programme within the five km radius and attempts are made to expand to other areas outside the original five kilometers, a number of challenges have come up. These challenges are on two fronts — part are experienced by the University and part are faced by the communities that are targeted by the programme. These challenges include:

- Markets and outlets for products are still few and small. There is competition between fresh and processed products within these market outlets. There is a need to design better marketing strategies that will enhance the perceived value of the processed products and hence improve their overall competitiveness in a wider geographical area and across income groups.
- Low levels of savings among the farmer groups leading to inadequate financing for most activities. The farmers need to learn the culture of saving and to be able to finance their farm activities from their own savings. Whereas agricultural credit is useful, it is costly and therefore many times out of reach for many small-scale resource poor farmers. Pro-poor initiatives like Savings and Credit Cooperative Organizations (SACCOS) need to be strengthened at the grassroots.
- Banks are still reluctant to lend to smallholder farmers and business start-ups. There is a need to lobby and entice mainstream banks to develop products and services that are farmer-friendly. Such products should require less stringent demands in terms of collateral security. And innovations emphasizing group guarantees and using the very crop or animal enterprise as security would ensure access to credit for many.
- Most agro-inputs are unavailable and of poor quality. There is generally a need to improve the seed systems in Uganda; the formal seed system is distributed mainly in urban centers, where only few farmers can access it. At the same time, the informal seed system which the majority rely on for planting materials is hardly regulated and supervised.
- Price fluctuations of most agricultural commodities make farmers' incomes unstable and this further compounds challenges of adequate farm planning. Innovations need to be designed to ensure smoothening of commodity supply and to prolong the shelf life of agricultural products.
- High illiteracy levels lead to poor record keeping and understanding of business concepts. Functional adult classes need to be strengthened so as to facilitate learning. For farmers to understand basic concepts in farming as a business, they need to have a working knowledge in basic literacy and numeracy.
- Trauma of the war is still haunting people and service delivery. The effects of the twenty year war are still very evident in northern Uganda. The communities need a lot of support on many fronts, including physical infrastructure, social services, restoring the role of the family structure and its task as an epicenter of farm production.
- Transport for staff and students to reach the geographically dispersed farmers. Mobility is another daunting challenge that both staff and students face as they attempt to conduct the outreach programmes. The farmers are geographically dispersed in far and hard to reach areas deep in the villages. There is a need for reliable transport to ensure that the academic staff adequately supervise the students and also visit the farmers.

Way Forward

The following initiatives are some of the various ways the outreach programme can be expanded and improved in the future:

- Facilitate formation of trading companies to market and sell products and produce. Collective marketing initiatives are very important for small scale farmers as they cannot individually attain the adequate economies of scale. By pooling their produce together, they can cut down on transaction costs, increase the commodity thresholds and increase their bargaining powers. The Faculty of Agriculture and Environment can take a leading role in ensuring that farmers form viable marketing groups.
- Diversify product development by expanding into specialty products e.g. dried pineapples, banana wine, cassava & OFSP through improved quality, packaging & branding. By encouraging farmers to develop new products along the commodity chains, they will be addressing the issues of fluctuating prices and seasonality of supply. This will ensure that supply is smoothened out throughout the years.
- Train farmers in business opportunity identification and exploitation.

- Encourage small scale irrigation and rain water harvesting for increased production of high value crops.
- Link Agro-input dealers to farmers and other stakeholders in the value chain.
- Train local banks (SACCOs), in agribusiness skills, resource mobilization, collateral options and risk mitigation.
- Train community members in improving savings and strengthen local banks (SACCO) to reach more farmers (rural clients).
- Student supervised enterprises (students initiate business innovations with faculty support for posterity).
- Entrench outreach activities in the University's strategic plan and budget to make such activities part of the routine undertaking of the University instead of looking at them as a one-time project.

References

Ministry of Agriculture, Animal Industry & Fisheries (MAAIF) of the Republic of Uganda, 2010. ***Agriculture for Food and Income Security: Agriculture Sector Development Strategy and Investment Plan: 2010/11–2014/15*****. Kampala, Uganda: The Ministry.**

Uganda 2010. Ministry of Finance Planning and Economic Development (MFPED). ***Report.*****, Kampala, Uganda: The Ministry.**

Uganda Bureau of Statistics (UBOS). 2010. Statistical Aabstract. Kampala, Uganda: The Bureau. www.ubos.org/onlinefiles/uploads/ubos/…/2010StatAbstract.pdf

United Nations Development Programme (UNDP). 2007. ***Uganda National Human Development Report: Rediscovering Agriculture for Human Development.*** **Kampala, Uganda: UNDP.**

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The Data Landscape of the Coral Triangle

Jeanette Norris

Abstract: **The Coral Triangle region is much studied and is the center of a number conservation and sustainability efforts. These programs, often led by national governments and other environmental organizations, require very similar information. However it can be challenging to take advantage of the data that is already being produced and determine what needs to be added to the already growing body of data. This project determines what data is available, how broadly useable it is and how to develop a model for the effective sharing of this information. While focused on the particular situation facing researchers of the Coral Triangle region, many of the lessons are applicable to other conservation and sustainable agriculture projects, especially considering that many datasets pertaining to ocean conditions provide Global Coverage.**

Resumé: **La région du Triangle de Corail est beaucoup étudiée et est le centre d'un nombre d'efforts de conservation et de durabilité. Ces programmes, souvent dirigés par des gouvernements nationaux et autres organisations environnementales, nécessitent des informations similaires. Toutefois, ceci peut être un défi de profiter des données qui sont déjà en train d'être produites et de déterminer ce qui doit être ajouté à la quantité déjà croissante de données. Ce projet détermine quelles données sont disponibles, combien est largement utilisable, et comment développer un modèle pour un partage efficace de cette information. Bien qu'axé sur la situation particulière que confrontent les chercheurs de la région du Triangle de Corail, bien des leçons sont applicables à d'autres projets de conservation et d'agriculture durable, en particulier compte tenu du fait que de nombreuses séries de données relatives aux conditions océaniques fournissent une couverture mondiale.**

Resumen: **La región del Triángulo de Coral es objetivo de numerosos estudios y es el centro de un gran número de esfuerzos de conservación y sostenibilidad. Estos programas, a menudo liderados por gobiernos nacionales y otras organizaciones ambientales, requieren información muy similar. Sin embargo, puede ser difícil aprovechar los datos que ya están siendo producidos y determinar qué hay que añadir al cuerpo cada vez más grande de datos. Este proyecto determina qué datos están disponibles, qué tan utilizables son y cómo desarrollar un modelo para el intercambio eficaz de dicha información. Aunque se centra en la situación particular que enfrentan los investigadores de la región del Triángulo de Coral, muchas de las lecciones son aplicables a otros proyectos de conservación y agricultura sostenible, sobre todo teniendo en cuenta que muchos conjuntos de datos relacionados con las condiciones oceánicas tienen una cobertura global.**

Data curation is an important aspect of the research process because it ensures that data can be preserved, used, and reused. Similarly, for the purposes of managing ecosystems, the ability to reuse and, perhaps more importantly, integrate data from a variety of different disciplines and sources is of utmost importance (Ogburn, Joyce L., 2010). The Coral Triangle Initiative provides an interesting case study in both data curation and ecosystems management, although it is well researched and there are a variety of data resources about it, there is still a great need for local well-managed data and easily discoverable international data.

The Coral Triangle is one of the most bio-diverse regions in the world (Cabral et al., 2013, Fidelman & Ekstrom, 2012, Foale et al., 2013, p. 175). Six nations within the region — Philippines, Solomon Islands, Papua New Guinea, Timor-Leste, and Malaysia — have come together in the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI) to responsibly manage the natural resources of this extraordinary ecosystem. In addition to the member nations, CTI also has international partners who provide information, data, support, and training. Partners include the U.S. Agency for International Development, Australian Government Department of Sustainability, Environment, Water, Population, and Communities, Asian Development Bank, Conservation International, and several others.

A central part of CTI's plan is the creation of new marine protected areas (MPAs), which are used by local governments to regulate the fishing occurring in their municipal waters. However, the management of these MPAs tend to be marked by a lack of both scientific knowledge about the ecosystems and funding to gain the needed information to manage them well (Clifton, 2009). Indeed, exerting too much energy in attempting to find the desired scientific information to make decisions on MPA implementation has been discouraged because it would prevent any action from being taken at all, thereby furthering the threat facing the ecosystem (Clifton, 2009, p.91). "It is important that sound science, natural and social, inform the selection and implementation of Seascapes; however, deficiencies in knowledge should not hinder action. Prior to Seascape selection, existing information should be compiled and studies conducted as far as feasible to fill any information gaps." (Atkinson, S., Esters, N., Farmer, G., Lawrence, K., & McGilvray, F., 2011, p. 14) Indeed, in some cases MPAs that are implemented without extensive research have still reaped important benefits for the ecosystem (Ban et al., 2012, p. 268).

Regarding the primary objectives of the CTI, the following goals were established in the Regional Plan of Action:

- Strengthening the management of seascapes;
- Promoting an ecosystem approach to fishery management;

- Establishing and improving effective management of marine protected areas;
- Improving coastal community resilience to climate change;
- Protecting threatened species
  (Coral Triangle Initiative, n.d.).

These goals speak to the purpose of the CTI and how they frame the initiative's work, as well as indicating the importance of interdisciplinary information and data. In addition to intergovernmental agreements and strategies regarding the shared ecosystem, the CTI also actively promotes knowledge-sharing and tool development. The information shared and the tools developed provide insight into the type of information that is commonly available to local managers and how it is used. Many tools, such as the decision support systems FISH-DA and COASTPLAN, as well as the 3D relief maps, rely on gathering information from local community members (Knowledge Management for CTI, 2013). Community stakeholders not only have expertise in the area that the managers may not have, but their inclusion can help increase local support of the policies(Wendt & Starr, 2009, p. 315).

Knowledge of the status of the ecosystem may be most readily available from local communities, but they may not understand the basic concepts of ecology such as extinction or the importance different types of habitats (Rajamani, 2013). Therefore, it is important to understand the likely limits of local knowledge and to actively promote ecological education in those communities. In the Coral Triangle, REEFGAME, an interactive game, was developed and is being used to educate fishers about the impacts of their actions on the environment, as well as to discover alternative actions in the face of depleted fish supply and a deteriorating ecosystem (Cleland, Dray, Perez, Cruz-Trinidad, & Geronimo, 2010). However, despite the potential for lack of understanding, the more successful MPAs have generally incorporated local stakeholders into their planning and management process (Ban et al., 2012, p. 264).

While the CTI promotes the use of local knowledge in MPA development and management, there is also extensive information that has been developed and continues to grow in the international community with regards to Coral Triangle MPAs and fisheries. A search of ProQuest using the terms "'Coral Triangle' and fisheries" returned over one hundred journal articles about the Coral Triangle in the past five years[i]. Additionally, a search of "'Coral Triangle' and "Marine Protected Area" returned almost fifty.

The existence of research findings in these journals does not, however, mean that everyone will also have access to the underlying data. In addition to research found in journals and other scholarly publications, there is also a wealth of data and information being produced by government agencies and other large organization. For example, the National Oceanic and Atmospheric Administration (NOAA) contributes remote monitoring data from its satellites as part of its role in the CTI support partnership (NOAA in the Coral Triangle, 2). This data includes environmental time series and climatologies for each of the ecoregions, including ocean acidification baseline, sea surface temperature, and other parameters (NOAA in the Coral Triangle, 2). Additionally, data from NOAA's Coral Reef Watch program is also incorporated into resources supported by CTI (Cros, Annick, 2012). These resources provide one perspective on the data resources and needs of the region, while another perspective comes from the tools and programs that the CTI promotes.

Three Support Programs

There are a number of programs designed to help decisions makers understand how different variables interact within an ecosystem, evaluate the current state of their Marine Protected Area, and hopefully determine the best policies for the area. Three such programs are promoted by the CTI, and each aims to accomplish a slightly different task: Fishing Industries' Support in Handling Decision Applications (FISH-DA), which is intended to be used as a decision support system for fishery management; Tool for Understanding Resilience of the Fisheries (TURF), which is intended to be used as a decision support system for fishery management; and COASTPLAN, which is particularly interested in the ability of fisheries and communities to adapt to climate change. COASTPLAN is specifically designed to:

- Synthesize basic fisheries information at the municipal and regional levels and provide estimates and scenario testing on fisheries carrying capacities and MPA size;
- Map various resources and anthropogenic stresses experienced by the community, and consequently allow spatial planning such as choosing the best site to be protected;
- Demonstrate, through visual representation, the effects of protection and effectiveness of reserves on the conservation of marine habitats and associated communities
  (Cabral, Reniel B., David, Eduardo D., Jr., Geronimo, Rollan C., Lim, May T., & Alino, Porfirio M., 2010, p. 4).

Despite the difference in their purposes, the three programs are similar in their approach to data. Their required data must be either being accessible or easily generated (Mamauag, Samuel et al., n.d., p. 16) Though a general lack of data is understood, it is also noted that, "the accuracy of the modeling scenarios highly depends on the accuracy of the data inputs." (Cabral, Reniel B., David, Eduardo D., Jr., et al., 2010, p. 4). The programs generally request information on the types of fish being caught (usually Demersal versus Pelagic), the size of the waters in question, the amount of that area that is open for fishing, the sizes of the catch, the type of fishing equipment used, and the types of fishes in the area. Additionally,

they each ask questions about fishers' incomes, cost of fishing activity, and whether fishers' households have income from other economic activity (Cabral, Reniel B., David, Eduardo D., Jr., et al., 2010; Cabral, Reniel B., Geronimo, Rollan C., & Alino, Porfirio M., 2010; Mamauag, Samuel et al., n.d.). TURF also requires more information about the environment, such as the state of the corals, mangroves, and seagrasses, and the sea surface temperature (Mamauag, Samuel et al., n.d.). Much of this information is assumed to come from either the local government or through interviews with stakeholders (Cabral, Reniel B., David, Eduardo D., Jr., et al., 2010; Cabral, Reniel B., Geronimo, Rollan C., et al., 2010, p. 5; Mamauag, Samuel et al., n.d.)

In COASTPLAN, the user also provides spatial information. "The user is asked to map resources and stresses of their fishery and assess current fishery status such as the level of threats each habitat is experiencing" (Cabral, Reniel B., David, Eduardo D., Jr., et al., 2010, p. 12). This requires drawing the MPA on the map and defining the type of zone (no-take, etc.) and indicating the threat-level to different habitats (coral reefs, seagrass beds, mangroves). While this has the potential to be quite coarse, it can give an estimation of the general state of the ecosystem. Additionally, it underlines the role of geographic data and visualization in the current methods used to monitor and evaluate MPAs.

Coral Triangle Initiative Supported Data Resource

Another project associated with the Coral Triangle Initiative is the Coral Triangle Atlas (CT Atlas). The Atlas provides an interactive map of the region with a variety of data layers as well as links to the original datasets. In many cases, datasets can be downloaded from their site or there will be a link to the original dataset. "Biophysical and socioeconomic information has been collected for decades by scientists and managers for different parts of the Coral Triangle. However, to date, little of this information has been centralized to form region wide layers that provide an overall view and enable management plans at a regional level" (Cros, Annick, 2012). While the decision management tools rely heavily on community expertise, the CT Atlas primarily holds data from sensors and satellites that are gathered by nations outside of the CTI.

Coral Triangle Atlas

The vision of CT Atlas is "to provide a unique opportunity for any organization working in the Coral Triangle to share their data and create a growing, updated database for better management decisions and science" (Cros, Annick, 2012). The data covers a broad range of topics, from mangrove distribution to sea surface temperatures. The resource contains a combination of online maps that can be used to visualize the data using multiple interactive layers and a database of MPAs in the Coral Triangle, as well as links to various resources, datasets, and publications for and about the region. Perhaps its most important contribution is integrating data from various sources which would otherwise require navigating separate interfaces from each of the individual data sources. In addition to providing the aggregation service, the atlas serves as a discovery tool as well: by linking out to the original datasets, it gives access to data that may otherwise be less likely to be immediately located.

CT Atlas is an excellent example of both the possibilities for integrating different data sources and the problems that are encountered in the process of integrating and reusing data. For example, such a tool readily identifies the need to complement existing sources of data by "finding the metadata for layers to complete the catalogue and standardize the attributes so that the layers can be collated" ("About Coral Triangle Atlas," n.d.). The need for metadata is particularly noteworthy for older datasets. For example, the 1997 Global Distribution of Mangroves has virtually no metadata associated with it, and then relies on description like "Data varies in scale and quality" ("Global Distribution of Mangroves (1997)," 1997, p. 2) making it more difficult to use in a collated GIS platform. While the products created by the Coral Triangle Atlas may not be particularly useful to scientific research, their focus is on the needs of managers who need to obtain necessary information as efficiently as possible. Tools such as the Coral Triangle Atlas work to this end by providing easy access to various types of data, while staying focused on the primary needs of the decision makers. The CT Atlas also creates a simple product by using geographic data to collate data into GIS layers. (The role of geographic data in ecological management is explored further in ecological modeling).

Reefs at Risk

Rather than providing datasets, or decisions support systems, the World Resources Insitute's Reefs at Risk studies create models for ecosystems. The methods for integrating various types of data provide options for managers and illuminate the difficulties of obtaining and integrating different types of data. The models use the strength of local and global threats to reefs to understand and predict changes in reef ecosystems. The analysis is divided between local threats, such as overfishing, destructive fishing, and coastal development, to global threats such as rising sea surface temperatures and ocean acidification (Burke, 2012, p. 10; Burke, Lauretta, Reytar, Katie, Spalding, Mark, & Perry, Allison, 2011). The destructive fishing and overfishing indicators are similar to those found in the decision support tools; however, others such as coastal development and pollution are generally not considered in the programs. The coastal development indicator takes into account "threats"

such as unsustainable tourism, sewage discharge, and costal construction whose strength is determined by the geographic proximity to the coast (Burke, 2012, p. 10). Again, this demonstrates the indispensable role geographic information plays in the use of data for ecosystem modeling.

The dependence on international datasets in part differentiates the type of data the Reefs at Risk project relies on versus that which the CTI suggests. Sources include ReefCheck, an organization that uses volunteers to record information about reefs ("About Reef Check — Saving Reefs Worldwide," 2007), World Port Index and HotelsbyMaps.com. Furthermore, the locations are also standardized using GeoNames.org. Despite the attempt to use international databases, the destructive and overfishing indicators, at least in part, are based on information from local experts (World Resources Institute, 2011).

External Sources of Data

The Coral Triangle Atlas provides important access to several external datasets, including datasets from Reefs at Risk, UNEP-WCMC's Biodiversity Map library, and NOAA, particularly their Coral Reef Watch product (Cros, Annick, 2012). However, the CT Atlas is not generally as up to date as the primary source (Cros, Annick, 2012; NOAA Satellite and Information Service, 2012), which in some cases can provide access to the near-real time product which is updated twice weekly, whereas the CT Atlas data from the Coral Reef Watch hasn't been updated, in some cases, since 2009. In other fields of interest, such as biodiversity and socioeconomics, there is little data contained in the CT Atlas; none the less, there are important resources that provide access to this information.

