



CASE STUDY

Kenya Agricultural Information Network (KAINET)

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ABREVIATIONS AND ACRONYMS

AGORA	Access to Global Online Research in Agriculture
AGRIS	International Information System for the Agricultural Sciences and Technology
AIRC	Agricultural Information and Resource Centre
AJOL	African Journals Online
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
ICM	Information and Communication Management
ICT	Information and Communication Technology
INASP	International Network for the Availability of Scientific Publications
ISP	Internet Service Provider
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KENET	Kenya Education Network
KLISC	Kenya Library Information Services Consortium
LAN	Local Area Network
NARL	National Agricultural Research Laboratory
PERI	Programme for the Enhancement of Research Information
TEEAL	The Essential Electronic Agricultural Library

EXECUTIVE SUMMARY

Kenya Agricultural Information Network (KAINet) was formed in 2006 to provide an information and technology enabled platform that enhances access and exchange of coherent agricultural information for different audiences. This was in response to the growing need among local and international agricultural stakeholders to exchange and access agricultural research outputs. KAINet promotes the use of methodologies, standardized tools and processes that maximize information collection, storage, retrieval and sharing among member institutions and individuals. Through these mechanisms, institutions under KAINet are encouraged to develop guidelines that define their information and communication management activities for positive impact and sustainability, while consolidating national agricultural information resources for increased availability and visibility to the public. The founding members of KAINet are Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI), KARI-National Agricultural Research Laboratories (KARI-NARL) and Ministry of Agriculture (MoA).

With regard to institutional readiness for openness of agricultural research outputs; all the partner institutions in KAINet have made significant changes in the development of their information infrastructure since 2006. All the five institutions collaborated in the development of a central digital repository (KAINet repository). However, further developments in individual institutions have been defined by local policy, administrative and infrastructural environments. For example, of the five institutions, KARI's and MoA's content on the institutional digital repositories could be accessed via the institutional websites, the KAINet website and the LAN. KEFRI's digital repository was not open to the general public/scientific community but could be accessed through the institutions' LAN. The digitization process in KEFRI, MoA, and KARI-NARL was slow due to inadequate equipment and understaffing within the libraries and documentation centres of these institutions. JKUAT halted the activities of data input since there was no clear policy on intellectual property rights in place. Out of the five institutions that were participating in KAINet, KARI had been able to make considerable progress towards ensuring that the metadata of most of its research outputs were included in the repository, as demonstrated in the high number of metadata records it has created in comparison with the other partner institutions. However, there are a limited number of full text articles in the KAINet repository. Lack of IPR, IR and ICM policies in the KAINet member institutions is a major impediment to openly sharing the full text versions of the research outputs, especially journals, theses, dissertations and other information on agricultural innovations.

The study found that efforts have been made by KAINet member institutions to share agricultural research information beyond the traditional consumers: the researchers. Various strategies are used to disseminate research outputs to stakeholders in the agricultural food chain. In order to reach farmers, extension agents, researchers, academic groups, policy makers, civil society and the general public, various pathways are used to disseminate information in formats that each group can understand. They include the use of radio, TV, agricultural shows, field days, exhibitions, road shows,

brochures, leaflets, and journal publications. At institutional level, the use of Web 2.0 has not been widely embraced for sharing research outputs. There were cases of the use of these tools e.g. sharing video clips on YouTube and RSS feeds; and isolated cases of the use of the tools at the individual researcher level.

Challenges facing KAINet include: limitations in capacity in terms of adequate levels of trained staff and equipment for e-repositories management; lack of a policy framework relating to IPR and ICM; lack of funds; unreliable internet connectivity; lack of ownership of KAINet among member institutions; and lack of focused and supportive leadership in KAINet. One key lesson learnt is that the sustainability of information sharing networks is founded on: strong, top level institutional management structures working in liaison with a network committee and supported by policy frameworks; and a strong coordinating unit for managing the network including an MoU for members that clearly outlines the roles and responsibilities of each. Further, to sustain the network, a clear fundraising strategy should be put in place and could include contribution by members towards the network activities. Integration of KAINet activities within institutional work schedules should also be done. In addition, all member institutions should be recognised as equal partners within the network.

1 INTRODUCTION

The purpose of this study was to collect local evidence and lessons learned on the ways in which public research outputs¹ are made truly accessible to different audiences (farmers, extension agents, researchers, academic groups, policy makers, civil society and the general public). The study documents good policy and practices for public information, open data management and knowledge sharing that encourage openness of agricultural research for innovation. This report will contribute to the evidence base of progress towards common goals as envisaged by the CIARD Initiative². Further, the report could serve to showcase KAINet, and participating institutions within KAINet, for sharing lessons and disseminating practices worldwide, and for benchmarking or gaining support from other CIARD stakeholders that are acting to foster more openness of research outputs.

The descriptive study design was used in this study. This involved the collection of data from all the KAINet partner institutions in Kenya. The study involved the collection of both primary and secondary data. The population of the study comprised all the five public institutions that are members of KAINet. They include: Kenya Agricultural Research Institute (KARI Headquarters), Kenya Agricultural Research Institute National Agricultural Research Laboratories (KARI-NARL), Kenya Forestry Research institute (KEFRI), Jomo Kenyatta University of Agriculture and Technology (JKUAT) and the Ministry of Agriculture (MoA). The sample for the study was drawn from the units dealing with the following generic functions within the above identified institutions:

- Research information and/or communication, strategy and/or policy;
- Research information management /communication:
 - multi-stakeholder research planning and development
 - communication media
 - publications development
 - website development and management
 - libraries and document/data repositories, metadata standards and thesauri/ontologies

More specifically, managers/individuals within the institutions that are responsible for the following were involved in the study: web development; library and documentation; head of research planning and management; communication management; information technology management; and systems administrators. Focal points from each institution

1 Types of output include: Technical reports, scientific reports, field reports, theses/dissertations, Conference Proceedings

2 ^{*} Further information on the CIARD Initiative, including Manifesto and Values, Checklist and Pathways: www.ciard.net

assisted in the identification of the key persons to participate in the study. A total of 24 individuals participated in the study.

