September 26, 2007

Major Agricultural Information Initiatives: With Emphasis on Developing Country Services

Barbara Hutchinson[*]

BACKGROUND

The purpose of this background paper on major agricultural information systems[1] is not only to provide an overview of the wide variety of online agriculture-related content[2] delivery services, but an understanding of the ongoing initiatives to bring continuity to an increasingly fragmented and sometimes duplicative information environment. While the revolution in information and communications technologies has made it possible to store and provide access to massive amounts of information, data, and targeted resources on a real-time basis, it has also considerably widened the playing field of participants in this process. What was once the domain of a handful of organizations is now a complex arena of stakeholders who are grappling with the complicated issues that affect the development of collaborative, multifaceted knowledge systems. At the same time, innovations, including Web 2.0[3] applications and rural information kiosks (World Bank 2007) as well as re-purposed traditional technologies such at radio and mobile phones, now make it possible to incorporate local knowledge directly into information services and to begin closing the digital divide that has limited the benefits of scientific advancements for farmers and rural communities in developing countries (Rao 2001; FAO 2004c; FAO 2005c; ITU 2007). That the intentions of the service providers have been virtuous and focused ultimately on improving livelihoods throughout the world is not in question; however, the reality of multiple organizations with similar missions and widely varying resource allocations has at times led to a climate of competition that has made it difficult to reach desired outcomes. In spite of these challenges, this paper will demonstrate a convergence of areas where progress has been made and where technical innovations may contribute to further progress in meeting the needs of the smallholder farmer in the future.

At the 1985 conference of the International Association of Agricultural Librarians and Documentalists (IAALD)[4] held in Ottawa, Canada, there was a call by the attendees and their affiliates for greater coordination of bibliographic services by the three major agricultural information service providers. Taking those concerns to heart, the heads of CAB International, the Food and Agriculture Organization of the United Nations' (FAO) AGRIS Unit, and the U.S. National Agricultural Library (NAL) held their own mini-summit and mapped out actions that were later implemented to help searchers of CAB Abstracts, AGRIS, and AGRICOLA know which service to consult for particular types of information (Howard 1986; Mann 1986). By the mid-1990s, this simple decision-making process was no longer possible and the previous centralized content management model had evolved into a decentralized approach involving a

[*] barbarah@ag.arizona.edu

[1] "a "system" is the highest level of organization, comprising "networks" of institutions and staff, which offer "services" based on information content, which in turn depend on information management "applications" (i.e. software), "tools" and "standards" (GFAR 2005, p.4)

[2] "content" is defined as databases, raw scientific data, spatial and graphic information, full-text research and grey literature (i.e. technical reports) and other information, tools, and knowledge products (CGIAR 2007).

[3] Described here as next generation Web technologies such as weblogs, social bookmarking, wikis, podcasts, RSS feeds (and other forms of many-to-many publishing)

[4] now International Association of Agricultural Information Specialists (http://iaald.org)

wide variety of stakeholders. With the advent of the World Wide Web, every organization could begin developing its own information services and new collaborations could be facilitated to share and disseminate resources. An early such web-based initiative was the Agriculture Network Information Center (AgNIC) from NAL and its U.S. land-grant university partners (Gardner et al 2004). Through the intervening years, the possibilities for meeting end-user needs have profoundly changed and improved. Fast-paced innovations in technology not only provide new opportunities but bring into question organizational structures and the ability of information professionals to keep pace with and adapt those technologies to better serve expanding numbers of constituencies (Hutchinson and Grieder 2002; Salokhe, et al. 2004).

COHERENCE INITIATIVES

By the year 2000, it had become clear to many that there was a need for

> developing coherence in international information systems for agricultural science and technology…set in the context of increasing inequity in access to agricultural information, and the emergence and adoption of new information and communication technologies (ICTs)[5] which [were] reducing costs and catalyzing a migration of content to digital formats (FAO 2005b, p.6).

As a result of this situation, the FAO sponsored two intergovernmental "Consultations on Agricultural Information Management" (COAIM) workshops in 2000 and 2002 to engage policymakers' attention on the topic. As part of these efforts, sessions were held to develop strategies to consider the area of access to science and technology information in the context of the AGRIS network and its participating Centres around the world (FAO 2000, FAO 2002). These sessions resulted in a decision to move away from the maintenance of bibliographic databases to the provision of a broader range of information services and capacity building. Key to this reorganization would be expanded partnerships and tools to facilitate the development of full-text repositories and databases through the adoption of a metadata[6] standard (Agricultural Metadata Element Set – AGMES) (Onyancha, Keizer, and Katz 2001). Also to be initiated was a more decentralized approach in further building the AGROVOC Thesaurus as a "multidisciplinary and multilingual tool for information description and knowledge representation" (FAO 2002, p.5; FAO 2007g). To manage these changes, FAO's World Agricultural Information Centre (WAICENT) would play a strategic role and offer through its portal opportunities for discussion and dialogue.

Following the COAIM events was a study of the issues facing stakeholders in developing countries and donor agencies supporting the development of major online agricultural information systems. Funded by the UK Department for International Development (DFID) under the auspices of the International Institute for Communication and Development (IICD), the resulting report was titled, "Fertile Ground: Opportunities for greater coherence in agricultural information systems". This report presented findings from an assessment of sixteen web-based systems and found "striking gaps, areas of inefficiency, and duplications, as well as a certain

[5] "Information and Communications Technologies (ICT) are taken to consist of hardware, software, networks, and media for collection, storage, processing, transmission and presentations of information (voice, data, text, and image)" (FAO 2004c, p.6).

[6] "Metadata is data about data. An item of metadata may describe an individual datum, or content item, or a collection of data including multiple content items" (from wikipedia).

mismatch between the information needs of the South[7] and what is being provided by the current donor-supported services" (Besemer, Addison, and Ferguson 2003, p. 1). Among the recommendations was a clearinghouse on technical standards, hosted by FAO, that would provide tools and guidelines for creating interoperability among web resources including vocabularies and ontologies, best practices for mark-up definitions, and protocols such as promoted by the Open Archives Initiative (OAI)[8]. A follow-on meeting, held in Lexington, Kentucky, USA in conjunction with the 2005 U.S. Agricultural Information Network (USAIN) conference, adopted four concrete action strategies: (1) develop a standard for project information; (2) test Open Archives methodology; (3) develop a standard for newsfeeds; and (4) implement a clearinghouse website on standards (Besemer & Addison 2005).

A principal context for these efforts was the United Nations Millennium Summit, held in 2000, whose participants agreed to a set of Millennium Development Goals (MDGs) for combating the world's most intractable problems for the poor and disenfranchised. Of the nine targets, three are particularly related to the agriculture sector: (1) halving extreme poverty and hunger by 2015; (2) empowering poor women; and (3) ensuring environmental sustainability (UN 2005). Another event, the first World Summit on the Information Society (WSIS) was held in December 2003, at which FAO officially launched its "Bridging the Rural Digital Divide[9] Programme" that identified ICTs as a means for achieving progress toward the MDGs. Recognizing that "under favourable conditions, these technologies can be a powerful instrument, increasing productivity, generating economic growth, job creation and employability, and improving the quality of life of all" (WSIS 2003, p.2), the WSIS Declaration of Principles provided a 'call to action' for agricultural development organizations "to apply ICTs to poverty reduction, food security, and the strengthening of rural livelihoods" (WSIS 2003; FAO 2005c). Thus, the MDGs and the WSIS directives became primary drivers for continuing to work toward "coherence" in agricultural information systems.

At about the same time, during 2003-04, the GLOBal ALliance of the Regional Agricultural Information Systems (GLOBAL.RAIS) project of the Global Forum on Agricultural Research (GFAR), consulted with stakeholders in various regions throughout the world about issues related to its agricultural information and communication system, EGFAR. The results of these consultations identified inequities in the availability, access, and ability to use current agricultural information systems. Social rather than technical constraints were noted as major contributors to these inequities, although particular impacts on women were not described. At a workshop held in June of 2004, discussions led to defining an agenda for a more harmonized global information system that would achieve economies of scale. Strategies were formulated to address: (1) Advocacy, (2) Capacity building, and (3) Integration of ICT services into information and communication mechanisms, with each built on new levels of collaboration among partner organizations and stakeholders. Through a new Global Partnership Programme (GPP) for Information and Communication Management (ICM) in Agricultural Research for Development (ARD), work would be carried out by Task Forces in the three focal areas that

[7] South used here to describe the developing world.
[8] "The Open Archives Initiative develops and promotes interoperability standards that aim to facilitate the efficient dissemination of content" (http://www.openarchives.org/documents/FAQ.html)
[9] "Rural Digital Divide is derived from a complex range of problems, including the lack of: telecommunications and other connectivity infrastructure; skills and institutional capacity; representation and participation in development processes; financial resources" (FAO 2005c, p.1) (see also www.fao.org/rdd)

operated under the basic principles of: open, inclusive, decentralized, and user-driven services (GFAR 2004). A follow-on proposal was made to strengthen National Agricultural Information Systems (NAIS) through the development of management information systems (MIS) that would integrate information on research outputs, institutions, experts, and projects (GFAR 2005), a goal in concert with the "Fertile Ground" recommendations. Although the GFAR website does act as a gateway to partner activities and offers a document repository, the most fully developed web resources are those of its regional systems (RAIS), in particular, the European Information System on ARD and the Forum for Agricultural Research in Africa (See Profiles: ARD-InfoSys+ and FARA). By 2005, in pursuit of achieving its ICM goals, the GFAR had combined forces with the FAO and DFID "coherence" initiatives also now involving the CGIAR, CTA, INASP, and other international, regional, and national organizations.

To continue building on the momentum of these efforts, FAO and its partners set a course to develop standards to promote Open Access[10] of agricultural information and to continue to facilitate discussions on collaborative approaches for serving the world's agricultural information needs. To this end, FAO hosted the 2005 "Expert Consultation – International Information Systems for Agricultural Science and Technology: Review of Progress and Prospects" that brought together representatives from the key agricultural information service providers, including the authors of the "Fertile Ground" report, for a common purpose (FAO 2005b). The agreed upon goal was "that stakeholders in agricultural science and technology should be better informed so that they might make better decisions (researchers, extensionists) and develop policies based on evidence (policymakers), leading to the economic and social enhancement of rural livelihoods of the poor" (FAO 2005b). Following presentations and discussions, three inter-related focal areas were identified for action reminiscent of the GFAR approach: Advocacy, Capacity Building, and Content Management. Advocacy identified the need to gather evidence to gain support from and encourage champions to help ensure progress toward "coherence". While Capacity Building actions focused on strengthening regional clearinghouses, increasing partnerships with professional associations for information specialists, and continuing to develop and produce training resource materials for the Internet and on CD-ROM such as the multilingual Information Management Resource Kit (IMARK)[11] The Content Management participants settled on four action strategies, again reminiscent of the "Fertile Ground" recommendations: (1) development of the Agricultural Information Management Standards (AIMS) website (hosted by FAO); (2) shared development of project-related information; (3) public domain software tools and applications; and (4) development of electronic repositories. To facilitate these strategies, it was also decided to work toward the implementation of a common metadata exchange format[12], a community directory for information on organizations and for news-feeds using RSS[13], and multilingual ontologies[14] (FAO 2004a; FAO 2004b; FAO

[10] Described here as "free availability of Internet content in all formats that may be repackaged for value-added services" (see also Subirats et al. 2007).
[11] IMARK includes modules on Managing Electronic Documents, Building Electronic Communities and Networks, Investing in Information for Development, and Digitization and Digital Libraries (http://www.imarkgroup.org/) (Chisenga et al. 2007) (see also profile)
[12] Described here as a "wrapper" for digital files that includes information about the nature and structure of the digital materials and the physical characteristic of the electronic file.
[13] "RSS is a family of Web feed formats used to publish frequently updated content such as blog entries, news headlines or podcasts" (from Wikipedia - http://en.wikipedia.org/wiki/RSS_(file_format))
[14] Ontologies are enhanced thesauri that contain terms, definitions of those terms, and the specification of those terms. Their purpose is to make electronic retrieval more precise. (FAO 2004a)

2004d; FAO 2006a; FAO 2006b; FAO 2006c; FAO 2007d; FAO 2007e; FAO 2007g; Kaloyanova et al. 2007). In each case, Task Forces with members from representative organizations were given the responsibility to implement the actions identified (FAO 2005b).