Biodiversity Datasets

Though the amount of biodiversity data in CT Atlas is limited, there are other large, international repositories of biodiversity data. Two of the most well-known are the Global Biodiversity Information Facility (GBIF) and FishBase. GBIF relies on data contributions by researchers and works to create a robust resource of biodiversity information. "Through a global network of countries and organizations, GBIF promotes and facilitates the mobilization, access, discovery and use of information about the occurrence of organisms over time and across the planet" ("Gbif.org: Home Page," n.d.). The data portal allows the user to find data based on species, countries, and original datasets. The countries option also provides a map of the chosen location along with the data. The majority of the records include geographic coordinates (GBIF, n.d.). FishBase similarly provides data records based on species, use and location. Also, like GBIF, the data is provided by users, and while it is a robust tool, all regions are not represented equally (Froese, R. & Pauly, D., 2013).

Socioeconomic Data Resources

Though socioeconomic data is listed as one of the layers supported by CT Atlas, there are no examples in the collection yet (Cros, Annick, 2012). There are a variety of other sources that do provide socio-economic data. SOCMON, for example, provides reports on the socioeconomic status of individual areas, but the datasets generally do not accompany the report. However, it is specifically focused on coastal regions and includes about fifteen reports from the Coral Triangle ("Welcome to SocMon," n.d.). Another resource is SEDAC, which primarily provides gridded data on various socioeconomic topics, including the relationship between people and the environment (CIESIN at Columbia University, 2013).

Easily Available Doesn't Mean Easily Usable

To say that the Coral Triangle is a data deficient region isn't entirely true. There are resources such as the Coral Triangle Atlas that collate scientific data about the region and provide free access to the resources (Cros, Annick, 2012). Many of the weaknesses found in the CT Atlas are covered by other datasets, such as Coral Reef Watch or OceanColor, which can provide near real-time products about the state of the seas in the region (NASA OceanColor, 2013; NOAA Satellite and Information Service, 2012). Sources such as FishBase are troves of well-organized data on the biodiversity of regions, and the uses of different fishes (Froese, R. & Pauly, D., 2013). SEDAC provides a series of maps and datasets about various socio-economic topics, including relationships between populations and the environment (CIESIN at Columbia University, 2013). While there is a wealth of resources, the difficulty comes in finding the resources to begin with, learning how to best use the available tools, and finally attempting to integrate the information with other data. In part it seems that this is precisely the issue that the CT Atlas is addressing.

The time required to learn and operate the separate interfaces, and then integrate the data isn't trivial, and despite the data being freely available, the cost of the time and resources spent on finding, obtaining, and using data can become quite expensive and tedious when they are taken from different sources (Ravindran, Liang, & Liang, 2010, p. 5009). However, the theme across most of these resources is the geographic element which can help to provide insight into how to further the management of data about the Coral Triangle in support of fisheries and the ecosystems. The Coral Triangle Atlas is certainly already using GIS technologies to integrate data from various sources ("About Coral Triangle Atlas," n.d.). Furthermore, geospatial metadata standards are widely used and available (Zeng, 2008, pp. 74–75). Furthermore, Badar, et al. show that using GIS data in combination with biophysical and socioeconomic data is an effective way to analyze similar situations (2013). Even

with the integrated data using GIS, the question of being able to use available data for the decision support tools currently being promoted remains.

Small-scale Data Curation

FISH-DA, TURF, and COASTPLAN rely on either official local data or surveys and observations for data on the economic situation of fishers, the tools used for fishing, and the fishers' catch, among other subjects (Cabral, Reniel B., David, Eduardo D., Jr., et al., 2010; Cabral, Reniel B., Geronimo, Rollan C., et al., 2010; Mamauag, Samuel et al., n.d.). Even through researching other datasets, this type of information about individual localities is not readily available from large international datasets. These local surveys potentially hold valuable information, but the data needs to be managed using the same standards as the large datasets. Indeed, good stewardship may be of enhanced importance considering that data from smaller studies does not tend to be as structured as that from satellites or other sources of large datasets (Akers, Katherine Goold, 2013, p. 59). Given the importance of geospatial information in the use and collation of this data, it is important that the metadata includes geospatial information in order to effectively fit the local survey data into a larger landscape. By allowing for the possibility of precise mapping of the data, it is possible to find correlations between the different data layers, in a manner that does not necessarily require extensive manipulation. Additionally, the CT Atlas encourages participation in their work through data contributions from organizations, governments and managers (Cros, Annick, 2012) which provides an opportunity to enhance a local data resource, while gaining assistance with the management of the data. Additionally, the CT Atlas lists socioeconomic data as one of the categories that they would include, despite currently there being no socioeconomic layers or datasets reflected in the user interface (Cros, Annick, 2012). The lack of data for this discipline speaks to the need for greater data management and sharing in the region.

Conclusion

The impact of data curation practices becomes clear through this analysis of the data uses and resources of the Coral Triangle. There are extensive datasets covering topics from urbanization to sea surface temperatures and marine biodiversity, many of which have been integrated into the CT Atlas. However, despite the amount of data generally available online, decision support systems and monitoring and evaluation programs prefer using information from local stakeholders. These local survey and observation data need to be carefully curated and shared. Not only can this serve to aid the long-term evaluation of policies, but sharing data and making it available through resources such as the CT Atlas can create a growing resource of local socioeconomic data and fishing practices among other information. Finally, there is a need for continued progress in making data resources easily discoverable.

Note

1. Based on search of ProQuest, as licensed by Syracuse University.

References

About Coral Triangle Atlas. n.d.. *Coral Triangle Atlas*. http://ctatlas.reefbase.org/about.aspx — Accessed 16 July 2013.

About Reef Check —Saving Reefs Worldwide. 2007. *Reef Check Worldwide*. http://reefcheck.org/about_RC_Reef/about_us.php — Accessed 22 July 2013.

Akers, Katherine Goold. 2013. "Looking Out for the Little Guy: Small Data Curation". *Bulletin of the American Society for Information Science and Technology* 39(3):58–59.

Atkinson, S., Esters, N., Farmer, G., Lawrence, K., & McGilvray, F. 2011. *The Seascapes Guidebook: How to Select, Develop, and Implement Seascapes*. Arlington, Virginia: Conservation International. http://www.coraltriangleinitiative.org/sites/default/files/resources/CI_Seascapes_Guidebook_select_develop_implement_seascapes.pdf

Badar, B., Romshoo, S. A., & Khan, M. A. 2013. "Integrating biophysical and socioeconomic information for prioritizing watersheds in a Kashmir Himalayan lake: a remote sensing and GIS approach". *Environmental Monitoring and Assessment* 185(8): 6419–6445. doi:10.1007/s10661-012-3035-9

Ban, N. C., Cinner, J. E., Adams, V. M., Mills, M., Almany, G. R., Ban, S. S., … White, A. 2012. "Recasting Shortfalls of Marine Protected Areas as Opportunities through Adaptive Management." *Aquatic Conservation: Marine and Freshwater Ecosystems* 22(2):262–271. doi:10.1002/aqc.2224

Burke, L. 2012. *Reefs at risk revisited in the coral triangle*. Washington, DC: World Resources Institute.

Burke, Lauretta, Reytar, Katie, Spalding, Mark, & Perry, Allison. 2011. "Reefs at Risk Revisited | World Resources Institute". *World Resources Institute*. http://www.wri.org/publication/reefs-at-risk-revisited#datasets — Accessed 21 July 2013

Cabral, R., Cruz-Trinidad, A., Geronimo, R., Napitupulu, L., Lokani, P., Boso, D., … Aliño, P. 2013. "Crisis sentinel indicators: Averting a Potential Meltdown in the Coral Triangle." *Marine Policy* 39:241–247. doi:10.1016/j.marpol.2012.10.012

Cabral, Reniel B., David, Eduardo D., Jr., Geronimo, Rollan C., Lim, May T., & Alino, Porfirio M. 2010. *Coastal Assessment Tool and Planning Software (COASTPLAN) Tool Demonstration Guide*. Quezon City, Philippines: Marine Environment & Resources Foundation. http://www.coraltriangleinitiative.net/knowledge-hub/tools-and-systems/coastplan/fact-sheet-on-coastplan

Cabral, Reniel B., Geronimo, Rollan C., & Alino, Porfirio M. 2010. *Fishing Industries' Support in Handling Decision Applications (FISHDA) Tool Demonstration Guide*. Quezon City, Philippines: Marine Environment & Resources Foundation. http://www.cor

altriangleinitiative.net/knowledge-hub/document-library/decision-support-systems/fishing-industries2019-support-in-handling-decision-applications-fishda-tool-demonstration-guide/view

Data Center in NASA's Earth Observing System Data and Information Systems (EOSDIS). 2013. "Socioeconomic Data and Applications Center." *SEDAC*. http://sedac.ciesin.columbia.edu/ — Accessed 21 July 2013.

Cleland, D., Dray, A., Perez, P., Cruz-Trinidad, A., & Geronimo, R. 2010. "Simulating the Dynamics of Subsistence Fishing Communities: REEFGAME as a Learning and Data-Gathering Computer-Assisted Role-Play Game." *Simulation & Gaming* 43(1):102–117. doi:10.1177/1046878110380890

Clifton, J. 2009. "Science, Funding and Participation: Key Issues for Marine Protected Area Networks and the Coral Triangle Initiative." *Environmental Conservation* 36(2):91–96. doi:10.1017/S0376892909990075

Coral Triangle Initiative. n.d.. About CTI-CFF. http://www.coraltriangleinitiative.org/about-us — 19 July 2013.

Cros, Annick. 2012. "Coral Triangle Atlas. ReefBase." http://ctatlas.reefbase.org/pdf/CTAtlasFlyer2012.pdf

Fidelman, P., & Ekstrom, J. A. 2012. "Mapping Seascapes of International Environmental Arrangements in the Coral Triangle." *Marine Policy* 36(5):993–1004. doi:10.1016/j.marpol.2012.02.006

Foale, S., Adhuri, D., Aliño, P., Allison, E. H., Andrew, N., Cohen, P., … Weeratunge, N. 2013. "Food Security and the Coral Triangle Initiative." *Marine Policy* 38:174–183. doi:10.1016/j.marpol.2012.05.033

Froese, R., & Pauly, D. 2013. "FishBase." http://www.fishbase.org/search.php — Accessed 21 July 2013.

GBIF. n.d.. "Welcome to the GBIF Data Portal." *Global Biodiversity Information Facility*. http://data.gbif.org/welcome.htm — Accessed 22 July 2013.

Global Distribution of Mangroves 1997. UNEP-WCMC. http://marine-portal.s3.amazonaws.com/resources/datasets/factsheets/6/original_Factsheet_Mangroves__1997.pdf?1344610449

Knowledge Management for CTI. 2013. "Decision Support Systems (DSS) — CTI-Coral Triangle Initiative." *The Coral Triangle Initiative Learning Resource Network*. http://www.coraltriangleinitiative.net/programs-and-projects/adb-reta-7307/decision-support-systems-dss — Accessed 21 July 2013.

Mamauag, Samuel, Alino, Porfirio, Martinez, Renmar, Muallil, Richard, Doctor, Ma. Victoria, Dizon, Emerlinda, … Cabral, Reniel. n.d.. *Tool for Understanding Resilience of the Fisheries (TURF) — Assessment of coastal fisheries ecosystems to climate change impacts*. Presented at the KM Tools Workshop, Jakarta, Indonesia. http://www.coraltriangleinitiative.net/knowledge-hub/tools-and-systems/turf/turf/view

NASA OceanColor. 2013." OceanColor Home Page." *Ocean Color*. http://oceancolor.gsfc.nasa.gov/ — Accessed 21 July 2013.

NOAA Satellite and Information Service. 2012. "NOAA Coral Reef Watch Product Overview." *Coral Reef Watch*. http://coralreefwatch.noaa.gov/satellite/product_overview.html — Accessed 21 July 2014.

Ogburn, Joyce L., (first). 2010." The Imperative for Data Curation." *portal: Libraries and the Academy* 10(2):241–246. doi:10.1353/pla.0.0100

Rajamani, L. 2013. "Using Community Knowledge in Data-Deficient Regions: Conserving the Vulnerable Dugong Dugong Dugon in the Sulu Sea, Malaysia." *Oryx*, 47(02), 173–176. doi:10.1017/S0030605312000154

Ravindran, N., Liang, Y., & Liang, X. 2010. "A Labeled-Tree Approach to Semantic and Structural Data Interoperability Applied in Hydrology Domain. *Information Sciences* 180(24):5008–5028. doi:10.1016/j.ins.2010.06.015

Welcome to SocMon. n.d.. *SocMon*. http://www.socmon.org/ — Accessed 22 July 2013.

Wendt, D. E., & Starr, R. M. 2009. "Collaborative Research: An Effective Way to Collect Data for Stock Assessments and Evaluate Marine Protected Areas in California." *Marine and Coastal Fisheries*, 1(1):315–324. doi:10.1577/C08-054.1

World Resources Institute. 2011. "Reefs at Risk Revisited Metadata Base Data." *World Resources Institute*. http://www.wri.org/publication/reefs-at-risk-revisited

Zeng, M. L. 2008. *Metadata*. New York: Neal-Schuman Publishers.

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Agricultural Information Access Among Smallholder Farmers: Comparative Assessment of Peri-Urban and Rural Settings in Kenya

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Abstract: **Farmers continuously gather new information to keep up with the emerging trends and technologies, and they also store and share this knowledge. The agricultural system in Kenya includes multiple sources available for the farmers as well as a wide range of ICT (information and communications technology)-based innovations for knowledge acquisition. This study investigated farmers' access to different sources of knowledge as well as ICT through a comparative assessment between peri-urban and rural settings, and found that setting and information needs are major influences on sources used. Despite the huge emphasis placed on the need to use ICTs to facilitate information access among smallholder farmers, the adoption levels of these technologies is still very low. This is largely due to lack of information about the existence of such technologies, and there is a need to create awareness about the ICT-based innovations and the potential they have for addressing the challenge of information access among farmers.**

Resumé: **Les agriculteurs ne cessent de recueillir de nouvelles informations pour se maintenir à la hauteur des nouvelles tendances et technologies, et ils stockent et partagent également cette connaissance. Le système agricole au Kenya comprend de multiples sources disponibles pour les agriculteurs ainsi qu'un large éventail d'innovations basées sur les TIC pour l'acquisition de connaissances. Cette étude a enquêté sur l'accès des agriculteurs à différentes sources de connaissances, ainsi qu'aux TIC grâce à une évaluation comparative entre les zones périurbaines et rurales ; et a jugé que l'établissement et les besoins d'information influent principalement sur les sources utilisées. Malgré l'énorme accent mis sur la nécessité d'utiliser les TIC pour faciliter l'accès à l'information parmi les petits exploitants, les niveaux d'adoption de ces technologies sont encore très faibles. Ceci est dû en grande partie au manque d'information au sujet de l'existence de ces technologies, et il est nécessaire de créer une prise de conscience des innovations basées sur les TIC et de leur potentiel pour relever le défi de l'accès à l'information parmi les agriculteurs.**

Resumen: **Los agricultores continuamente recopilan nueva información para mantenerse al día con tendencias y tecnologías emergentes, y también almacenan y comparten este conocimiento. El sistema agrícola en Kenia incluye múltiples fuentes disponibles para los agricultores, así como una amplia gama de innovaciones a base de tecnologías de la información y la comunicación (TIC) para la adquisición de conocimientos. Este estudio investigó el acceso de los agricultores a las diferentes fuentes de conocimiento y a las TIC mediante una evaluación comparativa entre entornos periurbanos y rurales. Los resultados indicaron que el entorno y las necesidades de información son los factores que ejercen más influencia en las fuentes utilizadas. A pesar del gran énfasis en la necesidad de utilizar las TIC para facilitar el acceso a la información entre los pequeños agricultores, los niveles de adopción de estas tecnologías aún son muy bajos. Esto se debe principalmente a la falta de información sobre la existencia de este tipo de tecnologías. Es necesario crear conciencia acerca de las innovaciones basadas en las TIC y el potencial que tienen para hacer frente al desafío del acceso a la información entre agricultores.**

Information, communication and knowledge have always mattered in agriculture, with farmers continuously seeking information, communicating with each other and sharing knowledge on new agricultural technologies. As this study found out, farmers have varying information needs and use different channels to communicate and have knowledge embedded in their attitude, practice and experiences which they share among themselves. This is true because Hartwich et al., (2007) argue that lack of exchange of information and knowledge among and between farmers and those who produce farm-relevant knowledge is the key issue in pro-poor agricultural development. The Agricultural Sector Development Strategy for Kenya (ASDS 2010–2020) lists various opportunities and advantages which can be exploited to build a robust and dynamic agricultural sector (GoK, 2010), including human resources. Knowledge such as that discussed in this study is embedded in systems and is also embodied in persons. This is evidence that there is availability of knowledge in the Kenyan agricultural sector. Sustainable agriculture is knowledge intensive and Juma (2011) articulates that for this to happen, key functions like extension and commercialisation including research and teaching need to be closely integrated. This implies success in KM, managing the knowledge available from the various institutions and actors.

Effective knowledge and information management in the agricultural sector will be achieved when the right knowledge and information is delivered to the farmers and other stakeholders at the right time in a user-friendly and accessible manner. To realize this, farmers should be involved in the knowledge management process as knowledge generated in a participatory manner has a greater likelihood of being accepted and acted upon by the farmers. This participatory approach will also enable the integration of traditional or tacit knowledge of farmers with

Table 1 – Organisations engaged in agricultural research in Kenya

Public-funded institutions	Commodity-funded institutions	International research institutions
▪ Kenya Agricultural Research Institute (KARI) ▪ Kenya Forestry Research Institute (KEFRI) ▪ Kenya Marine and Fisheries Research (KEMFRI) ▪ The University of Nairobi ▪ Egerton University ▪ Jomo Kenyatta University of Agriculture and Technology	▪ Coffee Research Foundation (CRF) ▪ Tea Research Foundation (TRF) ▪ Kenya Sugar Research Foundation (KESREF) ▪ International Maize and Wheat Improvement Center (CIMMYT)	▪ International Centre for Insect Physiology and Ecology (ICIPE) ▪ International Livestock Research Institute (ILRI) ▪ International Centre for Research in Agro-Forestry (ICRAF)

(Source: SRA, 2004)

the modern forms of knowledge, and further enhance the utilization of knowledge disseminated to smallholder farmers.

Knowledge management in the Kenyan agriculture sector (with respect to generation and dissemination)

According to the SRA (2004), there are twenty eight agencies engaged in agricultural research which fall under different categories such as public funded, commodity funded, and international research institutions and universities (see Table 1).

There are extension and advisory service providers in Kenya, both government and non-government, and the government of Kenya, recognizing the constraints facing the extension system, recently shifted to a policy of pluralistic extension provision (National Agricultural Sector Extension Policy — NASEP). This policy also appreciates that there are various sectors involved in agriculture activities and incorporates the activities of other sectoral ministries including livestock and fisheries.

