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Editor: Debra L. Currie, North Carolina State University, Raleigh, NC 27695-7111, USA. E-mail: debbie_currie@ncsu.edu
Assistant Editor: Amélie E.M. Charron, University of Kentucky, Lexington, KY, USA.

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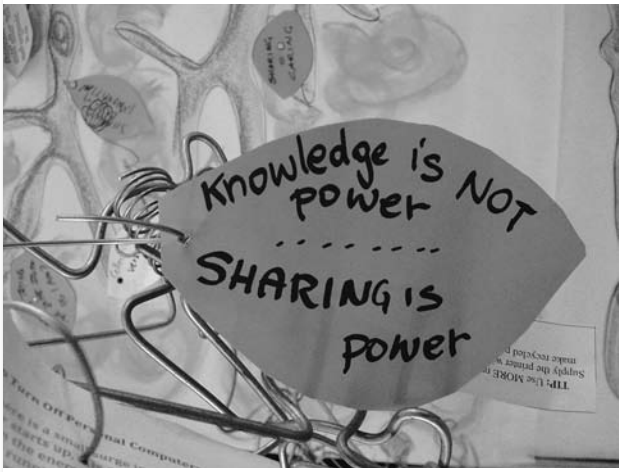
From the Editor's Desk

What an interesting year we have had so far. The economy may not be doing too well, but the agricultural information community seems to be thriving! I would like to start by writing about what is not in this issue, rather than what is. It takes but a few minutes on the Internet to recognize what a challenge it is to capture in a traditional journal more than just a hint of what is going on in the world. There was a time when article publication was seen as the quickest way to get your research and ideas out there; monographs were their much slower cousins. In the past decade or so, though, that notion has been turned on its ear. How can traditional journals possibly keep pace with the quicksilver movements of the Internet? Will they go the way of the dinosaurs?

Case in point: the first ever Knowledge Share Fair, which was held at FAO Headquarters in January. Organized by FAO, in collaboration with Bioversity International, the CGIAR ICT-KM program, IFAD and WFP, it was designed to provide an interactive experience for their staff and the Rome-based constituents, to share and learn from each others' good practices; experiment with tools and methodologies for knowledge sharing; create linkages and networks for future collaboration between the organizations; and develop ideas to support and enhance knowledge sharing within and across the organizations. This was definitely not just another conference. It relied heavily on social networking tools, including blips, blogs and tweets, for participation, presentation, and reporting. To learn more about this exciting and innovative event, see "News from IAALD" in this issue, or visit the Share Fair website at http://www.sharefair.net/.

This issue features an interesting mix of topics emanating from a number of different countries. It draws heavily on last summer's Japan World Congress, from which we selected six papers for publication that deal with improving access to information. With each passing day, we seem to have more tools at our disposal to facilitate access. Time and money may be stumbling blocks in our paths, but creativity, innovation, and persistence help us to keep pressing forward. All of the articles in this issue report on efforts that have had, either directly or indirectly, a real impact upon the human condition. Along with three articles from the Japan World Congress, we are pleased to bring to you "Embrapa Technological Information: A Bridge Between Research and Society," which reveals how an organization can develop and use information tools to fight technological and social exclusion.

Leaf contributed to the Tree of Knowledge at the Knowledge Share Fair.



Improving access as a theme also permeates the *AgInfo Dispatches*, which focus on tools and services that enable access to information. The first three are based on papers presented at the Japan World Congress: Sraku-Lartey discusses a forest information project in Ghana; Ramos and Austria look at providing e-access to the world's rice literature; and Moshoeshoe-Chadzingwa reports on the Lesotho Question and Answer Project. The final dispatch is a more technical piece that reports a new way of providing access to SciELO full text journal articles using AGRIS AP XML to harvest SciELO metadata and adding them to the AGRIS repository. This work by BIREME and FAO staff reveals the steady progress being made in metadata interoperability.

I hope you enjoy this issue. As always, please feel free to contact me at the address below if you have any comments, questions, or concerns.

Debbie Currie
IAALD Editor
1701 Su John Road
Raleigh, NC 27607
USA
PH: +1-919-515-7556
Fax: +1-919-513-1108
E-mail: debbie_currie@ncsu.edu

Emerging ICTs and Their Potential in Revitalizing Small-Scale Agriculture in Africa

Hilda Munyua, Edith Adera, and Mike Jensen

Editor's Note: This paper was presented at the World Conference on Agricultural Information and IT (IAALD/AFITA/WCCA), August 23–27, 2008, Tokyo, Japan.

Abstract: Agriculture plays a vital role in the social and economic development of most African countries and is the main contributor to economic growth and stability. Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 70% of the African population. However, most smallholders are resource-poor and face many challenges. Modern information and communication technologies (ICTs) have the potential to improve agricultural productivity by communicating knowledge and information to rural agricultural communities, providing capacity building, accessing markets and credit, restructuring of extension and scaling up inter-linkages of development interventions. This paper is based on an International Development Research Centre (IDRC) scoping study conducted in 2007 on ICTs and small-scale agriculture in Africa, which was carried out through a desk study, field observations, and individual and group interviews in Botswana, Ghana, Kenya and Uganda.

Resumé: L'agriculture joue un rôle vital dans le développement économique et social de la plupart des pays africains, et est le collaborateur principal à la croissance et stabilité économiques. L'agriculture à petite échelle et la moisson de ressources naturelles fournissent des revenues pour plus de 70% de la population africaine. Cependant, la plupart des petits exploitants ont de faibles ressources et font face à beaucoup de défis. Les technologies modernes de l'information et de la communication (TICs) ont le potentiel pour améliorer la productivité agricole en communiquant la connaissance et les informations aux communautés agricoles rurales, en fournissant le développement des capacités, permettant l'accès à des marchés et des crédits, en restructurant la vulgarisation et en augmentant proportionnellement les liens entre les interventions de développement. Cet article est fondé sur une étude de planification du Centre de recherche pour le développement International (CRDI), faite en 2007, sur les TICs et l'agriculture à petite échelle en Afrique, en se basant sur l'étude de documents, des observations sur le terrain, et des entretiens individuels et en groupe au Botswana, Ghana, Kenya et en Ouganda.

Resumen: La agricultura cumple una función vital en el desarrollo social y económico de casi todos los países de África, y es el sector que más aporta al crecimiento y a la estabilidad económicos del continente. La agricultura en pequeña escala y la recolección de productos derivados de los recursos naturales le permiten ganarse la vida a más del 70% de la población africana. Ahora bien, los pequeños agricultores disponen de pocos recursos y se enfrentan a muchos retos. Las modernas tecnologías de la información y la comunicación (las TIC) tienen la capacidad de mejorar la productividad agrícola porque comunican conocimientos e información a las comunidades agrícolas del sector rural, promueven el desarrollo de capacidades, dan acceso al mercado y al crédito, reestructuran la extensión rural, y expanden las interconexiones propias de las intervenciones del desarrollo. Este trabajo se basa en un estudio de posibilidades realizado en 2007 por el Centro Internacional de Investigaciones para el Desarrollo (IDRC, del inglés) sobre las TIC y la agricultura de menores recursos de África, en el que se hicieron un estudio de oficina, observaciones de campo, y entrevistas a individuos y a grupos en Botswana, Ghana, Kenia y Uganda.

Introduction

The agricultural sector has been described as the engine for economic growth and improved livelihoods in Africa (World Bank, 2006b; Diao et al., 2007). The majority of the population in Sub-Saharan Africa (SSA) lives in rural areas and depends directly or indirectly on agriculture (Diao et al., 2007). Agriculture contributes about 17% to the Gross Domestic Product (GDP) of many of these countries and accounts for 40% of their exports, apart from contributing to employment creation. According to the United Nations Development Programme (UNDP) (2005), about one-third of the continent's population is malnourished. Africa is the only continent where food production is falling, which makes the challenge of attaining the Millennium Development Goals (MDGs) and the World Food Summit (WFS) goal to reduce the number of hungry people from 790 million to 400 million by 2015 even more daunting.

Most of the food grown in Africa is produced by smallholders. Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 70% of the African population. Some 70–80% of this population lives in rural areas and farmers are predominantly women. Small-scale farmers have certain defining characteristics: they derive their livelihood from holdings of less than 2–5 hectares (usually less than 2 hectares) and typically own 10–20 head of livestock, although they may have less than 2 or none at all (Hirst et al., 1988). Small-scale farmers also tend to practice a mix of commercial and subsistence production (in crops and/or livestock). The family provides the majority of labour, while the farm provides the principle source of income (Narayanan and Gulati, 2002; Davis, 2006).

To improve productivity, these smallholders need access to improved technologies, best practices, and to appropriate, timely and comprehensive information and knowledge on production, value addition and markets.

The Food and Agriculture Organization of the United Nations (FAO) (2000) asserts that "information and knowledge play a key role in ensuring food security and sustainable development". Thus, Information and Communication Technologies (ICTs) are considered to be cross-cutting drivers of change for rural and agricultural development, by connecting rural and remote communities, and improving healthcare, education and agricultural productivity (Richardson, 1997). ICTs can, for example, speed up the extension of development services, and can be instrumental in strengthening partnerships and in providing a framework for shared learning (Van Audenhove, 2003). A networked information economy helps to achieve competitiveness, and although it cannot in itself solve poverty, hunger and disease, it provides new avenues for cultural production, creates new economic opportunities, and facilitates the sharing and dissemination of scientific outputs and innovative linkages between farmers, scientists and other actors (Benkler, 2006). It is not surprising, therefore, that ICTs have led to increased use of a networked information environment and the development of platforms for better sharing and exchange of information and knowledge.

The International Development Research Centre (IDRC) has recognized the importance of small-scale agriculture in Africa and noted that relatively little attention had been paid to the potential benefits in the broader use of ICTs to small-scale agriculture. As a result, the IDRC commissioned a scoping study on ICTs and small-scale agriculture in Africa in 2007, to provide an overview of emerging issues and document on-going ICT initiatives. This paper reports on the scoping study and examines the challenges faced by small-scale farmers and the potential of emerging ICTs in revitalizing small-scale agriculture in Africa.

Methodology

The study was carried out through a desk review of secondary sources of information covering small-scale agriculture and a wide range of ICT-related experiences and initiatives. Primary data was collected through field visits to institutions in Botswana, Ghana, Kenya and Uganda. During the field visits, observations were made at sites where specific initiatives were being implemented. Individual and group interviews were held with key informants in the agricultural sector. Where it was not possible to have face-to-face interviews, a checklist was e-mailed to respondents and responses returned by e-mail, or interviews were conducted using telephone and Skype. Among the criteria used to select the countries to be visited was the presence of regional and national initiatives in a country. The study population comprised the technical staff of local, national, regional and international institutions and development partners working in the agricultural sector and applying ICTs in Africa. One major limitation of the study was its broad geographical coverage. The general focus for the study was rural Africa and in particular Sub-Saharan Africa. However, due to time and resource constraints, field visits did not cover Francophone West Africa and North Africa. In sum, 40 institutions and 66 respondents provided feedback; 62% of the respondents were male and 38% were female.

Findings and Discussion

Small-scale farmers in Africa face many problems that are often complex and multi-faceted. One of the most pronounced challenges facing small-scale farmers is farm size, which has been declining over time. As a result, rural people have insufficient land to make a living (Jayne, 2001). Some rural community members are landless or near landless, leading to major social and economic problems. The small size of their lands leads to diseconomies of scale, and since most small-scale farmers are resource-poor, they find it difficult to access affordable credit and inputs for their produce. Most of these farmers have little experience in produce marketing (Mukhwana, Nyongesa and Ogemah, 2005), and lack access to good and efficient markets (Arua, 2007). Typical problems faced by these farmers include very high transport and transactional costs, small inefficient markets, low agricultural productivity, low levels of irrigation and erratic rainfall, vulnerability to high seasonal and inter-annual fluctuations, high rates of evapo-transpiration and very slow adoption of new technologies. Problems of this nature make the smallholder farm 'the global epicentre of extreme poverty' (UNDP, 2005). Further, 'of the roughly 850 million people living in chronic hunger, smallholder farmers constitute half' (FAO, 2004, cited in UNDP, 2005). Consequently, they cannot re-invest and continue to face the demands of declining production and productivity.

National policies have not adequately addressed the needs of small-scale farmers. According to the Chief Executive Officer of Farm Africa (2002), often 'there is a failure to listen to small-scale farmers and also a failure in government policy to support commitments to international development.' The Economic Commission of Africa (ECA) (2006) cites problems of weak backward and forward linkages between agriculture and other sectors. In addition, small-scale farmers contend with inadequate subsidies and unfair trade (Karaan, 2006), limited access to animal and mechanical power, reduced availability of labour due to rural-urban migration, weak information systems, a poor regulatory framework that does not facilitate investment and specialization in new and high value products, inadequate market information and a lack of agricultural information (Kidane, Maetz and Dardel, 2006). Further challenges include low uptake of research products, counterproductive policies and insufficient investment in market infrastructure (Jones, 2006).

Other more systemic factors include conflicts and disasters (Bunders and Broerse, 1991), under-investment in rural areas, limited access to improved technologies, weak infrastructure, high production costs, the HIV/AIDS pandemic, loss of biodiversity, and dependency on foreign aid. Institutions in Africa also suffer from a lack of adequate systems and capacity to share and disseminate essential outputs to small-scale farmers (Madukwe, 2006; Richardson, 2006). Kidane, Maetz and Dardel (2006) also note that 'unless SSA countries create conditions for smallholder farmers to improve their labour productivity through technological change and enhanced capital assets, and/or invest in the development of labour-saving technologies, it is difficult to envisage a significant production increase through area expansion'.

In addressing these issues, many emerging technologies are being examined for their potential in transforming agricultural development in Africa. As outlined below, the use and application of modern ICTs could occupy a pivotal position in this line of engagement, especially in the context of small-scale agriculture. Suggestions from the respondents in the study tackled many of the problems highlighted above, including concentrating on high-value agricultural (HVA) products, focusing on improvement in productivity, considering the options for commercial agriculture, paying increased attention to new markets and marketing strategies, and increasing agricultural production through biotechnology. Some of the emerging ICTs that were identified include Geographic Information Systems (GIS) and decision support systems, mobile mapping and hand-held personal computers (personal digital assistants/PDAs), precision agriculture and mobile (cellular) phone applications, community radio stations, radio frequency identification tags, WorldSpace satellite radio, and more generally, access to the Internet and web-based applications.

GIS-based Decision Support Systems – A Geographical Information System (GIS) makes visual comparisons between different types of data possible. It helps to establish relationships between different data sets and is important in the production of maps, charts and additional information associated with coordinates and time. It also helps in the analysis of post harvest variation in crop yield measures, and provides a holistic view of the production system. In Africa, GIS has been applied in a number of initiatives. The International Livestock Research Institute (ILRI) has used GIS technology to map fences in its livestock-wildlife ecosystem initiative. In South Africa, the Gender, Agriculture and Rural Development in the Information Society (GenARDIS) project has used GIS applications in natural resources management in the Roiboos tea lands and in exploring the spatial dynamics of gender in rural areas.

Mobile mapping is a component of GIS systems that enables the collection of field data, including unique geospatial time tags and attributes, for integrating into and/or updating a GIS (GIS Development, 2006).

Handheld Personal Computer (HPC) or Personal Digital Assistants (PDAs) – HPCs are small, light, and robust and have been used to provide access to information, mobile mapping and other data gathering tools (GIS Development, 2006). The International Small Group and Tree Planting Alliance (TIST) is training farmers involved in community-based reforestation projects in Kenya and Uganda to use PDAs and Global Positioning System (GPS) technology to gather reforestation data, which is then uploaded to an online database. In Tanzania, the Family Alliance for Development and Cooperation (FADECO) is using PDAs to access agricultural information, while Manobi in Senegal has developed a platform of services through which fishing professionals can access fishing-oriented or sea safety-oriented data and information using PDAs. This reduces the need for face-to-face contact and reduces telecommunication and transport costs.

Mobile (Cellular) Phone Applications – The cellular phone has provided market links for farmers and entrepreneurs. Growth in mobile phone usage in SSA has been explosive and now reaches more than a third of the population. This has reduced transaction costs, broadened trade networks and facilitated searches for employment (Guislain et al., 2006). Bertolini (2004) observes that the 'telephone is the only ICT used (if any) by the majority of farmers in Africa'. Some of the respondents in the study considered cellular phone applications, such as the Short Message Service (SMS), to be one of the most important emerging ICT applications in Africa.

In Kenya, the National Agricultural and Livestock Extension Programme (NALEP) recently launched a telephony information service, the National Farmers Information Service (NAFIS), which provides extension information to farmers in English and Kiswahili using audio format (NALEP, 2008). Other cellular phone applications include the provision of market information and electronic trading platforms, where farmers and traders access information on commodities being sold, their prices and the identity of their buyers and extension messages, such as Tradenet.biz. In Senegal, women are using telecentres linked to the Internet via mobile phones to access market prices (Hafkin and Odame, 2002). The mobile phone is also used as an electronic money transfer channel. For instance, the M-Pesa service in Kenya is an affordable and speedy option for money transfer from one person to another, using SMS. In essence, the phone subscription acts as a bank account and a debit card and is being used in the agricultural sector to pay farm workers and purchase farm inputs.

Mobile phone technology can also support other voice, image and video applications. In Kenya, the Kenya Agricultural Commodity Exchange (KACE) is collaborating with a local company to offer market information through Interactive Voice Response (IVR), a service that uses voice mail for information delivery. In Senegal, farmers can subscribe to real-time information

on agricultural and fish prices via their cell phones. Likewise, fishermen in Ghana and in other parts of the continent are using mobile phones to communicate information on where to fish and to obtain information on prevailing weather conditions and prices. Farmers, however, experience challenges with mobile phones due to lack of infrastructure such as the electricity needed to charge phones.

Community Radio Stations – Radio is an important mechanism for disseminating knowledge and information in different languages and formats (Girard, 2003; Ilbuodo, 2003; Bobbili et al., 2006), especially to poor people (Harris, 2004). Kweku's (2006) findings indicate that radio is the most highly used media in accessing development and agricultural information. Following the liberalization of airwaves in most African countries, there has been a mushrooming of radio stations, many of which facilitate agricultural marketing and dissemination of market information. In Zambia, the Radio Farm Forum (RFF), a government initiative, has shown that radio is important in addressing the common needs and problems of resource-deficient rural farmers by giving them an opportunity to listen to a radio discussion programme on agricultural problems and techniques (Bobbili et al., 2006). The convergence of ICTs, such as the Internet with rural radio, can provide powerful support to help harness and communicate knowledge for development. KACE for example has developed Soko Hewani (supermarket on air) that uses FM radio and cellular phones to connect to an electronic trading floor.

WorldSpace satellite radio enables rural communities to download development content where there is no Internet connectivity. It has been used by non-governmental organizations (NGOs) in Africa, to upload and download agricultural and development content.

In recent years, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has provided support to a number of community radio stations in Africa. The Panos Institute of West Africa (PIWA) produces and distributes programmes through a website that is a cost effective alternative to shipping CD-ROMs, cassettes and mail. It also provides training and technical assistance to radio stations. Radio stations are able to upload and download programmes free-of-charge in ten Francophone West African countries (Attias and Deflander, 2003). The Technical Centre for Agricultural and Rural Cooperation (CTA) also gives support to national and regional African, Caribbean and Pacific (ACP) rural radio producers. Support ranges from developing curricula to providing training in how to produce rural radio packs on agriculture. Other development agencies that support rural radio programmes include the FAO and Farm Radio International.

Radio Frequency Identification (RFID) – RFID can be used to capture data on individual livestock that is then transmitted to a central database as part of a repository of information for livestock farmers, state veterinary services and health authorities. RFID has been used in Botswana, Namibia and South Africa for livestock identification purposes under the livestock information trace back system in compliance with new regulations required by the European Union.

Internet and Web-Based Applications – The Internet, e-mail, websites and web-based applications are becoming increasingly important in sharing and disseminating agricultural information and there are many ongoing web-based application initiatives in Africa. The FAO and partners are implementing e-Agriculture, an initiative aimed at the intersection of agricultural informatics, agricultural development and entrepreneurship, focusing on agricultural services, technology dissemination and information delivered through the Internet. e-Agriculture is intended to promote the integration of agricultural stakeholders and technology with multimedia, knowledge and culture, and aims to improve communication and learning processes (FAO, 2006).

In Uganda, the Agricultural Research and Extension Network (ARENET) uses a web portal to provide information services and a question-and-answer service to small-scale farmers. Internet cafes, telecentres, information kiosks, and market information centres have attracted the attention of rural information brokers who disseminate agricultural information on the web. Also in Uganda, the Collecting and Exchange of Local Agricultural Content (CELAC) project has developed a web-based platform that facilitates the sharing of local agricultural knowledge using various ICTs. The project targets female farmers and has established resource centres with ICT facilities for farmers to ask agriculture-related questions using Yahoo and Skype and to engage in conferencing. In Kenya, the government is establishing digital villages that will make it possible for rural communities to access government services and development information and knowledge, including agriculture.

Precision Agriculture (PA) – PA has been described as the 'next great revolution in agriculture.' PA is also known as 'precision farming, information-intensive agriculture, prescription farming, [and] target farming' (Srinivasan, 2006). Taylor and Whelan (2005) define PA as 'an integrated information and production-based farming system that is designed to increase long-term, site-specific and whole farm production efficiency, productivity and profitability, while minimizing unintended impacts on wildlife and the environment.' PA has 'the ability to manage land by the square meter instead of the square mile' (Rasher, 2001). It adapts to variability: spatial — changes across farm; temporal — season to season; and predictive — difference between predicted and actual results (Wikipedia, 2006).