Primary data were collected through semi-structured interviews. Secondary data was collected through document analysis and analysis of information on organisations' websites, to assess how the organizations were making research information more available to stakeholders and hence aligning with the CIARD Manifesto and Checklist. An interview guide was designed based on the CIARD framework and checklist. Field visits were made to the five institutions and primary data collected through extensive interviews held with individuals in information, research and communication departments. Secondary data were collected through a desk study that reviewed documents from various institutions, publications, websites, electronic information on videos and CDs, needs assessment reports and workshop reports (for workshops conducted during the earlier stages of KAINet). Data collection was conducted between 2nd November and 24th November 2011.

Data was analysed qualitatively. All qualitative data obtained from the interviews and observations were first assembled. Data from audiovisuals was transcribed and the transcribed data and data obtained from open-ended items in the interview schedule was categorised along emerging themes and patterns. The data from the various sources was then triangulated to identify emerging common themes.

1.1 Kenya Agricultural Information Network (KAINet)

Kenya Agricultural Information Network (KAINet) was initiated in April 2006 in response to demand from national and international communities to build systems that promote information exchange and access among stakeholders in the agricultural sector, including researchers, extension workers, students, policy makers, major public libraries and archival institutions and others. The focus is to support decision-making, promote innovation in agriculture, and subsequently improve livelihoods, with the aim to modernize and increase productivity of the sector through the application of information and communication technologies (ICTs) for agricultural information management.

KAINET evolved from the International Information System for the Agricultural Sciences and Technology (AGRIS) pilot project in the country whose aim was to build capacities to manage information and establish institutional repositories of agricultural information. In the course of implementing the AGRIS project stakeholders resolved to establish a formal network which could help solidify their partnership and catalyse project activities beyond the project period. In a quest to achieve this, the network (KAINet) has established a national electronic repository based on the AGRIS tools and standards to ensure coherence in agricultural information.

The establishment of KAINet was through partnership and collaborative efforts between national and international partners. Its current membership comprises Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya Forestry Research Institute

(KEFRI), Kenya Agricultural Research Institute (KARI), KARI-National Agricultural Research Laboratories (KARI-NARL) and Ministry of Agriculture (MoA) at the national level. At the regional and international level, the partners include the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), CAB International (CABI) and Food and Agricultural Organization of the United Nations (FAO). The network financial support was aided by DFID through FAO and it has maintained a continued collaboration with FAO, ASARECA and CABI Africa.

KAINet is focused on the vision to make public domain agricultural information and knowledge in Kenya truly accessible to all, based on its mission to build a common and freely accessible information system through partnership in the generation, collection, processing, archiving and dissemination of agricultural information. The organizational core values to attain this are centred on social responsibility, respect, accountability, professionalism, teamwork and strong partnership, collective responsibility, innovativeness and meritocracy. The organization focuses on core objectives that entail establishing and managing performance-driven national Information and Communication Management (ICM) networking, resource mobilization and partnership mechanisms. These are used to: establish and manage information resources and systems for generation, collection, acquisition, processing and preservation of agricultural and related information; to promote the development and implementation of appropriate Information and Communication Technology (ICT)/ICM policies and legal frameworks; to promote the development and maintenance of adequate ICT/ICM infrastructure and facilities; to promote the development and implementation of strategic ICM human resources capacity building; and to enhance availability, access, sharing and utilization of agricultural knowledge and information.

KAINet adopted AGRIS methodologies and tools with WebAGRIS as its platform to implement partner institutional and national repositories. KAINet member institutions are now migrating to the AgriDrupal and AgriOceanDspace to enhance further accessibility and visibility of local content. These tools are complete, multilingual web-based systems used for processing and dissemination of agricultural bibliographic information.

The KAINet initiative supported development of institutional repositories at KARI-HQ, Kenya Forestry Research Institute (KEFRI), Ministry of Agriculture (MoA) and Jomo Kenyatta University of Agriculture and Technology (JKUAT), with the national repository (KAINet) harvesting from them. A KAINet website was then developed using Drupal for the purpose of enhancing online visibility of KAINet content. A web-based repository developed using WebAGRIS, with a search engine that makes the repository accessible and visible, was then integrated into the site making KAINet website a one stop platform of both the web presence and online repository.

KAINet repository is accessible through www.kainet.or.ke. The content on KAINet includes research literature and local agricultural knowledge with more than 38,000 metadata records and 1,500 full text documents. The scope of content ranges from climate change, forestry research literature, agricultural related literature and water use. Also included are simple brochures/leaflets, available mostly as metadata. Strategies

are being formulated to increase the number of full-text documents in the KAINet repository.

To ensure KAINet partners and other stakeholders are able to exchange data amongst themselves, KAINET adopted systems that meet specific architectural and functional requirements for information exchange. This was achieved by using WebAGRIS and AgriDrupal that have integrated the AGRIS Application Profile (AGRIS AP). The AGRIS AP is a standard created specifically to enhance the description, exchange and subsequent retrieval of agricultural Document-Like Information Objects (DLIOs). It is a format that allows sharing of information across dispersed bibliographic systems and is based on well-known and accepted metadata standards. Some partners within the KAINet family have implemented other tools that promote interoperability using the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH), and internal and external RSS Feeds.