Information and Communication Technologies (ICTs) also greatly influence how information and knowledge are accessed and shared in Kenya. There is increased use of ICTs in Kenya, which is viewed as an ICT hub in the Sub-Saharan region. The Kenyan government (GOK) has embraced various interventions to promote ICT use not just in agriculture, but in the government systems and processes as a whole. The national development blueprint (Kenya Vision 2030; Republic of Kenya, 2005) outlines that the Government of Kenya recognises the importance of ICTs in economic development and has initiated major steps to promote their use including the development and implementation of policies and regulations aimed at attracting investment within the ICT sector. Box 1 captures some of the interventions the Kenyan government has taken to promote ICT use.

Further, there is a huge body of knowledge embedded in the farmers' systems. As Rivera et al., (2001) articulate, agricultural knowledge is created from both modern and indigenous sources; the modern knowledge is created through scientific research by universities and research institutes, while the indigenous knowledge or the tacit knowledge is embedded in traditional knowledge, innovations and practices of local communities and is developed outside the formal education system. Thus, indigenous knowledge equally contributes greatly to the agricultural information landscape.

Box 1 – ICT Use in Kenya

- The E-government program (www.e-government.go.ke) was established in 2004 with a mandate to manage the implementation of ICT programs in government. There is an e-government strategy in place under this program, and it envisions the use of ICTs to transform government processes and provide services, information and knowledge to all government customers. This program is one of the fundamental elements in the modernisation of the government.
- There is an open data portal in place under the Kenya Open Data Initiative (www.opendata.go.ke) which provides and makes available to the public all government data on various subjects including expenditure and other programs.
- In 2007, the GoK launched the Kenya ICT board under the Ministry of Information and Communication, to oversee the development of ICT in Kenya. It has mandates for capacity building, advisory services to the government and marketing Kenya as an ICT hub (www.ict.go.ke).
- The extension policy (NASEP) advocates for use of ICTs and mass media in the approaches used by extension service providers. This policy promotes ICT in agriculture and extension through increased investment in agricultural knowledge and information systems, and also providing incentives to the private sector which is the main provider of communication and information technology services.
- The GoK has also liberalised the mobile cellular market in the country, which has seen the penetration of mobile phones and a widespread use of these in Kenya. As a result, voice and short messaging services have gained more popularity and are thought to offer easy accessibility.

Purpose of the study

Research and extension are some of the most knowledge intensive elements of agricultural innovation systems where extension services improve the knowledge base of farmers through a variety of means, such as demonstrations, model plots, specific training and group meetings. Rivera et al., (2001) argue that agricultural extension operates within a broader knowledge system that includes research and agricultural education. They further articulate that agricultural information systems for rural development link people and institutions to promote learning and to generate, share and use agriculture-related technology, knowledge and information.

As mentioned in the introductory part of this paper, the Kenyan government's extension policy seeks to address the challenges facing the extension services in the country, including constraints such as staff and capacity. Currently the extension officer to farm household ratio in Kenya is at 1: 1093, against the recommend 1:400 (FAO). The extension policy (NASEP 2008) promises innovative approaches, including a pluralistic approach in extension service provision involving various actors from government as well as the private sector, use of ICT services and provision of a favourable environment to facilitate use of the ICTs. This approach has the potential for enhancing farmers' access to agricultural information. The question, however, is to what extent has this potential been tapped? What is the status of the adoption of the innovations?

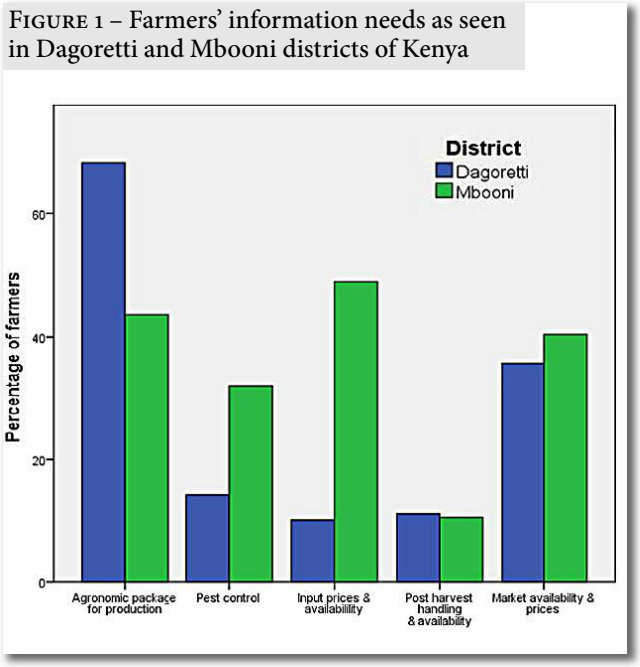
Based on these questions, the study sought to:

- Investigate the accessibility of the various sources of knowledge to the farmers, and the reasons behind the situation.
- Establish the extent to which ICT-based innovations for agricultural information acquisition are being used.
- Compare the findings between peri-urban and rural settings of Kenya.

The study was carried out in two districts in Kenya: Dagoretti and Mbooni. Dagoretti district is in the outskirts of the capital city (Nairobi) about eleven kilometers away and was used to represent the peri-urban setting, while Mbooni is the rural parts of eastern Kenya about two hundred kilometres from the city of Nairobi; this was used to represent the rural setting.

A total of two hundred farmers were reached and interviewed using semi-structured questionnaires, and additional focus group discussions (FGDs) were held with farmers in groups of 20–25 each. Two FGDs were held in each district and these were guided with a structured set of questions. Extension and advisory service providers present in the two districts were further interviewed and a total of sixteen representatives were reached, both government and non-government. Data was subjected to descriptive and inferential statistics using the Statistical Package for Social Sciences (SPSS) software.

Figure 1 – Farmers' information needs as seen in Dagoretti and Mbooni districts of Kenya



Results and discussion

Farmers' information needs differ between the two settings, with farmers in Dagoretti and Mbooni citing preferences for different knowledge types (see Figure 1). The difference was seen to be significant for three types of knowledge: agronomic package, p = 0.002; pest control, p = 0.003; and inputs prices and availability, p = 0.000).

This difference in information needs was seen to influence the sources of knowledge commonly used. There were eight main sources of knowledge identified from the study—government extension agents, NGO extension agents[1], Farmer associations, input suppliers, Neighbours, Farmer magazines, Private Companies, and self (tacit) knowledge—and the percentage of farmers using them significantly differs between the two settings (Table 2).

Use of neighbours and one's own (tacit) knowledge as main sources of knowledge is significant in both settings,

Table 2 – Percentage of farmers using different sources of knowledge in Dagoretti and Mbooni districts of Kenya

	Source used most often (%)							
District	Government extension agents	NGO extension agents	Farmer associations	Input suppliers	Neighbours	Own knowledge	Farmer magazine	Private companies
Dagoretti	76.7	1.0	4.9	2.9	5.8	7.8	1.0	0.0
Mbooni	28.9	1.0	3.1	10.3	12.4	17.5	0.0	26.8

a finding which emphasizes the importance of face-to-face interaction of individuals in knowledge acquisition and sharing, and further emphasizes the importance of implicit knowledge in agricultural production. Thus, what farmers need in the way of information has a significant influence on the source of knowledge used. These results clearly show that socialisation is a major process through which knowledge is created, shared and converted within the small holder set up, with the main models used for knowledge dissemination involving the face to face interaction between the farmers and the extension agents. The presence of input supply companies indicates that there are advisory services being offered by input supply firms (such as Syngenta), described by Swanson and Rajalati (2010) as "one-on-one advisory services provided by private sector/input supply firms to farmers who purchase production inputs from these firms." Swanson and Rajalati also note that this model is dominant in most industrially developed countries due to its win-win arrangement but according to this study, the model is fast picking up in Kenya with Syngenta confirming that they not only work in Mbooni district, but the whole of Eastern region of Kenya.

Table 3 – Farmers' use of different ICT types in Dagoretti and Mbooni districts

District		Types of ICT used to acquire knowledge			
		Radio	Television	Mobile phones	Internet
Dagoretti	*Count*	65	43	17	19
	% within district	87.80	58.10	23.00	25.70
Mbooni	*Count*	58	11	25	3
	% within district	90.60	17.20	39.10	4.70
Total	*Count*	123	54	42	22
	% of Total	89.10	39.10	30.40	15.90

With respect to ICT use for knowledge acquisition, 71.8% and 68% of farmers in Dagoretti and Mbooni respectively use ICTs to acquire knowledge, with only 28.2% and 32% in Dagoretti and Mbooni respectively saying they do not use ICTs for knowledge acquisition. A cross tabulation of the types of ICTs and number of farmers in each district (Table 3) shows that the most popular type of ICT used as a source of knowledge was the radio, with 87.8% of farmers in Dagoretti saying they rely on radio programs to obtain agricultural knowledge and 90.6% of those in Mbooni saying the same. In Dagoretti, the second most widely used ICT by farmers was the television, with 58.1% of farmers saying they use them to acquire knowledge, followed by the internet used by 25.7% , and lastly mobile phones used by 23%. This was in contrast to Mbooni where the cross tabulation show that the second ICT type used by farmers was mobile phones at 39.1%, followed by television (17.2% of farmers) and internet (4.7% of farmers) respectively.

The use of ICT types was influenced by accessibility of the different technologies and the reasons given by farmers were seen to differ between the two settings (Figure 2).

The results show that even though radio is widely use by most farmers and traditional forms of ICT such as radio have become more prevalent in advisory service provision with more radio stations giving airtime for agricultural programs or information (Nyirenda-Jere, 2010), only a simple majority, 54.4% and 52.2% of farmers in peri-urban and rural setting, respectively have easy access to these programs. This is because of inconsistency and inconvenience in the timing of the programs. With the widespread use of mobile phones, especially in Kenya, voice and short messaging services have gained more popularity and they offer easy accessibility. However, these results show that the mobile-phone based technologies are not easily accessible to most farmers, mainly due to lack of information about these technologies.

Conclusion and recommendations

In conclusion, the study found that the entry of non-government stakeholders in the extension and advisory services sector has increased the farmers' sources of knowledge because they have several options to consult when in need of information. There is a significant difference in channels used to obtain information in rural and peri-urban settings, and use of different sources of information is influenced by setting and context, based on information needs and accessibility. The study established that use of ICT is influenced by the nature of business with respect to types of crops grown, information needs and infrastructure. However, adoption levels of the ICT-based innovations are still very low and this calls for awareness campaigns, as well as training for farmers and extension workers on ICT usage to promote the adoption of these technologies. At the same time, the Government needs to ensure harmonization or put in place structures for collaboration among different stakeholders in extension service provision in order to facilitate the success of the extension policy. And finally, there is also need to ensure consistency in timing and airing of these programs for maximised uptake and use of the innovations.

Note

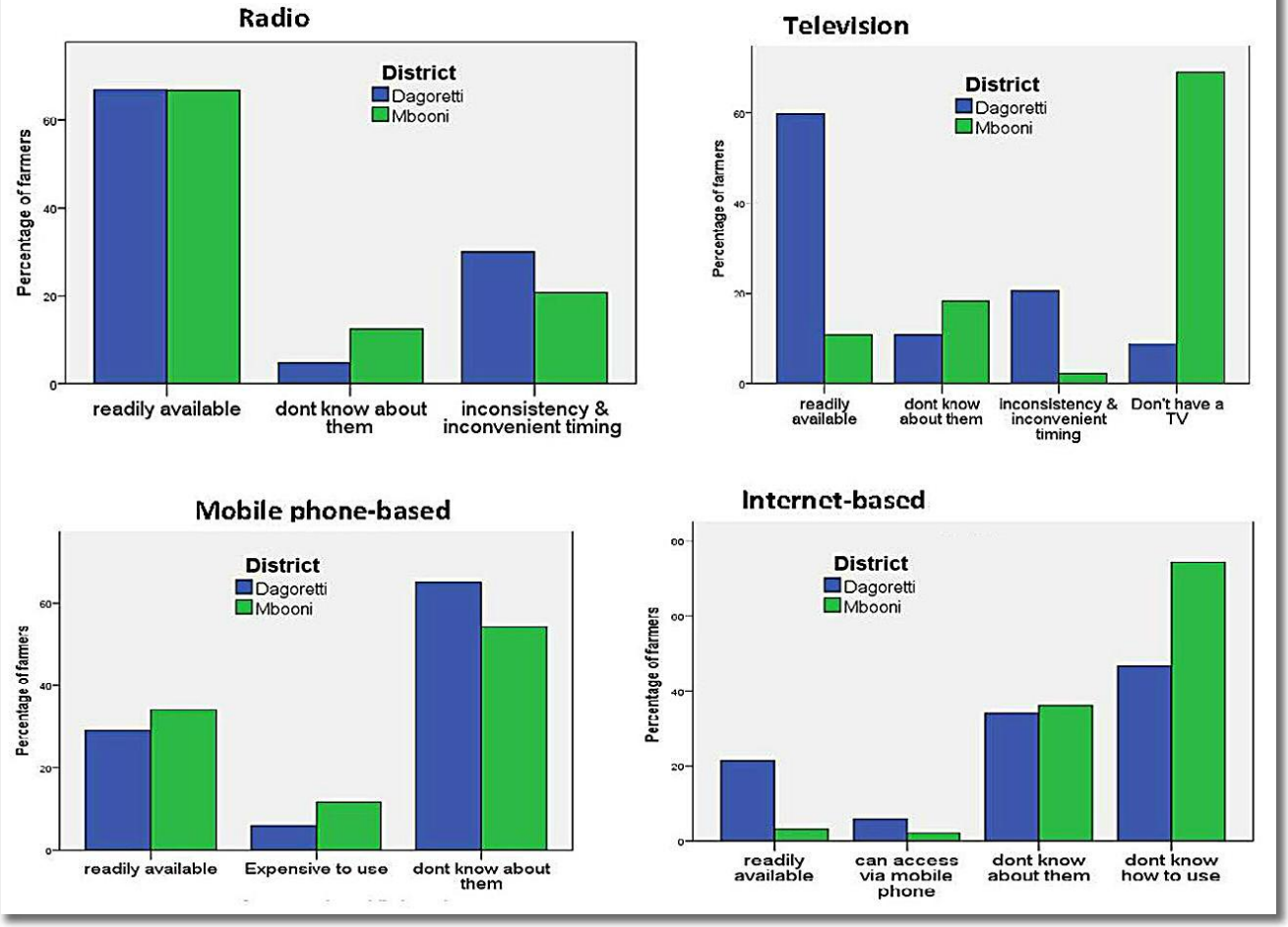
1. NGO extension agents were considered in the study to include all nongovernmental organisations that offer extension and advisory services to the farmers including faith based organisations, but excluding private profit making companies.

References

Government of Kenya. 2004. Strategy for Revitalisation of Agriculture (SRA 2004–2014). Nairobi: Government Printers.

Government of Kenya. 2005. Kenya Vision 2030. Nairobi: Government Printers.

FIGURE 2 – Reasons influencing farmers' accessibility of ICT-based innovations in Dagoretti and Mbooni districts



Government of Kenya. 2008. National Agricultural Sector Extension Policy (NASEP). Nairobi: Government printers.

Government Of Kenya. 2010. Agricultural Sector Development Strategy (ASDS) 2010–2020. Nairobi: Government Printers.

Hartwich, F M., L. Monge Perez, Ramos Ampuero and J.L. Soto, J L. 2007. "Knowledge Management for Agricultural Innovation: Lessons form Networks in the Bolivian Agricultural Technology System". Knowledge Management for Development Journal, 3(2): 21–37.

Juma, C. 2011. The New Harvest: Agricultural Innovation in Africa. Oxford: Oxford University Press.

Nyirenda-Jere, T. 2010. Unlocking the Promise of ICTs for Transforming Agriculture in Africa. http://knowledge.cta.int/Dossiers/S-T-Policy/ICKM-MIS-ICT/ICT-for-transforming-research-for-agricultural-and-rural-development/Feature-articles/Unlocking-the-Promise-of-ICTs-for-Transforming-Agriculture-in-Africa.

Rivera, W., K. Qamar and L. Crowder. 2001. Agricultural and Rural Extension Worldwide: Options for Institutional Reform in the Developing Countries Rome: FAO ftp://ftp.fao.org/docrep/fao/004/y2709e/y2709e.pdf.

Swanson, B and R. Rajalati R. 2010. Strengthening Agricultural Extension and Advisory Systems:Procedures for Assessing, Transforming and Evaluating Extension Systems. Agriculture and Rural Development Discussion Paper 45. Washington, DC: The World Bank.

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From Local to Global: Launching the New Rangelands West Portals and Database

Jeanne L. Pfander, Barbara S. Hutchinson, Valeria Pesce, and Matt Rahr

Abstract: In 1995 the University of Arizona (UA) Libraries, partnering with UA College of Agriculture and Life Sciences (CALS) rangelands specialists, joined as a charter member of the AgNIC initiative coordinated by the National Agriculture Library (NAL). The topic of rangelands was chosen by Arizona, and early on, the team recognized the challenge of representing the knowledge universe related to that topic. As a result, in 2001, the Deans of the UA Libraries and CALS invited their counterparts in the Western Land Grant Universities (LGUs) to join in a Western Rangelands Partnership. Today this collaborative effort, known simply as the Rangelands Partnership, has grown to include nineteen LGUs, with international participation from Australia, Mexico, and the United Nations' Food and Agriculture Organization (FAO). This collaborative partnership culminated in the release in December 2012 of a suite of websites — Global Rangelands, Rangelands West and hosted state Rangelands sites — with more than 13,000 resources.

Resume: En 1995, les bibliothèques de l'université de l'Arizona (UA), en partenariat avec des spécialistes en parcours, du collège de l'agriculture et des sciences de la vie (CALS) de l'UA, sont devenus membres fondateurs de l'initiative AgNIC, coordonnée par la bibliothèque nationale agricole (NAL). Le thème des parcours a été choisi par l'Arizona, et au début, l'équipe a reconnu le défi de représenter l'univers des connaissances liées à cette rubrique. En conséquence, en 2001, les doyens des bibliothèques de l'UA et de la CALS ont invité leurs homologues des universités de l'Ouest (LGU) à se joindre au Partenariat Western Rangelands. Aujourd'hui, cet effort de collaboration, connue simplement comme le Rangelands Partnership, s'est développé pour inclure dix-neuf LGU, avec une participation internationale de l'Australie, du Mexique, et de l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO). Ce partenariat collaboratif a abouti à la publication en décembre 2012 d'une suite de sites web — Global Rangelands, Rangelands West et autres sites étatiques sur les parcours — avec plus de 13 000 ressources.