Through PA, local situations can be assessed to enable a farmer to optimize use and vary the rate of inputs, such as fertilizer, across a field based on the need identified by GPS guided grid sampling. Satellite positioning and navigation have played a catalytic role in the evolu-

tion of PA. The technology encompasses four key information technologies, namely location determination (via GPS), GIS, computer-guided controllers for variable rate application (VRA) of crop inputs, and sensing technologies for automated data collection and mapping. Among the four, GPS and GIS have been more widely established and used (Swinton and Lowenberg-Deboer, 2001). PA has been used to increase yields for row crops, hay production, pasture management, animal grazing and other agricultural activities (GIS Development, 2006; Jarfe and Werner, 2006). PA also has the inherent capacity to provide an effective forum for disseminating research and experience and for assessing natural resources variability such as soil and landscape variability, weather forecasting and remote sensing.

PA has been unevenly adopted in developed countries, and is virtually unknown in Africa, except in South Africa, Mauritius, Sudan and Zimbabwe. The Mauritius Sugar Industry Research Institute (MSIRI) has adopted PA at an experimental level in sugar cane production. The result has been improved management of cane loading operations, avoidance of overloading and over-spilling, improved transport scheduling of trucks and verification of contractual work (Autrey, Ramasamy and Ng Kee Kwong, 2006; Jhoty and Autrey, 1998). Farmers in South Africa are using an aspect of PA for irrigation using ground water, and this has ensured a sustainable and efficient system based on soil type, soil water capacity, potential yield and topography (Dennis and Nell, 2006). In Sudan, an international company is working with ASBNACO -a Sudan-based company that manages the Agadi Farm -and the Arab Authority for Agricultural Investment and Development (AAAID), to introduce the use of an autosteer tractor, fitted with a GPS satellite guidance system that controls tractor steering. This has helped improve farm productivity while conserving the environment and has reduced planting time on the farm by 60%.

Due to the high levels of investment required, most PA applications have been undertaken on large-scale farms, where labour is more expensive but land and capital are less costly. Although PA has been adopted by some small-scale farmers who use it routinely, a key limiting factor of this technology is the funding required for the high-tech farming applications, which is beyond the financial reach of most African small-scale farmers (AAAID, 2006; Howcroft, 2006). The use of PA by Zimbabwe's Nemakonde Agricultural Development Company (NADC) provides various sophisticated agricultural services including differential GPS land mapping, soil sampling and variable application of soil nutrients and lime. In addition, more accurate information was available to guide decisions made by local agronomy services, such as fertilizer recommendations (Nell, Maine and Basson, 2006).

Distance Learning – As mentioned above, distance education modules on farming practices can be delivered using audio/radio, web-based means, CD-ROM, video and print format. The use of these different media has been promoted under the Collaborative Electronic Records Project (CERP) (Pye et al., 2003). In Burkina Faso, the Manegbzanga Association has introduced Agriflash, which provides TV viewers with content on agriculture-related topics.

Conclusion

Interest in ICTs has grown steadily in Africa but weak ICT policies and poor implementation capacity are among the biggest obstacles to wider use (Guislain et al., 2006). May, Karugia and Ndokweni (2007) add that one of the key factors affecting the use of ICTs in agriculture is inappropriate ICT policies, especially those that address rural communities and rural development. Sustainability is another key requirement for the use of ICTs, yet according to Kalusopa (2005), most ICT initiatives were project-based, and were disjointed and uncoordinated. The further use of ICTs calls for good ICT infrastructure, adequate ICT skills, good and affordable connectivity, and appropriate ICT policies (Maru, 2004; Richardson, 2006). In addition, there is a need for high bandwidth (Heeks, 2007).

Despite these challenges, there has been a massive rollout of basic information communication infrastructure in Africa. This has been spurred in part by the introduction of cellular technology, which has reduced subscriber costs. African governments have also continued to support ICT initiatives in under-served areas by offering incentives to the lowest competitive bidders for infrastructure provision. A number of countries are also making use of universal access funds that are meant to develop disadvantaged areas (World Bank, 2006a).

Findings of the present study have shown that radio stations and the cellular phone have become important tools in improving small-scale agriculture in rural areas. The Internet and web-based applications are becoming increasingly important in the sharing and dissemination of agricultural information and knowledge and the marketing of goods and services. The livelihoods of farmers could be enhanced through adoption of modern technologies such as PA, online markets and the application of appropriate ICTs in information and knowledge dissemination. Respondents of the study suggested the creation of 'one-stop centres' for training and for linking farmers to markets, and restructured extension services that target farmer groups to improve agricultural production and assist in the exchange of knowledge and information. However, the study established that there is low capacity and usage of ICTs and the ICT infrastructure in rural areas is a major problem. These challenges and their causes need to be addressed if ICTs are to benefit the small-scale farmer in Africa.

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Hilda Munyua is Executive Director, Knowledge Trends Ltd., Nairobi, Kenya. She is also working toward a doctoral degree at the University of KwaZulu Natal in South Africa.

Edith Adera is Senior Programme Officer and Mike Jensen is an Independent ICT Consultant for the International Development Research Centre (IDRC) -Eastern and Southern Africa.

Contact Information

Hilda Munyua
Executive Director
Knowledge Trends Ltd.
P.O. Box 1110 Village Market
Nairobi 00621
KENYA
Mobile: +254-720-297464
E-mail: munyua@iconnect.co.ke

Embrapa Technological Information: A Bridge Between Research and Society

Patrícia Rocha Bello Bertin, Fernando César Lima Leite, and Fernando do Amaral Pereira

Abstract: This paper presents the efforts undertaken by the Brazilian Agricultural Research Corporation regarding Science and Technology information management, through one of its Decentralized Units, Embrapa Technological Information. The major aim of this Unit is to promote and improve the processes of scientific communication — information that feeds and that results from research activities — and of science and technology dissemination — information that results from research activities and that is directed to the general public.

Resume: Cet article présente les efforts entrepris par la Corporation de recherche agricole brésilienne pour la gestion de l'information technologique et scientifique, à travers l'une de ses unités décentralisées, appelée Informations technologiques Embrapa (SCT). L'objectif majeur de l'SCT est de promouvoir et d'améliorer les processus de la communication scientifique (l'information qui nourrit et qui résulte des activités de recherche), et de la diffusion technologique et scientifique (l'information qui résulte des activités de recherche et qui est dirigée vers le grand public).

Resumen: Este artículo presenta los esfuerzos que ha hecho la Empresa Brasileña de Investigación Agropecuaria en el campo del manejo de la información, a través de una de sus unidades descentralizadas conocida como Información Tecnológica de Embrapa (SCT). El propósito principal de SCT está en la promoción y el mejoramiento de un doble proceso: el de comunicación científica — es decir, la información que llega a la investigación científica y la que ésta produce — y el de diseminación de la ciencia y la tecnología — o sea, la información que resulta de las actividades de investigación y que está dirigida al público en general.

Introduction

In today's globalized world, the minimization of time and space barriers favors the integration of diverse societies, cultures and economies. This has intensified the global exchange cycle, in which importance is assigned not only to increased financial capital flows, but also to another asset, both intangible and hard to quantify, albeit eminently productive, i.e. intellectual capital. Intellectual capital is the sum total of the knowledge of all workers in a given entity, agency, company, or institution, together with the efficacy of its management systems and a good relationship with the target population of the products or services of the organization.

The Brazilian Agricultural Research Corporation (Embrapa) has a long tradition of working to generate information and knowledge. The activities of one of its Decentralized Service Units, Embrapa Technological Information, or Scientific and Technological Information Service (SCT), and the organizational structures that preceded it, are based on the premise that when information management processes are properly conducted, the relationship between the institution and its target populations will be efficient and effective, whether for scientific communication or scientific dissemination. Thus, SCT's strategic guidelines generate lines of action that are first translated into projects and then into information services and products. These strategic guidelines are designed to support research, development and innovation (RD&I) activities and address social development demands.

The purpose of this article is to show how Embrapa has used SCT to manage, organize and disseminate information.

An Introduction to Embrapa

Embrapa was formed some 35 years ago to "provide feasible solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer." It has built a national and international reputation as a leading tropical agriculture RD&I company. As such, it has been courted by diverse countries and multilateral organizations wanting to capitalize on its success.

Embrapa is currently comprised of 54 units: 38 devoted to research, 3 to services, and 13 to administration. It is present in almost all the States of the Federation and the most diverse Brazilian biomes. Embrapa has also intensified its international activities through the creation of the Embrapa Virtual Laboratories Abroad-Labex in the United States (http://www.embrapa.gov.br/a_embrapa/labex/labex-usa), France (http://www.agropolis.fr/international/labex.html), and The Netherlands, as well as Embrapa Business Offices Abroad in Ghana and Venezuela.

To help build Brazil's leadership in tropical agriculture, Embrapa has invested primarily in training. The company has 8,278 employees, of whom 2,113 are researchers, with 25 or 1.2% holding Bachelor's degrees, 525 or 24.8% holding Master's degrees, and 1,563 or 74% holding PhD degrees. Embrapa also coordinates the National Agricultural Research Systems (SNPA, in Portuguese), which consists of public federal and state insti-

tutions, universities, private companies, and foundations. The SNPA carries out research in agriculture and related areas in the different regions of the country in a coordinated fashion.

With SNPA-generated technologies, Brazil has become the leader in tropical agriculture and has solved century-old problems associated with the production, domestic supply, and insertion into international markets of foodstuff and fibers, as well as renewable energy. An 87% increase in land productivity from 1970 to 2006, achieved through the technological development of Brazilian agriculture, prevented the conversion of forested lands into farmed land. To attain the current level of agricultural production with the technology available decades ago would have required triple the grain farmed land, i.e., clearing 90 million hectares of forest. Such major preservation of natural resources is an invaluable contribution of Brazilian agricultural research to the reduction of the global warming phenomenon (Embrapa, 2008b).

Recent research on the impact of the technologies that Embrapa develops and transfers to Brazilian society demonstrated social profits equivalent to R$ 15.47 million (Embrapa, 2008b). In a major effort to restore Embrapa's budgets in 2007, the federal government granted the company the largest nominal Net Operational Revenue in history: 1.157 billion reais, of which each real returned R$ 13.36 to the Brazilian society.

Even so, even more funding is needed to enable Embrapa's capacity for solving technological problems to keep up with society's demands. To that end, the Program for the Strengthening and Growth of Embrapa and Brazilian Agricultural Research will promote annual budget increases so that by 2010 the budget should be R$ 1.685 billion. That level of funding will enable Embrapa to modernize its infrastructure and laboratories and set up new research units in agricultural expansion areas, as well as train and increase its staff (Embrapa, 2008a).

Information Management in Embrapa's Strategic Planning

Research institutions must have information services that enable them to recognize quickly the demand for innovations and research results. The *1st Embrapa Master Plan (I PDE*, in Portuguese), the document that guided the company's activities during the 1988–1992 period, already emphasized the importance of information as the "primordial basis for the full development of research" (Embrapa, 1988). Since the research sector is the most interested in improving the global technical and scientific information network, the knowledge it produces is certified, disseminated and used as an input in the development of new knowledge via the subjacent scientific communication system. The science and technology information systems (S&T) of an institution must be well structured and integrated into the global scientific communication system. However, society will only benefit from that structure if institutional policies ensure that the information used and generated by research contributes to social development.

With this in mind, Embrapa began managing the information inherited from the National Agricultural Research Department, which was closed in 1973, by producing collective catalogues and a crude bibliographic commutation system. Among the macro-policies established in *I PDE: 1988–1992* related to research support, priority was assigned to increased resources for the information and documentation areas with a view to:

- promoting activities in the area of technical and scientific information in order to support researchers with current and retrospective information and documents that could influence significantly the researchers' level of application and contribute to increasing their performance as generators of scientific knowledge and technological innovations;
- networking with national and international, technical and scientific information, maintaining permanent control over the literature in agriculture and similar fields of knowledge and promoting the acquisition of those of interest to Embrapa; and
- coordinating the documentation and information activities of Embrapa's decentralized units and other entities that make up the SCPA (Cooperative Agricultural Research System) (Embrapa, 1988).

The master plan that guided Embrapa's activities from 1994 to 1998, *II PDE,* underscored the importance of information and knowledge, a fact readily observed in the company's mission for that four-year period: "to generate, promote and transfer knowledge and technology for the sustainable development of the agricultural, agro-industrial and forestry sectors of the economy to benefit Brazilian society" (Embrapa, 1994).

In order to fulfill that mission, among other things, the *II PDE* established it as Embrapa's responsibility:

- to ensure that the knowledge and technologies generated through research reach the target populations directly or through appropriate dissemination and transfer channels;
- to encourage other organizations to generate knowledge relevant to their mission; and
- to organize existing knowledge to make it more useful within the scope of the mission (Embrapa, 1994).

During that period, Embrapa began a priority information exchange and production program to support the research and development (R&D) actions whose purpose was to promote:

- (…) organizing and making available agricultural, agro-industrial, forestry, and other similar information to society, in general, and to the scientific community, in particular, with a view to improving the efficiency and effectiveness of the generation and transfer

Table 1 – Scientific production at Embrapa from 2000 to 2006

Type of publication	2000	2001	2002	2003	2004	2005	2006	Total
Article in proceedings / technical note	1,203	1,553	2,089	2,399	2,818	3,231	3,107	**16,400**
Article in an indexed journal	1,228	1,135	1,211	1,228	1,420	1,464	1,489	**9,175**
Chapter of a technical-scientific book	859	657	739	986	738	903	937	**5,837**
PhD and master thesis supervision	187	204	244	267	248	265	263	**1,678**
Summary in proceedings	3,252	3,069	3,730	3,576	3,7 79	3,843	4,093	**25,342**
Total	6,729	6,618	8,013	8,456	9,003	9,706	9,889	**58,432**

processes of knowledge, technologies, products, and services…

The *III PDE* was developed and made public as the guiding framework for the strategic realignment of Embrapa's actions during the 1999–2003 period. The document propounded overcoming the new challenges arising from the "great transformations" in the world scenario, namely, the globalization phenomenon accompanied by the opening of markets; the importance of the environment; the reform of the State; consumer power; and the technological revolution (Embrapa, 1998). The focus of Embrapa's activities during that period was agribusiness and associated opportunities for the economic development of the country. In fact, the emphasis assigned to issues related to information management in the previous master plan was substantially reduced in the *III PDE*. On the other hand, this master plan promoted the perspective of diffusing technologies and knowledge through the use of new channels and enhancement of business communications. Much was said about the need to transfer technologies and the qualification of information to achieve greater conformity with the modern vision of agribusiness.

The *IV PDE* (2004–2007) showed important progress in supporting the public policies that assigned priority to democratizing access to production factors (credit, technical assistance, inputs, and land), diminishing social and regional inequalities, and increasing social well-being, especially through the strengthening of family agriculture (Embrapa, 2004).

Like the previous master plan, the *IV PDE* did not include among the strategic guidelines and objectives any specific mention to information management. Nevertheless, a series of innovating actions were implemented during the *IV PDE* regarding the dissemination of information and knowledge that focused on increasing the production capacity of family farmers, especially related to the current public policies.

The current Embrapa master plan period — *V PDE (2008–2011)* — innovates in matters pertaining to organizational strategies for the middle term (2008–2011) and long term (2008–2023), in anticipation of the company's 50th anniversary (Embrapa, 2008b). Among the institutional challenges set forth in the master plan, the issue of information is considered of major importance, as well as a priority, particularly in strategic guidelines 4 ("Strengthening the management and protection of knowledge.") and 8 ("Strengthening institutional and market-oriented communication in order to act in a strategic manner vis-à-vis the challenges of the information society.") and respective secondary strategies.

Research Outputs of Embrapa

Agricultural research outcomes have become a fundamental element in science and technology planning in developing countries. That is especially true in Brazil, because the country's scientific production in the field of agriculture has been widely recognized throughout the world. During the 2003–2007 period, 4,139 Brazilian articles related to the agriculture field were indexed by ISI; this represents 4% of the world's total production (Produção, 2008). Embrapa, in turn, contributes significantly to Brazil's scientific production, as is shown in Table 1.

The input and first manifestations of RD&I outcomes are scientific publications and patents. In order for RD&I to be conducted efficiently and effectively, scientific communication processes must foster the information flows that feed this process (input). Furthermore, the results of the research activities must be organized and disseminated so as to maximize their impact within science itself. This will in turn support the generation of new knowledge through the management and communication of scientific information — and within society as a whole by means of the scientific dissemination processes. Since its formation, Embrapa has sought to guide RD&I according to such parameters through the activities of Embrapa Technological Information.

Embrapa Technological Information

Embrapa has always considered having well structured Service Units indispensable to support its central role in the SNPA. The implementation of a documentation and information center was deemed essential from the very beginning, along with a technology transfer and knowledge dissemination unit that would maintain close relations with the Brazilian technical assistance and rural extension services (Embrapa, 2006).

The first three organizational structures with specific roles relating to the various spheres of information, technology and communications were created in 1974: the Data Processing Department, Technology Dissemination Department, and Information and Documentation Department (DID). The latter arose from concern about facilitating the access of researchers to research outcomes from around the world and permitting public access to Embrapa research outcomes. DID's first responsibility was to establish a network of specialized libraries in all of the company's units, as well as documentation systems capable of seeking the information required from any country in the world (Embrapa, 2002).

The departments of Technology Dissemination and Information and Documentation coexisted within Embrapa until the 1980's, when the Technology Dissemination Department assumed responsibility for information and documentation and the latter department was closed. The growing demand for publishing dissemination material, periodicals and books led the company to invest heavily in modern publishing equipment.

The Information Production Service (SPI) was created in 1991 in order to guarantee an adequate structure that would organize the information available within the company, qualifying it in terms of form, contents and support to meet the demands of the various clienteles.

Over time the SPI has undergone changes in its organizational structure, experimented with three operational models and, at the same time, modernized its production and product distribution structure. Its name was changed in 1999 to Technology Transfer Communication Service, and it came to house printing equipment and a series of services compatible with publishing, together with videotape and CD-ROM collections.

To ensure the transfer of information and technical, scientific and socio-economic data, given the demands of the market and the Information Society, the unit underwent some administrative and managerial transformations in mid 2001. It implemented electronic media projects to make information available in a digital environment and online. At that time, its name was changed again, to Scientific and Technological Information Service (SCT), or Embrapa Technological Information.

Beginning in 2003, the unit joined in the effort to democratize access to information and, thus, contribute to the success of the public policies focusing on social inclusion. New information projects met the demands of those who generate information and those who consume it, with publications edited in the language, style, media, and format adequate to previously determined functions and clienteles — particularly to those excluded from having access to scientific and technological information.

Organizational Structure – Embrapa Technological Information is a decentralized services unit of Embrapa, with the mission of "Proposing, coordinating and executing solutions for the scientific management and dissemination of information generated by Embrapa to the benefit of the Brazilian society" (as in *III PDU SCT* — 2008–2011). The organizational structure of SCT is shown in Figure 1.

At present, SCT's 111 employees (high-school, Bachelor's and graduate levels-specialization, Master's degree and PhDs) make up the multidisciplinary team required for the planning and execution of the information-related work. Librarians, journalists, archivists, administrators, economists, systems analysts, pedagogues, graphic designers, language specialists, biologists, and agronomical engineers, as well as trainees in the various areas, make up the staff. Thus, the unit is equipped to plan, develop and implement information products and services for either dissemination or scientific communication.

A comparison of SCT's average annual budget of approximately R$ 3,094,972.34 (see Table 2) with Embrapa's net operational revenue in 2007 of R$ 1.157 billion

Figure 1 – Embrapa Technological Information Organizational Structure

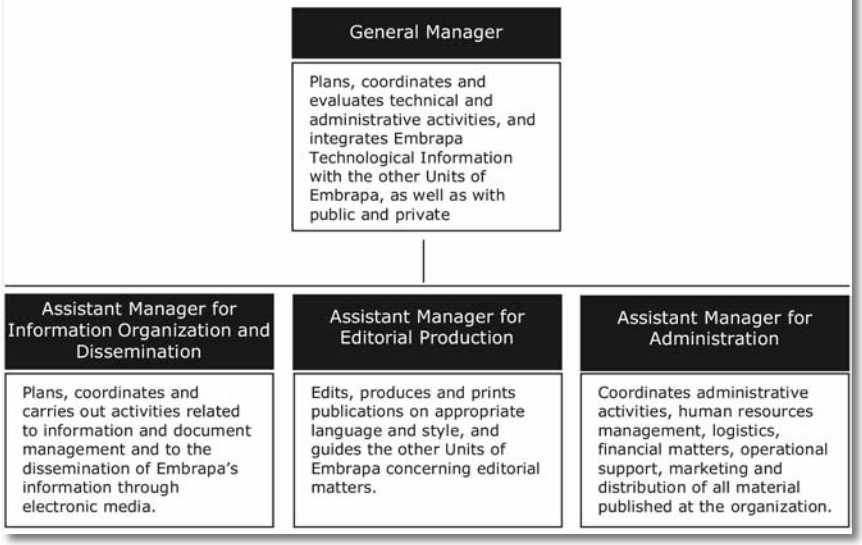


Table 2 – Annual budget of Embrapa Technological Information (1995–2008)

Year	Budget (R$)
1995	3,800,284.22
1996	2,431,607.93
1997	1,853,858.05
1998	1,616,895.33
1999	2,024,668.22
2000	1,778,940.34
2001	2,199,115.82
2002	2,184,396.09
2003	2,621,386.95
2004	3,411,657.29
2005	4,269,862.62
2006	4,394,969.87
2007	4,946,342.99
2008	5,795,627.00
Mean	**3,094,972.34**

shows that the unit's structure is low cost, considering that Embrapa has 54 decentralized (research and services units) and centralized (administrative) units.