Having already initiated many of the strategies, FAO presented the results and progress of the Expert Consultation and its related activities at the 2nd WSIS conference held in Tunisia in December 2005. In the area of "access to information and knowledge", the work featured the development and dissemination of global standards and procedures for agricultural information management and exchange through AIMS and included AgMES and an Agricultural Ontology Service (AOS) project for developing subject-specific ontologies. For Capacity Building in ICTs, the IMARK e-learning initiative was introduced along with the program's blended approach to training involving both face-to-face workshops and distance learning modules (FAO 2005c). At the same time, FAO was charged with responsibility for facilitating follow-up to the Action Plan objective on "e-agriculture", embracing all aspects of the application of ICTs in agriculture and rural development. In 2006, FAO moved to establish an e-Agriculture Working Group with participation from CTA, CGIAR, FAO, GTZ, IAALD, IICA, IICD, GFAR, IFAD, ITU, and UN-DESA. One of the main purposes of the Working Group is the initiation of a worldwide "E-Agriculture Community of Practice" to formalize a collaborative response to the WSIS agenda to reduce the digital divide through a concerted effort on multiple fronts (E-Agriculture Working Group 2007). The goal will be "to enhance the contribution of ICT to agriculture and rural development through a multi-stakeholder, people-centered, cross-sectoral platform that will bring together all stakeholders from relevant constituencies" (FAO [2007c], p.1). In addition, a web-based global survey was completed in 2006 with nearly 3,500 responses on the nature and scope of e-agriculture, and on the priorities that stakeholders feel need to be addressed.

In the spring of 2007, the Content Management Task Force from the 1st Expert Consultation, sponsored by FAO and CTA, met to review progress on priority actions, identify areas for collaboration, consider options for delivering integrated services for content management, explore areas of duplication, and assess opportunities for utilizing Web 2.0 technologies. In the area of Open Access publishing, it was noted that the there needs to be greater encouragement of authors to self-archive their materials in repositories[15] (Lynch 2006) and that employing standards such as outlined in the AGRIS Application Profile (AP) (FAO 2005a) can facilitate the development of value-added products. At the same time, recommendations were made to continue to encourage the development of "mini-ontologies", particularly in their application to standardizing project, organization, publications, and experts information services (now termed "integrated systems"). Using RSS feeds for delivering personalized and timely news on hot topics also was recommended. In particular, and due to the wide number of services managing information on organizations and projects (numbering between 9 and 12 depending on definition (See Table in Appendix 2)), it was suggested to create a registry of services and to build interoperability across systems by agreeing to common standards and protocols for information exchange. It was also recognized that this level of collaboration requires both institutional commitment and a demonstration of cost effectiveness. Thus, FAO representatives offered to write a white paper clarifying the issues and requirements for such an initiative (CTA 2007).

[15] Repositories are similar in intent to institutional repositories, notably in academic settings, which are the location for collecting, preserving, and disseminating intellectual output in digital formats.

A 2nd Expert Consultation on International Information Systems for Agricultural Science and Technology has been scheduled for 23-24 September, 2007 (FAO 2007a; FAO 2007b; FAO 2007c; FAO 2007f). The purpose is to evaluate progress on the work accomplished by the 2005-originated Task Forces, to gain input from a range of stakeholders, particularly representatives from national systems, and to officially launch an "e-agriculture"[16] community of expertise (already involving 1,200 members). This Consultation, sponsored by multiple donor organizations, will be part of weeklong set of e-agriculture meetings including the 8th Agricultural Ontology Service Workshop; a Web2ForDev: Participatory Web for Development conference; and GFAR and CGIAR meetings related to research, information, and knowledge. In particular, the CGIAR will be reviewing its ICT-KM (knowledge management) Program with the stated purpose to "open access to CGIAR research and knowledge." Through a strategy of conducting intensive needs assessments, creating integrated and open access to its "global public goods,"[17] strengthening networking and capacity building, developing value-added information products and services, as well as a monitoring and evaluation program, the CGIAR is restructuring for the purpose of sharing its knowledge to fight hunger and poverty throughout the world (CGIAR 2007). Thus, to ensure continuity and to avoid duplication of effort, it will be important to both evaluate and leverage progress made during these meetings when considering the most beneficial approaches for strengthening current agricultural content management and delivery services.

SMALLHOLDER OVERVIEW

Since the formation of the MDGs, numerous surveys, projects, and best practice studies have been undertaken to assess experiences using ICTs and to gain input from various stakeholders, especially those involved in supporting the development of rural livelihoods (FAO 2004c; FAO 2004e; OECD 2005; IICD 2006; World Bank 2007; WSIS 2005). In 2004, a CAB International study conducted for FAO evaluated mechanisms for documenting and disseminating outputs of agricultural research in Sub-Saharan Africa. This study involved stakeholders at all levels and looked at communication of research among different audiences: research to research, research to policy makers, and research to rural service providers. In the first case, initiatives such as AGORA for accessing journal articles, electronic repositories of documents stored in full with associated metadata, and a multilingual events tracker, as well as training in the use of such mechanisms were identified as priorities. In the second, improved use of mass media, case studies, and possible think-tanks were suggested areas of further development. ICT challenges were particularly prevalent in determining appropriate means for serving rural information service providers, the intermediaries such as extension personnel who work directly with farmers. In this case, strengthening local and regional networks, improving access to low-cost electronic communication services, developing local publishing enterprises, and making more effective use of mobile phones and radio programming, were suggested strategies that could fit

[16] E-agriculture is a term used by WSIS for use of ICTs in agriculture. As a field, it comprises "the enhancement of agriculture and rural development through improved information exchange, communication and learning processes, based on the user of the internet and other digital technologies by actors in agriculture locally, regionally, and worldwide" (FAO [2007]b) (http://www.e-agriculture.org).

[17] Global Public Goods (GPGs) are another way to describe "content" as in footnote #2.

under the umbrella of multi-purpose rural information centers (FAO 2004e; Asaba et al. 2006).[18] Further, the study suggested that inclusive partnerships were needed to avoid duplication and promote coordination of initiatives such as the development of toolboxes, guidelines, and pilot projects.

Other reports and projects have focused on the need for "demand-driven" bottom-up approaches where the important role of intermediaries and indigenous knowledge is recognized, and learning and knowledge sharing is a two-way process (Chapman, Slaymaker, & Young 2003; FAO 2004; Mchombu 2007). In this context, the FAO/DFID/World Bank document describing the project "Information and Communication for Developing in Support of Rural Livelihoods"[19] suggests that relevant information must be non-technical and made available in local languages and that education and training should emphasize practical and vocational programs. In addition, a balanced approach was proposed for integrating new affordable technologies with more traditional modes of information dissemination and communication, similar to those identified in the FAO/CABI 2004 study. Similarly, the 2005-initiated International Fund for Agricultural Development's (IFAD) First Mile project serves to help rural farmers and traders improve their access to markets and market information through the use of mobile phones, email, and the Internet, but with an emphasis on "building trust and collaboration along the market chain" (http://www.ifad.org/rural/firstmile/index.htm).

A significant aspect of developing more relevant agricultural information systems is the empowerment of women. The LinKS project is a regional effort in Southern Africa exploring the intersection of local knowledge systems, gender roles and relationships, food provision, and the conservation and management of agrobiodiversity.

> The project seeks to help development practitioners recognize that farmers have knowledge, practices and skills that are often highly sustainable and respectful of the natural ecosystems they depend on for their food and livelihoods. However it is important to understand in this context, that rural men and women have different knowledge about how to use and manage… resources that is derived from their different roles and responsibilities in the farming system. (quoted from website home page - http://www.fao.org/sd/LINKS/default.html)

Other projects are examining whether access to ICTs can contribute directly to an improvement in women's livelihoods. Studies in Uganda and Ghana have demonstrated the complexities in the social order that limit women's access to ICTs (Litho 2007; Nyarko 2007), although there have been studies in Africa documenting near-equal use of telephones by women as by men (OECD 2005).

Recently, the IICD published a report describing the lessons learned from 35 participatory ICT projects designed to enhance agricultural livelihoods in nine countries in Africa and Latin America (IICD 2006). Results demonstrated that ICTs can contribute to improved access to

[18] see also ESCAP 2007 for an assessment of telecentres as knowledge networks for agricultural information in India and the UNDP-APDIP 2006 report that suggests the quality of personnel at the telecentres is a significant factor in their level of success.

[19] This program appears to have resulted in the IDS "Livelihoods Connect" knowledge service [http://www.livelihoods.org] that provides fact sheets, multi-media resources, summaries of hot topics, and lessons learned among other customized features.

prices, markets, and product information that contributes to increased income levels. However, it also supported the results of previous studies by demonstrating that successes can be more fully realized when they include: knowledge sharing and empowerment through ownership; content based on local needs; practical capacity development; variety in ICT options including mobile phones, shared connectivity, two-way radio, and use of multimedia and drama; and the integration of ICTs into existing organizations. In addition, the report pointed out that policies leading to common standards for ease in sharing and retrieval of information should be encouraged (IICD 2006). A 2005 good practices report from OECD had similar recommendations. Themes of ownership, participation, capacity building, cooperation with the local private sector, and appropriateness of content were highlighted. More pertinent to this paper was a call to put more emphasis on the development of Open Source content and applications, and in the tailoring of that content to local users with attention to language, subject, and graphical formats (OECD 2005). If ICTs, and the agricultural information systems that are fundamental to them, are to have positive impact on rural livelihoods and the status of largely disenfranchised populations, these lessons learned should provide the framework for action. Expanding local involvement and demand-driven, locally-specific content; promoting more equitable access for all members of the agriculture community; leveraging existing technologies and systems; enhancing capacity; and advocating for harmonized ICT policies and approaches (FAO 2004c) – these are important elements in determining next steps.

STATUS OF CURRENT AGRICULTURAL INFORMATION SERVICES

Using the 2003 "Fertile Ground" report as a baseline for the number and type of significant agricultural information systems, it becomes evident that initiatives, services, and groups involved in this field have expanded considerably. Of the sixteen services surveyed in that year, only one is not included in the following "Profiles" section and in the accompanying Table in Appendix 2. As can be seen, the impact of the Web has been a proliferation of services, most all with some unique content and services. Although many are working toward more Open Source[20] solutions for sharing content (Lwoga & Chilimo 2006), there has been limited progress as yet toward true integration to facilitate one-stop access. However, there certainly have been considerable advancements since 2003. As already noted, the Content Management Task Force, including representatives from such services such as WISARD, InfoSys, and SIST, is moving toward greater coordination of information on organizations, projects and other data and documents - an area where there is now considerable overlap (CTA 2007). Repositories of full-text documents are beginning to grow in number, including those originating from organizations (i.e. CTA's Anancy, FAO's Document Catalogue, and IDRC's Digital Library) and those that operate on the behalf of consortia (i.e. Development Gateway Foundation, USAID's FRAME program, WEBAGRIS, AgNIC, and SIDALC). However, it appears there is no initiative as yet to harvest these resources under one user interface, other than the prototype AgOAI demonstration by AgNIC.

A value-added service that is particularly noteworthy is the CGVirtual Library, the only major federated search service available for agriculture and its related topics. This service provides stakeholders everywhere with quick access to the contents of more than 200 databases and over 4,000 journal titles, although some are limited to CGIAR personnel. Complementary to the

[20] Open Source here is defined as the free distribution of information and knowledge.

CGVirtual Library are the projects AGORA, PERI, Bioline, Eifl.net and AgEcon Search that offer either free or subsidized retrieval of full-text scientific literature related to agriculture. Other unique services with applicability for rural information providers include the CABI multimedia Compendia tools, and those that produce quality synthesized information based on current knowledge such as Eldis, Africa SIST, and CABI Internet Resources. Some services also include information on best practices, often supplied directly from stakeholders around the world, specifically InfoBridge, InfoSARD, and InterSard/WISARD, although portals may also deliver personalized resources. A customized service directly involving and supporting rural farmers is the web-based version of CTA's Question and Answer Service called RUN (Rural Universe Network), developed by the German Centre for Documentation and Information in Agriculture (ZADI). This demand-driven, decentralized, and multilingual communication and information system allows farmers and experts to communicate by email, with their questions and answers documented in a database for easy retrieval. Thus, as can be seen in these examples and the accompanying profiles in this paper, there are a growing number of services offering interactive and integrated services for a variety of stakeholder groups, although the overall picture still remains a fragmented one.