Interoperability within KAINet has increased the accessibility of the information/data and has resulted in partner institutions harvesting metadata from the FAO AGRIS database and vice versa. For example, KEFRI increased its metadata in the repository from 236 records to 1,156 by importing its previous contributions to the AGRIS database. Access of real time news and events, using RSS Feeds, from other agricultural related sources like AgriFeeds and e-Agriculture has improved the information/data on KAINet.

Visibility has been enhanced with the KAINet repository being registered with the CIARD RING and the KARI repository being among the few repositories in Africa being listed and accessed through OPENDOAR (<http://www.opendoar.org>). Statistics obtained from Google Analytics show that the access hits were at 3452 in November 2011. KARI and JKUAT are the most visible on the web as demonstrated by the statistics from Google Analytics. KARI had over 43,000 visits to its website in the month of November 2011 alone, while JKUAT had over 154,000 visits to its website during the period 1st August 2011 – 22nd November 2011. Statistics from the other institutions could not be obtained, either because they did not have an organised system in place for tracking usage of information on their website or they relied solely on web site hits (data was not available).

1.2 About CIARD and the Framework

Coherence in Information for Agricultural Research for Development (CIARD) is a global initiative working to make agricultural research information publicly available and accessible. The international initiative strives to ensure that public domain agricultural research outputs are truly accessible. CIARD consists of three areas of activity: advocacy, capacity building, and content management, each of which is coordinated by an international Task Force.

The initiative's vision is "To make public domain agricultural research information and knowledge truly accessible to all" with the aim of enabling organizations that create or possess public agricultural knowledge to disseminate it more effectively. The CIARD partners coordinate their efforts, promote common formats for information sharing and exchange, and adopt open information systems approaches, creating a global network

of accessible outputs of research and innovation greatly increasing the chance that they can be put to use, locally, nationally and globally. In pursuit of the core objectives to collaboratively develop common standards, share knowledge, and contribute to effective and coherent institutional approaches in agricultural science and technology information, CIARD has three priority areas:

1. Make content accessible by open content and open systems with common international standards;
2. Develop capacities through empowered individuals with awareness and skills and enhance self-sufficient institutions with ownership; and
3. Advocate for better investments in sound policies that enable easier access to information, coordinated approaches and evidence of benefits.

New information and communication technologies provide many opportunities for information to be handled and presented differently and more cheaply. The impact that public knowledge and research can have on agricultural and rural development and natural resources management should not be limited because most of this information is not easily or widely accessible - a factor that necessitates the existence of CIARD. However, CIARD is not just about technology, it actually addresses the way that technologies are used. This includes building and improving information systems, empowering the institutions and people using them with a framework and a set of tools that open access to their content resources. While recognizing that every institution has its own particular niche and set of clients, CIARD is encouraging them to interconnect and work together in ways that complement each other. In this way, tackling the fundamental issues involved in making local, national, regional and global information systems available and accessible is enabled. It follows that by participating in CIARD the benefits that institutions can derive entail: increased national and international visibility and use of their research output and content services; increased exchange of information content between their system(s) and others; increased access to specialised expertise and knowledge; and the proven solutions of the other institutions. The outlined benefits of CIARD engage various actors: research managers (including policy and decision-makers), researchers/scientists/academics, information professionals, and intermediaries between researchers and farming communities, such as rural extension and advisory services.

1.3 The Context for Openness of Agricultural Research for Innovation in the Organization

1.3.1 Summary of Relevant National/Institutional Enabling Environment

a. ICT Infrastructure

The government of Kenya has placed a lot of emphasis on using ICT to improve the livelihoods of Kenyans. ICT in Kenya is developed in line with Vision 2030 - a development plan by which Kenya is to become a newly industrialized nation by the

year 2030. The Kenya ICT Board and Kenya Education Network (KENET) have the mandate to ensure that the IT infrastructure is improved. The government has initiated projects and programmes that are geared towards improvement of internet infrastructure and the knowledge economy within the country. Some of these include:

- Developing affordable information and communication network infrastructure and application. The development of ICT Parks and Digital Villages are envisaged to gradually lead to low-cost provision of ICT goods and services.
- Improving the internet connectivity and bandwidth through installation and commissioning of The East African Marine Systems (TEAMS) in collaboration with the United Arab Emirates and local private firms, the East African Sub-Marine Cable Systems; installation of SEACOM and implementation of the National Terrestrial Fibre Optic Network Project, a project that is intended to complement the TEAMS project by ensuring maximum utilization of capacity and connectivity in all districts in the country.
- ICT hardware and software: the government has zero-rated the ICT hardware to speed up the acquisition of this important component. Further, the government is currently holding negotiations with various ICT software providers with a view to securing bargains which will make ICTs affordable and universally accessible.

At institutional level, there have been significant improvements in the ICT infrastructure within KAINet member institutions. This is demonstrated in the improvement of internet infrastructure, and access to equipment such as computers by researchers and scientists/faculty, in all the KAINet member institutions. All the institutions have websites and digitization is on-going at four KAINet member institutions. Digital repositories are in place, and at four of the institutions content is exported from the IR into the KAINet repository on a monthly basis. KAINet member institutions have incorporated activities such as WebAGRIS metadata entry, maintenance of file servers hosting the repositories, and collection of digital content from the field, into the annual work and performance contracts of staff members involved in the project.

b. Policy and Legal Frameworks

Different policies, and legal and regulatory frameworks, have been developed to guide and speed up the uptake of ICT in all sectors of the economy. Research and academic institutions participating in KAINet are guided by the Laws of Kenya, more specifically, the Science and Technology Act CAP 250 (17) which stipulates provisions for research institutions to make research outputs available for public use, subject to approval by the institution.