Resumen: En 1995, las bibliotecas de la Universidad de Arizona (UA), en alianza con los especialistas en pasturas de la Facultad de Agricultura y Ciencias de la Vida (CALS, sus siglas en inglés) de dicha Universidad, se unieron como miembros fundadores de la iniciativa AgNIC coordinada por la Biblioteca Agrícola Nacional (NAL, sus siglas en inglés). El tema de pasturas fue escogido por Arizona, y desde el principio, el equipo reconoció el reto de representar el universo de conocimientos relacionados con ese tema. Como resultado, en el 2001, los decanos de las bibliotecas de la UA y CALS invitaron a sus homólogos de las universidades públicas del Oeste (conocidos como "land-grant universities") a unirse en una Alianza de Pasturas de la Zona Oeste. Hoy en día este esfuerzo de colaboración, conocido simplemente como la Alianza de Pasturas, ha crecido hasta incluir a 19 universidades públicas, con participación internacional de Australia, México y la Organización de las Naciones Unidas para la Alimentación y la Agricultura (FAO). Esta alianza colaborativa culminó con la liberación en diciembre del 2012 de una serie de sitios web — Global Rangelands, Rangelands West y otros sitios patrocinados sobre pasturas a nivel estatal, con más de 13.000 recursos.

Introduction

In 1995 the University of Arizona Libraries, partnering with rangeland specialists from the University of Arizona College of Agriculture and Life Sciences (CALS), joined as a charter member of the AgNIC initiative coordinated by the National Agriculture Library (NAL). The topic of rangelands was chosen by Arizona because of the large amount of that land type in the state and the importance of addressing the many issues arising from the multidisciplinary nature of rangeland management. In fact, rangelands cover seventy percent of the world's land area and fifty percent of the U.S. (Holechek, 2001, p. 42). They include grasslands, savannahs, shrublands and deserts. Rangelands are important resources for wildlife habitat, watersheds, recreation and forage for livestock production and, therefore, are critical to economic development in rural communities and to people everywhere for access to natural resources and open space.

Early on, the Arizona team recognized the challenge of representing the knowledge universe related to rangelands. As a result, in 2001, the Deans of the Libraries and CALS invited their counterparts in the Western Land Grant Universities (LGUs) to send representative librarians and rangeland specialist to join in a Western Rangelands Partnership. Today this collaborative effort, known simply as the Rangelands Partnership, has grown to include nineteen LGUs, with international participation from Australia, Mexico, and the United Nations' Food and Agriculture Organization (FAO).

This paper will describe the efforts, "from local to global", that culminated in the release in December 2012 of a suite of websites providing access to a database of over 13,000 rangeland resources that are international (*Global Rangelands)*, regional (*Rangelands West)* and local (hosted state *Rangelands* sites). It will also describe the plans for ongoing development of these sites. resources.

Change is Constant

As the Rangeland Partnership collaborators worked together on the *Rangelands West* and state *Rangelands* sites, they recognized the need to change and evolve and to gain new resources. To inform these developments,

they developed a business plan and conducted needs assessments (Pfander, 2009) to guide development of technical requirements for a total redesign of the *Rangelands West* sites.

Key recommendations that emerged from the needs assessment described requirements that users felt were critical, including: frequently updated content, fast and relevant searches, libraries of documents and images, location-specific information, tools to foster interaction/networking, and a searchable directory of experts. The business plan addressed the issue of sustainability and recommended revenue generation through grants, Partner contributions and, potentially, sponsorships.

Moving Forward

In 2010, several members of the Rangelands Partnership—the University of Arizona, the University of California at Davis; and the University of Idaho—along with Rangelands Australia and the Food and Agriculture Organization of the United Nations, received a USDA International Science Education Program Grant. The grant's objectives were to:

- Redesign the *Rangelands West* portal to host a repository of global rangelands full-text and evaluated resources.
- Establish partnerships with key organizations and associations around the world as contributors to *Global Rangelands*.
- Upload and create infrastructure to provide faster and more user-friendly access to content.
- Create a customized search interface (faceted search) and implement social networking applications.
- Develop two multimedia learning modules (overview and Australia).
- Create synthesis papers on international outreach/Extension practices for natural resources management.

The results, to date, include the new *Global Rangelands* (http://globalrangelands.org/) portal (Fig. 1) and back-end database of over 13,000 records; a re-designed *Rangelands West* (http://globalrangelands.org/rangelandswest/) site (Fig. 2) and a redesigned state Rangelands site (http://globalrangelands.org/arizona) template (Fig. 3) that can be used by those partners which choose to do so (some partners are using the LibGuides system to create their state sites).

In addition, papers from the Australia Rangelands Society symposia series have been digitized and records added to the Global Rangelands database. Rangelands-related records have been harvested from the FAO database and also added to GR. The Partnership will also be exploring opportunities to collaborate with other organizations such as the Grasslands Society of Southern Africa and the International Land Coalition.

Progress has been made in implementing faceted search options in the Global Rangelands search interface, including the ability to limit searches by author, document type, and keywords. Multimedia learning content has been created through the UC-Davis developed WRANGLE (World RANGElands Learning Experience)

FIGURE 1 – Global Rangelands Portal

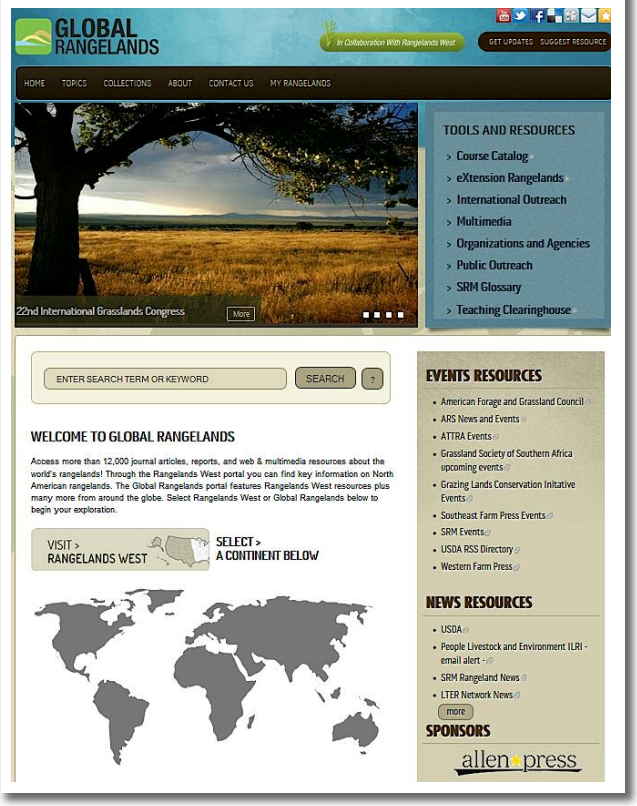
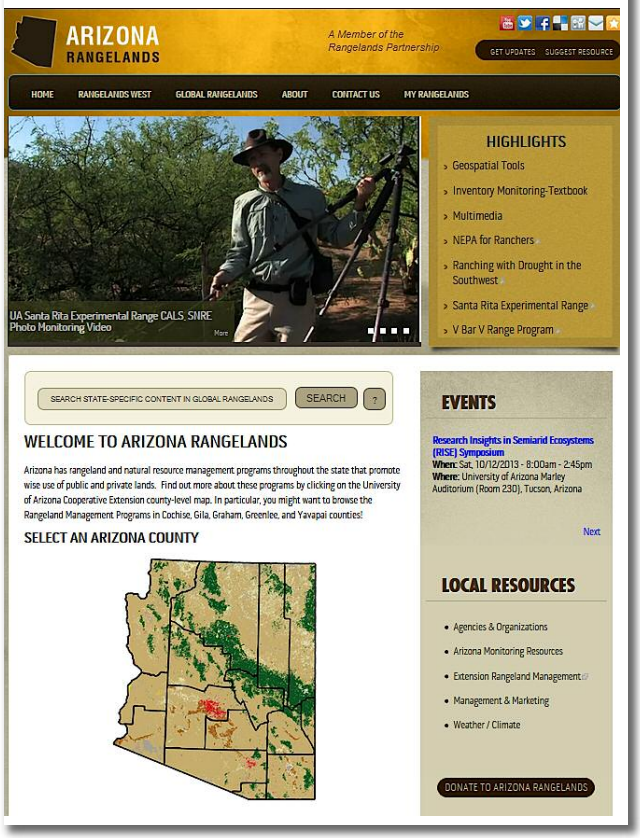


FIGURE 2 – Rangelands West Home Page

modules (Fig. 4) and other multimedia has been identified and added to the GR database.

Figure 3 – Sample Rangelands State Template

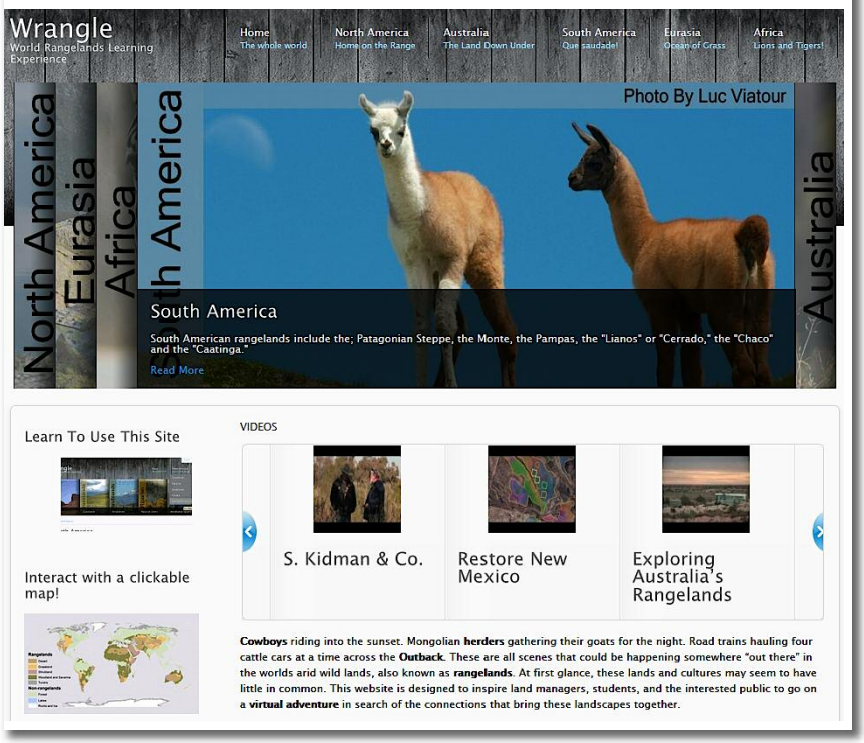


The international outreach section of the Global Rangelands site has been created as a resource on global extension practices involving participatory approaches and the use of Information and Communication Technologies (ICTs). Users can find information about international Extension practices, case study profiles, organizations working in this area, multimedia resources on international outreach, and links to resources on the use of ICTs in international Extension.

Technical Implementation and AGROVOC Integration

Both the *Rangelands West* and the *Global Rangelands* portals are built on the Drupal Content Management System (CMS), a powerful open-source platform that offers advanced features for submitting, organizing, searching, browsing, importing and exporting contents. The integration of external content, like the *Journal of Range Management* and *Rangelands* Archives at The University of Arizona Institutional Repository (uair.arizona.edu/journals) and the FAO Doc repository (www.fao.org/documents/en/docrep.jsp), is made possible by a very elegant import mechanism available for Drupal, which allows for importing or harvesting via CSV, RSS, and OAI-PMH (Open Archives Initiative — Protocol for Metadata Harvesting) formats. An additional module provides for faceted browsing capabilities (for the technically minded, this is accomplished by connecting Drupal to an Apache Solr instance for Solr-based browsing). The Drupal Organic Groups module is used to separate and establish editing roles amongst the different partners' repositories.

Figure 4 – World Rangelands Learning Experience (Wrangle.org)



In addition, the Global Rangelands and Rangelands West portals adopted some specific solutions recommended by the AgriDrupal[1] community, a group facilitated by the FAO and the Global Forum on Agricultural Research (GFAR) and made up of practitioners working with the Drupal CMS to implement useful functionalities for agricultural information management. These specific solutions include the adoption of core standard bibliographic metadata for describing the resources available in the portals and the integration of the AGROVOC thesaurus for tagging all contents.

AGROVOC is a controlled multilingual vocabulary covering all areas of interest to FAO, including several topics related to rangelands. Besides the usual advantages of using a controlled vocabulary for indexing resources (e.g. the consistent

use of the same terms for the same concepts across all collections and also across different portals and information systems), using AGROVOC broadens the potential range of information sources that can be harvested, as it is adopted worldwide by many organizations and is linked to other widely used thesauri[2] (like the U.S. National Agricultural Library's Agricultural Thesaurus; the Chinese Academy of Agricultural Sciences Thesaurus (CAAT); and Eurovoc, the EU's multilingual thesaurus). AGROVOC is integrated in the Rangelands West and Global Rangelands portals through a Drupal module that suggests AGROVOC terms when the editor is tagging contents and then makes the selected terms available for faceted browsing.

Future Technical Improvements

One future technical improvement would address the problem of relevant information sources on the web that do not use AGROVOC for tagging contents. In order to aggregate contents from these sources (e.g. via RSS feeds or page scraping) and have them fit with the semantic organization of the platform, the "automatic tagging" feature of the AGROVOC module for Drupal can be exploited. This feature analyses the text available with the resource and automatically assigns AGROVOC terms based on natural language processing techniques, thus making the aggregated resources searchable through the faceted browsing.

Another possible area for improvement is the possible inclusion of non-English resources, which would be easily provided for by Drupal's native support for multilanguage content. Additionally, non-English-speaking editors and visitors would be allowed to switch the interface language and browse AGROVOC terms in their preferred language (among the languages supported by the portals).

Finally, the provision of a Resource Description Framework (RDF) store is planned, which will supplement the basic RSS feeds to share the contents of the portals. The result will be to make all contents available as Open Data.

Some of these enhancements, especially the provision of an RDF store and the exposure of data as Open Data, will be better achieved upgrading to the latest version of the Drupal CMS, which will make the platforms more robust, performing and interoperable.

Global Rangelands Phase II

Web portal work is never finished; not surprisingly, the Rangelands Partnership has already identified a number of goals for Phase II. Desired new features and functionality include improvements to the user interface, social networking options (Twitter, Facebook and Google Plus), advanced searching options, faceted browsing, a mobile-friendly design, search boxes on each Collection page, options for exporting to citation management programs like Endnote and RefWorks, and continued addition of new content through harvesting or digitization efforts. Specific technical changes include:

Advanced Searching: will allow the user to specify criteria such as Keyword, Author, Title, Journal Source, etc. and narrow the results to specific years and document types. Advanced Search will complement current faceted searching capabilities.

Faceted Browsing: will allow a user to browse content at a generalized level without first having to provide a search term. For example, Faceted Browsing will allow users to "See all conference proceedings".

Browse All Authors Alphabetically: will give users the ability to browse Author by last name.

Print Friendly Pages: will provide a print friendly button that formats the content of the web page to match an 8.5 × 11 page paper.

State Template Improvements: Partners have requested the ability to add more "slides" to the front page rotating slideshow. This number will be increased along with the ability to add a dynamic secondary page allowing users to see all future upcoming events.

Streamlined Data Harvesting: will improve the back-end mechanism and workflow for importing data so that when new data becomes available on partners' repositories, it becomes searchable through Global Rangelands more quickly.

The technical team has made some improvements to the user interface. Now, when searching from a State template, the search results page has the same template as the State homepage. Prior to this, the search result page had the look of the Global Rangelands page template. This also has been addressed on the Rangelands West search results page. In addition, the Rangelands West search results page now includes results from the *Journal of Range Management* and *Rangelands* journals. Search boxes have been added to each collection's listing of resources. This can be found on the "Collections" menu item. A Rangelands West Facebook page has also been created.

Conclusion

The Rangelands Partnership is made up of a growing number of committed rangeland professionals, librarians, and technicians from around the world who largely volunteer their time to ensure access to quality rangeland management resources. The purpose is to provide information and data that will assist with informed decision-making and knowledge sharing for a wide range of audiences, including public and private landowners, teachers and students, and the general public. The Partnership welcomes opportunities for new collaboration with related groups and organizations and values comments and suggestions from all stakeholders. To this end, the authors of this paper welcome feedback

through the "contact us" feature on the Partnerships' portals: http://globalrangelands.org/contact.

Notes

1 AgriDrupal is a set of solutions implemented in Drupal that extend it with ready-to-use functionalities for agricultural information management: http://aims.fao.org/tools/agridrupal/

2 These linkages consist in mappings between AGROVOC terms and other Knowledge Organization Systems (KOS) implemented using semantic technologies and a Linked Data approach.

References and Related Papers

Holechek, J. 2001. The World's Growing Population Will Put Added Pressure on Range-Lands and the Value of the Services These Lands Provide. *Rangelands,* 23(6): 39–43.

Holechek, J.L. 2013. Global Trends in Population, Energy Use and Climate: Implications for Policy Development, Rangeland Management and Rangeland Users. *The Rangeland Journal,* 35(2): 117.

Hutchinson, B., J. Pfander, J. Tanaka, and Jason Clark. 2011. Rangelands West/Global Rangelands, eXtension Rangelands, and the Range Science Information System: A Suite of New Web Resources. *Rangelands,* 33(4): 55–63.

Hutchinson, B.S., J.L. Pfander, and G. Ruyle, 2008. "Collaborative Initiatives to Deliver Agricultural Information". In P. Hernon and R.R. Powell (Eds.), *Convergence and Collaboration of Campus Information Services.* Westport, CT: Libraries Unlimited, p. 177–197.

Pfander, J.L. 2009. *Summary of Results from the 2008 Rangelands Health & Management Information Needs Assessment Survey*. Paper presented at the Rangelands West Annual Meeting, Boise, ID.

Tanaka, J., B. Hutchinson, M. Fraker-Marble, R. Frost, K, Launchbaugh, and M. George. 2012." Using Rangelands on the Web as a Teaching Resource". *Rangelands,* 34(3): 39–40.

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Seed Village Programme: An Innovative Approach for Small Farmers

Dheeraj Singh, M K Chaudhary, M L Meena and M M Roy

Abstract: Quality seed is the key input for farmers to realize potential productivity, but there is an alarming gap between the demand for and supply of such seeds. To address this gap, the Krishi Vigyan Kendra, Central Arid Zone Research Institute, in Pali, India started a seed village program in selected villages during 2009–10. A seed village advocates self-sufficiency of villages in the multiplication and distribution of quality seeds. Under the KVK CAZRI Pali program, quality seeds of improved varieties of prominent crops of the area — namely, Wheat, Barley, Mustard and Cumin — were distributed to the identified farmers in the area annually. A number of trainings on seed production technology were also arranged, including isolation distance, sowing practices, seed treatment, and off-type plants. The results showed that the seed village concept is a novel and highly practical approach with a vast potential to produce and distribute quality seed in most crops.

Resumé: La semence de qualité est le principal intrant des agriculteurs pour atteindre les potentiels de productivité, mais il y a un écart alarmant entre la de mande et l'offre de ces semences. Pour combler cette lacune, l'Institut de recherche sur les zo nes arides centrales (appelé Krishi Vigyan Kendra) de Pali en Inde, a lancé un programme de Village de semences dans certains villages en 2009–10. Un Village de semences prône l'autosuffisance des villages dans la multiplication et la distribution de semences de qualité. En vertu du programme KVK CAZRI de Pali, des semences de qualité de variétés améliorées de plantes éminentes de la région — c'est-à-dire de blé, d'orge, de moutarde et de cumin — ont été distribuées annuellement aux agriculteurs dans la région. Un certain nombre de formations sur la technologie de la production de semences ont également été organisées, y compris sur l'isolement lié à la distance, les pratiques du semis, le traitement des semences, et le type de plantes. Les résultats ont mo ntré que le concept de Village de semences est une approche nouvelle et hautement pratique avec un vas te potentiel de production et de distribution des semences de qualité pour la plupart des réco ltes.