Information in Agriculture: From Scientific Communication to the Dissemination of Science

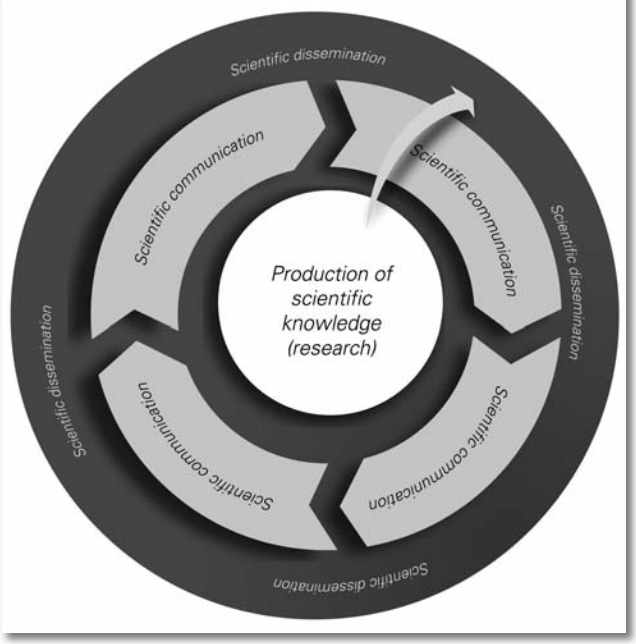
Developing countries like Brazil face structural problems such as poverty, which affects a high proportion of the population; income concentration; hunger; high illiteracy rates; foreign indebtedness; and poor health standards. A common characteristic of these problems is that S&T can contribute towards their minimization. Thus, promoting access to the information resulting from scientific research is potentially useful for creating the robust social, economic and technical infrastructure required for the development process (Chan and Costa, 2005). The accumulation of knowledge through scientific and technological progress and the facilitation of access to information are essential driving forces in the development of nations.

The information communication flow in the production of knowledge requires:

- scientific communication (researchers ↔ researchers and to the scientific community as a whole), and
- mediation of the scientific information for professionals (non-researchers), technicians and society at large, which favors social development.

Since Embrapa is a research institution, its researchers — and Embrapa itself — are inserted into a greater global scientific system, whose production, management and scientific communication processes are directly related to and influenced by a complex arrangement of institutions, development agencies, companies, and scientific publishers, among others. This means that the communication of scientific information in an institution such as Embrapa meets not only its own demands using its own mechanisms but also, and mainly, the imperatives imposed by the context of world science.

Figure 2 – Scientific communication and dissemination through Embrapa Technological Information



SCT Products and Services: From Research to Society

Within the scope of its mission, SCT proposes, coordinates and executes a series of activities that result in information products and services for research and society at large. The unit's patrons are individuals or public and private entities that benefit from its services and/or the information transmitted by its information products. Nevertheless, SCT gives priority to the demands of those social groups excluded from access to scientific and technological information, or even those having difficulty maintaining such access. SCT's activities are conducted taking into account the following contextual trends:

- Accelerated evolution of scientific knowledge, with growing interdisciplinary articulation, and more intensive application of technology in all categories of agribusiness and the sustainable development of rural areas.
- Growing concern of the population and governmental policies as regards the environmental, economic and social sustainability of commercial agriculture's production, as well as the quality and contribution of foodstuff to nutrition, health and quality of life.
- Attention to information and knowledge management as an instrument that enables access to information, as well as the sharing of information, in a competitive globalized world.
- Growing concern and competition in the information publishing market with respect to issues such as information security and intellectual, author, and property rights.
- Rapid increase in the number of people interested in electronic products and services.

Since the R&D outcomes in agriculture and related areas are the main focus of Embrapa's activities, SCT structures its products and services as a function of such outcomes. Thus, it is concerned not only with scientific information management aiming at improving internal and external scientific communication, but also with the management of information with a view to improving the communication processes between Embrapa and society (dissemination), as shown in Figure 2.

The main information products and services generated by SCT are described below, categorized by print media, electronic media and information management.

Print Media

In the last few years, SCT has produced and made available to internal and external clientele approximately

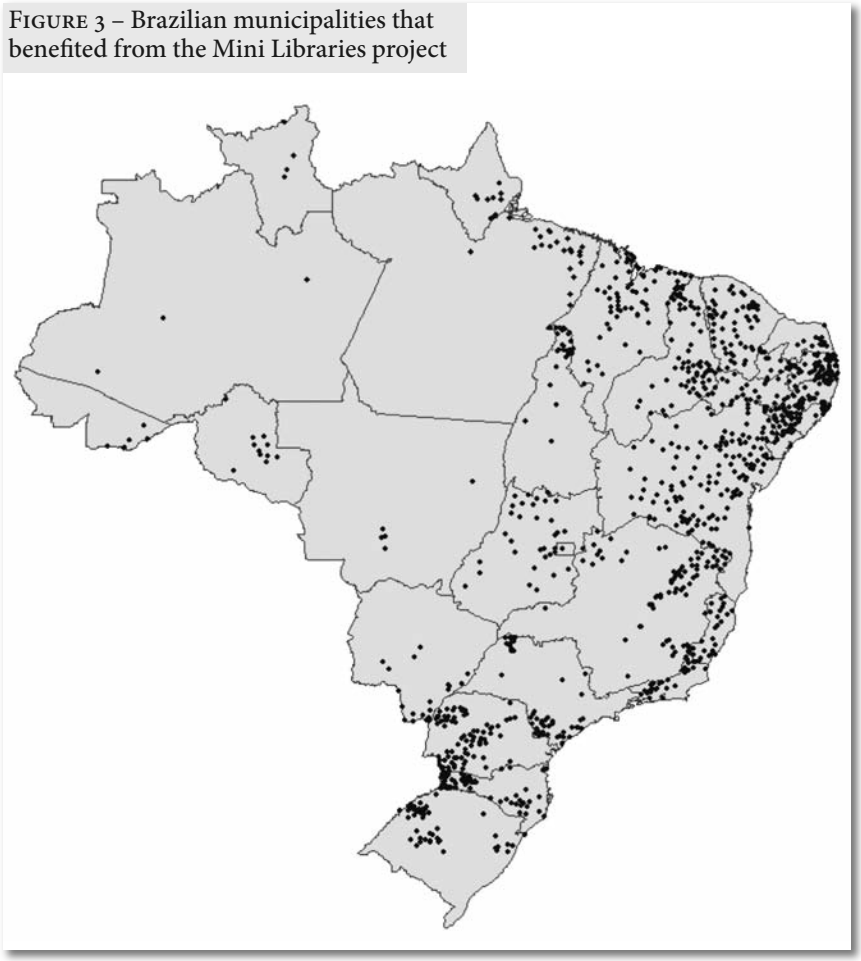
three million printed copies of books, magazines, manuals, periodicals, information leaflets, forms, posters, direct mailing material, letters, and folders.

Printed Publications & Journals –

- ***Pesquisa Agropecuária Brasileira*** – *Pesquisa Agropecuária Brasileira* (Brazilian Journal of Agricultural Research / http://seer.sct.embrapa.br/index.php/pab/index) is an open access journal, published monthly in print and online, that disseminates original technical-scientific papers resulting from research connected to agriculture, e.g. plant physiology, plant health, crop science, genetics, soils, food technology, and animal science. It is indexed by ISI (Web of Science and Current Contents: Agriculture, Biology & Environmental Science), Scopus, CAB Abstracts, AGRIS and SciELO. The technical-scientific articles, as well as the scientific notes and new cultivars, are published in Portuguese, Spanish and English. Reviews are published by invitation from the Editor.
- ***Cadernos de Ciência e Tecnologia*** – *Cadernos de Ciência e Tecnologia* (http://webnotes.sct.embrapa.br/cct/CCT.nsf/Principal) is published quarterly in print and electronic media. It is indexed in CAB Abstracts, AGRIS, AGRICOLA, Agrobase, and the Pesquisa Agropecuária Brasileira Database. It was created in 1984 to foster reflection, debate and a critical view of science, technology and agricultural development, with an emphasis on the social, cultural and political aspects of agricultural problems. The journal accepts original papers from researchers, scholars and analysts from the various areas and institutions that work with agriculture.

Mini Libraries – The Mini Libraries project (http://hotsites.sct.embrapa.br/minibibliotecas) includes the production and distribution of information products in different media to public schools in rural areas. The material contains technological information generated by Embrapa and instruction on the production of quality foodstuff, taking into account the realities of rural communities in the various Brazilian regions. Each mini library includes 108 print publications, 40 Rural Talk radio programs and 37 *Field Day on TV* program videos produced by SCT. The subjects covered by the various collections emphasize environmental preservation and education, citizenship values, cooperative enterprises, vegetable gardens and orchards, raising small and large animals, producing quality foodstuff, soil and water management, and how to begin a small food agro-industry, among others. By the end of 2008, as a result of partnerships established by SCT with the Ministry of Social Development and Combat Against Hunger, National Institute for Colonization and Land Reform, and Banco do Brasil Foundation, the Mini Libraries project installed mini libraries in 1,279 municipalities, meeting the needs of an estimated population of 100,000 students and surrounding communities, with almost 198,245 publications. Figure 3 shows the Brazilian municipalities that benefited from the Mini Libraries project.

Figure 3 – Brazilian municipalities that benefited from the Mini Libraries project



Electronic Media

Radio Program: *Rural Talk* – In 2003, Embrapa began using the radio to disseminate technologies and information useful in the daily lives of rural families in the Northeast Region's semi-arid zone, as one of the actions associated with the Zero Hunger (*Fome Zero*, in Portuguese) Program of the Federal Government. The following year, the Rural Talk radio program (*Prosa Rural*, in Portuguese / http://hotsites.sct.embrapa.br/prosarural) was initially broadcast by 50 radio stations. Rural Talk is a 15-minute program whose content is produced by Embrapa's research units in the Northeast Region. By the end of 2004, Rural Talk had been broadcast by 423 stations and covered the entire semi-arid region. More

than 1,000 radio stations currently take Rural Talk to thousands of Brazilian rural families who learn about low-cost, easy-to-adopt technologies and products developed by Embrapa for young people and family farmers in the Brazilian Semi-Arid and the Vale do Jequitinhonha (State of Minas Gerais), as well as the Northern, Central-West, Southeast, and Southern Regions of the country.

Rural Talk is distributed free of charge to radio stations throughout Brazil with the support of the Ministry of Social Development and Combat Against Hunger, the Brazilian Association of Community Radios, the Brazilian Communications Company, the Ministry of Communications, and the Brazilian Association of Radio and Television Stations. Figure 4 shows the Brazilian municipalities that have radio stations working in partnership with Rural Talk.

TV Program: *Field Day on TV* – Field Day on TV (Dia de Campo na TV, in Portuguese / http://hotsites.sct.embrapa.br/diacampo/) is a weekly television program created in 1998 to disseminate information and technologies resulting from research executed at Embrapa and state research organizations. These non-technical programs are designed for the most varied publics, including farmers, technicians, students, homemakers, and businessmen. The program is aired over public and private TV stations. Starting with just four programs in 1998, over 350 Field Day on TV programs have been aired to date.

Embrapa Portal – The purpose of the Embrapa Portal (http://www.embrapa.br) is to improve and broaden the communication and technology transfer capability of the company vis-à-vis the various sectors of society via the Internet. It uses a content management tool to speed up the maintenance and production of information by Embrapa's units and to help improve the electronic information publication process on the Web. Access to the Embrapa Portal enables clients, users and/or beneficiaries to obtain information generated by Embrapa through a single entryway.

SCT was charged with defining the visual identity of Embrapa on the Web and the architecture of the information to be made available via the Portal. Currently, SCT is responsible for coordination of the process of publishing content via the Embrapa Portal, in partnership with the Social Communications Office.

Embrapa Information Agency – The Embrapa Information Agency (http://www.agencia.cnptia.embrapa.br/) is a web system that makes it possible to organize, treat, store, publicize, and access technological information and knowledge generated at Embrapa and other research institutions. The information is organized hierarchically in a tree structure called the Tree of Knowledge. The Embrapa Information Agency contains all of the Trees of Knowledge developed by Embrapa's decentralized units pertaining to agribusiness products and themes. The first three levels of the hierarchy contain generic knowledge, while the deeper levels present more specific knowledge. Each item in the Tree of Knowledge is called a node, which is defined at each successive subdivision (sub-node) of the contents. The Tree of Knowledge contains validated information about all stages of the production chain, e.g. plant cultivation and raising animals, and the most diverse themes. In addition to this information, the Embrapa Information Agency provides users with complete access to various information resources, including articles, books, image and sound records, spreadsheets, etc. Information can be accessed by navigating a hyperbolic tree (graphical form of the Tree of Knowledge — see Figure 5), navigation over hypertext, or the use of a search service:

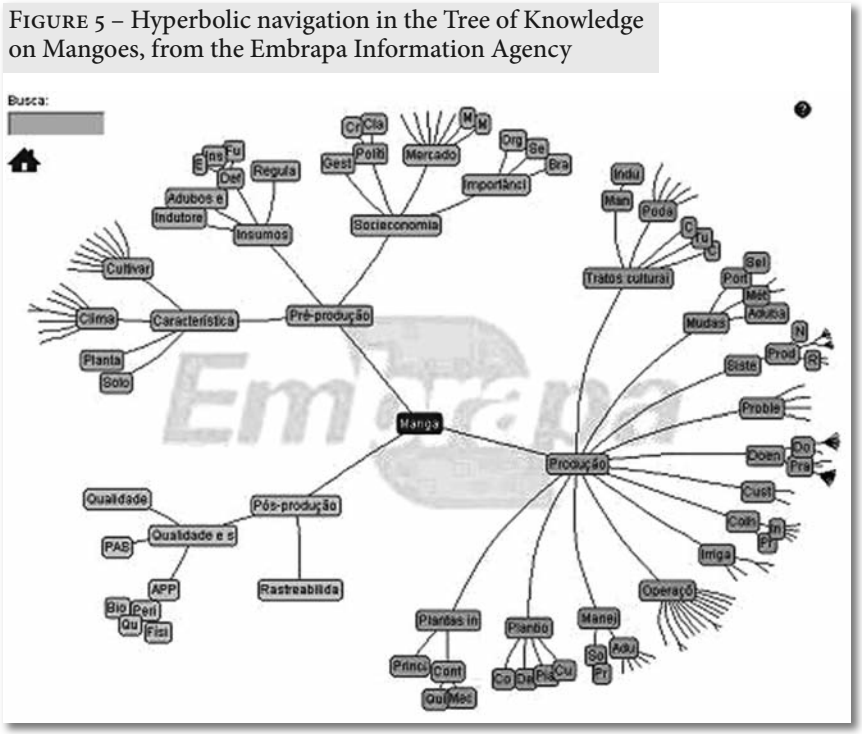
- Navigation of the hyperbolic tree makes it possible to visualize the ramifications and sub-nodes of each basic node.
- Navigation over hypertext shows nodal and sub-nodal

Figure 4 – Brazilian municipalities that have radio stations working in partnership with Rural Talk (*Prosa Rural*)

contents and enables access to the document file.

- The search service makes it possible to identify the route followed to reach the information within the hyperbolic tree when the user types in the subject desired in the search box.
- The advanced search option permits quality and precision retrieval of the information requested.

Figure 5 – Hyperbolic navigation in the Tree of Knowledge on Mangoes, from the Embrapa Information Agency



Information Management

Open Access to Embrapa's Scientific Information – Embrapa is designing a project whose purpose is to propose and implement a methodological model for the management of technical-scientific information. The model is based on the premises/mechanisms of Open Access to feed the research and development activities and broadly disseminate the information produced. The application of an open access model to scientific information at Embrapa and its effective use by part of the community would make it possible to:

- assemble and preserve the scientific intellectual production of the institution in digital form using specific techniques;
- provide unified access to the entire scientific production of Embrapa in electronic format and full text, and to external open access scientific information sources relevant to the research carried out in the institution;
- enhance the profile of the scientific production, the researchers and the institution itself by maximizing access to their intellectual production and, consequently, helping increase the impact of the outcomes of the research executed at Embrapa, i.e. an increased rate of citation of scientific articles written by Embrapa's researchers, and thus support the internationalization of the institution;
- provide tangible indicators for the evaluation of Embrapa's scientific production and demonstrate the public value and scientific, social and economic relevance of its activities; and
- provide scientific information services to external users, with special focus on universities, researchers, and research institutes in developing countries.

Embrapa's Memory – The purpose of the Embrapa's Memory project (http://hotsites.sct.embrapa.br/pme) is to retrieve, preserve, manage, and share Embrapa's technological and institutional knowledge and to record the history of the company and its units. The project will help strengthen the credibility and image of Embrapa within Brazilian society, especially among people in Brazilian agribusiness.

Embrapa's Library System – The SCT coordinates Embrapa's Library System, which is composed of 39 libraries and whose mission is to plan, coordinate, standardize, execute, and advise on the organization of information and technical, scientific and administrative documentation of the company, as regards acquisitions, technical processing and availability of information to the company, the scientific community, and society at large.

Management of Documentary and Archival Information – The Central Archives serves Embrapa's 13 Central Units on issues relating to the management of documents and archives, such as evaluation, control, classification, term of preservation, and elimination. SCT coordinates the management of archives and documents in the company's Decentralized Units.

Final Considerations

Embrapa Technological Information has transformed the knowledge generated by Embrapa's research into information available to academic and technical-scientific publics and has achieved internal and external public recognition since its creation.

As important as the mediation of scientific information for specialized publics is, SCT also focuses on organizing and disseminating information to excluded populations, as a way of supporting universal access to knowledge. The plurality of the Brazilian society and the country's rural areas and the diverse socio-economic and political arrangements, demand creativity and determination from a government-owned company such as Embrapa to ensure that the various forms of communication

within society reach all of the people. By doing so, the organization aligns with public policies aimed at the development of huge sectors of our population. There remains in Brazilian society a vicious circle of technological exclusion that marginalizes millions of Brazilians with regard to the benefits that science has brought to society, thereby strengthening the social exclusion processes. By making information available in the language(s), style, media, and format appropriate for the various segments of our population, SCT assigns priority to that part of the population excluded from access to knowledge and takes aim on the alleviation of technological and social exclusion.

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Patrícia Rocha Bello Bertin is Assistant Manager for Information Organization and Dissemination at Embrapa Technological Information, Brasilia, DF, Brazil.

Fernando César Lima Leite is Analyst of Embrapa Technological Information and a PhD Candidate in Information Science at the Department of Information Science – University of Brasilia.

Fernando do Amaral Pereira is General Manager of Embrapa Technological Information and a MSc Candidate in Science and Technology Policies and Management at the Center for Sustainable Development – University of Brasilia.

Contact Information

Patrícia Rocha Bello Bertin
Assistant Manager for Information Organization and Dissemination
Embrapa Technological Information
Parque Estação Biológica - PqEB, W3 Norte (final)
CEP 70770-901 Brasilia, DF
BRAZIL
E-mail: patricia@sct.embrapa.br
Web: http://www.embrapa.br/

Networking for Sustainable Development: The Papua New Guinea National Agricultural Information System

Peter Walton

Abstract: The Papua New Guinea National Agricultural Information System (NAIS) is a partnership of seven agricultural institutions, agencies and government bodies. Funding from the Australian Government in 2000 facilitated the development of a library system for a single institution, but it was the enthusiasm and commitment of agricultural librarians and information officers in subsequent years that led to its expansion to six other institutions. Comprising 18 libraries, it is much more than just a library system. NAIS is a vehicle for providing information access points at various locations in a country renowned for its lack of connectedness. Uniquely, NAIS is not connected by wires, and does not rely on any communications technology other than limited access to e-mail. It works because the most basic of tools is employed: the desire among participants to share knowledge and information; to maintain the integrity of the system; and most of all, to reach towards a common, shared vision. The approach used and the skills learned in the eight years since this initiative was conceived are easily adaptable, not only to other countries in the Pacific, but also to other developing countries.

Resumé: Le Système national d'information agricole de la Papouasie-Nouvelle-Guinée (NAIS) est un partenariat entre sept institutions, agences et institutions gouvernementales agricoles. La subvention du gouvernement australien en 2000 a facilité le développement d'un système bibliothécaire pour une seule institution ; mais c'était l'enthousiasme et l'engagement de bibliothécaires et de documentalistes agricoles dans les années suivantes, qui ont mené à son expansion vers six autres institutions. En englobant 18 bibliothèques, c'est beaucoup plus que juste un système bibliothécaire. Le NAIS est un véhicule pour fournir des points d'accès à l'information à divers emplacements dans un pays renommé pour son manque de connexion. D'une manière unique, le NAIS n'est pas connecté par les fils, et ne compte pas sur la technologie de communication en dehors de l'accès limité du courrier électronique. Il fonctionne parce que l'outil le plus fondamental est employé : le désir parmi les participants de partager la connaissance et les informations, de maintenir l'intégrité du système et, principalement, d'atteindre une vision commune et partagée. L'approche utilisée et les compétences apprises pendant les huit ans depuis que cette initiative a été conçue, sont facilement adaptables, pas seulement aux autres pays dans le Pacifique, mais aussi aux autres pays en voie de développement.