NORTH AMERICAN RELATED ACTIVITIES

The period since the 2000 USDA Blue Ribbon Panel review of NAL's programs and services, and the publication of the resulting report (Interagency Panel 2001), has been a particularly active time for those involved in developing agricultural information systems in the United States. There have been numerous meetings and discussions to gain the attention and support of government officials and associated agencies, as well as land-grant library deans and directors, to raise the awareness for coordinated action to improve information services and move them into a 21st Century technical environment (highlights of these activities are noted below). Although, as yet, there has been limited success in gaining financial support for a collaborative approach, there is new momentum among a number of organizations for working with national and international communities on agricultural information initiatives.

Through the efforts of on-the-ground librarians who are members of USAIN and/or the AgNIC alliance, a shared vision and commitment for improving information systems has been promoted. Members of USAIN's Executive Council and Government Relations Committee have contacted major library associations to support increases in the NAL budget, particularly for strengthening such initiatives as AgNIC. Letters have been written and contacts made to members of the Agriculture Legislative Committees asking for additional wording in the Farm Bill to recognize the importance of information dissemination initiatives. With the support of University of Arizona (UA) College of Agriculture and Life Sciences administrators, the author of this paper was given the opportunity in 2003 to meet with the Chair of the Senate Agriculture Committee on behalf of the AgNIC alliance, and also to present AgNIC's case formally to the USDA Under-Secretary of Research, Education, and Economics. Recently, the USAIN Executive Committee commissioned a White Paper on the importance of a strong agricultural information system to the economy and to quality of life issues. This paper is to form the basis of a plan and proposal for gaining new resources to build a next generation infrastructure.

At the same time, members of the AgNIC alliance, including partners ranging from ADEC (American Distance Education Consortium- a non-governmental organization) to collaborators

in Canada and Latin America, have engaged a cross section of stakeholders in formal discussions about its future. With assistance from the UA Libraries Dean, several meetings were held with land-grant library deans and directors to discuss land-grant involvement and support for AgNIC and NAL. Working with NAL, which operates the AgNIC Secretariat and in the last four years has offered small grants for cooperative projects, the AgNIC Executive Board helped organize three meetings with key representatives from USDA, Cooperative Extension, eXtension, NASULGC (National Association of State Universities and Land-Grant Colleges), land-grant libraries and colleges of agriculture deans and other interested parties. The purpose was to create a vision, plan, and support for a collaborative agricultural information and education system and to provide guidance to the AgNIC alliance and NAL on future directions. As part of this process, a survey of current library-extension-agricultural experiment station collaborations was conducted (Hutchinson et al. 2005) and reports on content development opportunities (McCue et al. 2005) and standards for interoperability for sharing online content (Gardner et al. 2005) were generated. Expanding and enhancing these efforts, ADEC has targeted "digital infrastructure" and "global collaboration in science and education" as two of its five strategic initiatives. As such, AgNIC and ADEC are working together to help create partnerships, relationships, and infrastructure that will strengthen international management of agricultural information, and begin the implementation of a management system for land-grant information (Heatley 2005; AgNIC [2007]; Heatley 2007). In addition, ADEC is involved in the new NASULGC “Africa Initiative for Higher Education” which is focused on capacity building and use of emerging information technologies and digital content in higher education institutions in selected countries. This effort will include digital teaching, research, and extension (Poley 2007). Other notable initiatives include:

(1) The Cornell-administered USAIN National Preservation Program, funded by the National Endowment for the Humanities, which has begun to digitize pre-1950 agricultural literature as the basis for a national historical repository - http://cals.arizona.edu/OALS/usain/Preservation/preservinitiative.html;
(2) The participation of six land-grant universities in the agriculture portion of the Carnegie Mellon Million Books project, also administered by Cornell, that supports digitization of public domain agricultural materials, particularly extension and agricultural experiment station literature - http://www.library.cmu.edu/Libraries/MBP_FAQ.html;
(3) The AgNIC-developed prototype metadata harvesting service as a tool for gaining access to agricultural information located in institutional repositories (see profile on AgOAI)
(4) The formation of new AgNIC Committees, to develop proposals for projects to gain control of “born digital” agricultural materials as well as “re-born digital” resources that were once available only in print format;
(5) An ADEC cooperative agreement with AgNIC/NAL that translated the NAL Thesaurus (NALT) into Spanish collaborating with a team located at the Universidad de Concepcion in Chile.
(6) Cooperating with the National Science Foundation and the U.S. Department of Agriculture, ADEC has contributed to the annual Chinese American Networking Symposium (CANS) with focus on distance learning and digital libraries and is engaged in scientific and technical exchanges in these areas with Foreign Agriculture Service (FAS) support.

(7) AgNIC's subject-specific portals - for example the Rangelands West initiative, now involving 19 land-grant universities in a collaboration of rangeland specialists and agricultural librarians, who are developing a customized structure to improve access as well as targeted user applications - http://rangelandswest.org;
(8) The AgEcon Search Open Source repository service from the University of Minnesota (also an AgNIC partner);
(9) The Plant Management Network as a model for combining subscription-based and freely available full-text content; and
(10) The NAL demonstration project for a National Digital Library for Agriculture (NDLA) that provides federated searching of multiple databases (see profile);

The convergence of these North American initiatives with the international e-agriculture efforts truly provide a "fertile ground" for achieving innovations in the field and for meeting the information needs of all stakeholders groups using the most appropriate dissemination tools. Through such worldwide collaboration, decades of research output, best practices, and lessons learned could be made available to people everywhere.

WHERE DO WE GO FROM HERE?

It is not in the scope of this paper to include a systematic review and assessment of the status of ICTs in the developing world, nor to evaluate the traditional roles and integrated model of research, extension, education, and information dissemination. However, to ensure progress in developing appropriate systems to meet the needs of smallholder farmers, as well as other stakeholders, a basic understanding of their strengths, weaknesses, and relationships is helpful. It is apparent that in the developing world, the U.S. land-grant university linear model of a direct transfer of information and best practices from researchers, to extension agents, to farmers has worked effectively only rarely in other countries (Read 1974). A possible new model will be one that is multi-directional, incorporates multiple stakeholder perspectives, and builds on the virtual environment "to cross borders and geographic distance" (Ballantyne 2007). Not only will more stakeholders be recognized in such a model (local leaders and businessmen, farmers cooperatives, friends and neighbors, and religious figures), but differences in governance structures for extension-type activities will be acknowledged as well as local forms of communication and indigenous knowledge and experience (Roling 2004). Although not a "magic bullet" or an end in themselves, ICTs have potential to facilitate services and organizational effectiveness that can ultimately help alleviate poverty (FAO 2004c, World Bank 2007). The problem lies in taking concerted action to use them in practical and sustainable ways, to build capacity in local institutions and groups, and to create the backbone of an agricultural information system by storing, preserving, and opening up information and data to innovations for value-added and user-driven services and delivery.

To create a reliable, relevant, inclusive, and cost effective agricultural information system that provides simple, interactive, easy-to-use interfaces to serve and involve a variety of stakeholders, a multi-tiered approach is suggested. Similar to the "onion model" used by both FAO and CGIAR to map the major factors affecting agricultural information systems (FAO 2005b, p.10), the approach outlined here consists of seven key, but highly inter-related, components: (1) Content development; (2) Standards; (3) Services; (4) Capacity building; (5) Infrastructure; (6) Partnerships; and (7) Policy and donor coordination. In this case, content development includes

creating more Open Access repositories of scientific knowledge; documenting best practices, lessons learned, and local knowledge; as well as expanding models for working with commercial publishers. To bring this content together in a cohesive and useful way, there needs to be continued advocacy for and commitment to the common use of standards in the global agricultural information community. When this level of cooperation and collaboration is achieved, it will be possible to generate the customized, multilingual services needed for improved decision-making. At the same time, levels of understanding in how to utilize and develop these services must be strengthened to build a core group of practitioners who will mediate with, involve, and assist farmers in the context of their particular community. And, of course, there must be a strong technical infrastructure to support access and communication. However, none of this will be accomplished without strong partnerships and the commitment and encouragement of government officials, agencies, and those in positions of power. True collaboration involves risk and a sharing of financial and intellectual resources. It is hoped that this year's "e-agriculture" meetings in Rome and the AgInfoWorld symposia will lead to such a collaboration – one that will ultimately have tangible and meaningful benefits for all stakeholders and, most especially, for improved livelihoods for smallholder farmers.

Appendix 1

Profiles of International Agricultural Information Initiatives

(**Note**: The International Association of Agricultural Information Specialists (IAALD) is actively involved in promoting communication, knowledge sharing, and use of innovative technologies among members. IAALD is also one of the sponsors of the "e-agriculture" week events. **Other Notes** on the following profiles: (1) selected international development information systems relevant to agricultural topics are included as are several regional initiatives; (2) relationships among initiatives and services are noted where possible; and (3) information was largely gathered from respective websites, while some references are included)

AIDA: Accessible Information on Development Activities
[http://aida.developmentgateway.org/] – AIDA is a worldwide directory of more than 130,000 development activities undertaken or planned by major donor organizations including IDB, IDRC, IMF, MacArthur Foundation, NARSIS, DFID, UNCDF, UNFPA, USAID, and World Bank. In addition, other agencies are aggregators of the AIDA database by region, country, and theme. AIDA's historical repository contains approximately 400,000 project records from 17 other agencies. AIDA is managed jointly by the OECD-DAC, UNDP, World Bank and the Development Gateway Foundation (see entry). No information is available on the AIDA website about its technical specifications. However, in the "Fertile Ground" report, the original AIDA schema was based on International Development Markup Language (IDML), with TCL/TK but migrating to Java software with an Oracle DOM parser required. AIDA also displays information from WISARD (see entry). **(projects)**

Africa: SIST (Scientific and Technical Information System) – [http://www.sist-sciencesdev.net/] - SIST (Système d'information scientifique et technique) is a project that aims to provide a scientific and technical information system for African research from 12 countries (mainly francophone). SIST promotes research by African researchers as well as linkages with information systems in the North. Programmatic themes include health, renewable energy, agronomy and social sciences. SIST also supports planning and development of information and communication systems by organizing workshops and offering an online discussion platform. Dossiers on science and technology issues such as dryland agriculture, food security, and livestock and fisheries are available on the website as are groupings of organizations, events, grants and fellowships, news, and jobs announcements. Summaries of science and technology issues are provided as are automatic news feeds. **(communication; summaries; organizations, events, news, etc.)**

Anancy – [http://www.anancy.net/] – is the virtual resource centre of the Technical Centre for Agricultural and Rural Cooperation (CTA), an international organization initiated in 1984 to improve the flow of information among stakeholders in agricultural and rural development in African, Caribbean, and Pacific countries. Developed in collaboration with the German Ministry of Agriculture, Centre for Documentation and Information in Agriculture (ZADI / ISICAD), Anancy is a relational database and portal to more than 10,000 of the Centre's publications as well as projects and contacts. The database can be searched by collections, themes, country, and region, and offers a multi-criteria web crawler called Bogle. The community platform for CTA training program is provided by eldis – [http://www.eldis.org/cta]. Other partners include Euforic and ARD-Infosys+. **(projects; full-text; experts; multi-search)**

ARD-InfoSys+ - [http://www.infosysplus.org/] – is a delivery platform of the European Information System on Agricultural Research for Development, part of GFAR, whose primary aim is to enable greater knowledge-sharing among European member states (national nodes) as well as with international

organizations. However, all information and communications tools are freely available from the main website. The primary information tool is relational database that provides access to extensive numbers of organizations, projects, experts, events, news items, and funding opportunities. The system is powered by ISICAD (see entry). Search options include free-text searches of the entire database; an advanced search for targeted searches on the six sub-sets listed above; thematic searches on major topics such as plant and animal production, farming systems, forestry, soil, water, environment, fisheries, and water, and which can be limited by geographical area, ecosystem type, and activity focus; and a country search feature. The sub-sets may also be browsed by groupings or as complete lists. A free-text search on "plant breeding" identified 282 ranked organizations, 166 projects, 3 funding opportunities, 11 events, and 51 experts; and limiting the search to South Asia resulted in a listing of 18 projects and 3 experts. A data management system allows registered members to load and edit entries in all sub-sets. Other tools include email alerts based on individual profiles; RSS-feeds of news and events; the Open Source group ware PhProjekt; RUN Journal for accessing electronic articles from the developing world; and a multi-search tool called "bogle" that uses major spiders such as Google, Lycos, and Yahoo to pull in content for customized profiles (also used by CTA). Examples of the latter include topical searches, specific commodities, and news items.
A parallel initiative has been developed for Africa. The **Forum for Agricultural Research in Africa (FARA)** [http://fara.infosysplus.org/] provides access to similar information and tools, as well as the work of the Forum in advocacy, coordination, and ICT policy development, and in its efforts to facilitate "at least 6% annual growth in agriculture by the year 2020." FARA's focus is on Sub-Saharan Africa and works in coordination with three Sub-Regional Fora. One of FARA's regional programs is the Regional Agricultural Information and Learning Systems (RAILS) "which addresses weaknesses and lack of capacity to global agricultural information and knowledge exchange. It is aimed at providing African ARD stakeholders equitable access and capacity to contribute to global information and knowledge" (from RAILS web page). **(interactive content management for organizations; projects, experts, events, etc.)** (see also EGFAR entry)