Resumen: El artículo explora cómo las bibliotecas agrícolas de la India han evolucionado y transformado en la era digital y cómo los avances tecnológicos yla mayor sofisticación de las herramientas basadas en la Web han permitido a las bibliotecas colaborar entre sí y compartir recursos. Los autores identifican diversas prácticas innovadoras adoptadas por 56 bibliotecas agrícolas de ese país y detallan los programas colaborativos a niveldel país y los proyectos de digitalización en curso, tales como Agricat de eGranth, un catálogo colectivo de libros y artículos sobre la agricultura y ciencias afines. También se describenactividades relacionadas con los repositorios institucionales digitales como Krishi Kosh y Krishi Prabha y el establecimiento de un consorcio nacional de revistas electrónicas y contenidos digitales accesibles para la comunidad académica de la India. Las subvenciones de proyectos financia dos por el Banco Mundial-Consejo de Investigación Agrícola de la India (ICAR, sus siglas en inglés), como el Proyecto Nacional de Innovación Agrícola (NAIP, sus siglas en inglés) han promovido la digitalización en la India y, al eliminar las barreras físicas, han acercado a las bibliotecas y la comunidad de usuarios de manera virtual.

Introduction

Quality seed of improved varieties is an important basic input for enhancing productivity of any crop species, but existing mechanisms to meet the quality seed requirements of small-scale farmers are not adequate and have serious limitations. In spite of many efforts, seed supply — particularly of food grain crops — is still a serious concern today, with the private seed sector reluctant to produce and market seeds due to economic considerations (Hedge,2004). Lack of timely availability of good quality seeds of high-yielding varieties is one of the major constraints contributing to stagnant yields of major crops. The other constraints include lack of proper storage facilities at the farm level, storage insect pests, and farmers' perception of better performance of locally produced seed.

At the same time, more than 80% of crops in developing countries are sown from seed stocks selected and saved by farmers (Osborne and Faye 1991; Jaffe and Srivastava 1992; Almekinders *et al*., 1994), while more than 85% of the total seed sown in India is produced by farmers. Hence, large areas of food grain crops are still sown with seeds saved by farmers. However, there is experimental evidence that cereal crops give ten to twenty percent less yield per hectare when farmers use their own saved seed (Reddy *et al.*, 2010).

Village-based seed banks provide an alternative seed system that addresses these problems and helps farmers become self-reliant (Reddy *et al.*, 2006). They ensure the availability of quality seed of improved varieties to village farmers and the integration of informal seed enterprises and farmers themselves in the seed production and supply systems; all of this enables a timely availability of quality seeds at the doorstep of farmers. Seed banks also help address the poor overall performance of the agricultural sector that has led to a decline in agricultural production and overall low economic growth. There has been a call for the intensification of agriculture through the development of improved varieties and production technologies (FAO, 1986). Seed banks are gaining momentum because they answer that call by offering access to and availability of good quality seed of improved varieties that farmers prefer at affordable prices and at the right time to enhance crop productivity income and household food.

Table 1 – Technology demonstrated and popularized

S. No.	Crop	Thematic Area	Technology demonstrated	Popularization methods
1.	Wheat Mustard Barley Cumin	Improved production technology package	▪ Improved variety ▪ Seed treatment ▪ Line sowing ▪ Irrigation scheduling ▪ Weed management ▪ Balanced dose of fertilizer ▪ Biofertilizers ▪ IPM ▪ Post harvest measures	▪ International Centre for Insect Physiology and Ecology (ICIPE) ▪ Result demonstration ▪ Extension literature ▪ Extension activities viz. Field day, Farmers Meet, Field visit, Farmers' Scientists Interaction, crop exhibition, farmers' fair etc.

They also offer a promise of enhanced crop productivity and local seed enterprises leading to higher incomes to farmers. The village seed model can be replicated elsewhere to other crops as well, while the concept of village seed banks has been promoted and successfully validated in Mahbubnagar district in Andhra Pradesh, India (Reddy *et al.,* 2010). With all that in mind, Krishi Vigyan Kendra (KVK) undertook a seed village program of its own.

Materials and methods

Krishi Vigyan Kendra (KVK), Central Arid Zone Research Institute (CAZRI), Pali in the state of Rajasthan, India started the seed village program (SVP) in its selected villages in 2009. Under this program, quality seeds of improved varieties of prominent crops of the area — namely Wheat (Raj 4037), Barley (RD 2035), Mustard (Urvashi) and Cumin (RZ 223) — were distributed by the KVK, CAZRI, Pali to the identified farmers in the area, who were selected per stand procedure. A number of trainings on seed production technology for the identified farmers in the seed villages were also arranged, as were programs on isolation distance, sowing practices, seed treatment, off type plant and other agronomic practices. Accordingly, wheat, barley, mustard and cumin crops were laid out in the KVK-adopted villages of Bitura Kalan, Inderwada, Bhagwanpura, Hingola Kalan, Kherwa and Dhamli of the Pali district. Regular visits by the KVK scientists to demonstration fields were ensured, with the scientists demonstrating and popularizing technology for the farmers (Table 1). These visits were also utilized to collect feedback for further improvement in research and extension programmes. Field days and group meetings were also organized at the demonstration sites to provide the opportunities for other farmers to witness the benefits of demonstrated technologies. Data were collected from the seed village program farmers and analysed with the suitable statistical tools to compare the yields of farmers' fields and seed village programme farmers' fields. In demonstration (SVP) plots, a few critical inputs such as quality seed, balanced fertilizers and agro-chemicals were provided and non-monetary inputs like timely sowing in lines and timely weeding were also performed, while traditional practices were maintained as a type of local check or control. The SVP farmers were facilitated by KVK scientists in performing field operations like sowing, spraying, weeding, harvesting etc. during the course of training and visits. The raw data was further utilized to generate additional information regarding horizontal spread and the adoption of a particular variety as per standard procedure (Reddy *et al.,* 2010).

Results and discussion

Impact of Improved Variety – The experiment's findings revealed that there was a substantial increase in the yield of the selected variety in all the four crops as compared to the local or traditional variety used by the farmers (Table 2). In wheat the varieties Raj 4037 yielded 42.2 q/ha as compared to 33.9 q/ha from local variety, thus showing a 24% increased yield advantage. In mustard there was a 35.7% yield advantage by using improved variety Urvashi over the local variety. In barley the variety RD 2035 yielded 39.90 q/ha over the local variety which yielded 29.20 q/ha thus gaining a yield advantage of 37% .Similarly in cumin the SVP farmers got an average yield of 6.7 q/ha from cumin variety RZ 223 as compared to local variety yielding 4.2 q/ha, thus depicting an yield advantage of 60% over the local variety. The results are also in accordance with the results of Singh *et al.* (2012) who stated that improved agricultural technologies and varieties significantly increased the yield in Rabi crops under normal climatic conditions. Research suggests that there is a good potential for improving performance and productivity in the agricultural

Table 2 – Impact of improved seeds of different crops in seed villages

S. No.	Name of crop	Variety	Yield of improved variety	Farmer practice yield	Percent increase
			(q/ha)	(q/ha)	
1.	Wheat	Raj 4037	42.20	33.90	24.48
2.	Mustard	Urvashi	20.90	15.40	35.71
3.	Barley	RD 2052	39.90	29.20	36.64
4.	Cumin	RZ 223	6.70	4.20	59.52

sector which can only be attained through positive transformation of the sector, including increased availability and use of improved seed varieties (Ampofo, 1990). The agricultural sector has benefited from myriad interventions that seek to improve yield, reduce poverty and increase incomes. Farmers have benefited much from the dissemination of high-yielding crop varieties in addition to other complementary technologies (Langyintuo and Dogbe, 2005; Faltermeier, 2007).

Economic analysis – An attempt was also made to determine the economics of the improved variety and to compare it with the local variety (Table 3). The findings revealed that in all the four crops the cost of cultivation of the local variety was on par with the improved variety but in the case of the gross returns and benefit cost ratio, a significant difference was observed. In wheat the gross return was 55,205 INR which was significantly higher as compared to the return from local variety (INR 35,200) with a B:C ratio of 2.1:1.4, respectively. In mustard the B:C ratio of improved (3.7) over the local variety (2.9) was significantly higher showing the superiority of the improved variety over the local variety. In Barley the gross return from the improved variety was 33,600 as compared to the return of INR 18,600 from the local variety. In cumin also the improved variety recorded a higher gross return and B:C ratio (INR 89,800 and 2.8) as compared to the local variety (INR 68,200 and 2.1). These results are also in close proximity with the result of Singh *et al.* (2005) who reported similar results while experimenting with pulse crops. The increase in productivity, rather than enhanced area, has contributed more towards increased production. This has been achieved mainly due to the adoption of new varieties and improved production technology (Singh *et al.,* 2009).

Table 3 – Comparative economics of improved vs local variety of different crops under SVP

S. No.	Name of crop	Gross return		Cost of cultivation		B:C ratio	
		Improved variety	Local variety	Improved variety	Local variety	Improved variety	Local variety
		---------- (INR/ha.) ----------					
1.	Wheat	55,205	35,200	26,200	25,000	2.1	1.4
2.	Mustard	78,300	59,400	20,900	20,000	3.7	2.9
3.	Barley	50,715	33,600	18,600	17,900	2.7	1.9
4.	Cumin	89,800	68,200	32,300	32,000	2.8	2.1

Table 4 – Horizontal spread of improved variety from seed villages

S. No.	Name of crop	Variety	Number of farmers		Number of villages		Area covered (ha.)	
			Initial	Final	Initial	Final	Initial	Final
1.	Wheat	Raj 4037	12	55	2	10	6	23
2.	Mustard	Urvashi	6	35	3	7	10	67
3.	Barley	RD 2035	10	39	4	12	8	26
4.	Cumin	RZ 223	12	91	5	18	22	175

Horizontal spread of improved variety from seed villages – Wheat variety Raj. 4037 has more effective tillers and a higher number of grains per spike. It performs well even under slightly saline/sodic irrigation water and soil conditions, hence from an initial group of twelve farmers it spread to fifty-five farmers covering ten cluster villages (Table 4). At the same time, the area increased from six hectares to twenty-three hectares. Farmers appreciated the early vigorous growth and branching of the Urvashi variety of mustard, which were due to its bold size and the quality of grain and pod containing higher oil content. It spread to seven villages covering sixty-seven hectares of land. Barley RD 2035 is a four row variety which is high yielding even under slightly saline/sodic irrigation water conditions and is resistant to yellow rust. From an initial number of ten farmers it spread to thirty-nine farmers covering sixty-seven hectares of land. Cumin var. RZ 223 is resistant to powdery mildew and blight and produced good quality seed with better aroma due to a higher volatile oils as compared to the local one. This variety spread to ninety farmers from an initial group of twelve farmers and covered an area of 175 hectares. The results are in accordance with the findings of Pandit *et al.* (2011) who concluded that farmers emphasized simultaneous selection more than an empirical selection based on yield only. Farmers' selected varieties are extending very rapidly and farmer-to-farmer seed transfers were found to be very effective in scaling-up the seed transfer and increase varietal diversity. Joshi *et al.* (1995) also reported that in addition to grain yield, farmers also consider other parameters like growing period, plant height, threshability, milling recovery, taste and other characters of rice. Farmers contribute to goal setting by identifying traits and providing a testing system that are suitable for multiple farmers and multiple locations and allow for the trade-off between many traits (Joshi *et al.*, 2002).

Adoption of improved seeds – Data presented in Table 5 reveals that for all the selected four crops (wheat,

Table 5 – Adoption of improved seeds by the farmers in seed villages

S. No.	Name of crop	Variety	Percent adoption	Variety	Percent adoption
1.	Wheat	Raj 4037	78.18	Local	21.82
2.	Mustard	Urvashi	82.85	Local	17.15
3.	Barley	RD 2035	74.36	Local	25.64
4.	Cumin	RZ 223	86.81	Local	13.19

mustard, barley and cumin), the beneficiary farmers have a high level of adoption ranging from 74–87% whereas in the case of the local variety the adoption rate was very low ranging from 13–26%; this shows the importance of the improved variety over the traditional variety. The main criteria for such high adoption rates are high yield with superior plant and grain characteristics. The results are also in conformity with Rashid *et al.* (2004) who indicated that farmers consider other characters like bold grains, large spike, strong stem, earliness, etc., along with yield; therefore, breeders have to emphasize farmers' attitudes during selection. If they don't, their varieties may not be well accepted by the users. The above findings are also in line with the findings of Baksh *et al.,* 2003, Singh *et al*., 2007 and Kudi *et al.,* 2011 who pointed out that high yield got the highest score and ranked first in adoption followed by other post harvest characters.

Conclusion

Under the seed village program, a substantial increase in the yield of selected crop varieties was obtained as compared to local varieties with a high rate of horizontal spread of seeds to more farmers. The results also show that for all the selected crops the beneficiary farmers recorded high levels of adoption for improved varieties as compared to local varieties. All of this shows their willingness to accept new technologies.

References

Almekinders C.J.M., N.P. Louwaars and G.H. de Bruijn. 1994. "Local Seed Systems and Their Importance for an Improved Seed Supply in Developing Countries." *Euphytica*, 78:207–216.

Ampofo S.T. 1990. "Farmers' Adoption of Recommended Practices." Paper presented at Farmer–Extension: The First Farming Systems Workshop, Accra, Ghana.

Baksh, E., M.H. Rashid and M.G. Rabbani. 2003. "Participatory Rural Appraisal of PVS Site Daulatpur, Thakurgaon, Dinajpur, Bangladesh." A PRA report of Wheat Research Centre, Bangladesh Agricultural Research Institute, Nashipur, Dinajpur, 31 p.

Pandit D.B., M.M. Islam, M.H-Rashid and M.A. Sufian. 2000. "Participatory Varietal Selection in Wheat and its Impact on Scaling up Seed Dissemination and Varietal Diversity. *Bangladesh Journal of Agricultural Research*, 32(3): 473–486.

Faltermeier L. 2007. "Adoption of Water Conservation and Intensification Technologies in the Lowland Rice Production System of Northern Ghana." Paper presented at the MEIDE Conference, Maastricht, Netherlands.

Food and Agriculture Organization (FAO). 1986. *Food Security Statistics.* Rome.

Hedge, D.M. 2004. "Becoming Self-reliant." *Hindu survey of India Agriculture 2004,* 45–47.

Jaffee S. and J. Srivastava. 1994. "The Role of the Private and Public Sectors in Enhancing the Performance of Seed Systems." *The World Bank Research Observations* 9: 97–117.

Joshi, K.D., R.B. Rana, K.B. Kadayat, and B.R. Sthapit. 2002. "Enhancing on-Farm Varietal Diversity through Participatory Varietal Selection: A Case Study of Chaite Rice in Nepal." *Experimental Agriculture,* 33:335–344.

Joshi, K.D., R.B. Rana, M. Subedi, K.B. Kadayat & B.R. Sthapit. 1995. "Effectiveness of Participatory Testing and Dissemination Programme: A Case Study of Chaite Rice in the Western Hills of Nepal." LARC working paper No. 95/49. Pokhara, Nepal: Lumble Agricultural Research Centre.

Kudi, T. M.L., M.L. Bolaji, M.O.L. Akinola and D. Nasa. 2011. "Analysis of Adoption of Improved Maize Varieties Among Farmers in Kwara State, Nigeria." *International Journal of Peace and Development Studies* 1(3): 8–12.

Langyintuo A.S. and W. Dogbe. 2005. "Characterizing the Constraints for the Adoption of a Callopogoniummucunoides Improved Fallow in Rice Production Systems in Northern Ghana." *Agriculture, Ecosystems & Environment* 110: 78–90.

Osborn T. and A. Faye. 1991. *Using Farmers Participatory Research to Improve Seed and Food Grain Production in Senegal.* Winrock International Institute for Agricultureal Development. Development Studies Paper Series. Winrock, Arlington, USA.

Reddy Ravinder Ch, Reddy K. Gurava, Reddy. G. Thirupati, S.P. Wani and Peter Bezkorowajnyi. 2006. "Enhanced Fodder Production with Innovative Sustainable Informal Seed System for Food Feed Crops: A Case Study of Village Seed Banks." Paper Presented at the International Conference on Livestock Services for Enhancing Rural Development, Beijing, China 16–22 April, 2006.

Reddy Ravinder Ch, S.N. Nigam, Rao P. Parthasarthy, Ahmed Shaik, R. Ratnakar, Alur Ashok, Kumar A. Ashok, B.V.S. Reddy and C.L.L. Gowda. 2010. "Village Seed Banks: An Integrated Seed System for Improved Seed Production and Supply — A Case Study." *Information Bulletin* No. 87. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 40 p..

Singh D., M. Choudhary and M.L. Meena. 2012. "Indian Rural Technology of Front Line Demonstrations Enhancing Agricultural Productivity Under Rainfed Conditions of Rajasthan." *Indian Journal of Social Research* 53(2):141–151.

Singh, B.B., G.P. Dixit and Masood Ali. 2009. "Improved Varieties and Technology Increase Lentil Production Substantially." *Agriculture Extension Review* XXI (2): 16–19.

Singh, Lakhan, Atar Singh and R. Prasad. 2005. "Response of Demonstrations on Pulses Yield at KVKs in Uttar Pradesh." Paper presented in 3rd National Extension Education Congress 2005, at N.D.R.I. Karnal, 27–29 April, 2005.

Singh, S.N., V.K. Singh, R.K. Singh and R.K. Singh. 2007. "Evaluation of On-farm Front Line Demonstrations on the Yield of Mustard in Central Plains Zone of Uttar Pradesh." *Indian Research Journal of Extension Education,* 7(2/3):79–81.