Resumen: El Sistema de Información Agrícola de Papua Nueva Guinea (NAIS, del inglés) es una asociación colaborativa de siete entidades, entre institutos agrícolas, organizaciones agrícolas y entes gubernamentales. Los fondos donados por el Gobierno Australiano en 2000 facilitaron el desarrollo de un sistema de bibliotecas para una sola de las instituciones mencionadas; de otro lado, el entusiasmo y la dedicación de los bibliotecarios y agentes de información del sector agrícola hizo que, en los años siguientes, el sistema se expandiera para incluir en él las otras seis instituciones. Puesto que cuenta ya con 18 bibliotecas, es mucho más que un simple sistema bibliotecario. NAIS es el vehículo que proporciona puntos de acceso a la información en varias localidades de un país que tiene fama por su falta de conectividad. Lo que hace único a NAIS es que no está conectado por cables, y no se apoya en ninguna otra tecnología informática diferente del acceso limitado que hace del correo electrónico (e-mail). NAIS funciona porque usa la herramienta más elemental, es decir, la voluntad que tienen los participantes de compartir sus conocimientos, de mantener la integridad del sistema y, más que todo, de llegar a realizar una visión común que ellos comparten. El enfoque empleado y las destrezas aprendidas en los 8 años transcurridos desde que se concibió la iniciativa pueden adaptarse fácilmente, no sólo a las condiciones de otros países de la cuenca del Pacífico, sino de los países en vías de desarrollo.

Introduction

Consideration of a national agricultural information system[1] for Papua New Guinea (PNG) was put forward formally in 1996 as a recommendation made at the National SDI Management Workshop organised by the Pacific Regional Agricultural Programme, although it had been discussed informally since the first national agricultural librarians' workshop in Port Moresby in November 1991.

In terms of agricultural research and development, information is needed by different categories of people, at different times and in different forms. For example, information is needed:

- by *researchers,* prior to conducting research, to ascertain what work was done previously and the extent of knowledge gained — trial reports, scientific papers;
- by *researchers,* while implementing research, to keep abreast of developments in the same or similar areas — research journals, studies;
- by *agricultural planners and policy makers,* to inform their decision-making — industry studies, consultancy reports, statistical information;
- by *extension and outreach staff,* as a resource to draw on to respond to farmer requests or to create awareness among their clients of new technologies or opportunities — technical reports, newsletters, extension materials in all formats;

- by *farmers,* for information on specific problems, or information about new technologies or opportunities — items in the popular media (newspapers, radio broadcasts), extension materials in all formats, demonstrations and farmer field days;
- by *agriculture teachers,* in support of their teaching — textbooks, basic handbooks, popular and technical periodicals, resource kits comprising extension materials in all formats;
- by *agriculture students,* in support of their learning — textbooks, basic handbooks, extension materials in all formats;
- by *manufacturers,* in terms of opportunities for value-adding, processing technologies and market opportunities — industry studies, market studies, demonstrations and shows; and
- by *agricultural traders* (sellers and buyers), for information about the sector being engaged with, market opportunities and trading potential — trade catalogues, industry studies, market surveys, trade studies, statistical information.

Clearly, there is a need for information at every level and in all endeavours. A lack of access to appropriate and credible information on a timely basis compromises the ability of an institution to fulfill its potential or carry out its mission. A national agricultural information system is a means of bringing all relevant resources together so that access to information is facilitated.

The Beginnings

The opportunity to realise the dream of a national agricultural information system came about in a curious way. In 1999, the author was invited by the Australian-funded ACNARS (Australian Contribution to a National Agricultural Research System) project to design and implement a library and information system for the newly-established Papua New Guinea National Agricultural Research Institute (NARI). The Institute was created in 1997 out of the Department of Agriculture and Livestock's Agricultural Research Division, and as such inherited seven research stations located in different parts of the country, and one laboratory in the capital, Port Moresby. If anything provided a perfect test-bed for a national agricultural information system, NARI's needs fit the bill.

It should be noted at this point that none of the research stations nor the laboratory were connected as part of an integrated computer network, and that at best each site had access to telephones and faxes for most of the time, and e-mail some of the time. However, the fact that e-mail was available, albeit limited, meant that it was possible to conceive of a decentralised but shared library catalogue database, with record amendments and additions being moved between the sites as simple text files. As a result, each research station would be able to provide access to the same shared database. At the time, the only library management software identified as being able to manage this process easily was Inmagic's DB/TextWorks.

The inclusion in 2001 of what was then the PNG Coffee Research Institute (now Coffee Industry Corporation (CIC), Research and Grower Services Division) in the system provided further useful experience.[2] By 2003, the successful integration of CIC into the NARI system became the incentive to extend the information system to other institutions; it simply became too great an opportunity to ignore.

Formal discussions on a national agricultural information system (NAIS) were held on several occasions with different stakeholders in October 2003 and March 2004. Three different options were identified: (i) the 'do nothing more' option, which would see NARI and CIC continue to collaborate, under the sole responsibility of NARI; (ii) extend the system to other institutions, but rely on NARI to manage the enlarged system on behalf of all parties; or (iii) extend the system to other institutions, but under a different management structure with equal partnership and shared management and financial responsibility.

It was decided that the second option provided the best short to medium term outlook in terms of feasibility and success, but that steps should be taken to ensure a greater chance of sustainability, not to mention a more equitable solution, in the longer term. This decision was based in part on an awareness that it is far easier to make long-term commitments based on something tangible, rather than some abstract concept.

And Then There Were Seven

Participation in NAIS has never been just about databases and computers, however important they may be; rather, it is about managing information and knowledge assets such that the resources held contribute towards the institution's objectives by providing support for research, outreach and decision-making processes. The best way to manage tangible information assets such as reports, papers and maps, is to organise them in a library to ensure that they are retrievable. This was how the process started with NARI and CIC; a willingness to share assets brought the institutions together as partners and also strengthened the resource base.

Each of the five new partner institutions came with a set of assets at different stages of development and usability. New Britain Palm Oil Ltd (NBPOL) is a very successful commercial enterprise, with a strong albeit commercially-oriented research programme (elite oil palm seeds). NBPOL had not only an organised library collection at the Dami Oil Palm Research Station (West New Britain), but also a series of EndNote databases comprising thousands of unique (to PNG) records. So there was a good basis for NBPOL's inclusion in NAIS. Ramu Sugar Ltd (RSL) is also a successful commercial enterprise

and also had a library collection, but the organisation was a little idiosyncratic and required the potential user to guess where a document might be located. To its management's credit, the benefits of an organised and documented library were recognized by the company.

The Cocoa Coconut Institute of PNG (CCI) came on board during a time of great internal organisational upheaval and also with a formidable task. Whereas there is a room set aside for a library at the CCI Headquarters at Tavilo (East New Britain), there has never been a library collection. CCI recruited a trained librarian, and the librarian from the NARI station just down the road at Keravat was able to mentor her progress and help her with unfamiliar tasks. Having someone close to hand is a bonus and an excellent example of the 'shared responsibility' philosophy that imbues the system.

The PNG Oil Palm Research Association (PNGOPRA), a collective of six commercial oil palm enterprises, and the PNG Oil Palm Industry Corporation (a smallholders' association) joined, bringing with them their network of three research stations (one of which is shared with NBPOL at Dami) and a range of technical and research publications.

Lastly, in 2006, the 'poor cousin', the national Department of Agriculture and Livestock (DAL) was able to participate, bringing with it a network of agricultural stations, links to Provincial departments of primary industries, and its extensive collection of DAL publications and technical and consultancy reports.

The Agricultural Information Resource Base

With seven partner institutions, encompassing 18 libraries and information centres, the PNG national agricultural information system (NAIS) comprises five components:

- a co-operative library catalogue database;
- a publications database of seven publishers;
- a database of researchers and other specialists in Papua New Guinea;
- a database of institutions and their capabilities in Papua New Guinea; and
- a bibliographic database of Pacific agricultural journal articles (from 1920).

The principal aim of the library catalogue database is to document all materials in the libraries of NAIS partners. However, the ultimate ambition is to build a definitive database of all documents on agricultural research and development in Papua New Guinea, and with the new partners coming on board, that ambition is closer to being realised. This is a unique exercise, not just in Papua New Guinea, but elsewhere in the region. The library catalogue contains records of: books (monographic and 'in series'); individual chapters (if about PNG agriculture); conference proceedings; individual conference papers (if about PNG agriculture); journal articles; dissertations (Masters level and above); journal/periodical titles (including books published 'in series'); unpublished papers, technical reports, trial and survey reports; raw and unanalysed trial or survey data; video and audio recordings; databases; websites; and electronic documents (e.g. PDF versions of NARI Toktoks). The database was first launched in December 2000; there were 32,797 records in the database as of May 31, 2008.

The ultimate ambition is to build a definitive database of all documents on agricultural research and development in Papua New Guinea

As a complement to the library catalogue database, and accessible from the same menu, a prototype database is being trialed that includes information on all researchers and other technical specialists, mostly at NAIS partner institutions. Data included for each person are their name, position title/s, programme/s, base, contact details, qualifications, disciplines, specialist expertise, particular skills, languages spoken, projects worked on, employment history and a photograph. There were 109 records in this database as of December 31, 2007. Outputs available include staff lists (by institution), lists of specialists, individual CVs, and information on the employing institution including contact details, mission statement and office locations. A complementary prototype database provides information on agricultural institutions in Papua New Guinea. Data included for each institution are their name, acronym, contact details, type of institution and information on publication and library services. There were 53 records in this database as of December 31, 2007. Outputs available include staff lists (by institution and department) and lists of specialist institutions.

The ability to prepare publication lists is a feature of the library catalogue database. Alongside this is a database of information on publishers and/or suppliers of agricultural publications in Papua New Guinea. The user is thus able to see what agricultural publications have been published in Papua New Guinea, and find out the cost and where to obtain copies. There are 735 publications from 10 publishers listed, of which 6 are featured on the main menu. Outputs available include publisher lists (by institution), series lists (by series title), and information on the publisher including contact details, distribution points, distribution details (cost of postage, etc.), ISBN publisher codes, and series titles.

The Pacific Index to Agricultural Journals (PIAJ) is included by default. PIAJ is an attempt (begun by the author in the late 1980s) to catalogue and index all articles in agricultural journals published in the Pacific Islands region. What makes PIAJ important is that it is the only bibliographic database that contains everything published in 13 agricultural journals, from 1920 to present.

The database thus represents over 88 years of agricultural research and development in the Pacific Islands. As of June 30, 2005, the database comprised 3,400 records of articles indexed. Outputs available include lists of papers (by author), subject bibliographies, lists of references and journal indices.

Strengths—Or Why the System Works

If prompted for a spontaneous answer, it could be said that the system works because of the people involved. There is little doubt that the NAIS operators are a considerable part of the reason for its success. Despite the odd interruption here or there—staff moving on, budgetary constraints, computer and phone problems—two years after the ACNARS project ceased in 2006, NAIS is still very much alive. The reason such interruptions have not impacted the system as much as might be expected is the system's architecture, i.e. there is no head, although it has a co-ordinator who can be one of many. Management of the system relies on a shared sense of ownership by the operators; i.e., no matter how little or how much a single individual does, their effort serves a common purpose. It is significant that many of the leading operators have been with the same institutions for many years. Indeed, several were participants at the agricultural librarians' workshop in Port Moresby in 1991, where the dream was born, so naturally there is a strong commitment to making the system work.

Another dimension that is not always noted is that every participating institution came to NAIS with networks of their own. If information access and information use are goals, then this is a significant benefit. For example, NARI had established a series of research advisory committees, at the farmer level; DAL has its links to Provincial agriculture departments; and CIC its links to coffee growers. Instead of expecting a single institution or initiative to disseminate agricultural information to one loosely-defined 'group of farmers,' each partner institution can supplement dissemination of its own information resources, to their specific target groups, with information from other institutions.

The best way to demonstrate that NAIS is a 'network of networks' is to consider the benefits of working with the University of Goroka, specifically with its agriculture teachers programme. With 400 agriculture teachers in the country, all trained at Goroka, any resources made available to student teachers necessarily find their way into classrooms throughout the country, and from there, into homes in all the villages. Combined with the University of Goroka-led 'Making a Living Programme', aimed at school leavers and intended to reduce rural-urban drift (and all that follows), there is an added incentive for the participating institutions to ensure that their information resources are available to the University, in a suitable format. The intention is that the University will become a full partner in NAIS, and it already has access to the databases.

Threats—What Might Stop It From Working

The greatest threat to the system as a whole lies in the 'validation process'. All records contributed to the system, whether new or amended, are checked to ensure that data entry complies and indexing standards are met. Database quality control has not been imposed but is the result of years of discussions and practice, and is something supported by all operators as a way to maintain the integrity of the databases and thus the system. As the system expands, the extent of quality control work increases, but does not become more complicated. Currently there are two operators who are capable of and have experience in validating records. A further two operators are capable of being trained in this role. The strategy is to accept that an operator will move on after a period of time. Provided there are staff in each institution (or at least a staff member in more than one institution) capable of being the validator, then the loss of one will have only limited impact. Recent experience has shown that this strategy works, when a validator went on maternity leave and another operator from a different institution was able to step in for her.

Management of the system relies on a shared sense of ownership by the operators

Nevertheless, the availability of staff and the skills and level of education they have pose a variable risk to the system as a whole. At the institutional level, if there is no one to manage the library resource and no one responsible for contributing records and updating the databases, then the institution will not benefit from its participation or investment. At the outset, institutions are required to have at least one staff member available to be trained, and preferably two, with the second acting as a backup. However, experience shows that once vacated, positions often remain unfilled for many months or even years. The reason this is such a concern is that it is often quite difficult to fill library positions in PNG. This has to do in part with the dearth of librarians in places where institutions in the agriculture sector are based, i.e. rural areas. But it also has to do with the poor level of training available for librarians in the country. This situation could be reversed were there to be an alternative approach to training paraprofessional and professional librarians in PNG.

The general level of education of the operators, and in particular, their understanding of the agriculture research and development sector and their role in it, is also a cause for concern. Some of the activities the librarians and operators are required to carry out, such as indexing, require a good general education and a good understanding of agricultural systems. Experience has

shown that it is very hard for a trainee to index an article with — to them — an incomprehensible title, e.g. "Meristem-tip culture and virus indexing of sweet potatoes". With experience, the operator will be able to index such esoteric content, but therein lies the problem: before an operator gains experience, he or she has to have the confidence to muddle through. The solution is to recruit individuals to operate the system who have a good basic education and some experience of or a qualification in agriculture or natural resources management. However, there are so many useful skills that are learned by trained librarians that to limit access to these positions to just agriculturalists, fishers or foresters would not be in the best interests of the system.

There is a risk that partner institutions will not be able to afford the cost of the small annual maintenance subscription. This will not affect their ability to use the software, i.e. it will not simply die. But should an institution not renew its maintenance subscription, it will be out of step with the other institutions. This may not pose immediate problems, but it may in the longer term. For example, recent versions of the software would not run on older versions of the Windows operating system, so all institutions had to continue using an older version of the software to ensure compatibility. This possible risk could be minimised if institutions commit to including the annual maintenance fee in annual budgets.

In all instances, the matrix-like architecture of the network is a strength when faced with the threats identified above; this system can adapt more quickly to sudden changes than a system that relies on a more centralised structure.

The Future

Three years after opening up the information system to other institutions, a national agricultural information system is a reality in PNG. There are strong indications that institutions are participating because they recognise that by co-operating and sharing, they have a greater chance of meeting their own information needs. Further development of the research and development capabilities of institutions in the agriculture sector, and of their staff, can only be fully realised if there is efficient and effective management of information.

Opportunities to increase the number of institutions participating in the system are limited only by the small amounts of funding available for software and training. This is not insurmountable, especially with the proposed development of a national IT network, PNGARNET. It is conceivable that it will be easier and less expensive to add more participating institutions, and provide much better access to the information resources across the country, at many different levels. Discussions have been held to export the system concept to other countries in the Pacific, particularly to our Melanesian neighbour, the Solomon Islands. The system content itself would be highly appropriate because of similarities in agricultural systems and soils; the system architecture could be 'adapted' easily for the local environment; and trainers drawn from among existing NAIS operators could provide just the sort of training that would be most appropriate. A link-up in PNG between NAIS and the Pacific Environment Information System, both using the same software, could bring benefits such as data exchange and technical co-operation and support. Theoretically, this partnership could be extended to the rest of the Pacific region.

NAIS has shown that it is possible to develop a home-grown solution in response to a specific need

Despite the risks to the system identified earlier, there is a strong commitment by the NAIS operators to make it work. The operators have stated that they know that advice and support will not always be available from projects such as ACNARS, but that they would do what they could to ensure the system was maintained. To have arrived at this level of commitment is in itself a big contribution to sustainability. Any future support to the sector, such as a funding for the national agricultural research and extension system, ought to include a significant contribution to maintenance and further development of NAIS. To not do so would negate the progress made to date and reduce the potential for incremental development in the future.

In the near to medium term at least, any solution to further development of the national agricultural research and extension system will have to be cognisant of PNG's limitations. Specifically, the telecommunications system is unreliable and access to the system limited; the power supply is similarly challenged; there is no fast computer network linking all institutions in the higher education and research sector, although this might be about to change;[3] and the training of librarians and other information workers in PNG is not adequate. Dealing with these realities will require commitment combined with innovative thinking on the part of both donors and beneficiaries. NAIS has shown that it is possible to develop a home-grown solution in response to a specific need. All involved, especially the librarians and information assistants, ought to be congratulated heartily on their achievement.

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Notes

1. The use of the term 'agriculture' in this paper should be taken to include forestry and fisheries, i.e. the whole natural resources sector.

2. The reason, at the time, that PNG Coffee Research Institute was able to participate was that they shared a research library with NARI at a station at Aiyura in Eastern Highlands Province. That was all the leverage that was necessary.

3. A new integrated high-speed computer network was initiated among research and tertiary institutions in Papua New Guinea in mid-2008, but the consequences of this for NAIS were not yet understood at the time this paper was written.

Peter Walton is an independent agricultural information management specialist based in Darwin, Australia.

Contact Information

Peter Walton
Information Works
PO Box 886
Sanderson NT 0813
AUSTRALIA
E-mail: peter@walton.com.au

Towards a Harmonization of Metadata Application Profiles for Agricultural Learning Repositories

Nikos Manouselis, Gauri Salokhe, Johannes Keizer, and Stephen Rudgard

Abstract: **Metadata interoperability allows the exchange and preservation of crucial learning and teaching information, as well as its future reuse among a large number of different systems and repositories. This paper introduces work around metadata interoperability that has taken place in the context of the Agricultural Learning Repositories Task Force (AgLR-TF), an international community of the stakeholders that are involved in agricultural learning repositories. It particularly focuses on a review and assessment of metadata application profiles that are currently implemented in agricultural learning repositories. The results of this study should be useful to those who are designing, implementing and operating agricultural learning repositories, thus facilitating metadata interoperability in this application field.**

Resumé: **L'interopérabilité des métadonnées permet l'échange et la préservation de ressources cruciales d'apprentissage et d'information pédagogique, de même que sa réutilisation future entre plusieurs systèmes et dépôts différents. Cet article introduit le travail autour de l'interopérabilité des métadonnées qui s'est fait dans le contexte du Groupe de travail de dépôts de ressources d'apprentissage agricole (AgLR-TF), une communauté internationale de partenaires qui sont impliqués dans les dépôts de ressources d'apprentissage agricole. Il se penche notamment sur une étude et évaluation des profils d'application de métadonnées qui sont actuellement exécutées dans les dépôts de ressources d'apprentissage agricole. Les résultats de cette étude devraient être utiles à ceux qui conçoivent, exécutent et font fonctionner les dépôts de ressources d'apprentissage agricole, facilitant ainsi l'interopérabilité de métadonnées dans ce champ d'application.**