The National Information and Communications Technology (ICT) Policy paves the way for research and academic institutions to develop policies and strategies that meet their specific needs. KARI, KEFRI and MoA have draft ICM policies in place, developed under KAINet, which need to be endorsed by the institution's management before implementation. KEFRI has an intellectual property rights policy in place while JKUAT has a communication policy.

1.3.2 General Landscape (research outputs/content, organizational structure, skills)

Openness of Research Outputs

Research outputs from the institutions' digital repositories can be accessed through the institutional websites and LAN. To enhance accessibility and knowledge sharing of the research outputs from the KAINet member institutions, KAINet has registered with the CIARD RING. KARI repository is listed among the repositories that can be accessed through OPENDOAR (www.opendoar.org). Registering with the CIARD RING and being listed in OPENDOAR has increased KARI's local and international visibility. To further increase the visibility and accessibility of research information, institutions are migrating to Dspace and AgriDrupal. In addition, researchers from participating institutions publish their papers in open access journals and in journals available through AGORA. Documentation of special programmes e.g. the Farmer Voice radio and Mkulima TV programme, and availing the information of such programmes on the institutions' websites have contributed to increased knowledge sharing with stakeholders and visibility of the institutions.

Dissemination of Research Outputs

KAINet participating institutions use the following strategies to disseminate information to the stakeholders: radio, TV, exhibitions, national agricultural shows, through the institutions' websites and publications (journal articles, brochures, newsletters, technical and annual reports). Outside KAINet, metadata of theses and dissertations undertaken in Kenya can also be accessed on the ResearchKenya.Org³ database, the repository of the Kenya Information Preservation Society (KIPS). The database contains over 11,000 metadata records.

Staff and Skills

At the onset of the KAINet project, the five institutions (KARI, KARI-NARL, KEFRI, MoA and JKUAT) had their staff trained on a number of topics that relate to web development - marketing, electronic information management, and policy, among others. Each institution had two to three individuals trained. Some of the individuals trained at the institutions have since been transferred to other departments within the institutions or have since left the institution, without passing their skills to colleagues.

³ www.researchkenya.org

2. THE “STATE OF OPENNESS OF AGRICULTURAL RESEARCH FOR INNOVATION” IN THE ORGANIZATION

In this section, a description of institutions’ openness to agricultural research for innovation is described. The CIARD Checklist and framework for questioning were used to collect information.

2.1. Institutional Readiness

2.1.1 Information Structure and Digitization

There have been significant improvements in the information structure within all institutions participating in KAINet. This is demonstrated by the improvement of internet infrastructure within the institutions, and access to equipment such as computers by researchers and scientist/faculty in all the institutions (JKUAT, MoA, KARI, KEFRI). All the institutions have websites. KARI, MoA and KEFRI have developed institutional repositories which have been populated with metadata and some full-text documents and are also continuing to digitize research outputs, although at a slow pace, and to make them available through the repositories. Repositories for KARI and MOA can be accessed via the institutions’ websites and LAN, and information from these repositories is exported into the KAINet repository. KEFRI has a repository in place which can be accessed internally via the LAN and through KAINet. JKUAT developed a repository and inputted some metadata records during the initial stages of KAINet. However, input of data was halted due to issues with IPR, the platform on which the repository was operating, and the content to be included in the repository. The institution is developing IPR and IR policies to address IPR issues relating to research outputs. Once these are approved by the university management, the plans are that digitization will commence. Digitization is ongoing at KARI-NARL. It has a repository that is accessed internally. The contents of the repository are exported to the KARI HQ e-repository.

2.1.2 Awareness of CIARD Within Institutions

KARI, KARI NARL and the MoA are aware of CIARD and what it advocates, especially with regard to making research outputs available, accessible and applicable. Within these institutions, support for the CIARD Manifesto has not been officially expressed. The other institutions i.e. KEFRI and JKUAT have heard about CIARD but were not aware of what it advocates with regard to openness of research outputs. However, the two institutions were engaged in activities involving making research information more available, accessible and applicable to various audiences, in line with some aspects of the CIARD Pathways. Activities being implemented at these institutions include: collection and preservation of data, making some content widely available via the institution’s website, and to some extent, digitizing content and advocating for the benefits of digitization within the institution.

2.2. Availability, Accessibility and Applicability of Research Outputs

2.2.1 Institutional Repositories

The KARI-HQ repository contains 1500 metadata records of which 750 are full text. The information already incorporated includes project reports, conference proceedings, annual reports, monographs and journal articles. The KARI-NARL's repository has 770 metadata records of which 350 are full text. At KARI HQ, about 40 documents are digitized each month and entered into the repository. KARI's digitization programme includes the digitization of older documents (previously available only in print form) and goes back about 15 years.

The Ministry of Agriculture (AIRC and Kilimo library) each has a repository. The Kilimo library is a branch of AIRC. It serves as a major source of information on agriculture and related fields. The AIRC institutional repository (IR) contains metadata with some having links to full-text documents. The IR can be accessed only on the AIRC LAN. The repository contains 711 metadata records. None of the records in the IR are available in full text. The Centre has a flatbed scanner which cannot manage heavy workloads.