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Transformation of Indian Agricultural Libraries in a Digital and Collaborative Era: A Case Study

Dr Neena Singh and Anil Chikate

Abstract: **The article explores how Indian Agricultural libraries have evolved and transformed in the digital era and how technological advances and increased sophistication of web based tools have enabled libraries to collaborate and share resources. The authors identify various innovative practices adopted by fifty six Indian agricultural libraries and detail the collaborative county-wide programs and digitization projects in progress such as eGranth's AgriCat, a union catalog of books and articles in agriculture and allied sciences. Also described are activities involving digital institutional repositories like KrishiKosh and KrishiPrabha and the establishment of a national level consortium for e-journals and digital content accessible to the Indian academic community. Grants from World Bank-ICAR funded projects like the National Agricultural Innovative Project (NAIP) have boosted digitization in India and have brought libraries and the user community into closer proximity virtually by removing physical boundaries.**

Resumé: **L'article explore comment les bibliothèques agricoles indiennes ont évolué et se sont transformées sous l'ère numérique, et comment les progrès technologiques et la sophistication croissante des instruments du web ont permis aux bibliothèques de collaborer et de partager les ressources. Les auteurs identifient diverses pratiques novatrices adoptées par cinquante-six bibliothèques agricoles indiennes, et détaillent les programmes de collaboration et projets de numérisation en cours au niveau des comtés comme la eGranth AgriCat, un catalogue de livres et d'articles dans les domaines de l'agriculture et des sciences alliées. D'autres activités numériques sont aussi décrites tels les dépôts institutionnels comme KrishiKosh et KrishiPrabha, et l'établissement d'un consortium au niveau national pour l'accès aux e-revues et au contenu numérique, par la communauté universitaire indienne. Des subventions venant de projets financés par la Banque mondiale-ICAR comme le Projet national d'agriculture novatrice (NAIP) ont stimulé la numérisation en Inde, et rapproché étroitement les bibliothèques et la communauté des utilisateurs pratiquement en supprimant les frontières physiques.**

Resumen: **El artículo explora cómo las bibliotecas agrícolas de la India han evolucionado y transformado en la era digital y cómo los avances tecnológicos y la mayor sofisticación de las herramientas basadas en la Web han permitido a las bibliotecas colaborar entre sí y compartir recursos. Los autores identifican diversas prácticas innovadoras adoptadas por 56 bibliotecas agrícolas de ese país y detallan los programas colaborativos a nivel del país y los proyectos de digitalización en curso, tales como AgriCat de eGranth, un catálogo colectivo de libros y artículos sobre la agricultura y ciencias afines. También se describen actividades relacionadas con los repositorios institucionales digitales como KrishiKosh y KrishiPrabha y el establecimiento de un consorcio nacional de revistas electrónicas y contenidos digitales accesibles para la comunidad académica de la India. Las subvenciones de proyectos financiados por el Banco Mundial-Consejo de Investigación Agrícola de la India (ICAR, sus siglas en inglés), como el Proyecto Nacional de Innovación Agrícola (NAIP, sus siglas en inglés) han promovido la digitalización en la India y, al eliminar las barreras físicas, han acercado a las bibliotecas y la comunidad de usuarios de manera virtual.**

Introduction

The IT industry in India has a played an eminent role in putting the country onto the global map. The success of Indian firms and professionals in Information Technology during the last decade has been not only dramatic but also noteworthy. There are several instances of bridging the digital divide across India through projects of e-governance, e-agriculture, e-education and learning, and e-businesses have been catching up and providing a multitude of services at one stop to simplify and ease the lives of common people.

If we look at the penetration of technology-enabled services in conventional degree-granting organizations like universities and other institutes of higher learning in India, the situation is quite diversified. While some have made considerable progress, others have a great deal of catching up to do. The expansion and enhancement of IT-based services and infrastructure in public funded universities, particularly the Indian Agricultural universities, has been progressing, though purposefully. The agricultural university libraries in India have been an integral part of the educational process and have been playing a vital role in shaping the future of education, research and extension activities in the country. The information professionals of agricultural universities have gone a long way in molding the future of the libraries and adapting it to the latest technological developments. The advent of information and communication technology has resulted in remarkable changes in the flow, content, and formats in which the information is presented. Keeping pace with these technological advancements, the Indian agricultural libraries are now making a transition to the era of collaboration and digitization to provide proficient retrieval systems and access to faster information around the clock.

Purpose, Limitations and Methods

This study surveyed and analyzed the University libraries and learning resources of fifty six Indian Agricultural university libraries across the country, including Veterinary

and Animal sciences. Discussed are the transformation of agricultural libraries in the digital era in terms of faster services and makeovers to revolutionize the functioning of libraries in delivering knowledge, the initiatives and upgrades made from automation activities to establish e-resources, institutional repositories, digital content management, and consortiums. The latest bibliographical details of universities were collected from the Indian Council of Agricultural Research (ICAR) — www.icar.org. Terms like libraries, information centers and learning resources centers are used interchangeably. Data collected from documentary sources and websites of libraries linked to the agricultural universities were analyzed and evaluated from the period of November 2012 to March 2013 to find examples of facilities created or imple-mented by Indian agricultural libraries using various in-formation and communication technologies. Likewise, e-mails were also forwarded to the library managers to better understand some of the services that were not clear-ly indicated and explained in their respective home pages.

Discussions

Indian agricultural libraries have strengthened their efforts to reorganize their resources as per the need of the digital era and to bring libraries and users in closer proximity; they have further developed information sources and found ways to use innovative technologies to deliver information in the best formats, more efficiently and in interesting ways. The launch of the World Bank aided National Agricultural Technology Project (NATP) in 1998 and National Agriculture Innovative Project (NAIP) in 2006 had marked new chapters in Indian agricultural research; these projects broadly aim to make agricultural research more knowledge based and IT-oriented so as to meet the current market trends and fast changing consumer demands. The Indian Council of Agricultural Research (ICAR), which is implementing the projects, is reaching out to centers like State Agricultural Universities, Agricultural Science and Technology Research Institutes, and other agricultural colleges for innovative ideas and research facilitations.

As stewards and aggregators of information, the libraries have been playing a crucial role in supplementing research and the grants provided by ICAR through these projects have made digital information resource development more successful. World Bank-aided projects gave a boost to digitization and a collaborative breakthrough movement in the country. Agricultural libraries became an inextricable part of nationwide collaborative consortium CeRA (the Consortium for e-Resources in Agriculture) in the year 2007 and are providing access to more than 3000 e-journals from premier publishers across the globe. Likewise a project like e-Granth is collaborating between several libraries for evolving Union catalogue and building digital repositories, the author discusses them in entirety in later part of the text.

Big Push to Automation Activities

Indian agricultural libraries were progressing slowly in automating their activities due to want of financial resources, but over the past decade the libraries got a big push with grants flowing in from the Indian Council of Agriculture Research (ICAR) and World Bank-aided projects. ICAR and the respective state government are the main funding agencies for the development of universities in India. They realized that libraries play a vital role in strengthening education and boosting research activities, and that the existing scenario of the agricultural libraries needed to be reinforced and beefed up, using technological innovations to increase collaboration, digitalization and access to electronic resources. Several annual development grants for libraries were released, some in the form of projects, others for strengthening of digital infrastructure and e-resources. The libraries then led a transition from conventional to automated functioning and are now advancing to digitization activities. As universities are controlled by different states, the situation of improving libraries is in different phases, with some quite advanced and others catching up considerably. A promising number of thirty five (62.5%) Indian agricultural libraries operate in an automated environment and have an OPAC, although Web surfing or OPAC are not very popular. Only eleven (19%) libraries, such as the Anand Agricultural University, the Marthwada Agriculture University in western India, the GB Pant University, and the Shere Kashmir Agriculture University in northern India have hosted their catalogues on their library homepage or have a web OPAC accessible 24x7.

If we look at inventory management in an automated environment, the situation is mixed: twenty seven (48.21%) libraries have automated inventory and are using barcodes and scanning technology. Uniquely, one library — the recently established the Uttrakhand University of Horticulture and Forestry, bifurcated from G B Pant University of Agril Technology — has advanced to Radio Frequency Identification (RFID) system. RFIDs, which are popular for inventory management and security issues in the western countries, are at early stages in Indian agricultural libraries, but already other libraries like the premier Indian Institutes of Technology or Institutes of Management are well automated using RFID techniques. The huge cost factor and the extensive collections in most agricultural libraries, however, have been deterrents to adopting advanced technologies like RFID-based document identification and security systems.

Almost all agricultural libraries (92.85%) provide internet browsing facility to their patrons. Most libraries have created an "e-library', a separate and distinct section within the library premises with increased bandwidth on connected computers with backup facilities to provide access to electronic resources such as e-books, e-journals, databases, and online portals. With grants from World Bank-funded NAIP, the Indian agricultural

libraries got a boost to expand e-resources, including subscriptions to databases, e-books and subscriptions to research material from prominent international publishing houses through the CeRA consortium. The Consortium for e Resources in Agriculture (CeRA)was created to provide refined access to e-journals within the community of National Agriculture Research System (NARS), and details about this will be explained in a later part of the article. A number of libraries have given discoverable links to the consortium in their respective library home pages. Besides CeRa, links have been provided to some other collaborative projects like e-Granth's Union catalogue and digital repositories such as KrishiKosh, which is discussed in the following text. It was also observed that a number of libraries are providing access to these services through campus local area networks (LANs) or Intranet and the discoverable links are not visible over the library web page, indicated in Appendix 1a–1b.

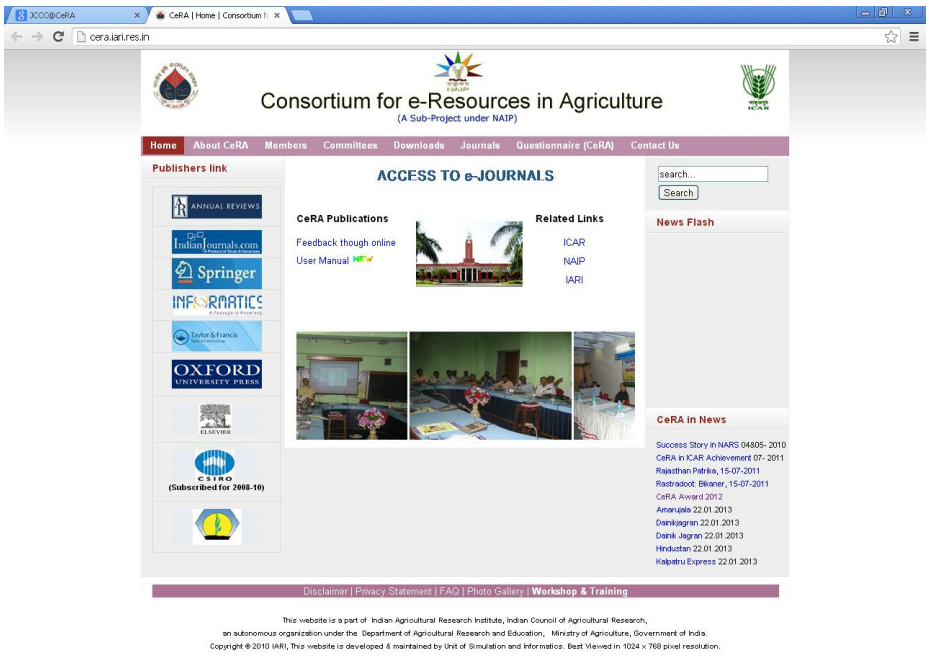
Collaborative Stratagems

A number of collaborative activities have been taken up by Indian agricultural libraries lately to boost and uplift their services to the user community, of which the prominent programs are discussed below.

Indian Agricultural Consortium – The agricultural libraries over the past few years have been witnessing a difficult phase due to budget shortfalls and limited financial resources to maintain subscriptions to the best research material. The escalating costs of reputed journals in agricultural sciences has lead several institutional libraries to deprive their patrons of much of the latest international research material. Also the rising costs of subscriptions to journals have forced the Indian community of researchers and information professionals to deliberate and look at cheaper alternatives, like open access and consortium mode of subscription for online access to information over the web. Thanks to the ICT revolution and World Bank-funded initiatives from the Indian council of Agricultural Research (ICAR, there has been support for projects like the National Agricultural Innovation Project (NAIP) or its sub project CeRA (Consortium of e-Resources in Agriculture). Realizing that the greatest cost cutting and most effective negotiations for reducing subscription costs are achieved by forming a consortia, the librarians and agricultural research community established a national consortium-project CeRA in 2007 to provide the Indian agricultural research and academic community country-wide access to international information resources and to enhance and advance the existing R&D information resources base to leading world class institutions. The national consortium project was established with the key objectives of providing access to e-journals and to evolve a NAAS (National Academy of Agricultural sciences) rating and Science Citation Index facility for evaluation of agricultural scientific publications in India.

The consortium was made functional in the year 2008, starting with subscriptions to some of the best online research materials from prominent publishers like Springer Verlag, Elsevier, Taylor & Francis, and Annual Reviews, as well as access the Indian Journals.com online. These made accessible 24x7 to all agricultural universities and ICAR research institutes through their respective IP addresses from a common platform or the website, www.cera.Jccc.in (Fig. 1). Most agricultural university libraries

FIGURE 1 – Web access to CeRa consortium—www.cera.Jccc.in



and research institutes have provided a link to this site in their home page and are creating awareness among the user community through orientations and in-house trainings.

Prominent Digitization Activities and Programs – Indian agricultural libraries have embraced new technologies and have started experimenting with digitization and collaboration with libraries under the Indian National Agricultural Research system (NARS). Google's book search, Project Gutenberg, Library of Congress' World Digital library, Windows Live Search books, the Million Book Project, the Internet Archive and other project have all been accomplished in alliance with India.

Most agricultural libraries in India have been working individually on digitization of their in-house research material, theses or rare books. A number of university libraries like the Indian Agricultural Research Institute (IARI), New Delhi, Anand Agricultural University in Gujarat, and G.B Pant University have created digital/institutional repositories, but large collaborative digitization projects involving groups of libraries have been conceived and realized only recently. With World Bank grants in aid flowing in to enhance Indian agricultural productivity and food security, several innovative projects have been sanctioned to advance and mobilize well tested models for the application of agricultural research and technology for profitability of farming, income generation and poverty alleviation.

Figure 2 – View of AgriCat web page, explored through www.egranth.ac.in

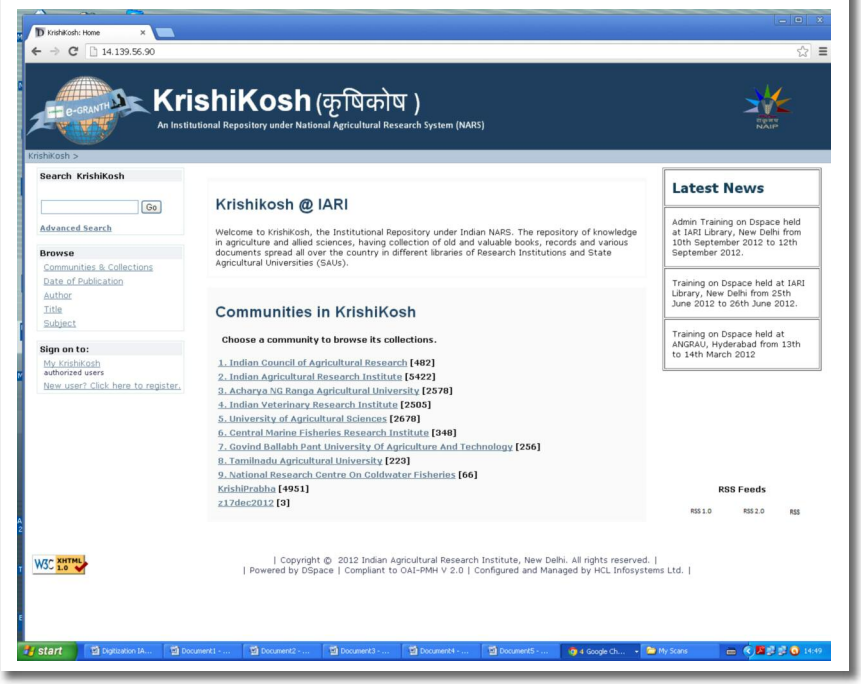
Under the Indian National Agricultural Research System's (NARS) major National Agricultural Innovation Project (NAIP), a sub project named E-Granth was created to strengthen agricultural digital libraries and information management. The project is designed to provide digital access to library resources or an OPAC and create an institutional repositories consisting of rare books and old journals publically accessible over internet or the web with partnership of OCLC in the USA. In the project's first phase, twelve partner institutions — including ICAR and seven state agricultural university libraries and four universities spread across the country — are participating in a consortium to create a union catalog/web OPAC and digitize the existing institutional repositories of IARI, IVRI, ANGRAU and UAS, Banglore which have rare books and journals. E-Granth is facilitating access to traditional as well as digital resources and share them among the Indian agricultural research community.

By creating a union catalog, the twelve participating libraries are collaborating with OCLC as an official sub group of "World Cat" sharing their resources globally. E-Granth aims to complete the conversion of the catalogs of the participating libraries into a MARC-21 compliant union catalog named "AgriCat." A strategy was followed to name the group catalog AgriCat and to adopt the OCLC Connexion software for online cataloging, and direct uploading of records to AgriCat and WorldCat in MARC-21 International Standard. Koha, an open source software, was identified for implementation of Union catalog.

OCLC's WorldCat is the largest union catalog in the world. The exiting catalogs were batch uploaded and processed by OCLC and added to WorldCat and AgriCat, which is a subset of WorldCat and has been developed as a union catalog of the twelve partner libraries intended to provide versatile search and retrieval facilities to share library resources accessible 24x7 at http://www.egranth.ac.in or http://agricat.org (Fig. 2). Searches can be made at three levels — a global search of libraries worldwide, an AgriCat search for holdings at the group level and a search of the individual libraries at the local partner level. Patrons can also register and create their own mini library using the features like MyWatch List and MySaved searches for further use and to share their views. The e-Grant project has initiated and built the digitization capacity in twelve collaborating libraries and will be replicated in other NARS libraries in the future.

KrishiKosh – KrishiKosh is an open access institutional repository (IR) developed as part of the E-Granth Project for sharing information and knowledge. The Indian agricultural state universities and ICAR research institutes have vast collections of rare old books, gray literature and research materials like research reports, theses or dissertations, extension literature, and several in-house periodicals holding informative articles; spread

FIGURE 3 – KrishiKosh—Institutional Repository as viewed through website



across the country, these resources have been digitized to promote open access and share resources amongst the agricultural research community in the country. The repository has been created using D-space digital library software initially involving four university libraries; these are two deemed universities — the Indian Agricultural Research Institute and the Indian Veterinary Research Institutes, Izatnagar — and two state universities — the UAS Bangalore and ANG Ranga Agricultural University, Hydrabad. The repository is accessible online 24x7 at http://www.egranth.ac.in (Fig. 3); five more university libraries have recently been added and it continues to grow.

KrishiPrabha – KrishiPrabha is yet another digitization initiative by the Indian agricultural information community focusing exclusively on doctoral dissertations. Also funded by the World Bank and ICAR, KrishiPrabha was initiated in 2000 by Haryana Agricultural University library in north India to create a digital repository of Indian Agricultural Doctoral Dissertations submitted by research scholars from forty three State universities in the country. Recognizing that agricultural universities produce a large number of valuable agricultural research information as part of scholarly research leading to doctoral degrees, and that these could be organized and digitized to provide easy access to the academic community which otherwise, the project sought to make available what would otherwise have remained largely unpublished, scattered and inaccessible .

Between 2000 and 2006, the Haryana Agricultural university library digitized over 10500 dissertations titles, and the database includes metadata and abstracts as well as the full text of these doctoral dissertations. All participating member libraries have IP based access to the repository, providing access to full text content, but restricts complete down loading and printing to prevent plagrism.