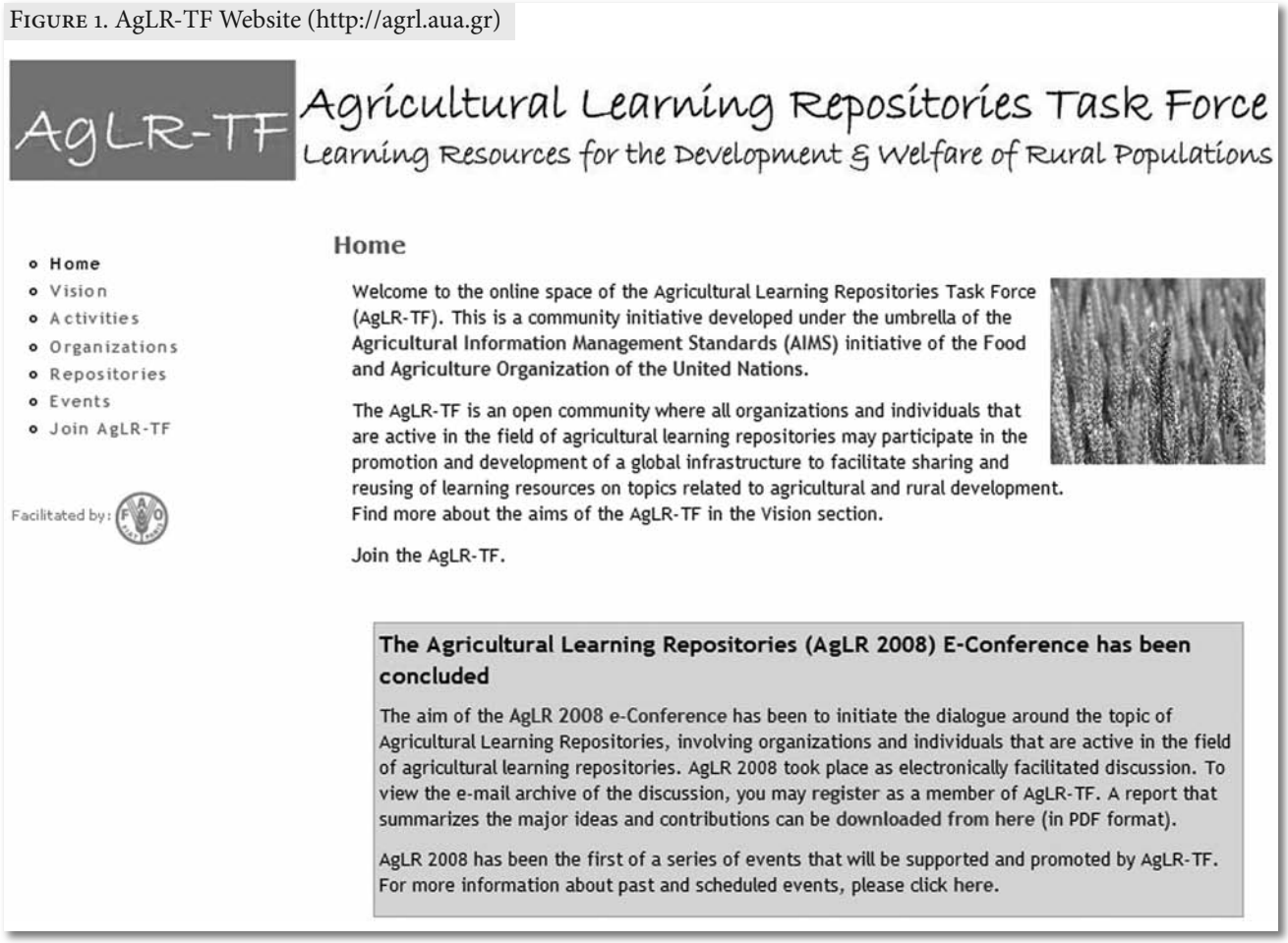
Resumen: **La capacidad de operación que existe entre los metadatos (interoperabilidad) permite lograr dos objetivos: el intercambio y la preservación de información crucial sobre la enseñanza y el aprendizaje, y el uso que se vuelva a hacer de esa información en el futuro por parte de numerosos sistemas y acervos de información. El artículo presenta el trabajo sobre interoperabilidad de los metadatos realizado en el campo de acción de la Fuerza de Tareas de los Depositarios del Aprendizaje Agrícola (AgLR-TF, del inglés), una comunidad internacional constituida por individuos y grupos interesados en el tema de los acervos o depósitos de información agrícola. Este trabajo está enfocado especialmente hacia una revisión y valoración de los modelos de aplicación de los metadatos, los cuales se implementan actualmente en los acervos del aprendizaje agrícola. Los resultados de este estudio serían útiles para quienes diseñan, ejecutan y operan los acervos del aprendizaje agrícola, lo que facilitaría la interoperabilidad de los metadatos en este campo de las aplicaciones.**

Introduction

In the education and training context, metadata interoperability has been judged as an essential issue. It allows the exchange and preservation of crucial learning and teaching information, e.g. competency profiles, learning activities, and descriptions of learning resources, as well as its future reuse among a large number of different systems and repositories. Recent standardization and specification efforts in the area of learning technologies have contributed to this direction. At the level of sharing, exchanging and reusing learning resources among different Learning Management Systems (LMSs) and Learning Repositories (LRs), learning technologies aim to preserve a high level of interoperability by implementing relevant standards and specifications such as the IEEE Learning Object Metadata (IEEE LOM, 2002), Dublin Core (DC, 2004) and its educational element set, and the recently introduced ISO Metadata for Learning Resources (ISO/IEC, 2005). However, in the field of agricultural education and training, learning technology (LT) specifications and standards have not been yet widely adopted. Few initiatives have reported implementing them, and when they have, it was only to describe learning resources using IEEE LOM, DC or a combination of the two (Stuempel et al., 2007). In addition, these efforts have been distributed and dispersed, leaving room for approaches with significant differences among them.

This paper focuses on metadata interoperability for describing agricultural learning resources. It first introduces the Agricultural Learning Repositories Task Force (AgLR-TF), an initiative that has been launched to connect and mobilize international stakeholders involved in agricultural learning repositories. It outlines the vision of AgLR-TF to create a network of organizations that will promote the development of a global infrastructure to facilitate sharing and reusing of learning resources, on topics related to agricultural and rural development worldwide. The paper then focuses on one particular AgLR-TF activity: the review and assessment of the metadata application profiles (APs) that are currently used for describing learning resources in agricultural learning repositories. It describes how this activity has led to the development of guidelines and recommendations for designing and implementing future APs for agricultural learning repositories in such a way that their interoperability is facilitated. It also describes how this activity has led to the development of a meta-mapping framework

Figure 1. AgLR-TF Website (http://agrl.aua.gr)



that will facilitate the interoperability and communication of learning repositories that use different schemas.

AgLR-TF Activities & Results

AgLR-TF is setting up a network of organizations for promoting the development of learning repositories on agricultural and rural development topics, by offering them a global infrastructure that will facilitate the sharing and reuse of learning resources. It aims at joining the forces of leading organizations around the world in order to provide guidance, standards, technologies, tools, recommendations, and best practices for building agricultural learning repositories. AgLR-TF intends to make learning resources on topics essential for the development and welfare of agricultural and rural populations around the world, available online on a global scale. At its launch (in February 2008), AgLR-TF aimed at organizing a variety of activities during 2008:

- Building a community of organizations and individuals working in the field of agricultural learning repositories;
- Creating an inventory of agricultural learning repositories around the world;
- Organizing an e-conference on agricultural learning repositories;
- Producing an initial set of best practice recommendations for implementing interoperable metadata in agricultural learning repositories; and
- Deploying a pilot demonstration of federated learning repositories on a global scale.

Significant progress has been made as far as these activities are concerned, as detailed below.

Community building – The website that was set up to promote the community-building activity and allow individuals and/or organisations to get involved in the AgLR-TF is presented in Figure 1. In addition, a D-Groups mailing list was set up to facilitate communication and information dissemination among the AgLR-TF members (http://www.dgroups.org/groups/fao/Ag-LR-TF/). Over 20 organizations from around the world have expressed their support of AgLR-TF activities (http://aglr.aua.gr/node/11). Furthermore, more than 100 people, from 26 different countries, have registered to the AgLR-TF community.

Inventory of repositories – An online registry for agricultural learning repositories has been developed (http://aglr.aua.gr/node/19) and invitations have been sent to relevant stakeholders to register their repositories. Thus far, ten repositories have registered to the AgLR-TF site.

e-Conference – An Agricultural Learning Repositories E-Conference (AgLR 2008 / http://aglr.aua.gr/node/

24) was organized from April 24 to June 15, 2008. AgLR 2008 aimed to initiate dialogue around these topics, involving individuals and organizations that are active in the field of agricultural learning repositories. It was an electronically facilitated discussion via the D-Groups mailing list that explored the needs and requirements of stakeholders involved in the development and operation of agricultural learning repositories. As a follow up to the AgLR 2008 e-conference, a physical event, the Workshop on Learning Technology Standards for Agriculture and Rural Development (AgroLT 2008 / http://infolab-dev.aua.gr/agrolt/2008/), was held in Athens, Greece in September 2008.

Best practices & recommendations – A survey of metadata schemas was completed in cooperation with the European Committee for Standardization/Information Society Standardization System (CEN/ISSS)'s Workshop on Learning Technologies (WS-LT / http://www.cen.eu/cenorm/businessdomains/businessdomains/isss/activity/wslt.asp). A group of WS-LT experts was formed to review, assess, and validate the results of the survey. As an outcome, a technical report on "Guidelines and recommendations for building metadata application profiles for agricultural learning resources" has been prepared. This report aims to provide an overview of the way metadata application profiles are implemented in agricultural learning repositories around the world. In addition, it also aims to review and validate the approaches followed, so that it provides guidelines and recommendations to existing or new developers of agricultural repositories.

Demo application – In order to develop a demo application that will exhibit how information from one repository can be presented (harvested) in another, a liaison was made with the Organic.Edunet European project (http://www.organic-edunet.eu) and the ARIADNE Foundation (http://www.ariadne-eu.org/). The goal was to set up a pilot demonstration of how repositories can exchange their metadata by applying protocols such as the Open Access Initiative Protocol for Metadata Harvesting (OAI-PMH / http://www.openarchives.org/OAI/openarchivesprotocol.html). To this end, a set of metadata records from the repository of FAO's Capacity Building Portal (http://www.fao.org/capacity-building/) was harvested into a demo Organic.Edunet repository. This demo repository has been made available for harvesting from the ARIADNE federation, so that its metadata records are made available through the federated search interfaces of ARIADNE (http://ariadne.cs.kuleuven.be/silo2006/NewFederatedQuery.do).

Metadata Application Profiles for Agricultural Learning Repositories

As mentioned earlier, the survey of metadata application profiles that took place within the AgLR-TF community has been combined with a parallel expert group validation activity that was formulated in the context of the CEN/ISSS WS-LT. More specifically, WS-LT decided during its February 2008 meeting to set up a formal liaison with AgLR-TF. From the WS-LT perspective, the aim of this liaison was to further promote the adoption and implementation of LT specifications and standards in learning repositories that support the needs of rural and agricultural populations.

Based on the work carried out in the CEN Workshop Agreement 15555 "Guidelines and support for building application profiles in e-learning" (CEN, 2006), it was agreed to set up a joint project team that would review implemented metadata APs for a sample of popular agricultural repositories, including the ones registered to AgLR-TF, in accordance with the 15555 guidelines (CEN, 2006). Then, it would try to elaborate a set of recommendations for achieving better interoperability between them.

Overall, the following APs were identified:

- Rural-eGov IEEE LOM AP (ReGov LOM)
- FAO Agricultural Learning Resources AP (FAO AgLR)
- CGIAR LOM Core AP (CG LOM Core)
- BIOAGRO LOM AP
- Biosci Education Network (BEN) AP
- Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP) AP
- TrAgLor LOM AP
- Intute: Health and Life Sciences AP (Intute AP)
- EcoLearnIT LOM AP

Of these, it was possible to analyze in detail only the first six. For the TrAgLor LOM AP only a preliminary analysis took place, based on existing information, such as a database instance of its implementation. For the Intute AP and the EcoLearnIT LOM AP no analysis was possible (they are listed here for reference reasons) since no formal documentation was at hand.

In the next sections, we present the main two outcomes of our analysis. The first outcome is a list of suggestions/recommendations for the developers of agricultural learning repositories who are implementing some metadata AP. The second outcome is an elaboration of a mapping between the elements of the various APs. More detailed results of this work can be found in Manouselis et al. (2008).

Suggestions for implementers – Based on the analysis of the sample of APs and the directions of relevant literature (e.g. CEN, 2006; Najjar, Ternier, and Duval, 2004), we came up with the following suggestions/recommendations to the designers/developers of metadata APs for AgLRs (Manouselis et al., 2008):

- Always provide supportive documentation describing the AP. Supportive documentation offers and allows an overview for the selection and reference for detailed

analysis within the adoption phase.

- Include in documentation reference to the technical implementation of the AP and provide any relevant technical bindings. References to technical implementations and provided technical bindings facilitate implementation and technical interoperability.
- Include in documentation supportive use cases that help clarify its scope, purpose and users. Use cases support the selection process during the comparison of AP candidates and provide information about implementation potentials.
- Use the latest and more stable version of the base schema available. Different versions of metadata specifications and/or standards often have important differences that do not ensure backwards compatibility. When starting an implementation project, it is suggested that AP designers/implementers chose the latest and more stable version of the base schema that is publicly available. For instance, in one examined case, although the project was initiated after the publication of the IEEE LOM standard in 2002, a previous version of LOM was used.
- When ad hoc or extended value spaces are used for some elements, it is necessary to make the new value spaces available in a public namespace, in order for conformance to be maintained. Public availability is needed to ensure interoperability of future APs by allowing references to these published namespaces.
- Instead of substituting the 'Langstring' datatype with the simpler 'Characterstring', it is suggested that simplicity is sought through appropriate interface design. For instance, when the type is changed from 'Langstring' to 'Characterstring', implementers have to make sure that during a transformation/mapping, the stored values for these elements are transformed into 'Langstring' datatypes in order to avoid information loss.
- The non-allowed modification rules of CWA 15555 (CEN, 2006) should be carefully respected, because breaking them can lead to problems when trying to export/exchange metadata. For instance, an extension to the cardinality of an element can lead to loss of information during a transformation/mapping.
- The elements most often occurring as mandatory in the existing APs should be considered for use also in other APs, to facilitate information exchange and interoperability. It is most probable that the information that is considered important in all other agricultural APs will also be important for a new one as well. To achieve interoperability in metadata exchange, information about a characteristic that is stored in all other APs will have to be stored in a new AP as well.

Elaboration of mappings – The next step was the elaboration of mappings of all studied APs with the two base schemas that they were developed upon, i.e. LOM and DC. An example of the way these mappings were carried out is presented in Figure 2, where the LOM-based APs are mapped against the elements of the LOM standard. In a similar way, the DC-based APs were mapped against the DC element set. From this exercise, it is possible to: (a) identify the main mappings between

Figure 2. A sample of the elements of LOM-based APs mapped to LOM standard's elements

IEEE LOM	ReGov LOM		BIOAGRO LOM		CG LOM Core		BEN		TrAgLOR	
1. General	1 General	M	1 General	M	1. General	M	1. General	M	1. General	
1.1 Identifier	1.1 Identifier	M	Identifier	M	1.1 Identifier	M	1.3 Catalog Entry	O	1.3 Catalog Entry	
1.1.1 Catalog	1.1.1 Catalog	M			1.1.1 Catalog	M	1.3.1 Catalog	O	1.3.1 Catalog	
1.1.2 Entry	1.1.2 Entry	M	Entry	M	1.1.2 Entry	M	1.3.2 Entry	O	1.3.2 Entry	
1.2 Title	1.2 Title	M	Title	M	1.2 Title	M	1.2 Title	M	1.2 Title	
1.3 Language	1.3 Language	M	Language	M	1.3 Language	M	1.4 Language	M	1.4 Language	
1.4 Description	1.4 Description	M	Description	M	1.4 Description	M	1.5 Description	M	1.5 Description	
1.5 Keyword	1.5 Keyword	M	Keyword	M	1.5 Keyword	M	1.6 Keyword	O	1.6 Keyword	
1.6 Coverage	1.6 Coverage	M	Coverage	M	1.6 Coverage	M	1.7 Coverage	O	1.7 Coverage	
1.7 Structure	1.7 Structure	O			1.7 Structure	M	1.8 Structure	O	1.8 Structure	
1.8 Aggregation Level	1.8 Aggregation Level	O	Aggregation Level	M	1.8 Aggregation Level	M	1.9 Aggregation Level	O	1.9 Aggregation Level	
2. Life Cycle	2. Life Cycle	M	2. Life Cycle	M	2. Life Cycle	M	2 Life Cycle	M	2. Life Cycle	
2.1 Version	2.1 Version	O			2.1 Version	O	2.1 Version	O	2.1 Version	
2.2 Status	2.2 Status	O			2.2 Status	O	2.2 Status	M	2.2 Status	
2.3 Contribute	2.3 Contribute	O	Contribute	M	2.3 Contribute	O	2.3 Contribute	M	2.3 Contribute	
2.3.1 Role	2.3.1 Role	M	Role	O	2.3.1 Role	M	2.3.1 Role	M	2.3.1 Role	
2.3.2 Entity	2.3.2 Entity	M	Entity	M	2.3.2 Entity	M	2.3.2 Entity	M	2.3.2 Entity	
2.3.3 Date	2.3.3 Date	M			2.3.3 Date	M	2.3.3 Date	M	2.3.3 Date	
3. Meta-Metadata	3. Meta-Metadata	M	3. Meta-Metadata	O	3. Meta-Metadata	M	3 Meta-metadata	M	3. Meta-Metadata	
3.1 Identifier	3.1 Identifier	M			3.1 Identifier	M	3.2 Catalog Entry		3.2 Catalog Entry	
3.1.1 Catalog	3.1.1 Catalog	M			3.1.1 Catalog	M	3.2.1 Catalog		3.2.1 Catalog	
3.1.2 Entry	3.1.2 Entry	M			3.1.2 Entry	M	3.2.2 Entry		3.2.2 Entry	
3.2 Contribute	3.2 Contribute	M	Contribute	O	3.2 Contribute	M	3.3 Contribute	M	3.3 Contribute	
3.2.1 Role	3.2.1 Role	M	Role	O	3.2.1 Role	M	3.3.1 Role	M	3.3.1 Role	

the elements of the agricultural APs, thus creating a meta-mapping framework that helps us map the elements of each individual AP into another AP; and (b) identify a number of elements that seem to be used more often in agricultural APs, thus creating an element set that all agricultural APs should take into consideration. The elements that seem to be appearing more often as mandatory or recommended in the sample of agricultural APs are the following:

- Most of the APs are using some element to store an *identifier* of the resource. In some cases, this is only a URL; in other cases, a formal catalog system can also been used.
- As far as the rest of the **general characteristics** of the resource are concerned, the following information is usually stored:
  - *Title*;
  - *Language*;
  - *Description*;
  - *Keyword* (free text or restricted);
  - *Coverage* (geographical/spatial or temporal).
- As far as the **life cycle** of the resource is concerned, the following information is usually stored:
  - Role of the *entities that have contributed* to the resource;
  - *Information about* these entities;
  - *Date* of contribution/production/publication.
- As far as the **technical characteristics** of the resource are concerned, the following information is usually stored:
  - *Technical format*;
  - *Technical location* (such as URL), when the Identifier element is not used for this purpose;
  - *Size*;
  - Some *technical requirements* for its viewing/execution.
- As far as the **educational characteristics** of the resource are concerned, the following information is usually stored:
  - *Type of the learning resource*;
  - *Intended end user role*;
  - *Educational context/level*.
- As far as the **copyrights** of the resource are concerned, the following information is usually stored:
  - *Cost*;
  - *Copyrights and restrictions in use*.
- As far as the **formal classification** of the resource is concerned, the following information is usually stored:
  - *Purpose* of classification;
  - The *classification system* used (very often AGROVOC or some other agricultural knowledge organization scheme);
  - *Terms* used from the selected classification system.

Conclusions

This paper introduced AgLR-TF, an international community of the stakeholders that are involved in agricultural learning repositories. It then focused on one particular activity that is taking place in the context of AgLR-TF, a review and assessment of the metadata APs that are currently implemented in agricultural learning repositories. This activity was supported by an expert group that was set up by the European CEN/ISSS WS-LT. In particular, this paper focused on how this cooperation between AgLR-TF and WS-LT resulted in a number of useful suggestions/recommendations for implementers of such APs, as well as the identification of mappings between the elements of the agricultural APs. In this way it was possible to create a meta-mapping framework that may help in mapping the elements of each individual AP into another AP. It also made it possible to identify a number of elements that seem to be used more often in these agricultural APs. The results of this work give support and feedback to the people that are designing, implementing and operating agricultural learning repositories around the world, so that metadata interoperability can be achieved among them.

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Nikos Manouselis is affiliated with the Informatics Laboratory, Agricultural University of Athens and Greek Research & Technology Network, Athens, Greece.

Gauri Salokhe, Johannes Keizer and Stephen Rudgard are all affiliated with the Knowledge Exchange & Capacity Building Division of the Food and Agriculture Organization of the United Nations (FAO-KCE), Rome, Italy.

Contact Information

Gauri Salokhe
Food and Agriculture Organization of the United Nations (FAO)
Viale Delle Terme di Caracalla
00100 Rome
ITALY
E-mail: Gauri.Salokhe@fao.org
Web: http://aglr.aua.gr/

Making Forest Information Accessible at FORIG

Margaret Sraku-Lartey

Abstract: The Forestry Research Institute of Ghana (FORIG) recently embarked on an exercise to redefine its research focus and redirect its research into areas like international timber trade and its implications for world trade, illegal logging, climate change, biodiversity conservation, improving rural livelihoods and many others. This re-prioritization of research calls for the identification of new and relevant sources of information and new information products to support the research process. This paper outlines the use of two new tools at the FORIG research library: 1) a bookmarking account to allow researchers to have instant access to current and up-to-date references in their respective areas of research, and 2) a digital repository to preserve research work and to increase its visibility, impact and use by other scientists around the globe.

Introduction

The 21st century has witnessed dramatic and rapid advances in science and technology that has brought about major changes in practically every area of human endeavor. These advances have facilitated research linkages between and within disciplines in almost all scientific areas (Kayambazinthu, 2007). This is especially true in the field of forestry, where many of the complex researchable problems cut across many disciplines, such as geography, economics, international trade, climate change, biodiversity conservation, agriculture, entomology, engineering and many others that go far beyond the administrative boundaries of individual research organizations. Collaborative efforts are currently underway in many forestry research institutions to avoid duplication of efforts and to share information resources, e.g. the Global Forest Information Service (http://www.gfis.net).

Efforts have recently been initiated at the Forestry Research Institute of Ghana (FORIG) to realign its research focus with current international research trends. As a result, new units and divisions have been formed and other divisions have been merged. In all, three new units and nine new divisions have been established. Research groups have been formed and scientists have been equipped with updated project management skills. Researchers are expected to conduct high quality user-focused research to international standards and to publish in international and local journals. Consequently, they must have access to reliable and high quality information to support the research process.

Web 2.0 and Its Application in Libraries

We are also witnessing advances in the management of information. Many libraries adopted the first generation web, making their services and catalogs accessible online. As the use of the web by libraries grew, newer and more dynamic technologies emerged, leading into the next generation web, or Web 2.0.