The Ministry of Agriculture Library (Kilimo library) institutional repository (IR) contains metadata, some with links to full-text. The IR can be accessed on LAN, MoA and KAINet websites. There are 1905 metadata records that have been entered in the repository. Out of these, only 167 are available in the IR in full text and include the following:

- handbooks –five (5);
- manuals – six (6);
- conference proceedings – seventy two (72),
- reports – seventy eight (78);
- journal articles – two (2);
- theses – four (4).

At KEFRI, the number of metadata records entered in the repository is 1332. Out of these, 1038 are technical/research reports, 123 journal articles, 16 conference papers, 32 manuals, 89 theses, four (4) monographs, 19 annual reports, six (6) working papers, 5 master plans. A hundred (100) of these documents are available in full-text through the institution's LAN. About 30 documents are digitized each year. The digitization process has been slow due to inadequate scanning equipment, and limited number of staff at the library.

The JKUAT institutional repository (IR) contains metadata of theses and dissertations. The IR can be accessed on JKUAT’S intranet. Data input in the repository was halted due to the need for an IPR and IR policy. Participation of JKUAT in the KAINet initiative spurred the thinking within the university and the realisation of the need to develop a repository that goes beyond agriculture one that would incorporate other disciplines covered by the university. Other than agriculture, being the major faculty within the institution, there are other faculties that wanted to have their content digitized and included in the institutional repository. To do this, it was necessary for JKUAT to migrate from WebAGRIS to Dspace, in addition to the fact that Dspace is being promoted by Electronic Information for Libraries (EIFL) as the platform for institutional repositories in universities in Africa. The JKUAT repository has 240 records composed of mainly metadata records and only twelve (12) are linked to full text documents. These records were entered in the initial stages of KAINet.

Table 1 provides information on the metadata records in the IRs from the KAINet participating institutions. Out of the five institutions, MoA has the highest number of metadata entries in the IR, followed by KARI and KARI-NARL. In terms of available records in full text in the IRs, KARI has the highest number of such records available. JKUAT has the least number of metadata records in the IR.

Table : Number of metadata records in the institutions’ e-repository

Records	Number of Records					
	KARI	KARI-NARL	MoA (AIRC)	MoA (Kilimo)	KEFRI	JKUAT
Metadata records in IR	1500	770	711	1905	1332	240
Available in full text in IR	750	350	0	167	100	12

2.2.2 Use of Agricultural Information Standards

All the digital repositories from the KAINet partner institutions were developed using guidelines from the Digitization Work Flow. Each institution adopted the digitisation work flow document that was developed by members of KAINet, with guidance from FAO, to fit its needs. The workflow explains the processes involved in the creation and mechanism of metadata entry. The workflow serves as a framework of the processes that are involved in the overall “project workflow” and the “capture workflow” which details the day to day procedures. The document also gives guidelines on what should be digitized and what should not (i.e. policy documents, scientific reports, journals, conference proceedings, extension materials, newsletters and periodicals). AGRIS Application Profile and AGROVOC are the international metadata standards, data exchange protocols and agricultural vocabulary and ontologies that are used by KAINet member institutions. The use of common international standards has contributed to the

interoperability of the KAINet, KARI and MoA repositories and also to the visibility of the content even on Google.

The repository of each institution holds research outputs of the individual organisations. The information covers all the research that has been done by researchers within the organisations. Each organisation is expected to export the contents of its repository to the KAINet repository on a monthly basis.

All the institutions involved in KAINet have an information management system for collecting the research output. All research done by researchers at the research institutions belongs to the institutions and researchers are expected to submit copies of their research outputs (theses, dissertations, field reports, journal articles) to the institution's library, which could ultimately end up in the digital repositories since these are mainly being managed by the institutions' libraries.

2.2.3 Access to the Repositories and Information from the Institutions' Websites

Research outputs available in the KARI e-repository can be accessed via the institution's website and LAN, as well as through KAINet. The Ministry of Agriculture repository can also be accessed through the ministry's website as well as through the LAN and KAINet. The KEFRI e-repository can only be accessed through KAINet and from the institution's library. At JKUAT one can access some of the research outputs and electronic scientific literature through the institution's LAN.

KARI and JKUAT were able to collect information on access to the information available on their websites. Google Analytics was used to track visits to the institutions' websites and usage in terms of what kind of information was being accessed, which country those who were accessing the information were from, and search engines that are used to do the searches. Most of those who are accessing the JKUAT and KARI websites were from Kenya, followed by users from the United States of America. Among the KAINet member institutions, KARI and JKUAT are the most visible on the web as demonstrated by the statistics from Google Analytics. KARI had over 43,000 visits to its website in the month of November 2011 alone, while JKUAT had over 154,000 visits to its website during the period 1st August 2011 – 22nd November 2011. At KARI, data collected from Google Analytics has not been analyzed and used to inform planning and policy activities. At JKUAT, the IT department uses the information to inform themselves on what kind of information is most popular with the users. However, the institution has not used this information to inform policy. KEFRI and MoA were not tracking the access and usage of information on their website and repository.

2.2.4 Openness of Research Outputs

KARI and MoA research outputs can be accessed on both the institutional websites, KAINet and LAN. Research outputs from the digital repositories of two KAINet member institutions i.e. KEFRI and JKUAT, can be accessed through the LAN. In an effort to increase the interoperability of the institutions, KAINet has implemented tools such as the internal and external RSS feeds that ease the exchange and sharing of information. KARI is the only institution within the KAINet family that has registered with the CIARD RING and the KARI repository is listed among the repositories that can be accessed through OPENDOAR (www.opendoar.org). The presence of KARI in this service has increased its visibility. Statistics obtained from Google Analytics show that the access hits grew from about 5000 in June 2010 to almost 40,000 in June 2011.