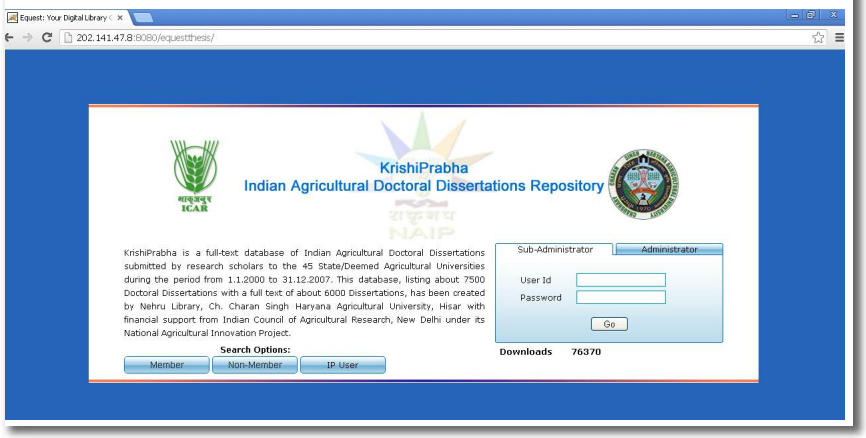
Google has proposed to index the content of KrishiPrabha repository in Google Scholar, and the proposal is under consideration with the NAIP and Indian Council of Agricultural Research authorities. Figure 4 shows the web site of KrishiPrabha as viewed over the world wide web.

Grants from the World Bank to ICAR have led to projects like NAIP and sub projects like E-granth and KrishiPrabha and have encouraged digitization, resource sharing and a consortium culture among the Indian agricultural information professionals as well as a user community comprised of a large number of members of the scientific and academic community. Digitization of Indian agricultural resources is vast; while lots still needs to be explored and exploited, a beginning has been made to develop the capacity for library and information management using digital tools and techniques which will lead to further growth and development.

Moving Libraries to the Web

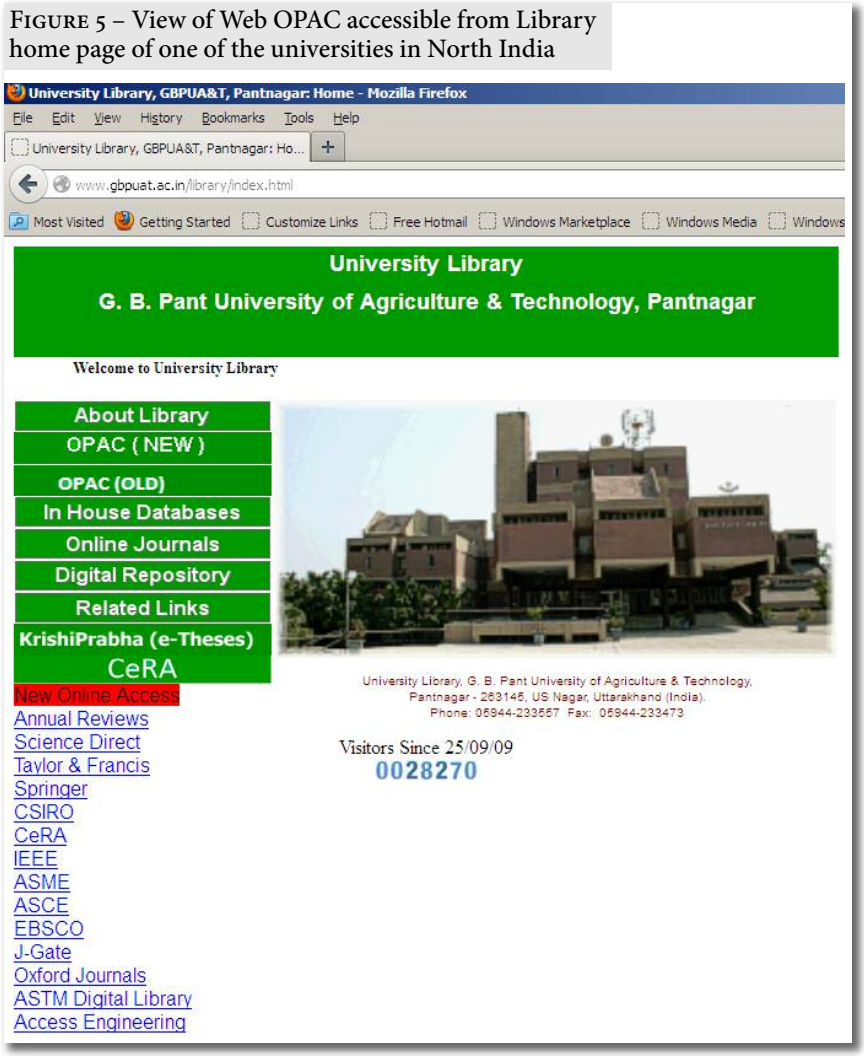
Indian Agricultural libraries have been successfully functioning in an automated environment, but it's now

FIGURE 4 – Web access to KrishiPrabha:
Indian Agricultural Doctoral Dissertation repository



imperative to emphasize Web 2.0 technologies such as blogs and Facebook and making services available 24x7. Digitization is picking up purposefully and Indian libraries are exploiting better internet connectivity, and therefore moving libraries to the next level of advanced automated services is indispensable. Websites have become important areas of communication and have revolutionized the process of library publishing and visibility for disseminating information to its user community. Most university libraries have provided information to patrons in static formats and there is little opportunity for them to interact and give their opinions or share information in a collaborative manner. Prominent examples of exploiting sophisticated web based tools in Indian agricultural libraries include the web OPACs, digital repositories, and access to collaborative union catalogs like AgriCat; however, not many libraries have moved to the trend of using social communication technologies or web 2.0 technologies.

Figure 5 – View of Web OPAC accessible from Library home page of one of the universities in North India



Eleven university libraries have provided access to their OPACs over the web (Fig. 5). Quite a number of libraries like that of PAU Punjab, HAU Haryana, UAS Bangalore, AAU Gujarat, MKP, and Maharashtra have also explored and provided discoverable links to free e-books in portable document format (PDF); e-Reference sources to their respective sites, directories like DOAJ and DOAR; online portals and gateways like Open J Gate; open digital libraries; wiki books; information on intellectual property rights and information literacy and more .

Web links to CeRA full text e-journals, KrishiPrabha digital repository of doctoral dissertations and access to e-journal portals like J-Gates and Open J-Gates is predominant with a few libraries like AUU, Assam CSAU& AT, Kanpur, AVBPUA&T Meerut, and NDUA&T, Faizabad who are considerably behind. Myriad university libraries and information centers like UAS Dharward, IGKV Chhattisgarh, MPKV and PRKV Maharashtra have provided department-wide full text electronic theses and dissertations of their institutions in searchable PDF format. KrishiKosh is aonther exemplary examples of collaborative digital institutional repositories of nine Agricultural libraries and is accessible 24x7 over National Agricultural Research System (NARS) website with links to individual universities.

Although all of this evidence of Indian agricultural libraries moving to web-based information resources is promising, the libraries and information centers of India need to explore how sophisticated web based tools can help them gear up and enhance their websites to be more user-friendly and interactive. Miscellaneous services presented over the libraries' websites are largely static, although they do offer information such as details of rules and regulations of the library, types of services offered, working units or sections of the library, statistics of library's' holdings and information about various off line databases. Another example is chat services, which are among the most widely accepted and used technologies in many countries. Indian library websites, however, don't offer this directly and instead require patrons to post to chat reference services like Ask-a-Librarian or Interact-With-Librarian. Twelve libraries are collaborating under an OCLC-E Grant project that uses Flicker-like tools to make online displays of books that enable patrons to view library collections and facilitate readers' interest and allow them to give reviews of or comments on books that they find interesting. The agricultural libraries have good visibility over the web and are now in

transition from static websites to better interactive web-oriented services using sophisticated web based tools. With the innovative Web 2.0/3.0 technologies, delivering services, collaborating, connecting and interacting with user community has become much simpler.

Conclusion

Indian Agricultural libraries have taken on the technology and are now using a number of sophisticated IT and web based tools to disseminate digital information to their user communities. Most libraries have mechanized their services to the extent of developing in house databases, web-based OPACs and automated inventory or circulation, although at different levels. Digitization and resources sharing of information sources is fast catching up with consortium based projects like Krishi-Prabha and e-GRANTH, but the agricultural libraries have to go a long way in developing institutional repositories and moving libraries more fully to the web and improving upon their static library websites.

Discussions, experimentation and collaborations between libraries and the user community, and platforms like various Library associations, academic meeting, conferences etc. can be used for furthering these causes. The only specialized Agricultural Library Association (AALDI) in the country got revived in the year 2008 after lying in dormancy since 1993, and there is a clear indication that agricultural information professionals are realizing their greater responsibilities and challenges in the digital era. They cannot remain oblivious to the technological advances, but must move on for the cause and extend digitization of resources and provide seamless access to information for their users.

Government financial support and good policy making and collaborative efforts from time to time are required for sustainable development of digital information resources management in agricultural libraries and information centers. A breakthrough has been made with the launch of World Bank-aided projects implemented by ICAR like NAIP, but how sustainable project will be is a crucial question and has to be explored.

References and Notes

1. Acharya N.G. Ranga Agricultural University, (A.N.G.R.A.U) http://www.angrau.net/

2. Allahabad Agricultural Institute, (A.A.I.) http://www.aaidudec.org/

3. Anand Agricultural University, (A.A.U.) http://www.aau.in/

4. Arvindan, M. 1988. Opportunities for Higher Agricultural Education in India. ICAR. New Delhi.

5. Assam Agricultural University, (A.A.U.) www.aau.ac.in

6. Beeding, Marshall. 2007. Library technology guides: Key resources in the field of automation. http://www.librarytechnology.org

7. Bidhan Chandra Krishi Vishwa Vidyalya, (B.C.K.V.V.) http://www.bckv.edu.in/

8. Bihar Agricultural University, (B.A.U.) www.bausabour.ac.in

9. Birsa Agricultural University Kanke, (B.A.U.) http://www.baujharkhand.org/

10. CeRa-The consortium for e-resources in agriculture sciences. http://cera.iari.res.in/

11. Central Agricultural University, Imphal, Manipur, (C.A.U.) http://www.cau.org.in/

12. Central Institute of Fisheries Education, (C.I.F.E.) http://www.cife.edu.in/

13. Ch. Sarvan Kumar Krishi Vishwavidyalaya, (C.S.K.K.V.) http://www.hillagric.ac.in/

14. Chandra Shekar Azad University of Agriculture & Technology, (C.S.A.U.A.T) http://csauk.ac.in

15. Chaudhary Charan singh Haryana Agricultural University, (C.C.H.A.U.) http://www.hau.ernet.in

16. Chhattisgarh Kamdehenu Vishwavidyalaya,(C.K.V.) http://cgkv.ac.in

17. Dr. Punjabrao Deshmukh Krishi Vidyapeeth Krishinagar, (DR.P.D.K.V.K.) http://www.pdkv.ac.in/

18. Dr. Y.S. Parmar University of Horticulture and Forestry, (DR.Y.S.P.U.H.F) http://www.yspuniversity.ac.in/

19. Dr. YSR Horticultural University, (DR.YSR.H.U.) http://drysrhu.edu.in

20. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, (DR.B.S.K.K.V.) http://www.dbskkv.org/

21. Govind Ballabh Pant University of Agriculture & Technology, (G.B.P.U.A.T.) http://www.gbpuat.ac.in/

22. Guru Angad Dev Veterinary and Animal Sciences University, (G.A.D.V.A.S.U.) http://www.gadvasu.in/

23. E-Granth E-Granth. Strengthening of Digital library and Information System. http://egranth.ac.in/

24. Indian Agricultural Research Institute Institutional Repository http://eprint.iari.res.in

25. Indian Agricultural Research Institute, (I.A.R.I.) http://www.iari.res.in/

26. Indian Agricultural Research Institute, NARS e-GRANTH http://www.egranth.ac.in/?q=node/1

27. Indian Veterinary Research Institute, (I.V.R.I.) http://www.ivri.nic.in/

28. Indira Gandhi Krishi Vishwa Vidyalaya, (I.G.K.V.V.) http://www.igau.edu.in/

29. Jawaharlal Nehru Krishi Vishwavidyalya, (J.N.K.V.) http://www.jnkvv.nic.in/

30. Junagadh Agricultural University, (J.A.U.) http://www.jau.in/

31. Karnataka Veterinary Animal and Fisheries Science University, Bidar, Karnataka (K.V.A.F.S.U.) http://www.kvafsu.kar.nic.in/

32. Kerala Agricultural University,(K.A.U.) http://www.kau.edu/cohortvellanikkara.htm

33. Kerala University of Fisheries & Ocean Studies, (K.U.F.O.S.) www.kau.edu

34. Kerala Veterinary and Animal Sciences University, (K.V.A.S.U.) www.kcasu.ac.in

35. Lala Lajpat Rai University of Veterinary science University, (L.L.R.U.V.S.U.) www.llruvas.edu.in/

36. Maharana Pratap University of Agriculture & Technology RCA Campus, (M.P.U.A.T.) http://www.mpuat.ac.in/

37. Maharashtra Animal & Fishery Sciences University, (M.A.F.S.U.) http://www.mafsu.in/

38. Mahatma Phule Krishi Vidyapeeth, (M.P.K.V.) http://mpkv.mah.nic.in/

39. Manyavar Shri kanshiram Ji University, of Agriculture, (M.S.K.U.A.) www.mskjuat.edu.in/

40. Marathwada Agricultural University, (M.A.U.) http://mkv2.mah.nic.in/

41. Matuszak,Gary. 2007. Enterprise 2.0 fad or future? KPMG. International http://www.kpmg.com/site collection documents/enterprise_2_Fad or future.pdf

42. Nanaji Deshmukh Veterinary Science University, (N.D.V.S.U.) www.mppcvv.org

43. Narendra deva University of Agriculture & Technology, (N.D.U.A.T.) http://nduat.ernet.in

44. National Agricultural Technology Project. http://www.icar.org.in

45. National Dairy Research Institute, (N.D.R.I.) http://www.ndri.res.in/

46. Navasari Agricultural University,(N.A.U.) http://www.nau.in/

47. Orissa University of Agriculture & Technology, (O.U.A.T.) http://www.ouat.ac.in/

48. Punjab Agricultural University, (P.A.U.) http://www.pau.edu/

49. Rajasthan University of Veterinary and Animal Sciences, (R.U.V.A.S.) http://rajuvas.org

50. Rajendra Agricultural University, (R.A.U.) http://www.pusavarsity.org.in/

51. Rajmata VRS Agricultural University, Gwalior, Madhya Pardesh, (R.VRS.A.U.) http://www.rvskvv.nic.in/

52. Sardar Vallbh Bhai Patel University of Agriculture and Technology, (S.V.B.P.U.A.T.) http://www.svbpmeerut.ac.in/

53. Sardarkrushinagar Dantiwada Agricultural University, (S.D.A.U.) http://www.sdau.edu.in/

54. Sher-e-kashmir University of Agricultural Sciences and Technology, (S.E.K.U.A.S.T.) http://www.skuast.org/new/index.html

55. Sher-e-kashmir University of Agricultural Sciences and Technology, (S.E.K.U.A.S.T.) http://www.skuastkashmir.ac.in/

56. Singh Neena. 2001. Internet: Importance and Usage for Library and Information Professionals. DESIDOC Bulletin of Information Technology. 21 (3) May .p 17–26.

57. Sri Venkateswar Veterinary University, Triupati, Chittoor, A.P., (S.V.V.U.) http://svvu.edu.in/

58. Swami Keshwanand Rajasthan Agricultural University, (S.K.R.A.U.) www.raubikaner.org

59. Tamil Nadu Agricultural University, (T.N.A.U.) http://www.tnau.ac.in/

60. Tamil Nadu Fisheries University, (T.N.F.U.) http://www.tnfu.org.in

61. Tamil Nadu Veterinary and Animal Sciences University, (T.N.V.A.S.U.) http://www.tanuvas.tn.nic.in/

62. U.P.Dean Dayal Upadyaya Pashu Chikitsa Vidyan Vishwavidyalaya, Avem Go Anusandhan Sansthan (U.P.D.D.U.P.C.V.V.A.G.A.S.) http://www.upvetuniv.edu.in/history.aspx

63. University of Agricultural Sciences GKVK, (U.A.S.) http://www.uasbangalore.edu.in/

64. University of Agricultural Sciences, (U.A.S.) http://www.uasd.edu/

65. University of Agricultural Sciences, Raichur, Karnataka (U.A.S.) http://www.uasraichur.edu.in/

66. University of Agricultural sciences, Shimoga,(U.A.S.) http://www.uasbangalore.edu.in/asp/agrishimoga.asp

67. University of Horticultural Sciences, Navnagar, Bagalkot, Karnataka, (U.H.S.) http://uhsbagalkot.edu.in/

68. University of Horticulture and Forestry, (U.H.F.) www.uuhf.ac.in

69. Uttar Banga Krishi Viswa Vidyalaya, (U.B.K.V.V.) http://www.ubkv.org/

70. West Bengal University of Animal and Fishery Sciences Khudiram Bose Sarni, (W.E.U.A.F.S.K.B.S.) http://www.wbuafscl.ac.in/

Appendix 1a

Agricultural Universities in North, East and Central Indian States

SL No	Universities	LAN/ OPAC	WEB OPAC	Inventory Mgt.	Internet Facilities	Data-base creation	E-Library Unit/ section	Digital reposi-tory	Online E-Journal E-books	E-Granth Consor-tium	Cera Consor-tium	Krishi prabha	ETD
1	PAU Punjab	√	√	√ BC	√	√	√	N	√	N	√	√	N
2	GADVASU, Ludhiana, Punjab	√	N	√ BC	√	√	√	N	√	N	N	N	N
3	HAU © Haryana	√	N	√ BC	√	√	√	√	√	√	√	√	
4	NDRI © Haryana	√	√	√ BC	√	√	√	N	√	√	√	—	N
5	LLRUV&AS* Haryana	N	N	N	√	N	√	N	√	N	√ WLN	N	N
6	GBPUAT © Pantnagar	√	√	N	√	√	√	√	√	√	√	√	—
7	UUHF* Garhwal, Uttarakhand	√	N	√ RFD	√	√	√	N	√	N	√	√	—
8	DYSP Solan	√	N	√ BC	√	√	√	N	√	N	√	√	—
9	CSKHPKV © Palampur	√	√	√ BC	√	√	√	N	√	√	√	√	N
10	SKUAT-K Kashmir	√	N	√ BC	√	√	√	N	√	N	√ WLN	√ WLN	√ WLN
11	SKUAT-J Jammu	√	N	√ BC	√	√	√	N	√	N	√ WLN	√ WLN	N
12	IARI © Delhi	√	—	√ BC	√	√	√	√	√	√	√	√	√
13	CSAUA & T Kanpur	√	N	N	√	√	√	N	√	N	√	√	N
14	SVPUAUT Meerut, UP	N	N	N	√	N	√	N	N	N	√	√	N
15	NDUAT Faizabad	N	N	N	√	N	√	N	N	N	√	√	√
16	IVRI, © Izatnagar, UP	√	N	√ BC	√	√	√	√	√	√	√ WLN	√	√
17	PDDUPCV Mathura, UP	√	N	√ BC	√	√	√	N	√	N	√	N	√
18	AAI, Allahabad, UP	N	N	N	√	√	√	—	√	N	√	—	—
19	MSKUA&T* Banda,UP	—	—	—	√	—	—	—	—	—	—	—	—
20	AAU Assam	N	N	N	√	N	√	N	N	N	√	√	N
21	MAU Mainpur	√	N	√ BC	√	√	√	N	—	—	—	—	—
22	OUAT Orissa	√	N	N	√	√	√	N	√	N	√	√	N
23	BAU Jharkhand	N	N	N	√	N	√	N	√	N	√	√	N
24	RAU, Pusa Bihar	√	N	√	√	√	√	N	N	N	√ WLN	√ WLN	N
25	IGKV Chhattisgarh	√	√	√ BC	√	√	√	—	√	N	√ WLN	√ WLN	√
26	CKV* Duraj, Ch	—	—	—	√	—	—	—	—	—	—	—	—
27	JNKV, Jabalpur, M.P	N	N	N	√	N	√	—	√	—	√	√	N
28	NDVSU* Jabalpur MP	—	—	—	—	—	—	—	—	—	—	—	—
29	RVSKVV* Gwalior MP	—	—	—	√	—	—	—	—	—	—	—	—
30	UBKV* W. Bengal	N	N	N	√	√	√	N	√	N	√	√	N
31	BCKVV W. Bengal	√	N	√ BC	√	√	√	N	√	√	√	N	
32	WBUAFS, Kolkatta	√	√	√ BC	√	√	√	N	√	N	√	N	N