Bioline International – [http://www.bioline.org.br/] - "is a not-for-profit electronic publishing service committed to providing open access to quality research journals published in developing countries. BI's goal of reducing the South to North knowledge gap is crucial to a global understanding of health (tropical medicine, infectious diseases, epidemiology, emerging new diseases), biodiversity, the environment, conservation and international development." (quoted from USAIN web site "Resources for Librarians in Developing Countries" by L. Pellack)
[http://www.usain.org/developingresources.html]) **(journals service)**

CAB International (CABI) – [http://www.cabi.org] - CABI is a U.K.-based not for profit organization established by a United Nations treaty level agreement between more than 40 Member Countries**.** CABI specializes in scientific publishing (for-profit information products, although special pricing is available for member countries and consortia), research (particularly pest identification and biocontrol), and communication (capacity building). CAB Abstracts and CAB Abstracts Archive proprietary databases provide bibliographic references with comprehensive abstracts to nearly *seven million records* covering global aspects of the applied life sciences back to 1913. Global Health and Global Health Archive are similar services, but with more coverage of international and grey literature on issues of public health including nutrition and food security. CAB Abstracts Plus adds full text resources to the database such as journal articles, conference proceedings, reviews, distribution maps of plant diseases and pests, as well as descriptions of fungi and bacteria. CABI also produces Internet Resources portals on specialized topics that include bibliographic information, full text documents, reference materials, news items, calendars, links to listservs, fact sheets, and job announcements. Topics include: *AgBiotechNet*, *Animal Science*, *Forest Science*, *Nutrition and Food Sciences*, *Organic Research*, and *VetMed Resource*. CABI Compendia, compiled in cooperation with stakeholders around the world, are

interactive, mutlimedia tools available on the topics: *Animal Health and Production, Aquaculture, Crop Protection*, *Forestry*, and *Invasive Species* (under development). Included are diagnostic tools, datasheets, distribution maps, and image collections. The CAB Thesaurus containing more than 48,000 descriptive terms, is used for indexing all CABI products. The CABI website also provides access to a CABI projects database with findings and reports, as well as to news items and blog entries. Delivery Platforms include CABIs own platform, CAB Direct, as well a numerous commercial services. CAB Direct interfaces with the proprietary in-house platform which delivers the web front end of CABI's Internet Resources. A new version of this platform called CIPP (CABI Internet Products Platform) is now being developed and the first product modules are due out late 2007/early 2008. CIPP uses asp.net, C#, CSS, XML, XSL and AJAX technologies. CAB Direct also is Open URL compliant. **(bibliographic/abstracts, full-text; portals; fact sheets; projects, news; mutlimedia tools)**

CGIAR Virtual Library – [http://vlibrary.cgiar.org/V?RN=973737381] – as part of a broader move to be an "organization without boundaries", the Consultative Group on International Agricultural Research (CGIAR) created the CG Virtual Library as a gateway to global agricultural knowledge. This initiative not only supports the work of the 15 international CGIAR centers, but it provides Internet users anywhere with integrated access to all CG Center Library Catalogs as well as more than 200 library and agricultural databases and over 4,000 electronic journal titles. Major agricultural topics covered include soils, water, forestry, fish, food policy and security, rice, AgHealth, and the social sciences. The federated search provides results from AGORA-CABI, AGRIS, AGRICOLA Articles, Eldis, Pub Med, WAICENT Info Finder, AgNIC, AgEcon Search, and many other databases. Library catalogs included in CGVLibrary range from Wageningen, SIDALC, Cornell University, Oxford University, to the U.S. Library of Congress. The search interface is extremely easy to use and the results are quick and descriptive. For a search on "rangelands", the numbers of records found in each location are identified, with the total number at 2,095. Thus, results can be viewed by database or browsed as a full set. The systems runs on a locally hosted commercial software, ExLibris Metalib and SFX Product (open URL link resolver) to link to full-text of subscribed materials as well as those freely available on the web. Future plans include adding more CG publications, projects, and catalogs to the federated search feature, creating more targeted resource sets, and more fully integrating other electronic resources into CGVlibrary (i.e. AGORA, AGRIS, CAB, INASP). CGIAR Virtual Information Center - http://www.cgiar.org/vic/index.html – also offers direct access to each CGIAR centers and a provision for submitting questions that will be answered by experts in their respective fields. **(federated search of multiple databases and library catalogs)**

Development Gateway Foundation (DGF) – [http://www.developmentgateway.org] – is an international non-profit organization with headquarters in Washington, D.C., whose purpose is to reduce poverty by advancing the use of information and communications technology (ICT) in developing countries. The DGF website acts as a portal for development information worldwide and is available in French and Spanish besides English. DGF also operates dgCommunities collaborative spaces both as a place to find knowledge resources and as an interactive space for sharing work, participating in discussions, and finding people with similar interests. Members number 36,000 with over half from developing countries. Topics covered relevant to agriculture include environment and development, water resources management, food security, and ICT for development. One or more volunteer guides who are topic experts facilitate each community. Contents include links to more than 60,000 reports, best practice documents, events, websites, news items and other resources submitted by community members. Customized e-mail alerts are available. Donors include national governments, international organizations such as UNDP and World Bank, and private companies (IBM) and individuals. **(communication; full-text, events, experts, news, etc.)**

DGroups - (Development through Dialogue) [http://www.dgroups.org/] – serves to facilitate online communication and discussion among international development communities. Dgroups offers a

platform along with easy to use tools, devoid of commercial ads, and targeted at low bandwidth users. As of September 2007, the system supported 2,345 groups and contained 38,677 resources. Dgroups is a joint initiative of international funding agencies such as DFID, IICD, and World Bank as well as others; and counts among its users the CGIAR, CTA, FAO, INASP, and IAALD. **(communication)**

e-Agriculture.org – [http://www.e-agriculture.org/examples.html] - is the forum for "a global initiative to enhance sustainable agricultural development and food security by improving the use of information, communication, and associated technologies in the sector. The overall aim of the forum is to enable members to exchange opinions, experiences, good practices and resources related to e-agriculture, and to ensure that the knowledge created is effectively shared and used worldwide." E-Agriculture is one of the action lines identified in the declaration and plan of action of the WSIS. The website offers abstracts and links to worldwide news and events related to the topic, and global examples of stories of projects, activities, or practices that illustrate existing or potential e-agriculture activities. This list provides over 150 resources submitted by participants from over 135 countries and is based on the results from a 2006 survey. **(communication, news, events)**

EGFAR – [http://www.egfar.org/egfar/] – is the website of the Global Forum for Agricultural Research (GFAR). It contains the GFAR Document Repository that provides access to the collections of the GFAR Secretariat and allows authors to self-submit documents. The database system was developed in collaboration with FAO and interfaces with the web through XML, and follows AGRIS AP and AGROVOC standards. An RSS feed of GFAR publications has also been implemented. The GFAR database of organizations is also available in the **Web Ring** section of the site http://www.egfar.org/egfar/website/webring/webring/institutions_db. GFAR is an active partner in the "coherence" movement and is collaborating with partners to make its information resources available on other websites and deliverable on request to our users. XML exports and email alerts are planned. (Giovannetti & Maru 2004) **(organizations; full-text)**

Eldis - [http://www.eldis.org/] – is a free online service offered by the Institute of Development Studies, Sussex, U.K. Its purpose is to provide access to a full array of selected, evaluated, and synthesized resources on development policy, practice, and research. Specifically, Eldis contains more than 22,000 summarized and full-text documents from over 4,500 development organizations, extensive resource guides, dossiers to introduce new issues, country profiles, email newsletters, and newsfeeds, as well as information on jobs and events. Contributions of documents, news, and jobs announcements are actively solicited and can be submitted online. Eldis is funded by Sida, Norad, SDC, and DFID. Its stated purpose is to " support the documentation, exchange and use of evidence-based development knowledge" using customized electronic delivery systems to "reach audiences of researchers, development practitioners and policy formers at national and international levels". No technical specifications about eldis services were available online. **(sythesized information; full-text; portals; interactive content management for documents, news, events, jobs)**

ElFL.net (Electronic Information for Libraries) – [http://www.eifl.net:9080/cps/sections/services] - "eIFL.net is a not for profit organization advocating for the wide availability of electronic resources by library users in transitional and developing countries. Its core activities are negotiating affordable subscriptions on a multi-country consortial basis, supporting national library consortia and maintaining a global knowledge sharing and capacity building network in related areas, such as open access publishing, intellectual property rights, Open Source software for libraries and the creation of institutional repositories of local content." (quoted from home page) Current member countries are located in regions of Africa, South-East Asia, the Middle East, and parts of Europe and the former Soviet Union. **(journals service)**

Euforic (Europe's Forum on International Development) [http://www.euforic.org/] – Established in 1997, Euforic is a platform for information exchange, communication and capacity sharing in international cooperation and development. Euforic makes information on Europe's international cooperation more accessible; facilitates communication and dialogue among organizations involved in Europe's international cooperation; and brokers collaboration, learning and knowledge exchange on international cooperation issues. In recent years it has pioneered web 2.0 approaches to creating and sharing development information. **(organizations)**

Food Science Central - [http://www.ifis.org/ixbin/home?_IXSESSION_=XMc3x_Q95GT&search-form=index.html&submit-button=search&_IXmenu_=1] – is a gateway to both free and subscription-based information on food science, food technology, and food-related human nutrition. It is produced by IFIS Publishing from the International Food Information Service (IFIS), a non-profit organization. Services include Food Science and Technology Abstracts, a database containing more than 740,000 records dating from 1969 to the present. It is a fee-based service available in print format as well as through the Internet and on CD-ROM. Also freely available to registered users on the Internet are scientific articles and reports; information on patents, books, and standards; news items; e-mail alerts; and links to other web resources. **(bibliographic, full-text, news)**

FRAME – [http://www.frameweb.org] **–** is a gateway for sharing knowledge on the environment and natural resources sponsored by the U.S. Agency for International Development (USAID), although the program supporting FRAME involves partner organizations from around the world. The FRAME website offers a platform for discussion of issues, access to a monthly e-newsletter for practitioners and policymakers, and an interactive document repository organized by theme, sub-topics, and region. **(full-text, communication)**

GFIS.net (Global Forest Information Service) – [http://www.gfis.net/gfis/home.faces] - is an interactive gateway to news, events, publications, databases, library and document collections, and job announcements. A link to "providing information" provides guidelines for approved information providers to add content. GFIS.net is an initiative of the Collaborative Partnership on Forests (CPF). It is led by the International Union of Forest Research Organizations (IUFRO), together with FAO, the Center for International Forest Research (CIFOR) http://www.cifor.cgiar.org/, the National Biological Information Infrastructure (NBII) http://www.nbii.org/ and the Secretariat of the United Nations Forum on Forests (UNFF) http://www.un.org/esa/forests/. The Mission of GFIS is to facilitate information and knowledge sharing among the global forestry community by developing common standards and tools and building partnerships. **(interactive content management for news, events, full-text, bibliographic references, datasets, jobs)**

ICT-KM - [http://ictkm.cgiar.org/index.asp] **-** The ICT-KM Program of the CGIAR promotes and supports the use of ICTs and knowledge management to improve the effectiveness of the CGIAR's work on behalf of the poor in developing countries. It includes the development of a CGIAR-wide intranet/extranet system (CGXchange) that provides content, tools and services including the CGVlibrary and a Learning Object Repository (CG Online Learning Resources database - http://learning.cgiar.org/). The home page includes links to communication tools such as a blog, newsletter, and news archive, as well as document library including annual reports. **(communication, full-text, best practices)**