Consequently, researchers at KARI are supported to publish their research papers in open access journals that have been approved by the institution. There is a research committee at KARI that vets the open access journals to establish their authenticity and quality. Having publications in open access journals has also contributed to the increase in KARI's visibility on the web. KEFRI, JKUAT, and MoA, do not provide financial support to researchers who wish to publish in open access journals that require payment in order for papers to be published. Online searches done by the consultant in some open access journals and journals available through AGORA showed that scientists who mainly published their work in open access journals were affiliated to KARI, KEFRI and JKUAT.

2.2.5 Policies Covering Research Outputs

Research and academic institutions participating in KAINet are guided by the government of Kenya Science and Technology Act CAP 250 (17). It states that research institutes own:

1.” ...all rights in all discoveries, inventions and improvements in respect of processes, apparatus and machines made on behalf of Research Institutes. Research Institute but may be made available by it for use in the public interest. (2) Publication relating to work carried out on behalf of a Research Institute shall be subject to approval by the Institute.”

The ICM/ICT policy that was developed by the institutions during the initial phase of KAINet is still in draft form at KARI, MoA and KEFRI. KEFRI has an Intellectual Property Rights (IPR) Policy in place, while JKUAT is in the process of finalising IPR and IR policies and is awaiting endorsement by the senate/management before implementation. JKUAT also has a communication policy in place.

KEFRI's IPR policy covers the following: industrial designs, patents, copyright on literary works, new plant or tree varieties, contract research, research collaboration, trade and service marks and process and mechanism. Section 4.2 of the KEFRI IPR policy states that “*KEFRI shall own any Intellectual Property Rights that are made, conceptualised,*

discovered or created by members of staff, students on attachment, visiting researchers and collaborators in the course of their employment and responsibilities”.

The JKUAT communication policy document makes a commitment to provide stakeholders with timely, accurate, clear, objective and complete information regarding information flow, communication channels, feedback mechanisms and crisis communication management. The policy establishes principles, rules and procedures applying to communication among all members of the university community and its stakeholders. The policy provides guidelines on the use of Information and Communication Technology to facilitate sharing of information and knowledge in support of the core businesses of training, research and innovation. As previously mentioned, the institutional repository policy and the intellectual property rights policy have been developed, but are awaiting endorsement by the university management before they can be implemented.

At KARI, the implementation framework and the Strategic Plan 2009 – 2013 provide guidelines on the use of research outputs by the organisation and other stakeholders.

2.2.6 Ownership of the Research Outputs

At KARI, KEFRI and MoA, research outputs in the form of research reports, technical reports, manuals, and handbooks belong to the institutions. Theses and dissertations belong to the University awarding the degree to the scientist, regardless of the scientist’s institution of affiliation. Individual researchers from KARI, KARI-NARL and KEFRI are expected to submit copies of their theses/dissertations to the institutions’ libraries/documentation centres upon completion of their studies. At MoA, employees pursuing higher education are not bound by the institution to submit copies of their theses/dissertations to the library for documentation upon completion of their studies. Due to this, many scientists do not submit the documents to Kilimo library. Research outputs from all the institutions can be used and reused as long as the source of the information is acknowledged by users of such scientific information.

2.2.7 Use of Web 2.0 and Social Networking/Media to Share Research Outputs

The use of Web 2.0 to enhance visibility and exchange of research outputs, including metadata, has not been widely embraced for sharing research outputs. KARI and KAINet websites make use of the RSS feed on their websites. The KEFRI website has integrated RSS feed, but the site is not yet publicly available.

The MoA, KARI and JKUAT use YouTube to disseminate videos about events at their institutions. At individual level, there were isolated cases of use of tools such as Facebook, blogs, and Skype by researchers. However, it could not be established if such tools were being used to share research information.

At JKUAT there are a number of training resources on Web 2.0 tools held for students and faculty; they cover the use of social networking tools for sharing information. JKUAT and KEFRI have Facebook pages. However, not many researchers at the institutions are aware of their existence.

2.2.8 Building Informal and Formal Networks to Repackage Outputs

Institutions (KEFRI, KARI, JKUAT, and MoA) as well as individual researchers collaborate with private and international stakeholders. These stakeholders include farmers, researchers, academics, NGOs, extension agents, and so on. To effectively communicate research findings to the different audiences, repackaging of research outputs is necessary. At KARI all the activities to do with repackaging are managed by an Outreach, Packaging and Transfer Division. The research information is repackaged into pamphlets, documentaries and videos on various agricultural technologies, and also communicated on national radio and TV (Kenya Broadcasting Corporation - KBC). KARI, in collaboration with JKUAT and KBC, airs the “Farmers Voice” radio programme where the local language Kiswahili is used. Clips from TV documentaries on specific programmes are put on the website and on YouTube for the wider audience, in addition to distribution of CDs on agricultural technologies to stakeholders. At KARI, MoA and KEFRI repackaging of research outputs is done by in-house staff. For the radio and TV programmes, the staff members work in collaboration with experts from KBC. At JKUAT staff and students are involved in producing the radio and TV programmes.

2.2.9 Dissemination of Research Information/Outputs

All the institutions use the following strategies to disseminate information to stakeholders (farmers, private sector, local and international NGOs): radio, TV, brochures, exhibitions, national agricultural shows, and through the institutions’ websites.