Web 2.0 applications are having a significant impact on library activities worldwide. Web 2.0 includes the use of social applications and networks such as Delicious, Flickr, MySpace, Facebook, etc.; tagging, which essentially enables users to create subject headings for the resources they find; instant messaging, blogs, wikis, RSS feeds and many more. With Web 2.0, library collections are changing, becoming more interactive and fully accessible to users. Library services are also changing, focusing more on the facilitation of information transfer and literacy rather than providing controlled access to it (Maness, 2006). Web 2.0 is user-centered and interactive and provides an opportunity for multi-media and innovative experiences for those who use it.

key URL: http://www.csir-forig.org.gh/library.htm

Despite the obvious advantages that Web 2.0 has to offer, many libraries, especially in developing countries, have yet to fully incorporate the applications into normal library procedures. Reasons for this include the fact that these new applications are often being used for social interaction outside of libraries and many libraries find it difficult to envisage how these can be applied to libraries and information management. In addition, many librarians in the developing world have yet to familiarize themselves with the potential of Web 2.0 for libraries.

However, it is clear that sooner rather than later, libraries in developing countries will have to adopt some of these new applications, providing they benefit their users.

Bookmarking with Delicious

The complexity of forestry research makes it impossible for research activity to be confined to only one institution. This means that many different organizations are involved in the forestry research process and are generating relevant information that other organizations and researchers can cite to support their own research. FORIG's new approach to research calls for the use of additional sources of information to support the research process and to ensure that scientists have access to these information sources, many of which can be found on the web.

Of the many social networking applications currently available, the FORIG library (http://www.csir-forig.org.gh/library.htm) settled on social bookmarking as a workable tool and subsequently registered an account at http://delicious.com/foriglib/. Delicious enables users to share web resources with each other. Several web resources that provide information similar and relevant

to the research thrusts of FORIG have been bookmarked and made accessible to all researchers at FORIG. The main purpose for doing this is to create a one-stop shop for all relevant information to ensure that researchers spend less time in their search for information. Tags are used to help make searches easier. Due to the interactive nature of social bookmarks, it is possible for both users and librarians to recommend books, articles and other relevant resources to be made accessible online.

Setting Up a Repository Using DSpace

A second application that we are introducing at FORIG is an open source software for creating digital repositories. In the simplest terms, a digital repository is used to store digital content, which can then be searched and retrieved for later use (Hayes, 2005). Further, a repository supports mechanisms to import, export, identify, store and retrieve digital content, and enables staff and institutions to then manage and preserve it, and therefore derive maximum value from it. Digital repositories may include research outputs and journal articles, theses, e-learning objects and teaching materials or research data. A benefit of institutional repositories is that they enable the free sharing of information, thus encouraging collaboration and the widespread communication of institutional, education and research activity. They have great potential to impact positively on the quality of research and the learning experience. The obvious benefits and advantages of having a digital repository in an institution is what encouraged FORIG to develop its own repository.

FORIG has been in existence for close to 50 years, conducting high quality user-focused research for the benefit of the country. It has accumulated a large volume of datasets, research and technical reports, journal articles and other resources. Many of these resources are not readily available when needed because they are located in the offices of individual scientists. The need to make these resources available to its own researchers and to remain visible in international circles, and the need to preserve FORIG's institutional memory, made the decision to create a digital repository an obvious one. The high cost of proprietary software and the difficulties in maintaining such software was compelling enough for FORIG to decide on using the open source DSpace technology (www.sdspace.org).

Policies covering the institutional repository are still being developed but initial considerations include the communities to be developed, what kind of material to include and who can submit resources to the DSpace community. The policy will be developed with the help of all stakeholders so that a workable system can be put in place. Other issues to be considered are staff training, user education and training, and marketing and promotion. This will be done during the implementation process.

Other Web 2.0 technologies may be tried in the future, but for now the focus is on making the digital repository and the use of bookmarking a success.

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Margaret Sraku-Lartey is Librarian at the Forestry Research Institute of Ghana (FORIG), Kumasi, Ghana.

Contact Information

Margaret Sraku-Lartey
Forestry Research Institute of Ghana (FORIG)
P. O. Box 63, KNUST
Kumasi
GHANA
E-mail: mslartey@csir-forig.org.gh
Web: http://www.csir-forig.org.gh/library.htm

Enabling Electronic Access to the World's Rice Literature

Mila M. Ramos and Carmelita S. Austria

Abstract: This paper introduces the Rice Bibliography made available by the International Rice Research Institute (IRRI) to enable instant access to the world's rice technical literature. The service compiles citations to the world's technical literature on rice, provides a single electronic platform to access rice technical literature, enables instant access to abstracts and full text electronic documents, and delivers full text documents upon request by scientists.

Introduction

Nearly half of the world's population depends on rice for nourishment (Chandler, 1982). This humanitarian concern led to the establishment of the International Rice Research Institute (IRRI / http://www.irri.org) in 1960. It is one of 15 diverse international agricultural centers sponsored by the Consultative Group on International Agricultural Research (CGIAR / http://www.cgiar.org). The CGIAR is "a strategic alliance of members, partners and international agricultural centers that mobilizes science to benefit the poor" (CGIAR). IRRI is a non-profit research and training institution that aims to reduce hunger and poverty, improve the lives of rice farmers and consumers, and promote sustainable agriculture. These activities are conducted in collaboration with national agricultural research institutions.

Just as rice is crucial for the survival of people worldwide, so is the knowledge generated by rice scientists in all parts of the world.

In the past, technical literature on rice was not fully documented, which severely thwarted awareness of research results. The IRRI Library and Documentation Service (LDS / http://ricelib.irri.cgiar.org/) was established to fulfill one of IRRI's main objectives as set forth in its Articles of Incorporation and By-laws, i.e. to create and develop a library that would provide access to the world's rice literature. From its inception, the LDS has sought a means to link rice literature with researchers everywhere.

Currently, IRRI houses the world's largest collection of rice literature, ready to be shared with scientists upon request. The electronic Rice Bibliography (http://ricelib.irri.cgiar.org:81/screens/opacmenu.html) attempts to address the information needs of rice scientists everywhere by enabling instant access to the world's rice technical literature.

Objectives

The main objective of the Rice Bibliography is to link rice knowledge with scientists worldwide. The specific objectives are:

- to compile citations to the world's technical literature on rice, both published and unpublished, and written in any language;
- to develop and maintain a single electronic platform for access to rice technical literature;
- to enable instant access to abstracts and full text electronic documents via hyperlinks created on most bibliographic records, with due respect of copyright; and
- to deliver full text documents upon request by scientists.

Background

Before the advent of library automation, the LDS tried to bridge the gap between rice knowledge and scientists via a printed bibliography, the *International Bibliography of Rice Research*, which covered literature published between 1951 and 1960. This was updated by annual supplements and then by a more frequently published *Rice Literature Update*. With the automation of the LDS in 1996, rice literature was made more accessible to scientists via its website (Ramos, 2004) — see Table 1.

key URL:
http://ricelib.irri.cgiar.org:81/screens/opacmenu.html

Through the years, the literature of rice research has increased tremendously, making it difficult, if not impossible, for rice scientists to be fully aware of recent developments in their field of interest. The rice database attempts to fill this gap, as it can now be used by scientists worldwide, 24 hours a day, from any computer with an Internet connection. The database now holds 269,595 citations (as of May 18, 2009), all backed up by full text documents in print, microform, or electronic formats that are available upon request by researchers worldwide.

Access Points

The Rice Database may be accessed via several portals. The main one is the LDS website; other prominent websites with links to the database are the CGIAR Virtual Library and the Food and Agriculture Organization of the United Nations (FAO) website.

Features and Services

The database covers both published and unpublished rice technical literature originating from any country. Currently, it has nearly 270,000 documents written in more than 80 languages (62% English, 20% Japanese, 7.6% Chinese, and so forth) — see Table 2.

The database sits on a user-friendly platform supported by the Millennium software (http://www.iii.com/products/millennium_ils.shtml). It has both basic and advanced searching features. Export

Table 1 – Evolution of the Rice Database

Title	Year Published	Years Covered	No. of entries	Format	Remarks
International Bibliography of Rice Research					
	1963	1951–60	7,274	Print	Flagship project of the IRRI Library
International Bibliography of Rice Research: Supplements					
	1962–1993	1961–1992	153,258	Print	Ceased publication with the 1992 supplement
Rice Literature Update					
	1990–present	1989–present	102,816	Print	Frequency evolved from 3 times a year to bimonthly to quarterly and finally semiannually
International Bibliography of Rice Research					
	2004	1951–2004	243,652	CD-ROM	Aims to reach out to researchers with no Internet access
Rice Database					
	1996–present	1951–present	269,595	Electronic	Updated daily; accessible worldwide, 24 hours a day via the Internet at http://ricelib.irri.cgiar.org:81/screens/opacmenu.html

and import of data is enabled by the Z39.50 protocol. Search results may be modified or exported according to scientists' needs. The export formats supported are ASCII, ProCite, EndNote, MARC, XML and HTML.

Through the Rice Database, the LDS is able to provide a variety of information services to 90 countries worldwide:

- Current Awareness. Scientists are made aware of what is new in their field; the bibliography is updated daily, with the most recent publications added as soon as they are published.
- Literature Searches. Scientists conducting literature reviews for rice projects will find the database very useful.

Table 2 – The World's Rice Literature by Major Languages

Language	Number of Records	Percentage
English	164,398	62%
Japanese	51,722	20%
Chinese	20,100	7.6%
Korean	5,131	1.9%
Spanish	4,587	1.7%
Portuguese	3,838	1.5%
Russian	3,200	1.2%
French	2,945	1.12%
Thai	1,148	0.44%
Indonesian	1,004	0.38%
Others	5,301	2%
Total	263,374	

- Exchange of Publications. The *Rice Literature Update* is sent to more than 300 libraries worldwide in exchange for their organizations' publications.
- Instant Document Delivery. Requests for full text documents (pdf or photocopies) are filled, free of charge, for scientists working in developing countries.

The online rice database is being used consistently, mostly by scientists from developing countries. This is evidenced by requests received daily from many users. The site is visited by an average of 4,600+ visitors per month and has earned words of appreciation from various clients. The rice database has proven to be a useful tool for researchers because it generates savings in time and effort by serving as a one-stop shop for rice technical knowledge. Full text documents are just a few mouse clicks away.

In recognition of its value to rice research, the Rice Database was selected as the 2009 recipient of the Association of College and Research Libraries (ACRL) Science and Technology Section (STS) Oberly Award for Bibliography in the Agricultural or Natural Sciences.

Conclusion: Moving Towards the World Digital Rice Library

Maintaining the world's largest collection of rice literature and sharing it with researchers requires financial, material, and human resources. There are definitely some challenges that need to be addressed:

- Coping with the ever increasing volume of rice technical literature
- Identifying materials published in countries whose literature output is not covered by prominent indexing and alerting services
- Digitization of literature that are still in print format
- Continually increasing costs of electronic information

sources carrying rice literature, i.e. journal subscriptions and pay-per-view
- Costs of sustaining free document delivery to scientists in developing countries
- Providing access to full text documents without violation of copyright laws
- Staff shortages

The LDS is committed to facing these challenges and to serving the information needs of rice scientists efficiently. The Rice Database and the accompanying services will be sustained for as long as resources are available and Management support is present. Looking to the future, the ultimate goal is to digitize all of the rice literature in the collection, so that the present collection can be transformed into the World Digital Rice Library.

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Mila M. Ramos is Chief Librarian and Carmelita S. Austria is Assistant Chief Librarian at the International Rice Research Institute (IRRI), Los Baños, Philippines.

Contact Information

Mila M. Ramos
Chief Librarian
International Rice Research Institute (IRRI)
Los Baños Headquarters
Los Baños
PHILIPPINES
E-mail: mila.ramos@cgiar.org
Web: http://ricelib.irri.cgiar.org/

Taking the University to the People: The Lesotho Question and Answer Project

Matšeliso Moshoeshoe-Chadzingwa

Abstract: This paper outlines ongoing strategies of the National University of Lesotho (NUL) library to move beyond the campus tradition of managing agricultural information solely for "academics". The service has forged links with farmer associations, an aid agency, women's groups, media houses, government departments, and extension workers to collect, translate, synthesize, analyze, document and disseminate questions and answers for a holistic agricultural information management.

In line with the NUL vision of taking services to the people, the NUL Library takes advantage of the CTA-supported Question and Answer Service (QAS) project to devise a means of opening up its previously costly and closed access facilities to agricultural stakeholders country-wide. The Library taps on affordable ICTs to link academics with practitioners. Imparting skills to farmers, recognizing their experiences and indigenous knowledge, channeling appropriate answers to their queries, and using appropriate ICTs, such as radio, cell phones, and portable electronic databases, is found to be as important to farmers as it is to academics.

Introduction

In June 2007, the Government of Lesotho declared a food crisis in the country for the second time in five years. Analysts affirmed that it was the worst famine in 40 years. Whereas Lesotho used to produce about 30% of its total food requirement, by 2000 it had gradually become reliant on food aid and other humanitarian assistance. Moreover, as part of the southern African sub-region that is now the epicenter of the HIV and AIDS pandemic, Lesotho is losing one of the key drivers or investments for development, namely, its human resource. This is reflected in its fall from a rank of 127 in the 2001 United Nations Human Development Index, to 149 five years later.

Taking the University to the People

Education is at the center of development strategies. The NUL is at the apex of the education sector in Lesotho. The only university in the country, it was founded in 1945 as Pius XII College. Although located in the lowlands of the country, its Institute of Extra Mural Studies (IEMS) uses distance learning to reach other parts of the country that have hitherto been difficult to connect by Internet.

Although "national" in almost all respects, and despite the fact that Raseroka (1999) asserts that a university library in a developing African country is a de facto "national" library, the NUL and its library have for many years focused exclusively on its core business of teaching, learning and research within its campuses. The university library has mainly focused on teachers, students, and researchers.

The 2002 NUL vision — "to be a leading African University responsive to national socio-economic needs; committed to high quality teaching, life-long learning, research and community service…" — was translated into the 2007–2012 Strategic Plan (NUL, 2007). Pursuant to this plan, each academic department or division was expected to chart its own way to reach out to urban and rural dwellers, giving meaning to the purpose of serving the people. For its part, the NUL library aimed to tap affordable appropriate ICTs to open up its collection for the people and for development. Ideally the NUL library strived to interact with faculties, in the normal processes of acquiring, utilizing, analyzing and dispensing synthesized information for the benefit of communities that were otherwise disadvantaged by distance and channels used.

The NUL's vision and its Library's mission corresponded with three opportune phenomena: the Millennium Development Goals (MDGs), which provided a focus on development needs and challenges; the World Summit on the Information Society (WSIS), which ushered in, among other things, the notion of e-Agriculture; and growing partnerships and collaboration between the NUL Library and local and external partners. The latter include CTA (Technical Centre for Agricultural and Rural Development) as well as local United Nations agencies that agreed to support and operate together with and within the NUL Library through a cooperative called the Development Information Centre (DIC).

The Lesotho Question and Answer Service

The NUL Library coordinates national activities for a CTA-supported Southern Africa regional 'question and answer service' project. Through the Lesotho Question and Answer Service (LEQAS / http://library.nul.ls/leqas.html), the library:

- Receives technical assistance that includes agricultural information;
- Devises innovative ways and means of targeting users, mainly farmers;
- Involves other relevant players, such as the regional node in neighbouring South Africa;
- Taps ICTs to facilitate flow of information among local stakeholders; and
- Assesses the impact and determines the way forward.

For the first phase, which started operating in 2007, the project has:

- Established a Management Structure comprising librarians, farmers and their unions, representing all

the regions, the College of Agriculture, Media House, with principal institutions being the Faculty of Agriculture of NUL and the Ministry of Agriculture and Food Security's (MAFS) Agricultural Information Services (AIS), the largest and oldest extension service in the country;
- Opened a dedicated office within the NUL Library to operate the project;
- Provided fittings, furniture and facilities such as a fax and telephone, while a toll-free telephone line is being installed;
- Engaged a full time assistant for the "help-desk", to take statistics and queries from both academic and non-academic clients;
- Paid two selected local radio stations for one time slot per week each;
- Ensured that a radio program entitled "A Farmer, Pose Your Question and Be Answered" was officially launched by the MAFS Cabinet Minister in April 2008;
- Sought professional translators to translate materials from English to the vernacular, so these can be distributed to regional centers and major clients;
- Obtained agricultural databases such as AGORA and The Essential Electronic Agricultural Library (TEEAL) "a library in a box," which is portable and may be taken to the remote but connected areas of Lesotho.

KEY URL: http://library.nul.ls/leqas.html

A major emphasis has been to reach out to farming communities via radio. The national Radio Lesotho covers the whole country and government officials have so far aired programs for farmers that are followed by questions. University lecturers, researchers and farmers and women's groups have also contributed to talk shows followed by questions and discussions on a second private radio station called CR. In both cases, there is a compilation of questions that are responded to on-air or received by post or from walk-in clients of a non-academic nature, and an incentive for lecturers to research and talk about the topics on the radio. The types of questions asked — and answered — are diverse and have included:
- Categories and treatment of soils of Lesotho;
- What crops and vegetables to grow during which seasons of the year in which agro-ecological zones of the Lesotho;
- Drought-resistant crops;
- Diversifying crops from food to cash crops;
- How to grow non-traditional vegetables such as mushroom and olives;
- Growing and prospects of selling sunflower grains;
- Where to get synthesized guides and in the vernacular language; and
- Government regulations when exporting wool, leather and hides as individuals or as a group.

Impact and Lessons Learned

An in depth impact assessment of the project has not yet been carried out, but the following are discernible impacts:
- Lecturers find themselves compelled to use the QAS collection more as they prepare for the radio programs, and when they return with difficult queries;
- There is a level of interaction in the process that allows researchers to announce their research findings and get immediate feedback;
- Farmers are empowered to express their information needs; they are also exposed to situations where they have to seek it by all available means;
- Judging from the exponential increase of the number of questions asked each week at the two stations, the programs are patronized and growing;
- With electronic information, the costs of a virtual library are reduced and resources can be shared;
- Assistance from one development partner enables another to support the next project requirement;
- Students who listen to radio programs are also likely to combine their knowledge of theory with practice; hence the University is more likely to produce graduates who are trained for the world of work;
- Use of the partnering libraries within Lesotho and the sub-region is enhanced through technical queries that are handled by the regionally-operated inter-library lending;
- Translated bulletins, syntheses of radio programs, and inputs from local practitioners become an indispensable portion of the indigenous as well as endogenous knowledge that augment the library's conventional collection;
- The majority of the farmers reached, as learned from the CTA assessment study, often fall in the category of those who have not gone through intensive formal education, i.e. they may not be 'information literate', but are knowledgeable through experience.
- There is still a need to extend the service in a more vigorous manner to the four distance learning centers of NUL, especially those operating in the highlands, which are difficult to access in many respects.

By June 2008, we can observe that the project is sustained by the NUL Library and the external donors. But as soon as the stakeholders observe the benefit of information, and know where and how to source it, they will certainly get to it themselves.

Once Internet connectivity and telecommunication infrastructure is available countrywide, it will be cheaper for all to have mobile phones, and for all the institutions to provide library service at affordable rates.

The Lesotho Horticultural Association has remarked that the QAS is home-driven, involves local expertise, and thus is sustainable! The partnership approach followed is proving to be effective, so the future is bright for the Lesotho Question and Answer Project.

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Matšeliso Moshoeshoe-Chadzingwa is University Librarian at the National University of Lesotho, Roma.

Contact Information

Matšeliso Moshoeshoe-Chadzingwa
University Librarian
National University of Lesotho
P.O. Roma 180 ROMA
LESOTHO
E-mail: m.moshoeshoe-chadzingwa@nul.ls
Web: http://library.nul.ls

Making SciELO Articles Available to the Agricultural Community Using OAI-PMH in AGRIS AP XML Format

Stefka Kaloyanova, Gustavo Fonseca, Fabio Batalha, Solange Santos, Renato Murasaki, Abel Packer, Steve Katz, and Johannes Keizer

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Abstract: This article reports a new way of getting access to SciELO full text journal articles using AGRIS AP XML format to harvest SciELO metadata and to include them in the AGRIS repository. It covers the following main steps of the work carried out:

- **Selecting 43 journals with agricultural thematic from the SciELO website;**
- **Defining the methodology for harvesting;**
- **Harvesting legacy data and then doing incremental harvesting for the new data from the selected SciELO journal articles for inclusion in the AGRIS XML repository;**
- **Inclusion of SciELO articles and open access to them through the AGRIS search portal at http://www.fao.org/agris/search/search.do?query=%2Bcenter%3A%28XS%29; and**
- **Testing and proposals for improvement and future use of this feature.**

We share the methodology used, problems encountered, and the expected benefit. This work proves that semantically rich metadata based on the "AGRIS Application Profile" for agricultural science and research publications from the SciELO repository can be handled by the OAI-PMH protocol. It shows how the selected subset of metadata created with an ISIS application can be harvested through the OAI-PMH protocol, which in turn allows for the creation of additional services by giving greater access and visibility to SciELO data in the new AGRIS AP format as compared to the used Dublin Core (DC) format.

The strategy that we adopted was to adapt BIREME's OAI-PMH plug-in for direct generation of AGRIS AP XML from the SciELO application. The existing BIREME OAI-PMH plug-in interface was upgraded to accept and expose metadata using AGRIS AP in addition to the existing DC schema. This approach was elegant but required more time for realization and implementation by BIREME and FAO staff.

Introduction

SciELO (Scientific Electronic Library Online) is a model for cooperative electronic publishing of scientific journals on the Internet, especially conceived to meet the scientific communication needs of developing countries, particularly Latin America and the Caribbean countries.