InfoBridge: Sharing Information for Sustainable Development – [http://www.infobridge.org/jml/index.php?option=com_frontpage&Itemid=1] – provides tools to promote partner-controlled services for sustainable development and poverty alleviation managed by the InfoBridge Foundation (IBF)**,** a non-profit organization, founded in 2002 in the Netherlands. The

InfoBridge database is a shared repository of information about sustainable (rural) development and poverty alleviation. It currently contains more than 7,300 records on good practices, experts, organization, and projects and is set up for remote entry. Also available are country guides for various African and South Asian countries, a Forum for discussions, and a news service. Partners in IBF include organizations in India, Bangladesh, Uganda, Zambia, and DFID and the Development Gateway Foundation. **(communication; best practices; projects; organizations; experts)**

InfoSARD – [http://www.infosard.net/infosard/home.htm]- is a freely available platform for use by individuals and organizations around the world who are involved in ARD, IPM, sustainable rural development, and natural resources management. It offers storage capacity and a set of advanced data management tools to enter, manage and share information, mostly notably project, practice, organization and expert information. Specific networks and programs use InfoSARD to run dedicated information services for target user groups, including the CGIAR – Global Project Portfolio, InterSard – Community of Good Practices; RWC-PRISM – Rice-Wheat Consortium, Project and Research Information System for the Indo-Gangetic Plains [http://www.infosard.net/rwc/home.asp]; WISARD – Web-based Information Services for ARD. As with WISARD, efforts are made to achieve high ranking in search engines like Google. InfoSard applies open standards to ensure interoperability with other systems. Also accessible through AIDA and ARD-InfoSys+. Coordination is through WIS International in The Netherlands. **(interactive data management tools for projects; best practices; organizations and experts)**

InterSard – [http://www.infosard.net/intersard/home/home.htm] - is a consortia initiative of non-profit organizations for the purpose of building a network of Southern and Northern partners for the documentation and sharing of information. The focus is on areas of social and technological innovations in sustainable agriculture and the management of natural resources in rural areas. Focal points at organizational, national or regional levels are responsible for data input and management of best practices that are entered into a module built by WISARD. When describing best practices, a number of links are made between other data including projects, organizations, experts, and publications. While WISARD operates on a global scale, InterSard currently covers South and Southeast Asia. Key partners include the AME Foundation www.amefound.org and GEAG www.geag.org, both in India. InterSard-Asia has been implemented with EU funding and there are plans to expand activities to Africa and Latin America in the future. **(best practices; full-text; organizations, projects, experts)**

ISICAD – [http://www.isicad.org/isicad/index.php] -is based at the German Centre for Documentation and Information in Agriculture (ZADI) and has a team of programmers who have developed Open Source information products to support rural and agricultural development work in Africa, Asia and Latin America. Tools available include: a web-based Question and Answer Service "RUNetwork"; the Virtual Library Online that is used for CTA's Anancy; a market-price information- GIS system which provided the platform for the West African Market Information Systems Network (RESIMAO/WAMIS-NET) www.resimao.org; and the "PHProjekt" group ware tools for facilitating communication and presentation. Other tools manage and identify relationships between information on organizations, projects, funding opportunities, experts, news and events such as utilized by ARD-InfoSys+. The system is open and interactive. E-mail alerts and RSS news feeds are available. Partners include CTA, FAO, GFAR, FARA and many others involved in the "coherence" initiative. The ISICAD site is available in English, French, Spanish, German, and Indonesian. **(interactive data management tools for discussions; library databases; GIS systems; and organizations, projects, experts, etc.)**

KIT (Royal Tropical Institute) – [http://www.kit.nl/smartsite.shtml?ch=FAB&id=10158] - is an international, independent knowledge institute located in The Netherlands which hosts a searchable database containing information on project activities of the following KIT Departments: Agriculture & Enterprise Development; Biomedical Research; Health Care Training; Health Care & Disease Control;

Tropenmuseum Information; and Library & Documentation. Database searches are also available for publications, image collections, historical maps, and the library catalog (contains an extensive collection of scientific and popular books, periodicals, articles and maps concerning developing countries). KIT produces customized portals on topics such as Rural Innovation Systems and dossiers on gender issues, ICTs, and knowledge management. **(projects; full-text; portals)**

PERI (Programme for the Enhancement of Research Information) – [http://www.inasp.info/file/105/access-to-journals-and-research-content.html] – is the largest activity of the UK-based International Network for the Availability of Scientific Publications (INASP) which encompasses capacity building in developing countries, particularly in the use of ICTs, and in strengthening local publishing capabilities including disseminating national research. The "access to journals and research content" service offers more than 20,000 full-text online journals, including Africa Journals Online, as well as access to such major database services as CAB Abstracts, and resources from organizations such as the OECD and World Bank. The service provides developing countries with document delivery services and the database is also available via CD-ROM or DVD. **(journals service; full-text)**

WISARD – [http://www/wisard.org/wisard/home.asp] – is the "Web based Information Services for Agricultural Research for Development" platform for providing access to projects, experts, organizations, and other outputs including documents, articles, and web pages. WISARD itself consists of an easy to use interface giving both access to and the ability to input and update information. Currently, WISARD contains more than 15,000 resources that are also available through AIDA and ARD-InfoSys+ (see entries). It is also used as a platform for creating customized portals by other organizations such as FARA, the CGIAR Project Portfolio archive, the InterSard Good Practices database, and the FAO Global IPPM archive. The FAO CARIS projects database is currently integrated with the WISARD platform which now contains over 55,000 records. Developers of WISARD products, based in The Netherlands, are actively engaged with GFAR, FAO, DFID, CTA, and the CGIAR in "coherence" initiatives. New web 2.0 tools and approaches also are being developed for FARA and a Global Horticulture portal including an Open Source discussion application and Open Source virtual learning environment. **(interactive content management for organizations, projects, experts, events; full-text; customized tools)**

International Initiatives Under the Auspices of FAO

AGLINET (Agricultural Libraries Network) – "Coordinated by FAO's David Lubin Memorial Library, AGLINET is a voluntary network of agricultural libraries around the world with strong regional/country coverage and other comprehensive or very specialized subject resource collections. All member libraries provide, upon request, low-cost inter-library loan and photocopy service to other member libraries, bibliographic information, reproductions (fiche or photocopy) and other cooperative activities as appropriate." (taken from USAIN web site "Resources for Librarians in Developing Countries" – [http://www.usain.org/developingresources.html] **(library network)**

AGORA (Access to Global Online Research in Agriculture) – [http://www.aginternetwork.org/en/] – is an initiative begun in 2004 to provide developing countries with access to journal content from major scientific publishers in the fields of food, agriculture, environmental science and related social sciences. Now including more than 1,100 journals, some from French scientific publishers, AGORA is currently serving researchers and students at more than 1,200 institutions in 107 eligible countries including those in Francophone regions. It is produced by a collaboration of public and private partners, including: FAO (Food and Agriculture Organization), major scientific publishers, Cornell University's Mann Library, the Rockefeller Foundation, the UK's Department of International Development (DFID), as well as others. A counterpart covering health journals is **HINARI** (Health InterNetwork Access to Research Initiative) of

the World Health Organization, OARE involving UNEP and partners, and the CD-ROM-based **TEEAL** (The Essential Electronic Agricultural Library). **(journals service)**

AIMS (Agriculture Information Management Standards: interoperability, reusability, cooperation) - [http://www.fao.org/aims/index.jsp] – is an initiative born of the various "coherence" meetings to "facilitate collaboration, partnership and networking among partners by promoting information exchange and knowledge sharing; and to harmonize the decentralized efforts currently taking place in the development of methodologies, standards and applications for management of agricultural information systems; consequently, providing 'one-stop' access to system designers and implementers." The purpose is also to involve as wide a sector of the agricultural community as possible; including information providers, research institutes, academic institutions, educational/extension institutions and also the private sector. **(standards; full-text)**

- **AGRIS Application Profile (AP) -** [http://www.fao.org/agris/Centre.asp?Content=SM&Menu_1ID=SM&Menu_2ID=SM1&Language=EN] - is a metadata standard created specifically to enhance the description, exchange and subsequent retrieval of agricultural materials no matter the format. It is a standard that allows sharing of information across dispersed bibliographic systems and is based on accepted metadata standards such as the Dublin Core Metadata Element set (DCMES) and the Agricultural Metadata Element Set (AgMES). The AGRIS AP user guide provides guidelines on Best Practices for Information Object Description. Generating AGRIS AP XML from local databases is a technical document for how to disseminate and export data from local databases using the AGRIS AP XML format. **(standards)**

- **AgMES : The Agricultural Metadata Element Set** – [http://www.fao.org/aims/agmes_elements.jsp] – is the metadata standard developed by FAO for the description and discovery of agricultural information resources. "The AgMES initiative aims to encompass issues of semantic standards in the domain of agriculture with respect to description, resource discovery, interoperability and metadata exchange for different types of information resources." **(standards)**

- **AGROVOC Thesaurus and AGROVOC Concept Server** – [http://www.fao.org/aims/aos.jsp] - AGROVOC is a multilingual (including 11 languages with others under construction), structured and controlled vocabulary used for AGRIS indexing and designed to cover the terminology of all subject fields in agriculture, forestry, fisheries, food and related domains such as the environment. Currently, an **AGROVOC Concept Server** is being developed for building the Thesaurus into an "ontology service". "Ontology is a new concept that is emerging from the various Semantic Web initiatives, which roughly speaking can be defined as a semantic system that contains terms, the definitions of those terms, and the specification of relationships among those terms. Current activities to create a Concept Server using AGROVOC as the starting point are underway. (see also http://www.fao.org/aims/onto_domains.jsp) **(ontologies/standards)**

The **FAO website -**[http://www.fao.org] – is a comprehensive resource for information on agriculture, forestry, fisheries, sustainable rural development, economics, food and nutrition. Currently, there are approximately 3 million web pages, over 100 databases, and thousands of documents available through the site on key issues in agriculture. Some of the major databases include FAOSTAT (containing over 1 million time-series statistical records from over 210 countries), GIEWS (the Global Information and Early Warning System on Food and Agriculture); and EMPRES (the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases). Links on the homepage include the "Virtual Library" of FAO that provides for the search and retrieval of publications and documents through: The FAO Corporate Document Repository; FAO library catalogue on-line; The FAO Sales Catalogue; and David Lubin Memorial Library on-line. An "Information Finder" search box is the

quick entry point into the meta-search tool developed by the World Agricultural Information Centre (WAICENT) to navigate and access the content of the site. WAICENT was established in 1989 to enhance access to timely and relevant technical information and to encourage FAO members to utilize information as a key resource for development. As such, the WAICENT home page [http://www.fao.org/waicent/] is a portal to FAO databases, FAO news, WAICENT activities, 250 of the main FAO websites, the Information Finder, and to featured sites related to information technology and information access. A relatively new Knowledge Forum site is a gateway to interactive services such as best practices, thematic knowledge networks, and a help section called "Ask FAO" [http://www.fao.org/knowledgeforum/index_en.htm]. Other key databases and websites in this area are described below. Much of the information was adapted from the FAO website. **(portals; search tool)**

FAO's Information for International Agricultural Research site – [http://www.fao.org/agris/Centre.asp?Content=SM&Menu_1ID=SM&Menu_2ID=SM1&Language=EN] - provides access to the AGRIS/CARIS Magazine; the AGRIS/CARIS Network; documentation tools for WebAGRIS, AGRIS AP, and AGROVOC; and links to the AGRIS and CARIS databases as well as the FAO Online Catalog, FAO Resource Finder, and lists of other bibliographic and project databases.