- a. *Radio and TV programmes:* KARI, MOA (AIRC), KEFRI and JKUAT disseminate research information through radio and TV programmes. KARI and JKUAT use the Farmers Voice radio. Mkulima TV programme is delivered by JKUAT. KARI, JKUAT and MoA (AIRC) operate question and answer sessions where scholars/experts provide answers to some of the frequently asked questions of farmers and other stakeholders.
- b. *Publications:* KARI, JKUAT and KEFRI publish journals where their research outputs are disseminated. KARI publishes the East Africa Agriculture and Forestry Journal (EAAFJ). Bibliographic details of journal articles contained in this journal are available in the KARI e-repository. A subscription fee has to be paid to access the full text of this journal. JKUAT publishes a number of journals. They include the Journal of Agriculture, Science and Technology (JAST), and the Journal of Civil Engineering. AIRC publishes a wide range of publications including manuals and handbooks, newsletters, brochures and leaflets. It also

develops videos and radio programmes. At KEFRI, dissemination also takes the form of press releases and magazines that are co-produced with the Ministry of Forestry and Wildlife.

- c. *Agricultural shows and exhibitions*: institutions exhibit research outputs such as new plant varieties at national shows and distribute brochures to different audiences attending the shows.
- d. *Road shows*: The MoA also creates awareness on certain issues using radio shows for some programmes and projects. For example, the Ministry’s National Accelerated Agriculture Input Access Programme (NAAIAP) has had a road show campaign to create awareness on thematic topics e.g. Food Security, and Agri-business in Western Kenya which was done in collaboration with a local radio station (i.e. West FM).

Table : Summary of strategies used to disseminate research outputs to stakeholders, and the frequency of use of the strategies

Strategy	KARI	MoA (AIRC)	MoA (Kilimo)	KEFRI	JKUAT
Radio Programmes	***	**		*	***
TV Programmes	***	**			***
Publications (journal articles, newsletters, brochures, etc.)	***	**	*	***	***
Agricultural Shows and Exhibitions	**	**	**	**	**
Field Days	**	**	*	**	*
Road Shows			*		

Key:

***: Once a month or every two months. **: Once every 3 months. *: Bi-annually/ annually (once a year).

3. KEY ISSUES & CONCLUSIONS

3.1 Benefits of Digitization and Membership of KAINet

1) Enhanced human, physical and structural capacities in information collection, storage, management and use.

Membership of the KAINet network enabled members to accrue various benefits, primary among which was the introduction to the advantages of digitization of information. This process was achieved through the support from sponsors of the project, in terms of ICT equipment including scanners, computers and servers. Further, the capacity of the participating institutions was enhanced through the training of staff in the areas of web development and information management, social media use, database creation and open access, to enable them to manage the digitization process in their individual institutions. However, a needs assessment for the KAINet project revealed that the participating institutions had weak policy structures which could not guide the digitization and open access goals of the endeavour. Consequently, participating institutions were trained in policy formulation and development skills that culminated in the generation of individual institutional draft ICM/ICT policies that are now a point of reference.

2) Development of e-repositories

Except for one institution that had halted the further development of its e-repository, most of the network members were introduced to digitization through the KAINet project. Using common formats and tools, they were able to disseminate and share their research outputs with other agriculture based institutions, increasing the visibility of their researchers, their outputs and the profiles of their institutions. Digitization has brought about coherence of information sharing among members of individual institutions. The digitization made it possible to locate information which was previously locked up in “people’s lockers”. When all the e-repositories are up and running, and available through the websites, their use by other researchers will increase the impact of the research outputs.

3) Increased visibility and use of research outputs

All the institutions reported that their visibility had increased both at local and international level due to their participation in the KAINet project. There is increased availability of information/data on institutions’ websites which could easily be accessed by researchers in Kenya and other parts of the world. There is an increased exchange of information content between KAINet member institutions and awareness of other available research outputs.

4) Associated benefits of digitization process

The creation of e-repositories has other associated benefits for institutions and information users. For example, the librarians reported more efficient and informed interaction with researchers after exposure to the processes of research output generation and use, which are domains of the research community. Also, the prerequisites of running repositories prompted some institutions to install internet access and generate institutional websites which now serve other ICT needs of the institutions. In most institutions, sensitization through KAINet has enabled the institution to embrace the idea of keeping information open and accessible to users and is the force behind open access activities like an open access week that has become a permanent fixture of the yearly calendar of one of the institutions. Digitization has also brought about coherence of information sharing among members of the institutions and others outside of the institution.

3.2 Challenges

The five institutions faced various challenges as they strove to digitize their research outputs and make information more available, accessible and applicable to their audiences.

1) Capacity

The institutions still face limitations in capacity in terms of adequate levels of trained staff and equipment for e-repositories management. While these capacities were developed under KAINet, members were of the view that this was not adequate. The training provided under KAINet was not in-depth enough due to the short training period accorded each course and the limited number of people trained from each institution. Consequently, the digitization programme implementation was challenged because of high transfer and turnover rates of trained staff, in addition to the inability by the institutions themselves to fund digitization of the information resources.

The lack of capacity to manage institutional e-repository systems stood out as a major challenge. In terms of equipment, most institutions still lacked computers and heavy duty scanners to work with bulky documents. Although this issue is being addressed by their respective management offices, the long and elaborate Government procurement procedures have curtailed this further. For example, it took three years to get the relevant equipment and to hire staff for the digitalization process in one institution. As a result, suggestions have been made to seek funds from donors, through a proposal developed by KAINet. The institutions also face challenges in repackaging research outputs into simple formats for their audiences due to the high costs of hiring personnel to translate the materials from English to the local languages, as well as the costs of paying for airtime and space in the local radio and TV as well as local newspapers.

Most of the institutions still lack the ICT infrastructure and capacity in understanding of new information trends to effectively publish their resources online. There is also a great need to inform and educate academics and researchers so that they have a clear understanding of the role of Web 2.0 and social media in sharing research information.