The SciELO Methodology includes 3 components:

- Enabling the electronic publication of complete editions of scientific journals, the organization of searchable bibliographical and full text databases, the preservation of electronic archives and the production of statistical indicators of the scientific literature usage and impact;
- Application of the SciELO Methodology in operating websites of collections of electronic journals; and
- Development of partnerships among national and international scientific communication players, aiming at the dissemination, improvement and sustainability of the SciELO Model (Packer and Meneghini, 2007).

FAO (Food and Agriculture Organization of the United Nations) in collaboration with other partners like the CGIAR (Cooperative Group on International Agricultural Research) and GFAR (Global Forum for Agricultural Research) aims to improve global access to agricultural knowledge and information. For this reason, some initiatives have been launched to achieve agreement on data and information exchange standards (http://www.fao.org/aims/). One of the important pillars in this collaboration is the AGRIS Application Profile (AP), a metadata schema designed to facilitate the exchange and harvesting of medium complex, high quality bibliographic data. Compared to the simple DC format usually implemented in OAI harvesting mechanisms, the AGRIS AP offers a richer set of metadata and qualifiers including the used vocabularies. The use of the AGRIS AP in harvesting bibliographic data makes it possible to retrieve and trace much better knowledge from these publications.

key URL: http://www.fao.org/agris/search/search.do?query=%2Bcenter%3A%28XS%29

The AGRIS AP has been widely introduced and accepted within the existing AGRIS network. This made it possible to transfer a highly centralized process of data production into a decentralized but interoperable system. The architecture for the new network has been described (Subirats et al., 2007) and is the basis for various pilot projects with national networks.

FAO and BIREME (Latin American and Caribbean Center on Health Sciences Information) have a long-standing collaboration. Some of the SciELO journals are catalogued and searchable through the library catalogue and access to the articles is given through the FAO Virtual Library. Linking SciELO journals into the global agricultural network and providing a possibility for additional search of the selected journal articles through the AGRIS search engine is important major step, giving new access and more visibility to the content of SciELO journals.

The Process

SciELO is a center of excellence for online journals in the Life Science area. By checking the list of journals on the SciELO website, it was possible to identify 43 journals

with subject content relevant to agriculture at large (see http://www.scielo.br/scielo.php?script=sci_alphabetic&lng=en&nrm=iso).

The work then proceeded as follows:

- **Defining the methodology for harvesting** – Two different approaches were studied for harvesting SciELO online scientific journal articles and their further inclusion as AGRIS AP XML files in AGRIS repository:
  - ***Using the existing SciELO XML formats*** – SciELO metadata are already exposed in simple Dublin Core XML and in a detailed XML format that is used for PubMed.

    A simple example of the script used for ListRecord in order to get DC format metadata for a journal with the ISSN 0001-3765 can be seen at http://www.scielo.br/oai/scielo-oai.php?verb=ListRecords&metadataPrefix=oai_dc&set=0001-3765

    The possibility to use DC XML and apply XSLT transformation for converting it to AGRIS AP XML was evaluated. Mapping from DC to AGRIS AP was done. Some of the problems we encountered were related to the absence of some of the mandatory AGRIS AP elements in the SciELO Simple Dublin Core XML file. Proposals on how to generate missing AGRIS AP elements were considered.

    An example of the PubMed version of SciELO metadata is shown at http://artigos.scielo.br/S0001-371419980003.xml. This format contains more detailed data. It is used by PubMed Central and also includes some Google Scholar specifications. Mapping for conversion from this format to AGRIS AP XML was done. The AGRIS AP standard conversion and implementation in terms of content of the fields was evaluated. Some of our findings were the following:
    - — author names differed from AGRIS rules, e.g. Smith, A. John instead of Smith, A. J.
    - — the publisher, author details, and citation articles at the end of the record were available through the links provided.

    Use of those two formats for AGRIS AP harvesting proved to be a poor solution and the proposal was not approved.
  - ***Direct generating of AGRIS AP XML from the SciELO application*** – The alternative solution was to produce direct AGRIS AP XML from the BIREME Database.

    BIREME decided to use a plug-in different from the OAI AGRIS plug-in developed by FAO (Kaloyanova et al., 2008). Their strategy was to adapt the existing BIREME OAI-PMH plug-in script (PHP program) by adding a possibility to produce AGRIS AP XML format in addition to DC format. This was used initially for harvesting legacy data. Subsequently, an incremental harvesting run by AGRIS harvester will be used to capture the new data from the selected 43 SciELO journals for inclusion in the AGRIS AP XML repository. This approach was more elegant but required more time from BIREME and FAO staff.
- **Adaptation of BIREME's OAI-PMH plug-in to produce data in the AGRIS AP XML format** – The existing BIREME OAI-PMH plug-in interface was upgraded to accept and expose AGRIS AP in addition to the existing DC format.

  AGRIS AP (FAO, 2005) syntax is a more complex, agricultural community specific metadata format, richer than Simple DC, with mandatory and nested elements that respect and explore the more complex structure of the original metadata for further integration in value added services (Salokhe, 2007).

  AGRIS AP structure was studied by BIREME's staff. FAO staff played the role of facilitator, giving feedback, documentation, materials, and examples until the valid AGRIS AP format was produced.

  The need for XSLT transformation before inclusion of AGRIS AP in the AGRIS database was identified. It was created and runs at present on each extracted batch file, translating ISSNs from 9 digits to 12 to fit the specific identifiers of AGRIS (12 characters). This transformation was sent to the SciELO Unit to be integrated into the online OAI-PMH plug-in interface and automatically applied to the output.

  An additional XSLT transformation was required to normalize the OAI-PMH part and produce a valid XML AGRIS AP file, as for example, to include the missing <!DOCTYPE ags:resources SYSTEM "http://purl.org/agmes/agrisap/dtd/"> as well as the namespace definition for the resources.

```
<ags:resources xmlns:ags="http://purl.org/agmes/1.1/"
    xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:agls="http://www.naa.gov.au/recordkeeping/gov_online/agls/1.2"
xmlns:dcterms="http://purl.org/dc/terms/"
xsi:schemaLocation="http://www.purl.org/agmes/agrisap/schema/
http://www.purl.org/agmes/agrisap/schema/agris_ap.xsd">
```

  This XSLT was used during manual harvesting at the described stage. It will be used until the AGRIS harvester includes and runs this procedure automatically.

  The received AGRIS AP XML files were checked and validated using XMLSpy editor.
- **Testing and implementation of harvesting at FAO** – Harvesting great volumes of (legacy) data over the Internet is not an easy process (see Figure 1). The initial process included harvesting legacy data (all selected articles) in AGRIS AP XML files and loading them into AGRIS using the same process as was used for PubMed. A batch load was produced for each journal. For some big files, we divided the output into more than one file. After the initial loading of legacy data was complete, incremental harvesting using OAI-PMH

was tested at FAO. This was done automatically using OAI-PMH verb ListRecords. AGRIS AP format was introduced as a parameter in the verbs of OAI-PMH. We applied a script for ListRecords for harvesting SciELO journal articles using different sets (setSpec) identified by the ISSN of the journal in AGRIS AP XML format (see Figure 2).

Here are samples of the 6 verbs used for OAI-PMH:

- ***Identify***
  http://www.scielo.br/oai/scielo-oai.php?verb=Identify
- ***ListMetadataFormats***
  http://www.scielo.br/oai/scielo-oai.php?verb=ListMetadataFormats
- ***ListSets***
  http://www.scielo.br/oai/scielo-oai.php?verb=ListSets
- ***ListIdentifiers***
  http://www.scielo.br/oai/scielo-oai.php?verb=ListIdentifiers&metadataPrefix=oai_dc_agris&from=1997-01-01&until=1999-01-01&set=0001-3714

  http://www.scielo.br/oai/scielo-oai.php?verb=ListRecords&metadataPrefix=oai_dc_agris&from=1998-01-01&until=1999-01-01&set=0001-3714

The limit for a batch harvest was set at 100 records and then Resumption Token was used for the rest of the result. In order to run in batch mode, a script including the Resumption Token (a parameter &resumptionToken) was used when the result was divided into more than one batch. For example, http://www.scielo.br/oai/scielo-oai.php?verb=ListRecords&metadataPrefix=oai_dc_agris&from=1999-01-01&until=1999-12-31&set=0001-3714&resumptionToken=HR__S0001-37141999000400013:0001-3714:1999-01-01:1999-12-01

- ***ListRecords***
  http://www.scielo.br/oai/scielo-oai.php?verb=ListRecords&metadataPrefix=oai_dc_agris&from=1997-01-01&until=1999-01-01&set=0001-3714
- ***GetRecord***
  http://www.scielo.br/oai/scielo-oai.php?verb=GetRecord&metadataPrefix=oai_dc_agris&identifier=oai:scielo:S0001-37141998000300001

Figure 1 – Process for Adding SciELO Metadata to the AGRIS Repository

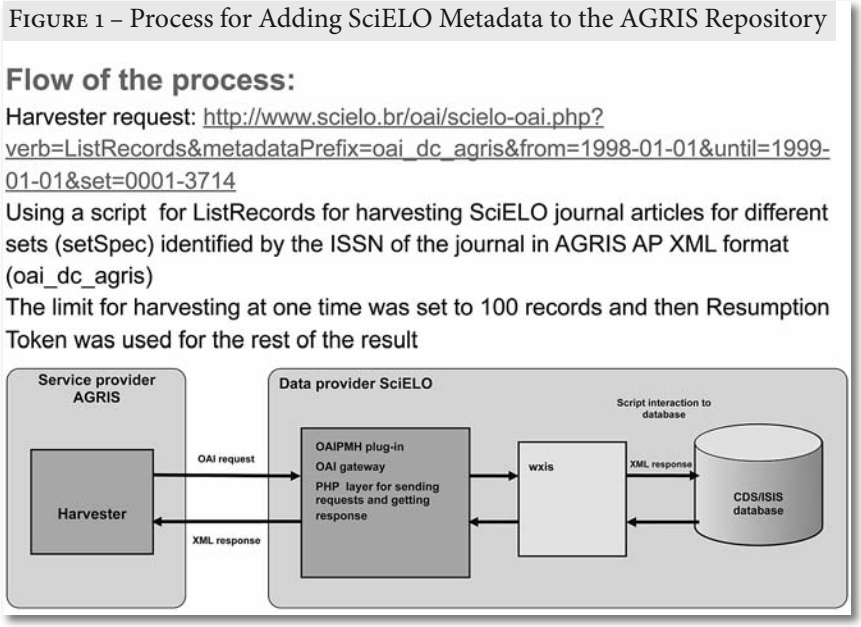

Figure 2 – OAI-PMH Plug-In at SciELO

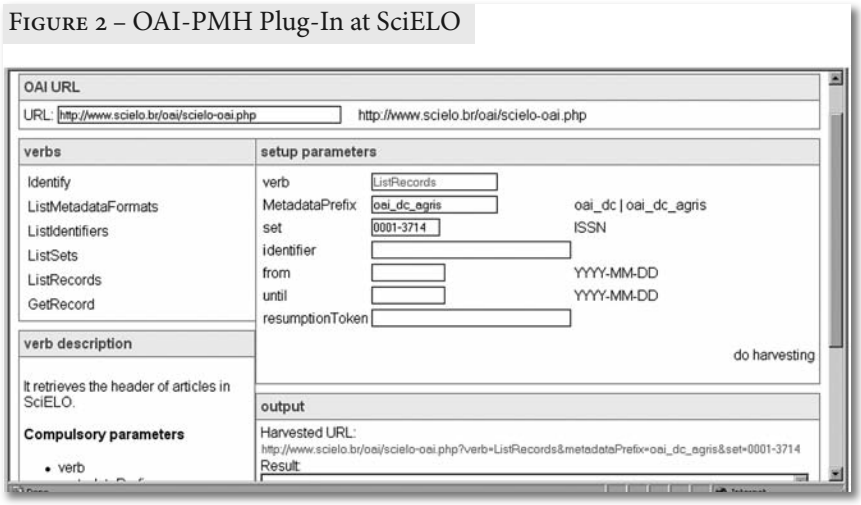

Figure 3 shows the result from harvesting in AGRIS AP XML. Future harvesting will be done automatically. We are now testing the inclusion of AGRIS AP as a possible parameter in the existing harvesters (PKP2 and OCLC Harvester2).

Results and Future Prospects

- **Overall results and implementation** – SciELO data were harvested in AGRIS AP format for the first time. We have harvested metadata from 30 journals so far. The files are valid and three of them were registered and included in the AGRIS database for search.

  We have already included more than 17,000 SciELO journal articles in AGRIS. Table 1 shows some of the journals that have been harvested. The articles from the selected SciELO journals can be viewed by using the AGRIS search engine at http://www.fao.org/agris/search/search.do?query=%2Bcenter%3A%28XS%29

We will run XSLT transformation in batch mode locally after the harvesting is done until BIREME introduces it in the online OAI plug-in. Some adjustments to the OAI-PMH format are still required. The inclusion of SciELO as a data provider in the AGRIS Harvester at FAO is underway.

- **Encountered Problems** – Some of the problems met during the transformation to the AGRIS AP XML included:
  - some records from SciELO have no subject element. This is a problem because subject is a mandatory element for AGRIS AP. A solution could be the automatic assignment of a subject when none is present, e.g. using keywords from the journal or article title;
  - AGROVOC is not used in SciELO and the AGRIS semantic tools cannot be applied to SciELO data if based on AGROVOC;
  - some forbidden characters were found in the text of the AGRIS AP metadata (HTML tags), which had to be cleaned or enclosed in CDATA in order to produce a valid file;
  - language identification is missing (for example, xml:lang attribute) from the citationTitle, the title of the journal or the subject; for example:

    <dc:subject>amplification</dc:subject>

    should be:

    <dc:subject xml:lang=”en”>amplification
    </dc:subject>
    <dc:subject” xml:lang=”pt”>identificação
    </dc:subject>
  - DOIs of related articles were not included in the list of references in the SciELO XML representation:

    <dc:relation>
    <dcterms:references scheme=”ags:DOI”>
    10.1590/S0001-371419990002000…
    </dcterms:references>
    </dc:relation>

    Those links can be seen in the full text presentation of the records;

Figure 3 – Structure of the Result Harvested through OAI-PMH

```
<?xml version="1.0" encoding="UTF-8" ?>
- <OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/ http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
  <responseDate>2008-06-23T08:22:32Z</responseDate>
  <request verb="ListRecords" metadataPrefix="oai_dc_agris" from="1997-01-01" until="1999-01-
01" set="0001-3714">http://www.scielo.br/oai/scielo-oai.php</request>
- <ListRecords>
- <record>
- <header>
  <identifier>oai:agris.scielo:BE1998000301</identifier>
  <datestamp>1998-09-01</datestamp>
  <setSpec>0001-3714</setSpec>
  </header>
- <metadata>
- <ags:resources xmlns:ags="http://purl.org/agmes/1.1/"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:agls="http://www.naa.gov.au/recordkeeping/gov_online/agls/1.2"
xmlns:dcterms="http://purl.org/dc/terms/">
- <ags:resource ags:ARN="BE1998000301">
- <dc:title xml:lang="en">
- <![CDATA[
MICROBIAL COUNTS OF DARK RED LATOSOL SAMPLES STORED AT DIFFERENT
TEMPERATURES
  ]]>
  </dc:title>
- <dc:creator>
  <ags:creatorPersonal>Vieira, Francisco Cleber Sousa</ags:creatorPersonal>
  <ags:creatorPersonal>Nahas, Ely(Universidade Estadual Paulista)</ags:creatorPersonal>
  </dc:creator>
- <dc:publisher>
  <ags:publisherName>Sociedade Brasileira de Microbiologia</ags:publisherName>
  </dc:publisher>
- <dc:date>
  <dcterms:dateIssued>1998</dcterms:dateIssued>
  </dc:date>
  <dc:subject>bacteria</dc:subject>
  ...
  <ags:availabilityLocation>SCIELO</ags:availabilityLocation>
  <ags:availabilityNumber>10.1590/S0001-37141998000300001</ags:availabilityNumber>
  </agls:availability>
- <ags:citation>
  <ags:citationTitle>Revista de Microbiologia</ags:citationTitle>
  <ags:citationIdentifier scheme="ags:ISSN">0001-3714</ags:citationIdentifier>
  <ags:citationNumber>vol.29 num.3</ags:citationNumber>
  <ags:citationChronology>1998/09</ags:citationChronology>
  </ags:citation>
  </ags:resource>
  </ags:resources>
  </metadata>
  </record>
```

  - AGRIS and SciELO use different standards for data description, e.g. author name is Sircili, M. in AGRIS, and Sircili, Marcelo Palma in SciELO.

- **Conclusion** – The new format of representation in AGRIS AP of SciELO metadata enriches the AGRIS collection and gives more access and visibility to SciELO journals and their full text articles.

  This work shows how the resources from distributed sources can be integrated using common rules and standards (AGRIS AP and OAI-PMH). OAI-PMH can process different formats of the resources, defining and following the common (minimum) requirements (after the mapping of the local structure to the AGRIS AP elements).

  The selection of a subset of SciELO articles using general criteria, i.e. journals with agricultural content, and its integration into the AGRIS portal, i.e. searchable within the common repository and portal,

Table 1 – Selected Journals Harvested from SciELO

Journal name	ISSN	Number of records
Brazilian Journal of Microbiology	1517-8382	700
Anais da Academia Brasileira de Ciências	0001-3765	995
Anais da Sociedade Entomológica do Brasil	0301-8059	371
Arquivo Brasileiro de Medicina Veterinária e Zootecnia	0102-0935	1291
Revista de Microbiologia	0001-3714	98

enables users to do a common search in AGRIS and find SciELO records in addition to those from AGRIS.

Once SciELO articles are included in the AGRIS repository, it will be possible to carry out more precise searches by subject, author, etc., as well as to implement semantic tools created for the AGRIS portal.

Identifying the source of the indexing terms (thesaurus) for SciELO records will give additional possibilities for search query expansion by browsing a vocabulary during the search application.

BIREME's OAI-PMH plug-in can be used (online) by any agricultural centre that collects input in AGRIS AP in order to import SciELO records and include them in local databases and local search engines, without the need to catalogue them again. The experiment with SciELO Brazil can be further expanded by harvesting other SciELO data providers such as Cuba, Mexico, Chile and Spain.

Our experience with this new way of improving the visibility of and accessibility to SciELO data through AGRIS service providers shows that this important first step towards open access publishing and exchange of common technologies (in this case, between FAO and BIREME) can be used for all other areas of work that are as closely related as agriculture and health.

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Subirats, Imma, Irene Onyancha, Gauri Salokhe, and Johannes Keizer. 2007. "Towards an architecture for open archive networks in Agricultural Science and Technology." ftp://ftp.fao.org/docrep/fao/009/ah766e/ah766e00.pdf

Stefka Kaloyanova, Steve Katz, and Johannes Keizer are affiliated with the Food and Agriculture Organization of the United Nations (FAO).

Gustavo Fonseca, Fabio Batalha, Solange Santos, Renato Murasaki, and Abel Packer are affiliated with the Latin American and Caribbean Center on Health Sciences Information/Biblioteca Regional de Medicina (BIREME).

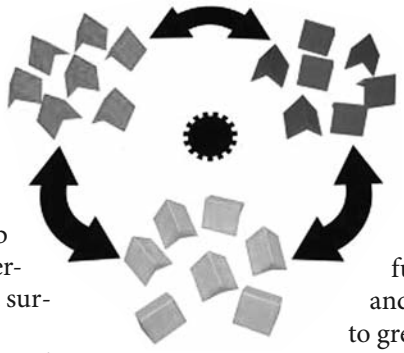
Contact Information

Stefka Kaloyanova
Information Systems Analyst
Food and Agriculture Organization of the United Nations (FAO)
Viale Delle Terme di Caracalla
00100 Rome
ITALY
E-mail: Stefka.Kaloyanova@fao.org
Web : http://www.fao.org

News from IAALD

Musings from the IAALD President…

How Accessible is Your Agricultural Information?



The Internet, with mobile phones, is revolutionizing the ways we communicate, and how we can share, access and exchange information. Each workshop and conference, each Google alert and newsfeed, each social networking web service reveals more and more of the diversity and richness of the information that surrounds us.

We can access more agricultural information than ever before … or can we? Despite the best efforts of the open access movement, digging deeper for specific research information, for example, reveals many reports and articles to be much less accessible than we would hope, data that are tricky to identify and obtain, and much knowledge embedded in people and networks.

Access to agricultural information is limited in various ways, including:

- articles published in commercial journals are frequently not available, unless a fee or subscription is paid;
- researchers often choose to disseminate their results in limited-access high impact journals, because they are assessed on these, rather than in other forms — like radio, video, extension, blogs, etc. — where the message might be more accessible to more people;
- research projects often give insufficient attention to communication and dissemination, or focus only on the 'final' outputs, so much of the total learning is never captured or passed on;
- many organizations do not have complete repositories of the outputs of their staff and they select what they put in their online libraries or websites;
- outputs are frequently saved in and published online in proprietary 'closed' formats that not everyone can open and read;
- licenses for research outputs often discourage re-use of the content and use cumbersome permission procedures;
- full text on websites is often, inadvertently, hidden from search engines; and
- many information systems do not use common standards so metadata cannot be easily shared, harvested and exchanged; it cannot travel.

There is a surprisingly widespread lack of awareness of these and many other limitations that keep agricultural research information inaccessible. Research managers and many information specialists think their outputs are accessible, until they look a bit deeper at their own organizations and programmes. There is also much confusion and a surprising lack of sharing and solid collaboration on the 'pathways' to greater accessibility — for there are many, and many that really work. Perhaps researchers and information services that 'compete' for impact and visibility are reluctant to share strategies as well as the tips and tricks that will make agricultural information truly accessible?