Agricultural Universities in West and South Indian States

SL No	Universities	LAN/ OPAC	WEB OPAC	Inventory Mgt.	Internet Facilities	Data-base creation	E-Library Unit/ section	Digital reposi-tory	Online E-Journal E-books	E-Granth Consor-tium	Cera Consor-tium	Krishi prabha	ETD
33	SKDU Gujrat	√	√	N	√	√	√	√	√	N	√	√	√ WLN
34	AAU, Anand Gujrat	√	√	√ BC	√	√	√	√	√	N	√	√	√
35	NAU, Navsari Gujrat	√	N	√	√	√	√	√	√	N	√	√	√
36	MPUAT, Udaipur, RJ	—	—	—	—	—	—	—	—	—	—	—	—
37	SKRAU, Bikaner, RJ	√	N	√ BC	√	√	√	N	√	N	√	√	√
38	RUVA, Bikaner, RJ	—	—	—	√	—	—	—	—	—	—	—	—
39	MPKV © Maharashtra	√	N	√ BC	√	√	√	N	√	√	√	√	√
40	CIFE © Mumbai Maharashtra	√	N	—	√	√	√	√	√	√	√	√	—
41	PRD, Akola Maharashtra	√	N	√ BC	√	√	√	N	√	N	√	√	√
42	MWAU Maharashtra	√	√	√ BC	√	√	√	N	√	N	√	√	N
43	KVP, Dapoli Maharashtra	N	N	N	√	N	√	N	√	N	√	√	N
44	MAFSU Maharashrta, Nagpur	√	N	√ BC	√	√	√	N	√	N	√ WLN	—	N
45	TAU, Tamilnadu	N	N	N	√	√	√	√	√	√	√	√	√
46	TNVASU © Tamilnadu	√	√	√ BC	√	√	√	√	√	√	√ WLN	N	√
47	TNFU* Naga Patana	—	—	—	—	—	—	N	—	—	—	—	—
48	KAU, Kerala	√	√	√ BC	√	√	√	N	√	N	√	√	√
49	KVASU* Kerala	—	—	—	√	—	—	—	—	—	—	—	—
50	KUFOS* Kochi, Kerala	—	—	—	—	—	—	—	—	—	—	—	—
51	ANGRAU, © A.P	√	N	N	√	√	√	√	√	√	√	√	√
52	UAS © Bangalore, Karanataka	√	N	N	√	√	√	√	√	√	√	√	√
53	UAS Dharward, Karnataka	√	N	N	√	√	√	N	√	N	√	√	N
54	UAS Shimoga Karnataka	√	N	√ BC	√	√	√	N	√	N	√	N	√
55	KVAFSU* Bidar Karnataka	—	—	—	√	—	—	N	—	—	√	—	—
56	UHS Navanagar Karnataka	N	N	N	√	N	—	N	√	N	√ WLN	N	N
	TOTAL	35	11	27	52	38	45	12	41	12	45	35	18
	Percentage %	62.5%	19.64%	48.21%	92.85%	67.85%	80.35%	21.42%	73.21%	21.42%	80.35%	62.5%	32.14%

NOTE – (1) √: Indicates Universities having facilities.

(2) N: Indicates Universities not having facilities.

(3) BC: Indicates inventory management through barcode system.

(4) RFD: Inventory management through RFID system.

(5) WLN: Services provided through campus intranet / not hosted in library web page / web link not provided.

(6) ©: Collaborating Libraries under E-Granth–OCLC Project.

(7) *: Universities established in /After 2004.(Relatively new), are in developing state, and in process of automation.

Collaboration for Impact

Indira Yerramareddy, Luz Marina Alvaré and Katarlah Taylor

Abstract: **On February 10–12, 2011, the International Food Policy Research Institute (IFPRI) organized a high level 2020 global conference titled "Leveraging Agriculture for Improving Nutrition and Health" in New Delhi, India (http://2020conference.ifpri.info). To support the conference, IFPRI's Knowledge Management team organized a collaborative bibliography of research publications relevant to the conference topics in an online public group "Agriculture, Nutrition, and Health" using Mendeley, a reference manager and academic social network. This group provides a space for researchers to share publications and partake in online discussions. This paper discusses how collaboration has been enabled among the different attendees of the conference. It also discusses how this collaboration has proven successful and impactful long after the conclusion of the conference.**

Resumé: **Le 10–12 février 2011, l'Institut international de recherche sur les politiques alimentaires (IFPRI) a organisé à New Delhi (Inde) une conférence mondiale 2020 de haut niveau intitulée "Exploiter l'agriculture pour améliorer la nutrition et la santé" (http://2020conference.ifpri.info). À l'appui de la conférence, l'équipe de gestion des connaissances de l'Institut a organisé une bibliographie collaborative des publications de recherche pertinentes pour les thèmes de la conférence, avec un groupe public en ligne "Agriculture, Nutrition et Santé" en utilisant Mendeley, un gestionnaire de références et réseau social académique. Ce groupe fournit aux chercheurs un espace pour partager des publications et participer à des discussions en ligne. Cet article décrit comment la collaboration a été activée entre les différents participants à la conférence. Il examine aussi comment cette collaboration s'est avérée fructueuse et percutante longtemps après la conclusion de la conférence.**

Resumen: **Del 10 al 12 de febrero del 2011, el Instituto Internacional de Investigación sobre Políticas Alimentarias (IFPRI, sus siglas en inglés) y su Iniciativa Visión 2020 celebró una conferencia internacional de alto nivel titulada "Potenciar la agricultura para mejorar la nutrición y la salud", en Nueva Delhi, India (http://2020conference.ifpri.info). Para apoyar a la conferencia, el equipo de Gestión del Conocimiento del IFPRI organizó una bibliografía colaborativa de publicaciones de investigación pertinentes a los temas de la conferencia en un grupo público en línea "Agricultura, Nutrición y Salud", utilizando Mendeley, un sistema de gestión de referencias bibliográficas y red social académica. Este grupo brinda un espacio para que los investigadores puedan compartir publicaciones y participar en discusiones en línea. Este documento analiza cómo se ha dado la colaboración entre los diferentes asistentes a la conferencia. También analiza cómo esta colaboración ha demostrado ser exitosa e impactante mucho después de la celebración de la conferencia.**

Introduction

The International Food Policy Research Institute (IFPRI), established in 1975, provides evidence-based policy solutions to sustainably end hunger and malnutrition and reduce poverty. The Institute conducts research, communicates results, optimizes partnerships, and builds capacity to ensure sustainable food production, promote healthy food systems, improve markets and trade, transform agriculture, build resilience, and strengthen institutions and governance. IFPRI collaborates with partners around the world, including development implementers, public institutions, the private sector, and farmers' organizations, to ensure that local, national, regional, and global food policies are guided by relevant and timely research. IFPRI is a member of the CGIAR Consortium.

IFPRI organizes numerous conferences throughout the world especially in developing countries to raise awareness to end hunger, malnutrition, and poverty. A decade ago, with fewer resources, email was the standard for IFPRI for communicating information among researchers and experts throughout the world. Though cost effective, this is a very time consuming and ineffective way of sharing information. Later IFPRI moved to other paid services like Reference Manager Database and Endnote and spent less time collecting the information and organizing it. Researchers outside IFPRI had to pay for their own licenses to use these tools, which limited wider acceptance. In order to foster better collaboration between researchers, IFPRI tried several free and paid reference manager tools for its various conferences. EndNote, RefWorks, and Zotero are reasonably good but didn't serve the IFPRI purpose of facilitating ease of collaboration in a fruitful fashion.

This paper discusses how IFPRI has adapted Mendeley, an integrated reference manager and academic social network, to improve collaboration between diverse groups of researchers and experts in order to create sustained impact of IFPRI sponsored research. We chose an IFPRI organized conference to test our thesis.

Collaboration for Impact: A Test Case

On February 10–12, 2011 in New Delhi, India, IFPRI organized a high level 2020 global conference on "Leveraging Agriculture for Improving Nutrition and Health." The conference objectives were to inform, influence, and catalyze action by key actors—policymakers, nongovernmental organizations, the private sector, educators, and researchers—to better use investments in agriculture to achieve nutrition security and good health for the world's poorest people. It brought together information and ideas

on how to strengthen linkages among agriculture, nutrition, and health. Other objectives were to identify "best practices" in policies and programs, further knowledge and build consensus on priorities for appropriate action, and facilitate networks amongst stakeholders. The "Impact Assessment Report" and "Impact Assessment Brief" provide more details of the conference.

In order to better serve the objectives of the conference, IFPRI wanted a solution that would spread awareness of the conference widely to all relevant stakeholders. We also wanted to enable dynamic exchange of information between the stakeholders not only to improve the relevance of the research but also enhance its impact. We had a few brainstorming sessions to identify factors to guide us in our choice. We wanted it to be compatible across platforms – desktop, web, and mobile devices. We wanted enough storage space for supporting large numbers of users. As many of the IFPRI stakeholders are from developing countries, cost was an important concern. And of course, ease of use was of utmost importance.

After a careful analysis, the Knowledge Management (KM) team of IFPRI in coordination with the conference organizers adapted the Mendeley tool to provide a collaborative bibliography of research publications related to agriculture, nutrition, and health. We also provided a space for researchers to share publications and discussions. Mendeley is a reference manager like Endnote and an academic social network like LinkedIn.

Mendeley and Its Features

Mendeley contains a wealth of information on collaborative research activity and its users create hundreds of thousands of groups in which they can share document references and files as well as have discussions around their topics of choice. As a reference manager and academic social network, Mendeley:

- Assists in cataloguing and managing academic papers and articles
- Shares academic and scientific knowledge with selected colleagues
- Discovers academic knowledge and allows detailed searches of academic papers
- Puts like-minded people in touch and facilitates research projects
- Permits use and reuse of the citations for writing papers

Mendeley helps researchers to manage, share, and discover academic knowledge. Compared to other tools, Mendeley has a great feature of having two inter-connected parts serving different functions — a cloud portion called Mendeley web and a desktop client called Mendeley desktop. Mendeley desktop manages, shares, reads, annotates and cites your research papers whereas Mendeley web manages your papers online, helps you discover research trends and statistics, and connect you to like-minded researchers. Mendeley extracts research data and aggregates research data in the cloud. It automatically backs up and syncs files between different computers, allowing one to add papers while at work or home or in a conference. This way it speeds up the process without delaying in passing the latest and up to date information to researchers throughout the world. It organizes PDFs, and you can annotate and highlight references in PDFs as well; full text searching is also available. You can filter papers by authors, keywords, tags, or publications. It imports documents from a wide variety of sites–Google Scholar, ScienceDirect, PubMed, ISI Web of Science, RePEc and others. Some other features are drag and drop PDFs, add tags and edit document details. Mendeley automatically extracts document details from PDF documents using either DOI (Digital Object Identifier) or PMID (PubMed identifier or PubMed unique identifier).

Implementation of an Academic Public Group

After initial discussions with the conference organizers, the Knowledge Management team created a Mendeley public group called "Agriculture, Nutrition, and Health." The creation of a discussion group is easy, and there are several optional properties that can be set to configure the group. The categories and tags allow stakeholders who are potentially interested in the topics covered by this group to easily find the discussion group.

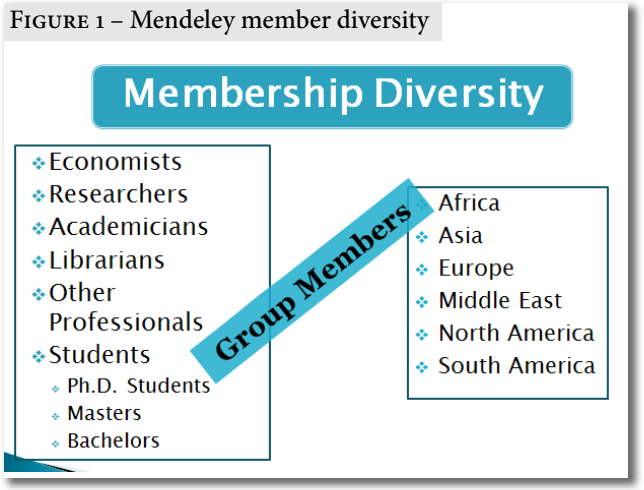
The cross-linking of the conference and the discussion group increased the visibility for the conference. The main purpose of the group is to serve as a repository of bibliography of research publications related to agriculture, nutrition, and health, in support of the conference theme. More importantly, the bibliography is crowd sourced, substantially increasing the reach at the same time reducing the cost.

There are about 230 members, including followers, who joined the group. There are active discussions going on within the group. The group has a geographically distributed membership with diverse backgrounds. It covers all the regions of the world. The active members include professors, doctoral students, librarians, economists, academics, policy makers, experts, and other researchers (Fig. 1).

Continuous Collaboration for Sustained Impact

Beyond the conference, the collaborative bibliography and the discussion group continue to be used by an active community of researchers and other stakeholders for sustained impact. The Mendeley platform assists this by indexing and organizing PDF documents and research papers into personal digital libraries. It gathers document details from PDFs allowing you to effortlessly search, organize and cite. It also looks up PubMed, CrossRef, DOIs

FIGURE 1 – Mendeley member diversity



and other related document details automatically, importing papers quickly and easily from resources such as Google Scholar, ScienceDirect, Wikipedia and many more with the click of a button. More importantly, the active discussion facilitated by the online group between geographically distributed researchers, academics, experts, and policy makers with diverse backgrounds has the potential to substantially improve the quality and relevance of new research projects and/or policy initiatives.

Active discussions are easily facilitated, and documents that enhance the discussion can be added by different users. Easy cross-linking to social media sites such as Facebook enhances the quality of the discussions, and users can provide feedback through useful comments, as well as express interest through comments and likes. With one click, users can share the content to different users using different platforms like Facebook and Twitter. The content can also be emailed directly from the group page, so when for example a researcher from India requested literature on 'agriculture and health', this tool helped us send the relevant references instantly.

One of the advantages of an active group is that it is easy to solicit constructive criticism to improve the quality of research publications. Though the depth of comments may not always be of the same quality as offered through a formal review process, the rapid turnaround is a major advantage. As an example, a Ph.D. student from the University of KwaZulu Natal, a member of the group from Africa, solicited such comments on his article to be published in a journal.

The public group also provides an avenue for IFPRI to rapidly and widely disseminate relevant reports to the stakeholder community. For example, we announced the 'IFPRI Global Hunger Index' immediately after release. This allowed more people to know about what IFPRI is researching and how IFPRI is using the compiled data. More importantly, policy makers and other researchers can use these data to substantiate their arguments, and their eventual decisions are guided by evidence. As pointed out earlier, this is the main goal of IFPRI.

Here is another example of how many stakeholders read our flagship product "2011 Global food policy report". The usage-based readership statistics about papers, authors and publications are automatically compiled by the system, and can be used to make future research and reports more relevant to the potential stakeholders.

Applying the Lessons Learned

Our thesis was substantiated—we have concluded that online collaborative groups are highly effective. One way of fostering such communities is through the creation of collaborative bibliographies and online discussion groups closely associated with important IFPRI conferences. The IFPRI conference on RESILIENCE was held in May 2014, and IFPRI's successful experience with online collaborative group for the previous conference led us to create a similar experience for this conference as well.

We have encouraged the creation and publishing of online biographies using Mendeley because we believe that this substantially increases the creation of online collaborative communities. Researchers can efficiently embed their profiles and publications from the group on their bio pages. Some researchers also embedded relevant groups into their staff bio pages in addition to their profiles and publications.

IFPRI has created different groups: some groups are private and some are public (Invite-only and Open). Researchers are using Mendeley groups for different purposes. A couple of examples are shown below:

- Two or more authors situated across the globe from each other are collaborating on writing a paper—the group "Agricultural technology adoption in Africa" is private and they shared the references, highlighted and annotated the papers for other authors to look and comment; once the paper is done, they created the bibliographies in no time.
- The group 'bEcon (economics literature about the impacts of genetically engineered (GE) crops in developing economies)' is a public group. It is a selective collection of peer-reviewed applied economics literature that assesses the impacts of genetically engineered crops in developing countries.

Conclusion

Collaboration is the key to success for most of the conferences, and online collaborative groups are easy to form and easy to develop visibility. The Mendeley group contribution is one of the paths to keep a live bibliography built by experts. With the capacity of Mendeley tool, a reference manager and academic social network, and having desktop and online access, the 2011 conference successfully achieved its objective of improved collaboration between experts in the area of agriculture, nutrition,

and health to improve the lives of the poor people in the developing countries. Even several years after the conference, the message is alive and being passed around to different audiences.

For any conference, collaboration leads to a lot of benefits. Collaboration is enabled when peers and experts can critique each other or contribute ideas, and is also enabled when people share research, documents, data, etc. from libraries that you are maintaining. So after seeing the success of the IFPRI conference "Leveraging Agriculture for Improving Nutrition and Health," IFPRI implemented in creating another Mendeley group for its high level conference "Resilience."

Article Links

CGIAR Consortium (http://www.cgiar.org)

Reference Manager Database (http://www.refman.com)

Endnote (http://endnote.com)

RefWorks (http://www.refworks.com)

Zotero (http://www.zotero.org)

***IFPRI Assessment Report* (http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/127315)**

***IFPRI Impact Assessment Brief* (http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/127459)**

Mendeley (http://www.mendeley.com)

Mendeley group "Agriculture, Nutrition, and Health" (http://www.mendeley.com/groups/844241/agriculture-nutrition-and-health)

IFPRI *2011 Global food policy report* (http://www.mendeley.com/catalog/2011-global-food-policy-report)

Mendeley group "bEcon (economics literature about the impacts of genetically engineered (GE) crops in developing economies)"

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