- **AGRIS**– [http://www.fao.org/agris/] – FAO implemented AGRIS in 1975 to begin building an International Information System for the Agricultural Sciences and Technology through the development of a collaborative network of institutions around the world. Currently, the AGRIS bibliographic database contains 2.3 million records including grey literature not generally available through normal channels. This data is now available in AGRIS AP XML format and is collected from AGRIS resource centres in countries worldwide. To date, 240 national, international, and intergovernmental organizations participate in AGRIS development. In the newly implemented AGRIS interface, both "Simple" and "Search Assistant" advanced strategies provide access to the repository. Some records provide a link to the full-text document. Additionally, a Google search for the full text document of a bibliographic record can be executed. AGRIS is multilingual and uses the AGROVOC Thesaurus as its controlled vocabulary. **(bibliographic; full-text; interactive)**

- **WEBAGRIS -** http://www.fao.org/agris/Centre.asp?Content=SM&Menu_1ID=SM&Menu_2ID=SM1&Language=EN - is an AGRIS initiative to provide an advanced system for distributed data input, processing, and dissemination via the Internet or CD-ROM. It is based on common standards of data input and dissemination formats (XML, HTML, ISO2709), as well as subject categorization schema and the AGROVOC Thesaurus. WEBAGRIS also allows for linking to documents in electronic format. New functionality includes sort, print and export options, a multiple database search option, and the ability to save searches. The WEBAGRIS system can host a website for member Centres to facilitate data entry, searching and/or exporting data to the central AGRIS database and/or publishing on CD-ROMs. It can be used as a local application or in a common networked environment to join collections of information (through exporting, harvesting data, etc.). WEBAGRIS can improve accessibility through the use of multi-database searching and harvesting. The system is based on the Web technology and can be run from a standard Internet browser. The current WEBAGRIS version 2.0 was developed by the AGRIS/CARIS and Documentation group of GILW, FAO, in close cooperation with the Institute for Computer and Information Engineering (ICIE), Poland and IICA/CATIE, Costa Rica. It is available in English and Spanish and is included as a main part of the new Integrated Library System for Agricultural Libraries, LISAGR. **(bibliographic; full-text; interactive)**

- **CARIS** – [http://www4.fao.org/caris] - is FAO's Current Agricultural Research Information System for identifying current agricultural research projects being carried out in - or on behalf of - developing countries. CARIS is built cooperatively with international partners and identifies projects dealing with all aspects of agriculture: plant and animal production and protection; post harvest processing of primary agricultural products; forestry; fisheries; agricultural engineering; natural resources and the environment as related to agriculture; food and human nutrition; agricultural economics; rural development, and agricultural administration; legislation, information, education and extension. CARIS itself includes more than 35,000 records, but with its recent merger with WISARD now contains over 55,000 records. **(projects)**

- **FAO Corporate Document Catalogue** - [http://www4.fao.org/faobib/] - provides access to about 140,000 references of FAO documents with about 1,000 of documents available in full text via links to the FAO Document Repository. Format is XML, but also accepts PDFs. **(bibliographic, full-text)**

IMARK - Information Management Resource Kit – [http://www.imarkgroup.org/] is a multilingual, partnership-based, e-learning initiative on information management with outputs on the Internet and on CD-ROM. Modules include Managing Electronic Documents, Building Electronic Communities and Networks, Investing in Information for Development, and Digitization and Digital Libraries, with another module on Networking for Development due out at the end of this year. This partnership initiative, including CTA, IICA, and UNESCO among others, has now distributed over 50,000 CDs throughout the world and has almost 10,000 online learners. **(ICT training)**

oneFish Community Directory [http://www.onefish.org] is described as "a fishery projects portal and participatory resource gateway for the fisheries and aquatic research and development sector." This interactive global service provides access to research and development resources; current news, events, and jobs announcements; as well as a platform for online discussion groups. As of August 2007, oneFish contents numbered 69,288 knowledge objects including project descriptions and reports; 748 topics; and 2,854 members. 79 editors, in addition to the Chief Editor, manage the contents. Major section headings are: Donor/Projects, Aquaculture, Freshwater Fisheries, Marine and Coastal Fisheries, Utilization and Technology, Stakeholders/Organizations, and Virtual Offices. Each section includes sub-topics that may be managed by the Chief Editor or volunteer topic editors or populated by electronically capturing relevant information from originators' systems (or any combination of these three methods). Predominately in English, the service also provides French and Spanish search and browse interfaces. Content can be uploaded by individual researchers and/or organizations which will be reviewed by topic editors/subject specialists prior to acceptance. Contributors may also manage and share their own topic areas and set up permissions for access and development. In addition, "Virtual Offices" provide an opportunity for organizations to manage their own documents and facilitate and archive discussions. oneFish facilitates the online continuation of the FAO Fishery Project Information System (FIPIS), shares data with AiDA, has adopted AiDA IDML international standards for project records, and incorporated the FAO AgMes Standard for other knowledge types. oneFish was developed by the multi-donor funded Support Unit for International Fisheries and Aquatic Research (SIFAR), which was based at FAO from 1998 to 2004, working alongside the FAO Fisheries Department. Customized community directory server (CDS) software, developed by WAICENT, underlies the system, and the AGROVOC thesaurus and specialized keyword lists provide the basis for a controlled vocabulary. Search and retrieval can also be accomplished by email for those with slow Internet access. Following the closure of the SIFAR Project in 2004, oneFish has continued as an independent project hosted by FAO and successively funded by DFID, NORAD, and the World Bank PROFISH Programme. In 2007 oneFish was formerly `adopted' by the FAO Fisheries and Aquaculture Department. (**interactive content management for documents, news, events, jobs; discussion forums)**

SDdimensions: Communication for Development - [http://www.fao.org/sd/kn1_en.htm] – is an FAO program under the newly formed Natural Resources Management and Environment Department that "encompasses many different media and approaches – folk media and traditional social groupings, rural radio for community development, video and multimedia modules for farmer training, and the Internet for linking researchers, educators, extensionists, and producer groups to each other and to global information sources." (from home page). Links are offered to audiovisual aids, distance education tools and case studies and lessons learned on topics such as ICTs, indigenous knowledge, rural radio, gender, and participatory communication**. (case studies, projects)**

Current and Prototype Agricultural Information Services from the Americas

(**Note:** Professional associations such as the U.S. Agricultural Information Network (USAIN) [http://www.usain.org] and the Asociacion Interamericana de Bibliotecarios y Documentalistas Agricolas (AIBDA) [http://www.iica.int/AIBDA/] are actively involved in promoting communication and knowledge sharing among stakeholder groups, as well as the use of the agricultural information services described in this paper).

AgEcon Search (Research in Agricultural and Applied Economics) – [http://agecon.lib.umn.edu/] - is a free, open access repository of full-text scholarly literature in agricultural and applied economics developed and maintained by the University of Minnesota Library and the Department of Economics, but with financial support from USDA, the American Agricultural Economics Association, and the Farm Foundation. Serving as a permanent archive for research materials, authors and organizations can submit working papers, conference papers, journal articles, and other materials directly into the system. The service currently provides access to the contents of 19 scholarly journals and weekly email alerts are offered for announcing new content. Materials in other languages are accepted, but English abstracts are required. Results of searches are returned as PDFs. Topics covered include sub-disciplines such as agribusiness, food supply, natural resource economics, environmental economic, policy issues, agricultural trade, and economic development. AgEcon Search is powered by Dspace and will be released in a new format soon. The beta version includes FAQs, usage statistics, and a persistent URL displayed in each record. The University of Minnesota also is a member of AgNIC and provides agricultural economics content to that system. **(journal service; full-text; interactive)**

AGRICOLA/NAL Catalog – [http://agricola.nal.usda.gov/] – this database serves as the catalog to the USDA National Agricultural Library's (NAL) collections as well as an index to extensive agricultural information from around the world. One of the major international agricultural databases, dating from 1970, and now containing more than 4.1 million records, AGRICOLA is comprised of two bibliographic databases, the NAL Online Public Access Catalog (primarily books, audiovisual, and other materials) and the Article Citation Database (articles from 633 journals and including book chapters, reports, and reprints). Search results: plant breeding (more than 10,000) and Africa (283); water harvesting (321); rangelands (4,889); Malawi (1,175). Although primarily an index, many thousands of the current listings have direct links to the full-texts of the documents cited. AGRICOLA offers quick, keyword, basic, and advanced search capabilities. The NAL Agricultural Thesaurus (NALT) and Library of Congress Subject Headings (LCSH) serve as the controlled vocabularies for indexing and cataloging records. AGRICOLA technical specifications are available on the NAL website [http://agricola.nal.usda.gov/help/specs.html] and the system is Z39.50 compliant. **(bibliographic; full-text)**

Agriculture Network Information Center (AgNIC) - [http://www.agnic.org/] – begun in 1995, the AgNIC alliance and partnership now numbers nearly 60 voluntary member organizations and institutions, including the USDA National Agricultural Library (NAL), U.S. land-grant institutions, the American Distance Education Consortium (ADEC), the Canadian Agricultural Library, and Latin American organizations such as SIDALC (Agricultural Information and Documentation System for America). Initially, the purpose was to provide single-point access to selected, reliable agricultural information

through linked websites on specialized topics developed by each partner, with partners contributing metadata to a central database. However, newer technologies, limited institutional resources, and time constraints on individuals has limited the development of the central database concept to only a portion of the content. There are more than 8,000 selected resources available through the search and browse functions. Search results: water harvesting (3); plant breeding (45); rangelands (26); Africa (36). Current particular strengths of the AgNIC website are its international Calendar of agriculture-related events, News items from around the world, and links to partner websites. RSS feeds of the searches from the search page and the calendar and news are available. The National Agricultural Library Thesaurus (NALT) is the controlled vocabulary used for the browse function. The current technology incorporates a number of Open S ource technologies including Zope, Plone, and various products from the Apache Software Foundation. **(subject portals; events and news; interactive)**
(prototype) AgNIC External Full-Text - "AgOAI" - (contact Melanie Gardner for access [mgardner@nal.usda.gov] - AgNIC has developed this service pulling in metadata from targeted full-text, open access repositories. Currently, this growing list includes nine resources such as African Journals Online, Organic Eprints, and university-based institutional repositories. This service contributes nearly 15,000 additional metadata resources to the overall AgNIC search. Access to this set of recofd is allowed on the "advanced search" section on AgNIC. The display is uncluttered and document retrieval is quick and meaningful. Document titles and descriptions are provided along with the URL to the complete document. Results of searches: Malawi (0); water harvesting (370) and Africa (375); plant breeding (793) and Africa (796); rangeland* (1). This service is an example of OAI harvesting of selected full-text repositories. The harvester used was OCLC's OAIHarvester2. **(federated harvesting; full-text)**

Current Research Information System (CRIS) –[http://cris.csrees.usda.gov/Welcome.html] – this database provides access to more than 40,000 ongoing and recently completed research, education, and extension projects sponsored by the U.S. Department of Agriculture. Project information is entered into CRIS through a website maintained by the University of Vermont. This information remains in the database for two years after the project end date. The home page also provides quick links to project information on such hot topics as mad cow disease, avian influenza, obesity, and food safety. General "assisted" searches are easy to use. Search results lead quickly to full reports and names of researchers. Sample searches: rangelands (721) and Africa (40); plant breeding (1,826) and Africa (86) and India (71); water harvesting (64); Malawi (17). However, the results are somewhat misleading in that a term such as India may only be mentioned in a report or as a reference to the location of a researcher and not a focus of a particular project. Plans now are to move CRIS into a relational database environment in early 2008 utilizing Oracle on a Linux platform, with applications development in JSP/JAVA. However, for the immediate future, the presentation layer will remain the same. **(projects)**

eXtension – [http://www.extension.org] – Although specifically targeted to American consumers, a description of eXtension is included here because of the potential relevance of Cooperative Extension materials to the international community. Taking a similar approach to AgNIC, the public face of eXtension are portals on selected topics such as: entrepreneurship, personal finance, horses, wildlife damage management, and imported fire ants. Others in the works cover the topics cotton, consumer horticulture, and dairy cattle. These "communities of practice" are developed by groups of extension professionals in more than 70 U.S. universities, many on a voluntary basis. Included in the portals are full text articles, news and events, and extensive lists of frequently asked questions (FAQs). For behind the scenes information about eXtension activities, plans, and online professional development opportunities, the website [http://about.extension.org] provides more information. **(subject portals including extension materials and faqs)**

IDRC Digital Library (International Development Research Centre) – [https://idl-bnc.idrc.ca/dspace/help/about_en.html] – provides access to a repository of documents generated since 1970 by IDRC-funded projects, IDRC funding recipients, and IDRC staff about subjects related to

international development. The repository is Open Source running on a DSpace platform and is in the process of being made available in an OAI-PHM (Open Archives Initiative Protocol for Metadata Harvesting) compliant platform. Included in the repository are final technical reports, theses, articles, books, workshop reports, conference proceedings and evaluation reports. Approximately 20% of the repository is full-text; the IDRC offers document delivery for other materials. **(bibliographic, full-text)**