These issues were recently discussed as part of the wider CGIAR annual meetings. A movement to address accessibility issues across the CGIAR centers is gaining momentum. We look forward to concrete progress in 2009.

Other organizations like FAO and GFAR are also getting together through the CIARD initiative (http://www.ciard.net/) that seeks to be a catalyst for exchange and action; several experiences and pathways have been shared on the *AgInfo News* blog (http://iaald.blogspot.com/). A recent workshop on research communication in Africa touched on these issues, and was reported by both IAALD (http://iaald.blogspot.com/search/label/commpact) and Euforic (http://euforic.blogspot.com/search/label/commpact). The UK Government through DFID has been pushing communication as an essential part of research for development — read more on the R4D blog (http://r4dconsult.wordpress.com/).

How accessible is your agricultural information?

The CGIAR discussions built on a 'Triple A' approach that focuses on the *availability*, *accessibility* and *applicability* of research outputs (http://ictkm.wordpress.com/2008/12/13/opening-access-to-agricultural-research-as-discussed-in-maputo/). Something similar is being developed through CIARD and its manifesto for change.

It is up to each of us and our organizations to examine how truly available, accessible and applicable

If you enjoyed this piece,

check out the *AgInfo News* blog at

http://iaald.blogspot.com/

It's a great way to keep current on happenings within the AgInfo community.

our own information, data and knowledge really are … and to work with others to ensure that agricultural knowledge does not remain on the shelf, in our heads, or stuck on an intranet! Information needs to be open, to be helped to travel, to be put to use.

adapted from an* AgInfo News *blog posting dated January 2, 2009

New IAALD UK Chapter in Formation

Plans are in progress to set up a UK chapter of IAALD, with a launch meeting tentatively planned for January 2010. The group, provisionally known as FIBS (Frontiers in Bio-and environmental Sciences) will provide support for a wide range of information professionals working across the bio-and environmental sciences in the education, research, publishing, corporate and government sectors, who currently lack such a focus group following the demise of the Aslib Biosciences Group. The new group will work closely with ALLCU (Association of Libraries in Land-based Colleges and Universities). A survey of the potential 'constituency' will be conducted this summer to ascertain the most beneficial activities; at this stage, we envisage a regular schedule of meetings in various parts of the UK coupled with web-based activities to ensure continuity. The initial planning group is drawn from Oxford University, CABI, Intute, ALLCU and IAALD, but expressions of interest have been received from a number of other organisations and all are welcome! Contact Roger Mills at roger.mills@ouls.ox.ac.uk for further details - and watch for announcements of the IAALD UK 'launch event'!

submitted by Roger Mills

Agricultural Knowledge Exchange in Russian Language Conference

An international conference with the theme "Agricultural Knowledge Exchange in Russian Language" will be held October 1–2, 2009, in Moscow, Russia. Partnering in the event with IAALD are the Ministry of Agriculture of the Russian Federation, the Food and Agriculture Organization of the United Nations (FAO), the Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, and the Central Scientific Agricultural Library of the Russian Academy of Agricultural Sciences.

The purpose of the conference is to provide an international forum for the presentation of the work of Russian-speaking experts and their partners in agricultural education, science and practice, and to discuss developments in agricultural information and knowledge exchange. It will offer a platform for discussion, analysis and review of current status and future actions in these fields. The objective is to achieve a better understanding of global and national constraints, particularly in countries marginalised from the mainstream West European communities. The conference also aims to encourage and enhance the development of international co-operation in the important field of knowledge dissemination. It will introduce the new international initiative on Coherence in Information for Agricultural Research for Development (CIARD), and promote action to strengthen collaboration among agricultural institutions in Russian-speaking countries towards making research information more publicly accessible.

For more information, go to:
http://www.timacad.ru/en/events/fao_en.php

Themes for the 2010 IAALD World Congress Announced

The overarching theme of the 2010 IAALD World Congress, to be held April 26–29, 2010, in Montpellier, France, is "Scientific and Technical Information and Rural Development: Highlights of Innovative Practices." Its objective is to take stock of various initiatives and communities of practice in the agricultural information sector. The Agenda of the Congress will be articulated through a set of various sub-themes across comprehensive information contents, different end users and/or producers of information as well as various levels of information, considering its relevance at the local or global level.

- Sub-theme 1: *Innovative learning processes:* This subtheme would include papers illustrating innovative learning processes of various stakeholders, including farmers. Various experiences such those of the so-called "farmer universities" of Brazil and village level e-learning in the agricultural sector in India can be presented. Some papers may also illustrate the role played by technical Centres such as those working on specific commodities.
- Sub-theme 2: *Information services, the need for a continued redefinition:* This sub-theme is designed to present well-structured comprehensive information services that are tailored to fit the needs of the end users and are affected by on-going changes in information technology. These would include, among others, SDI, Q&A services, Open Access mechanisms, Web 2 services and RSS services and rural radios.
- Sub-theme 3: *New trends in communication and information exchange involving a wide range of stakeholders:* This sub-theme would cover all issues related to information exchange as well as communication processes amongst all the stakeholders involved in agricultural research for development. Experiences from various networks (e.g., by commodity, theme, activity, etc.) may be featured under this session. Special emphasis on information needs and communication approaches of Farmer Organisations may be covered as well. Likewise, issues related to innovation as a multi-stakeholder mechanism and how innovation is co-produced by a wide range of actors could be an interesting focus of this Session.

- Sub-theme 4: *Combining different types of information:* This theme is dedicated to "high value information systems". It will cover papers highlighting or illustrating integrated and relational information systems (e.g. Who is doing what, and what are the results or lessons learned?), knowledge-based systems, systems facilitating decision making processes, and systems enabling the diagnosis of species (such as weeds, etc.). Presentations showcasing different prospective analysis and models can be considered under this session.
- Sub-theme 5: *The role of information systems in enabling public policy:* This theme would be dedicated to information systems facilitating and enabling the definition of public policy including information mechanisms delivering a specific thematic expertise, but also other initiatives taken in the area of biodiversity at the grassroots level, e.g. those related to information systems pertaining to ecosystems services. Papers illustrating the role played by scientific and technical information specialists, and the way this information is available for a wide range of citizens may be presented, particularly those that touch on innovative ways to open a public debate on key global issues.

Each sub-theme session will be opened by a keynote speaker, followed by several oral presentations and a comprehensive poster session, and will conclude with a discussion forum. Everyone is invited to submit one or more abstract(s) for oral or poster presentations, on a topic related to the congress themes. The deadline for abstract submissions is October 15, 2009. For more information, including the first Call for Papers, go to:

http://iaald2010.agropolis.fr/

XV RIBDA: Innovation in Open Access to Agricultural Information

XV RIBDA will be held October 27–29, 2009, in Lima, Peru, with the theme "Technological Innovation in Open Access for Agricultural and Environmental Information." RIBDA is the Triennial Conference of the Inter-American Association of Librarians, Documentalists and Specialists on Agricultural Information (AIBDA). The goals of XV RIBDA are:

- To debate current technological innovations in the area of Open Access OA) including their implications for improved transmission of knowledge, exchange of experiences, and agricultural and natural resources usage and planning.
- To present to the American community the advances of the OA movement for the free transference and diffusion of knowledge in agricultural and related areas.
- To propose actions, applicable to the conditions and realities of the countries of AIBDA members, that will benefit professional practices and Latin American society.

The conference is open to researchers, academics, information brokers and specialists in agricultural and environmental information. It will be of interest to computer scientists, librarians, documentalists, archivists, economists, agricultural engineers, environmental planners, professional associations of information and college students, among others.

For more information (in Spanish), go to:
http://www.aibda.com/eventos/index.php/ribda/2009

AgInfo News ***blog posting dated February 8, 2009***

IAALD Participates in the Knowledge Share Fair

From January 20 to 22, 2009, FAO Headquarters was the stage for an innovative event called the Knowledge Share Fair for Agricultural Development and Food Security. This initiative was jointly organized by Bioversity International, Consultative Group on International Agricultural Research (CGIAR) ICT-KM program, Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), and World Food Programme (IFAD). The event was organized to showcase examples of good knowledge sharing practices in the field of agricultural development and food security. Specifically, it was structured to allow attendees to learn from each other how knowledge sharing practices, methods and tools have enhanced their work and made their project(s) more successful and effective.

During the Fair, 700 registered participants roamed the building, taking part in the numerous activities on offer. The participants came from organizing agencies, as well as from partner agencies such as Department for International Development (DFID), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), European Commission (EC), European Space Agency (ESA), Global Forum on Agricultural Research (GFAR), Institute of Development Studies UK (IDS), Institute of Natural Fibres, International Association of Agricultural Information Specialists (IAALD), International Development Law Organization (IDLO), Swiss Agency for Development and Cooperation (SDC), Technical Centre for Rural and Agricultural (CTA), World Bank and World Health Organization, to name a few.

With such broad representation, it comes as no surprise that many IAALD members were involved in the event — from organizing to presenting and everything in between. The event was called a "fair" — as opposed to a conference or workshop — to indicate that it was

Fishbowl demonstration at the Knowledge Share Fair

something new and different — and fun! Highlights included:

- Over 50 people took the "90 second challenge," explaining the value-added of knowledge sharing in short digital videos (see http://sharefair.blip.tv/posts/?topic_name=ks90).
- The Tree of Knowledge morphed from bare-branched to majestic full leaf as participants added handwritten leaves representing their ideas and thoughts on knowledge sharing (see http://sharefair2009.blogspot.com/2009/02/tree-at-share-fair.html).
- A team of social reporters documented the event in a variety of tools, such as the Share Fair Blog and Twitter. Through these means, thousands of people were following the Fair at a distance, in real time. Over 1,000 photos were put on a photo sharing website called Flickr (http://www.sharefair.net/photo-gallery/en/). The event was also cited in the media.

IAALD President Peter Ballantyne organized a session entitled "The Agricultural Library of the Future," which started from the premise that libraries and library-like services have powered agricultural information and knowledge sharing for decades. In a 'googling' world, however, where information and knowledge sharing are often seen as a 'Do-It-Yourself' skillset, are they still relevant and what can they do for us? Johannes Keizer (FAO), Margaret Zito (FAO Library), Hugo Besemer (Wageningen UR), and Andreas Psoroulas (WFP) opened the session with their thoughts, followed by a group discussion (see http://iaald.blogspot.com/2009/02/agricultural-library-of-future-points.html).

Peter also presented a summary of the Share Fair during the Closing Ceremony, including a 'snapshot' of the visible outputs: 40+ video blips (1300+ views); 150+ tweets (from lots of 'twits'); 130+ Delicious bookmarks; 50+ blogposts (30+ from ictkm); 250+ photos from 15 photographers; and 22 training sessions (400+ trainees) (see http://www.slideshare.net/sharefair09/share-fair-closing-ceremony-by-peter-ballantyne-presentation). Obviously, much has been 'written' about the Share Fair — too much to be summarized here, but well worth exploring. Many of the sessions were covered in the *AgInfo News* blog (http://iaald.blogspot.com/), but for the most comprehensive coverage and continuing updates (as planning gets underway for Share Fair 2010), visit the Share Fair blog at:

http://www.sharefair.net/

adapted from a* Share Fair *blog posting dated May 28, 2009

Mary Ochs Appointed New Director of Cornell's Mann Library

IAALD member Mary Ochs, who is well-known throughout the international agricultural information community for her pioneering work in international agriculture, was appointed the new director of Cornell University Library's Albert R. Mann Library in April 2009. Ochs had served as interim director since October 2008, when she replaced newly appointed Associate University Librarian Janet McCue.

Mary Ochs

"Mary's strong ties to the teaching and research mission of Cornell and involvement with some of the most innovative initiatives on the information frontier make her uniquely qualified for meeting the tough challenges currently confronting higher education in New York State," said Anne R. Kenney, Carl A. Kroch University Librarian.

During her long career at Cornell University Library, Ochs has left her mark on collection development, instruction, reference, interlibrary loan and international initiatives. She has an extensive track record in grant writing and project management, including awards received from the Gates Foundation, the Rockefeller Foundation, the National Endowment for the Humanities and the Institute of Museum and Library Services.

We wish Mary all the best in this exciting new endeavor!

adapted from a Cornell University Library News Release dated April 15, 2009

The Participatory Web — New Potentials for ICT in Rural Areas

IAALD President Peter Ballantyne contributed a piece to a recently published GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) report, *The Participatory Web — New Potentials of ICT in Rural Area,* on the potential of Web 2.0 applications as platforms for networking and knowledge exchange in agriculture and rural development. His contribution, entitled "Innovation, Interaction, Information: Using the Social Web in Agricultural Development," concludes:

> Where information and knowledge in agriculture once comprised rather linear processes managed by specialists, tomorrow's harvests will spring from more organic approaches where innovators of all types become active creators and managers of information and knowledge. This is already happening as researchers and farmers become bloggers, extension workers build wikis, and librarians become film makers. Underlying it all, the new 'social' Web 2.0 acts as a catalyst for people to interact, for knowledge sharing and communication to flourish and for innovators to connect and act together.

To read the full report, go to:
http://www.gtz.de/de/dokumente/en-ict-web.pdf

AgInfo News ***blog posting dated January 12, 2009***

Upcoming Events

2009

- **IFLA Agricultural Libraries Discussion Group:** ***Worldwide Trends in Open Access to Agricultural Information*** **(session at the World Library and Information Congress / 75th IFLA Council and General Conference)**, Milan, Italy, August 23–27, 2009. For more information: http://www.ifla.org/annual-conference/ifla75/call-agricultural-en.htm
- **4th International Information Technology Forum:** ***Information and Communication Technologies — ICTs — for sustainable development***, Hanoi, Vietnam, August 26–28, 2009. For more information: http://www.witfor.org
- **6th International Conference of Animal Health Information Specialists (joint conference with ICML 2009 / 10th International Congress on Medical Librarianship)**, Brisbane, Australia, August 31–September 4, 2009. For more information: http://www.icml2009.com/reg/fees.html
- **Agricultural Knowledge Exchange in Russian Language**, Moscow, Russia, October 1–2, 2009 (see article in *News from IAALD* in this issue). For more information: http://www.timacad.ru/en/events/fao_en.php
- **State of Forestry Information Worldwide:** ***The evolving role of forestry information specialists in today's rapidly changing world: Are libraries still relevant?*** **(session at the XIII World Forestry Congress)**, Buenos Aires, Argentina, October 18–25, 2009. For more information: http://www.fao.org/forestry/53818/en/
- **XV RIBDA / Reunion Interamericana de Bibliotecarios y Documentalistas Agricolas (Inter-American Conference of Librarians, Documentalists, and Specialists on Agricultural Information):** ***Innovación en el Acceso Abierto a la Información Agrícola y de Medio Ambiente (Technological Innovation in Open Access for Agricultural and Environmental Information)***, Lima, Peru, October 27–29, 2009 (see article in *News from IAALD* in this issue). For more information: http://www.aibda.com/eventos/index.php/ribda/2009
- **Eleventh International Conference on Grey Literature:** ***The Grey Mosaic: Piecing It All Together***, Washington, D.C., USA, December 14–15, 2009. For more information: http://www.textrelease.com/gl11callforpapers.html http://www.aibda.com/eventos/index.php/ribda/2009A

2010

- **IAALD XIIIth World Congress:** ***Scientific and Technical Information and Rural Development***, Montpellier, France, April 26–29, 2010 (see article in *News from IAALD* in this issue). Deadline for abstract submissions is October 15, 2009. For more information: http://iaald2010.agropolis.fr/
- **USAIN 2008 / 12th Biennial Conference of the United States Agricultural Information Network:** ***Agriculture without Borders: Creating Knowledge and Partnerships Across Disciplines and Across the World***, West Lafayette, Indiana, USA, May 9–12, 2010. For more information: http://usain.lib.purdue.edu/
- **WCCA 2010 / 8th World Congress on Computers in Agriculture and Natural Resources**, Québec, Canada, June 13–17, 2010.

- **ACE 2010 / Agricultural Communicators in Education Conference**, Key West, Florida, USA, July 2010. For more information: http://www.facebook.com/group.php?gid=19149539931
- **World Library and Information Congress / 76th IFLA Council and General Conference: *Libraries: Engaging, Embracing, Empowering***, Brisbane, Australia, August 15–19, 2010. For more information: http://www.ifla.org/IV/ifla76/index.htm
- **AFITA 2010 / Asian Federation of Information Technology in Agriculture**, Malaysia.
- **AIAEE 2010 / 26th Annual Conference of the Association for International Agricultural and Extension Education**, Saskatoon, Canada. For more information: http://www.aiaee.org/
- **EFITA 2010 / European Federation for Technology in Agriculture, Food and the Environment**, Netherlands.
- **NETC 2010 / National Extension Technology Conference**, Auburn, Georgia, USA.

2011

- **AIAEE 2011 / 27th Annual Conference of the Association for International Agricultural and Extension Education**, Windheok, Namibia. For more information: http://www.aiaee.org

International Association of Agricultural Information Specialists
Association internationale des spécialistes de l'information agricole
Asociación Internacional de Especialistas en Información Agrícola

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XIII[e] Congrès mondial de l'IAALD organisé par Agropolis International 26-29 avril 2010, Montpellier, France

Information scientifique et technique et développement rural

© Ville de Montpellier

Le regain d'intérêt pour l'agriculture et les questions soulevées par les crises alimentaires accentuent les besoins en information de qualité pour tous les acteurs du développement rural. En apportant leurs connaissances et leur savoir-faire, les professionnels de l'information scientifique et technique peuvent contribuer à répondre à ces besoins. Le congrès organisé par l'IAALD et Agropolis International favorisera un dialogue constructif entre les professionnels de l'information et ceux du développement rural pour faire face aux grands enjeux agricoles.

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Contact : iaald2010@agropolis.fr
http://iaald2010.agropolis.fr

Agropolis International
Avenue Agropolis
F-34394 Montpellier CEDEX 5
Tél. : +33 (0)4 67 04 75 75

International Association of Agricultural Information Specialists
Association internationale des spécialistes de l'information agricole
Asociación Internacional de Especialistas en Información Agrícola

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IAALD XIIIth World Congress organized by Agropolis International 26-29 April 2010, Montpellier, France

Scientific and Technical Information and Rural Development

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The renewed worldwide interest in agriculture and questions dealing with food crises increase the need for quality information for actors in rural development. Bringing their knowledge and know-how, the Scientific and Technical Information specialists can contribute to providing quality information. The congress organised by IAALD and Agropolis International will ensure fruitful exchanges between information specialists and actors of rural development facing these key challenges in agriculture.

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Contact: iaald2010@agropolis.fr
http://iaald2010.agropolis.fr

Agropolis International
Avenue Agropolis
F-34394 Montpellier CEDEX 5
Tel.: +33 (0)4 67 04 75 75

Instructions for Authors

Agricultural Information Worldwide: An International Journal for Information Specialists in Agriculture, Natural Resources, and the Environment (*AgInfo World*) is the official journal of the International Association of Agricultural Information Specialists (IAALD). *AgInfo World* provides an international forum for high quality articles on information, knowledge and communication activities related to the applied life sciences, including agriculture, food from production to marketing, natural resources, fish and wildlife, environment, and agricultural extension and education. Priority will be given to practical and applied topics, such as but not limited to best practices. Research articles with practical applications will also be considered for publication.

Articles submitted will go through a blind review process with an independent reviewer and will be returned to the author for corrections and modifications if necessary. Research should be statistically valid and replicable with the results of broad applicability. English, French, and Spanish language articles will be considered for publication. Generally, full articles should not exceed 5000 words, but longer articles will be considered on a case-by-case basis.

All *AgInfo World* articles are published with a specific tabular style and follow bibliographic conventions as listed in the *Chicago Manual of Style* 15th edition. References should be complete and tables should comply with the editorial style represented in *AgInfo World*. Notes and references should be presented at the end of an article, not as footnotes. An English language abstract of 150 words or less is required at the time of submission. Additional abstracts in French and Spanish are welcome. Articles submitted should be accompanied with the institutional affiliation and address of each author as well as a brief biography.

In addition to full articles, *AgInfo World* also publishes short reports and updates on projects, tools, and organizations in its *AgInfo Dispatches* section. Dispatches will be less formal in nature and will be reviewed for acceptance by the Editor. Dispatch submissions do not require abstracts and should not exceed 1500 words.

As of January 1, 2008, *AgInfo World* will only accept manuscripts submitted in standard electronic formats, either on disk (accompanied by a hard copy) or as e-mail attachments. MS Word (.doc) or Rich Text Format (.rtf) documents are preferred; please contact the Editor regarding other acceptable formats. Graphics may be embedded in the native word processor file, but for optimum layout efficiency and reproduction it is best to also submit them separately on disk or by e-mail.

To learn more about publishing in *AgInfo World*, please contact the Editor:

Debra L. Currie, IAALD Editor
1701 Su John Road
Raleigh, NC 27607
USA
E-mail: debbie_currie@ncsu.edu

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IAALD'S MISSION is to enable its members to create, capture, access and disseminate information to achieve a more productive and sustainable use of the world's land, water, and renewable natural resources and contribute to improved livelihoods of rural communities.

To further this mission:

IAALD **CONNECTS** agricultural information specialists worldwide, providing platforms and spaces for information dissemination, exchange and knowledge sharing;

IAALD **CONVENES** agricultural information specialists worldwide, organising meetings and catalyzing dialogue among all agricultural information stakeholders;

IAALD **COMMUNICATES** and advocates the value of knowledge and information to its members and others, improving the status and practice of agricultural information management and dissemination;

IAALD **COLLABORATES** with members and other partner organisations, facilitating educational and other opportunities across agricultural information communities.

Executive Committee of IAALD

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