(prototype – may not be available after October 2007) National Digital Library for Agriculture (NDLA) [http://ndla.nal.usda.gov/]– Currently only a design concept, the NDLA prototype provides a simple search interface to a variety of resources from 9 partner organizations, including AgNIC, the FAO Corporate Document Repository, and data sources from 48 content providers (including the 17 scientific and technical organizations and 13 U.S. federal agencies that contribute to science.gov). In much the same format as science.gov, search results returned a list of ranked items that identify the contributing service and some additional descriptive information, although there are some obvious problems with erroneous abstracts. Sample searches included water harvesting and Africa (27), Malawi (729 – largely NASA references), plant breeding (307 results) and rangelands (405 results). In this version, links to full-text were problematic. Additional services piloted included links to: USA.gov news feeds, gmail for asking a question, OCLC World Cat link to library catalogs, and local Extension agents and weather reports. The developers of the site, the USDA National Agricultural Library (NAL), request comments, suggestions, and help in directing the development of the NDLA. Commercial software, "Explorit" developed by Deep Web Technologies, powers the federated search function. **(federated search of multiple databases and resources)**

Plant Management Network – [http://www.plantmanagementnetwork.org/] – Although primarily an institutional subscription service, the Plant Management Network is a different model for delivering full text content. It is a subscription service to four peer-reviewed journals: *Applied Turfgrass Science*, *Crop Management*, *Forage and Grazinglands*, and *Plant Health Progress* (recently added to AGORA) as well as to a number of specialized related resources. However, it also offers two freely available search and retrieval services. The "Plant Science Database" delivers several thousands of resource pages (including research articles, news items, and management recommendations) from partner universities, companies, and associations. In addition, the new "Ag and Plant Science Info from Partner Institutions" gives quick access to partner institutions extension and other applied science materials. A search on "rangelands and Africa" netted 29 documents. **(subscription journal service; free full-text, news, and extension materials)**

SIDALC – [http://orton.catie.ac.cr/] – is the Agricultural Information and Documentation System of the Americas (Latin America and the Caribbean), established in 1999 by the Inter-American Institute for Cooperation on Agriculture (IICA) and also in collaboration with the Tropical Agricultural Research and Higher Education Center (CATIE), both based in Costa Rica. "One of the most important components of the SIDALC is its document collection. A megabase of agricultural data known as Agri2000 was developed and is maintained by the Orton Memorial Library (IICA/CATIE). In addition, the system has other, non-document resources contributed by the different agricultural information services and systems at the national, regional and hemispheric levels. These will underpin the Agricultural Information Finder, which combined with Agri2000, will form the Agricultural Virtual Library. The operation of this hemispheric network is based on the information resources and installed capacity of IICA and the institutions that are an active part of the national networks of libraries." (quoted from the site) SIDALC also participates in AgNIC and AGRIS. **(bibliographic; full-text; projects and experts)**

Appendix 2 - Glossary

ADEC – American Distance Education Consortium
AGMES – Agricultural Metadata Element Set
AgNIC – Agriculture Network Information Center
AGORA – Access to Global Online Research in Agriculture
AGRIS – International Information System for the Agricultural Sciences and Technology
AGROVOC – Multilingual Agricultural Thesaurus
AIMS – Agricultural Information Management Standards
AOS – Agricultural Ontology Service
ARD - agricultural research and development
CABI– formerly the Commonwealth Agricultural Bureau, now CAB International
CATIE - Tropical Agricultural Research and Higher Education Center
CGIAR - Consultative Group on International Agricultural Research
COAIM - Consultation on Agricultural Information Management
CTA - Technical Centre for Agricultural and Rural Cooperation
DFID – Department for International Development (UK)
DESA – UN Department of Economic and Social Affairs
ElFL.net – Electronic Information for Libraries
EGFAR - electronic GFAR
ESCAP - United Nations Economic and Social Commission for Asia and the Pacific
FAO - Food and Agriculture Organisation of the United Nations
FARA - Forum for Agricultural Research in Africa
FAS – Foreign Agriculture Service (U.S.)
GFAR - Global Forum on Agricultural Research
Global.RAIS – GLOBal Alliance of the Regional Agricultural Information Systems
GPP - Global Partnership Programmme
GTZ - Deutsche Gesellschaft für Technische Zusammenarbeit
HINARI - Health InterNetwork Access to Research Initiatives
IAALD – International Association of Agricultural Information Specialists
ICT - Information and Communication Technology
IDRC - International Development Research Centre
IDS – Institute of Development Studies (UK)
IFAD – International Fund for Agricultural Development
IFIS – International Food and Information Service
IICA - Inter-American Institute for Cooperation on Agriculture
IICD - International Institute for Communication and Development
IMARK - Information Management Resource Kit
ITU - International Telecommunications Union
INASP – International Network for the Availability of Scientific Publications
MDGs - millennium development goals
MIS - management information system
NAIS - National Agricultural Information Systems
NAL – USDA National Agricultural Library
NGO - non-governmental organization
OAIS – Open Archives information system
OECD – Organization for Economic and Co-Operative Development
PERI – Programme for the Enhancement of Research Information
RAIS - regional agricultural information system
SIDALC - Agricultural Information and Documentation System of the Americas
TEEAL – The Essential Electronic Agricultural Library
USAID – United States Agency for International Development
USAIN – United States Agricultural Information Network
WAICENT – World Agricultural Information Centre (FAO)
WSIS – World Summit on Information Society
ZADI – German Centre for Documentation and Information in Agriculture

Appendix 3

Table: Capabilities of Agricultural Information Initiatives

	Bibliographic	Full-text	Portal	Projects	Journals	Communication	Best Practices	Events, News	Organizations	Experts	Multimedia	Standards/tools	Federated/\multi-search	Synthesized Info	Library services	Custom Tools	Interactive
AIDA				x													
Africa SIST						x		x	x					x			
Anancy		x		x						x							
InfoSys+				x				x	x	x						x	x
Bioline					x												
CAB Abs	x											x					
CAB Abs+	x	x															
CABI Int. Resources	x	x	x	x				x						x			
Compendia											x						
CABI projects				x				x									
CGVL													x		x		
DGF		x	x			x		x		x							
DGroups						x											
e-agriculture				x			x	x									
EGFAR		x							x								
Eldis		x	x					x						x		x	x
EIFL.net					x												
Euforic									x								
Food Science	x	x						x									
FRAME		x				x											
GFIS.net	x	x						x									x
ICT-KM								x							x	x	
InfoBridge				x			x		x	x							
InfoSARD		x		x			x		x	x						x	x
InterSard		x		x			x		x	x							
ISICAD				x		x		x	x	x					x	x	x
KIT		x	x	x													
PERI		x			x												
WISARD		x		x				x	x	x						x	x
AGLINET															x		
AGORA					x												

	Bibliographic	Full-text	Portal	Projects	Journals	Communication	Best Practices	Events, News	Organizations	Experts	Multimedia	Standards/tools	Federated/\multi-search	Synthesized Info	Library services	Custom Tools	Interactive
AIMS		x										x					
AGRIS AP												x					
AgMES												x					
AGROVOC												x					
FAO website InfoFinder			x										x				
AGRIS	x																x
WEBAGRIS	x	x															x
CARIS				x													
FAO DocCat		x															
IMARK											x					x	
oneFish		x				x		x									x
Communication for Devlt				x												x	
AgEcon Search		x			x												x
AGRICOLA	x	x										x					
AgNIC		x	x					x								x	x
AgOAI		x														x	
CRIS				x													x
e-Xtension			x				x										
IDRC-DL	x	x															
NDLA													x				
Plant Mgt Network	x				x			x									
SIDALC	x	x	x							x							x

Appendix 4

References

(**Notes:** (1) FAO documents are organized from earliest to most current date; (2) some FAO documents are listed by author name; (3) *IAALD Quarterly Bulletins* include many relevant articles to the topic of this paper that are not included in this bibliography; (4) only a few key documents on ICTs are referenced here; and (5) many of these publications were also used in compiling the above profiles)

Three papers have been marked with ***. This is the author's note indicating that these reports are "must reads."

AgNIC. [2006]. AgNIC Highlights–1995 to Present. http://www.agnic.org/about/history/highlights

Alvarez, L.M. 2006. CGIAR Virtual Library. AgNIC 11th Annual Meeting, 27-28 April, 2006, Beltsville, MD, USA. http://www.agnic.org/about/proceedings/meetings/CoordCom/agnic-coordinating-committee-meeting-2006/cgiar.ppt

Asaba, J.F., et al. 2006. Bridging the Information and Knowledge Gap between Urban and Rural Communities through Rural Knowledge Centres: Case Studies from Kenya and Uganda. *IAALD Quarterly Bulletin* 51(3/4): 143-151.

Ballantyne, P. 2004. Enhancing Access to Scientific Information: How INASP Seeks to Strengthen the Scientific Information and Publishing Capacities of Developing Countries. *IAALD Quarterly Bulletin* 49(3/4): 84-88.

Ballantyne, P. 2007. Personal communication, September 19, 2007.

Besemer, H., C. Addison, and J. Ferguson. Fertile Ground: Opportunities for Greater Coherence in Agricultural Information Systems. Research Report No. 19, December 2003. The Hague: International Institute for Communication and Development. http://www.ftpiicd.org/files/research/reports/report19.pdf

Besemer, H. and C. Addison. Coherence in Agricultural Information. Report of an expert workshop, held on 19-20 May 2005 in Lexington, USA. ftp://ftp.fao.org/gi/gil/consultations/lexington_report.pdf

***CGIAR. [2007]. Global Public Goods: From Data and Information to Food. http://ictkm.cgiar.org/document_library/program_docs/IP06_Strategic_Docs/ICT-KM_GPG_Strategy.pdf

Chapman, R., T. Slaymaker, and J. Young. 2003. Livelihoods Approaches to Information and Communication in Support of Rural Poverty Elimination and Food Security. London: Overseas Development Institute.

Chisenga, J., J. Keizer, S. Rudgard, I. Onyancha, and R.P. Zwart. 2006. FAO's Capacity Building Initiatives in Accessing, Documenting, Communicating, and Managing Agricultural Information. *IAALD Quarterly Bulletin* 51(3/4): 170-176.

CTA. Meeting Report: Content Management Task Force – International Information Systems for Agricultural Science and Technology, 1-2 March, 2007. Wageningen, The Netherlands: Technical Centre for Agricultural and Rural Cooperation.
ftp://ftp.fao.org/gi/gil/gilws/aims/publications/papers/20070416CMTF-Report.pdf

Dodsworth, E. 2004. Knowledge Tools for Decision Support: CABI's Contribution. *IAALD Quarterly Bulletin* 49(3/4): 92-95.

e-Agriculture Working Group. 2007. Analysis of Global e-Agriculture Survey.
http://www.e-agriculture.org/fileadmin/uploads/documents/survey-analysis-2007.pdf

ESCAP. Assessment of the Status of the Implementation and Use of ICT Access Points in Asia and the Pacific. United Nations Development Account Project on Knowledge Networks through ICT Access Points for Disadvantage Communities. March 2007. United Nations Economic and Social Commission for Asia and the Pacific.
http://www.unescap.org/icstd/applications/projects/DAKN/TelecentresAsiaPacific.pdf

FAO. 1998. A new direction for FAO's information services: the World Agricultural Information Centre (WAICENT). Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/009/ah505e/ah505e00.pdf

FAO. 2000. Report of the First Consultation on Agricultural Information Management (COAIM). Rome, Italy, 5-7 June 2000. Rome: Food and Agriculture Organization of the United Nations.
http://www.fao.org/docrep/x7936e/x7963e00.htm

FAO. 2002. Second Consultation on Agricultural Information Management (COAIM). Information Document. AGRIS – A Strategy for an International Network for Information in Agricultural Sciences and Technology within the WAICENT Framework. Rome, Italy, 23-25 September, 2002. Rome: Food and Agriculture Organization of the United Nations.
http://www.fao.org/DOCREP/MEETING/005/AC502E.HTM

FAO. 2004a. Applying New Trends to the Management of Bibliographic Information on Agriculture. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/008/af233e/af233e00.pdf

FAO. 2004b. From Thesauri to Ontologies: A short case study in the food safety area in how ontologies are more powerful than thesauri From thesauri to RDFS to OWL. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/008/af236e/af236e00.htm

FAO. 2004c. Information and Communication for Development in Support of Rural Livelihoods. Project Document. FAO/Government Cooperative Programme. Version 19/10/04.

FAO. 2004d. Metadata Exchange without Pain: the AGRIS AP to Harvest and Exchange Quality Metadata. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/008/af235e/af235e00.pdf

FAO. 2004e. Report of the FAO Expert Consultation on Mechanisms for Documenting and Disseminating Outputs of Agricultural Research in Sub-Saharan Africa, 12-14 May 2004. CAB International, Africa Regional Centre, Nairobi, Kenya. Rome: Food and Agricultural Organization of the United Nations. ftp://ftp.fao.org/gi/gil/consultations/report_nairobi_en.pdf

FAO. 2005a. The AGRIS Application Profile for the International Information System on Agricultural Sciences and Technology Guidelines on Best Practices for Information Object Description. Rome: Food and Agriculture Organization of the United Nations.
http://www.fao.org/docrep/008/ae909e/ae909e00.htm

FAO. 2005b. Expert Consultation - International Information Systems for Agricultural Science and Technology – Review of Progress and Prospects. 19-21 October 2005. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/gi/gil/consultations/consult_infosys_en.asp

FAO. 2005c. FAO's Approach to WSIS 2005: Bridging the Digital Divide. . Rome: Food and Agriculture Organization of the United Nations.
http://www.fao.org/rdd/doc/FAO%20Approach%20to%20WSIS2005.pdf

FAO. 2006a. FAO's Capacity-Building Initiatives in Accessing, Documenting, Communicating and Managing Agricultural Information. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/009/ah802e/ah802e00.pdf

FAO. 2006b. From AGROVOC to the Agricultural Ontology Service / Concept Server. Rome: Food and Agriculture Organization of the United Nations. ftp://ftp.fao.org/docrep/fao/009/ah801e/ah801e00.pdf

FAO. 2006c. Seventh Agricultural Ontology Services Workshop on the "Ontology-based Knowledge Discovery: Using Metadata and Ontologies for Improving Access to Agricultural Information" – Workshop Report. 10-11 November 2006, Bangaluru, India: Indian Institute of Sciences. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/gi/gil/gilws/aims/publications/workshops/AOS_7/AOSworkshop_Bangalore.pdf

FAO. 2007a. Advocacy Task Force Progress Report. 2nd Expert Consultation: International Information Systems for Agricultural Science and Technology (IISAST). Rome: Food and Agriculture Organization of the United Nations.

***FAO. 2007b. An Architecture for Open Archive Network in Agricultural Science and Technology. 2nd Expert Consultation: International Information Systems for Agricultural Science and Technology (IISAST). Rome: Food and Agriculture Organization of the United Nations.

FAO. 2007c. Content Management Task Force Progress Report. 2nd Expert Consultation: International Information Systems for Agricultural Science and Technology (IISAST). Rome: Food and Agriculture Organization of the United Nations.

FAO. 2007d. First AGROVOC E-Conference Report. Rome: Food and Agriculture Organization of the United Nations. ftp://ftp.fao.org/gi/gil/gilws/aims/publications/papers/AGROVOC_E-Conference_Full_report.pdf

FAO. 2007e. Ontology-based navigation of bibliographic metadata: example of the Food, Nutrition and Agriculture Journal. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/009/ah765e/ah765e00.pdf

FAO. 2007f. National Case Studies. 2nd Expert Consultation: International Information Systems for Agricultural Science and Technology (IISAST). Rome: Food and Agriculture Organization of the United Nations.

FAO. 2007g. Requirements for the Treatment of Multilinguality in Ontologies within FAO. Rome: Food and Agriculture Organization of the United Nations.
ftp://ftp.fao.org/docrep/fao/009/ah765e/ah765e00.pdf

FAO. [2007a] AGROVOC Flyer. ftp://ftp.fao.org/gi/gil/gilws/aims/references/flyers/agrovoc_en.pdf
Metadata Flyer. ftp://ftp.fao.org/gi/gil/gilws/aims/references/flyers/metadata_en.pdf
Ongologies Flyer. ftp://ftp.fao.org/gi/gil/gilws/aims/references/flyers/ontologies_en.pdf

FAO. [2007b] Consultation Draft: Business Proposal: E-Agriculture Community of Practice. (unpublished)

FAO. [2007c] Flyer for A Global Perspective on E-Agriculture: People, Institutions, Technology, 21-28 September 2007.

Gardner, M. , J. Gilbertson, B. Hutchinson, T. Lynch, J. McCue, and A. Paster. 2002. Partnering for Improved Access to Agricultural Information: The Agriculture Network Information Center (AgNIC) Initiative. *ARL Bimonthly Report* 223. http://www.arl.org/bm~doc/agnic1.pdf

Gardner, M. et al. 2005. Standards for Interoperability – Agricultural Information and Outreach: Draft preliminary report, April 1, 2005. (unpublished)

GFAR. [2005] Furthering the Sharing and Exchanging Agricultural Research and Development Information: A GLOBal.RAIS Proposal. Rome: Global Forum on Agricultural Research.

GFAR. 2004. GLOBAL.RAIS Inter-Regional Workshop: Towards a Global Agenda for ICM in ARD. June 10-11, 2004, Rome, Italy. Rome: Global Forum on Agricultural Research.

Giovannetti, J.F., and A. Maru. 2004. Information and Communication Management in Agricultural Research for Development: The ICM4ARD Proposal from the Regional Fora and GFAR as a Global Framework for Action. *IAALD Quarterly Bulletin* 49(3/4): 99-104.

Heatley, R. 2005. Potential Areas for Collaboration within a Digital Land Grant Information System.
http://www.usain.org/library_extensioncollab/Heatleycollab.html

Heatley, R. 2007. Plan to Develop a Digital Information Infrastructure to Manage Land Grant Information. http://www.adec.edu/whats-new.html

Howard, J. 1986. The National Agricultural Library as a Source of Agricultural Information. *IAALD Quarterly Bulletin* 31(3): 131-135.

Hutchinson, B, et al. 2005. Collaboration and Cooperation among Libraries, Cooperative Extension and Agricultural Experiment Stations in Land-Grant Universities: The Results of a 2004-05 Survey.
http://www.usain.org/library_extensioncollab/CollaborationReportFinal6-05.pdf

Hutchinson, B., and A.P. Grieder, eds. 2002. Using the Agricultural, Environmental, and Food Literature. New York: Marcel Dekker, Inc. (In particular Chapter 1: An introduction to the literature and general sources by A.P. Grieder and Chapter 15: International Rural Development and Rural Sociology by A.L. Hayden).

IICD. 2006. ICTs for Agricultural Livelihoods: Impact and Lessons Learned from IICD Supported Activities. The Hague: International Institute for Communication and Development. http://www.iicd.org/articles/booklet-impact-agric

IMARK. Information Management Resource Kit. http://www.imarkgroup.org/

Interagency Panel for Assessment of the National Agricultural Library. 2001. Report on the National Agricultural Library – 2001. Washington D.C.: USDA.

ITU. 2007. World Information Society 2007 Report: Beyond WSIS: Executive Summary. International Telecommunications Union and United Nations Conference on Trade and Development. http://www.itu.int/osg/spu/publications/worldinformationsociety/2007/WISR07-summary.pdf

Kaloyanova, S., I. Onyancha, G. Salokhe, Ward, F.L.H., and J. Keizer. 2007. Information Technologies and Standards for Agricultural Information Resources Management: AGRIS Application Profile, AGROVOC, and LISAGR. Rome: Food and Agriculture Organization of the United Nations. ftp://ftp.fao.org/docrep/fao/010/ag870e/ag870e00.pdf - Also, *IAALD Quarterly Bulletin* 52(1/2): 17-21.

Kapange, B. 2006. Agricultural Information: Improving Access to Remote Areas in Tanzania. *IAALD Quarterly Bulletin* 51(3/4): 152-158.

Lwoga, E.T. and W. Chilimo. 2006. Open Access and Open Source: Considerations for Agricultural Academic Libraries in Promoting Collaboration and Sharing of Information and Knowledge. *IAALD Quarterly Bulletin* 51(3/4): 177-185.

Lynch, D.A. Improving Access to Research Results: Six Points. *ARL: A Bimonthly Report on Research Library Issues and Actions from ARL, CNI, and SPARC*, no. 248 (October 2006): 5-7. http://www.arl.org/bm~doc/arlbr248sixpoints.pdf

Mann, E. J. 1986. Past, Present, and Future Developments in the Transfer and Dissemination of Agricultural Information: The Case for a Single, Coordinated, World Agricultural Information System. *IAALD Quarterly Bulletin* 31(1): 5-9.

McCue, J. et al. 2005. "Stocking the Shelves" Report. Leadership Council for Agricultural Information and Outreach. Subcommittee on Content. [currently unpublished]

OECD. Good Practice Paper on ICTs for Economic Growth and Poverty Reduction. World Summit on the Information Society, Geneva 2003 – Tunis 2005. Document WSIS-II/PC-3/CONTR/1-E. OECD http://www.oecd.org/dataoecd/2/46/35284979.pdf

Onyancha, I., J. Keizer, and S. Katz. A Dublin Core Application Profile in the Agricultural Domain. DC-2001. International Conference on Dublin Core and Metadata Applications, Tokyo, Japan, 22-26 October, 2001. Rome: Food and Agriculture Organization of the United Nations.

OAI. Open Archives Initiative Frequently Asked Questions website http://www.openarchives.org/documents/FAQ.html, accessed September 14, 2007.

Pellack, L. [2005] Resources for Librarians in Developing Countries. United States Agricultural Information Network Web site http://www.usain.org/developingresources.html

Poley, J. Personal communication, September 2007.

Rao, M. 2001. Spanning the Digital Divide: Understanding and Tackling the Issues. World Summit on the Information Society website: http://www.bridges.org/spanning/report.html

Read, H. 1974. Partners with India: Building Agricultural Universities. Urbana-Champaign, Illinois, USA: University of Illinois at Urbana-Champaign, College of Agriculture. (For the Council of United States Universities for Rural Development in India).

Roling, N. Communication for Development in Research, Extension, and Education. Paper presented at the 9th UN Roundtable on Communication for Development, 6-9 September 2004, Rome, Italy. http://www.fao.org/nr/com/gtzworkshop/RolingPaperENG.pdf

Salokhe, G. et al. 2004. FAO's Role in Information Management and Dissemination – Challenges, Innovation, Success, Lessons Learned. Rome: Food and Agriculture Organization of the United Nations. ftp://ftp.fao.org/docrep/fao/008/af238e/af238e00.pdf – Also, *IAALD Quarterly Bulletin* 49(3/4): 73-83.

Subirats, I., I. Onyancha, G. Sakokhe, and J. Keiser. 2007. Towards an Architecture for Open Archive Networks in Agricultural Sciences and Technology. Rome: Food and Agriculture Organization of the United Nations. ftp://ftp.fao.org/docrep/fao/009/ah766e/ah766e00.pdf

UN. 2005. The UN Millennium Development Goals website. http://www.un.org/millenniumgoals/

USAIN Task Force. Developing the Next Generation Information Infrastructure to Ensure America's Leadership in Agricultural Sciences in the 21st Century [Draft]. [2007]. A background document commissioned by the U.S. Agricultural Information Network (USAIN). In press.

Varley, J. B. oneFish Community Directory Project: Sharing Knowledge, Experiences, Best Practice and Lessons Learned in an Open Environment. Poster Presentation at the Euraslic, 4-6 May 2005, Split, Croatia. http://www.onefish.org/servlet/BinaryDownloaderServlet?filename=1116331202016_oneFish_Euraslic05_Poster_Paper.doc&refID=256518

Wikipedia. The Free Encyclopedia that Anyone Can Edit. http://en.wikipedia.org/

***World Bank. 2007. Using Information and Communication Technologies (ICT) to support Rural Livelihoods: Evidence, Strategies, Tools. Summary of Key Points from Presentations and Discussions at a workshop for World Bank staff. http://www.infodev.org/en/Article.130.html

WSIS. 2003. Declaration of Principles: Building the Information Society, a global challenge in the new Millennium. http://www.itu.int/dms_pub/itu-s/md/03/wsis/doc/S03-WSIS-DOC-0004!!MSW-E.doc

WSIS. 2005. WSIS Executive Secretariat: Report on the WSIS Stocktaking. http://www.itu.int/wsis/documents/doc_multi.asp?lang=en&id=2167|0

Young, P. 2004. National Digital Library for Agriculture. *IAALD Quarterly Bulletin* 49(3/4): 114-120.