2) Organizational culture

The administrative culture in government institutions takes the top-down approach in implementation of policies and activities, which explains why the KAINet project faced challenges because of focusing on middle level officers. Although the entry points into all the institutions were through top management, capacity development activities focused mainly on middle level managers. This approach has been detrimental to the progress of digitization in most institutions. Project activities would not get approval by senior management due to their lack of detailed knowledge of the project benefits and processes. Specifically, access to institutional funds to sustain the digitization process has been an issue. Another glaring outcome of this phenomenon has been the delay in the approval of ICM and ICT policies developed by the middle level staff (without direct involvement of top management) with capacities developed under KAINet. The recommendation is to have two administrative machineries to run the network, one comprising of members of senior management cadre and the other of middle level staff. In this arrangement, decisions can be made by the senior officers and passed down to the lower level for implementation purposes.

3) Contextualization of the digital process

Digitization activities have been affected by the fact that uniform processes and tools were recommended for use by KAINet members without consideration of individual institutional needs. For example, activities in one institution (i.e. JKUAT) had to stop because WebAGRIS, which is a windows-based platform, recommended by the network was not compatible with the Linux platform being used in the university. However, when the Linux version of WebAGRIS was introduced, library staff who were managing the repository did not have the required skills to manage a Linux-based system and could not get support from the parent institution's information technology department.

4) Internet connectivity

Low internet connectivity frustrates the accessibility of information available on the e-repositories by the researchers and other users. Three of the institutions under KAINet did not have their repositories in operation because of poor internet connectivity, curtailing the achievement of digitization targets. These institutions were still working on updating their networks, indicating that accessibility to documents and applicability of the research outputs was being compromised. Further, universal access to Kenyan agricultural content captured under KAINet was constantly at risk due to the fact that the KAINet website was always down.

5) Governance structures and policy framework

The institutions in the network face the challenge of authenticating the digitization processes that have been introduced into environments that lack supporting policies and implementation frameworks. The five institutions visited were all in the process of having their ICM policies approved by their management boards, a process that has now taken several years for some institutions. Similarly, they were facing challenges in hiring ICT staff to support digitization. Most of the institutions had weak monitoring and evaluation and quality assurance systems for information collection, storage, retrieval and sharing internally and among member institutions. Consequently, most institutions were still grappling with IPR issues, curtailing the quality of the repositories which were limited to storing documents of abstracts and metadata.

6) Sustainability of the network

The network was facing sustainability challenges due to managerial, funding and ownership issues. While member institutions have made available staff to work on network related activities at the national coordinating level, costs related to the management of the network e.g. payments for management meetings, web hosting for the portal including domain name registration renewal, are borne by KARI.

Consequently, the entrustment of the coordination role to the middle level cadre of staff, and lack of funds from the participating institutions, has slowed down the operations of the network and demotivated the members. This is exemplified by irregular network meetings and a decrease in the level of digitization of documents in almost all the institutions.

Also, there is a feeling of discontent among members about the ownership of the network. Participating members feel that the hosting institution (KARI) has dominated the identity of the network, as demonstrated by the presentation of the best e-agriculture award by the Computer Society of Kenya to KARI on two occasions, in 2010 and 2011, instead of it being presented to KAINet. There is also discontent with the manner in which the benefits of the network in terms of capacity building of members and infrastructure distribution. The suggestion by respondents is that the network be hosted on a rotational basis and the activities managed by systems including a secretariat, MOU and strategic plan. There is need to expand membership beyond the founding members and to seek funding to sustain the network activities.

3.3 Key Lessons Learned

- 1) The efficiency and success of information sharing networks among Government-based institutions lies in prior planning and preparation in terms of solid governance frameworks (which include IPR and ICT related policies) and strategies of operation, monitoring and evaluation, as well as quality assurance systems. This should be supported by relevant and sustainable infrastructure and human resource capacity to facilitate and uphold the digitization process and

related activities to make information open, available, accessible and applicable in formats that can reach wide audiences.

- 2) Sustainability of information sharing networks should be entrenched in strong management structures of senior level staff committees, supported by policy frameworks, a coordinating unit, and an MoU for members, which should clearly outline the roles and responsibilities of each member institution within the network. Further, member institutions should contribute towards the planning and management of the network, integrate network activities within their normal institutional work schedules, and a clear fundraising strategy for network activities put in place.
- 3) The decision by institutions to develop e-repositories, in a bid to make information available, accessible and applicable to many audiences, attracts benefits that go beyond the sphere of institutional and researcher visibility, to include improved ICT infrastructure, policy development and staff capacities for the institutions, and should be encouraged.

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List of People Interviewed

Names By Institution	Designation
Kenya Agricultural Research Institute (KARI Headquarters),	
.Dr Joseph G. Mureithi	Deputy Director, Research and Technology
Dr Felister W. Makini	Deputy Director, Outreach and Partnerships
J.J. Ouda	Acting Deputy Director, Information Communication and Management; Deputy Director, Technology Packaging & Transfer; Editor in Chief, E.A. Agriculture & Forestry Journal
Mr. Patrick Maina	Head of Library and Documentation Unit
Mr. Antony Biegon	ICT Officer
Mr Victor Ngatiri	ICT Manager
Mr Richard Kedemi	System Administrator KARI and KAINET Coordinator
8.Mr Mukundi	KARI Editor
Kenya Agricultural Research Institute National Agricultural Research Laboratories (KARI –NARL)	
1. Ms Penina Mwangi	Head of Library
Kenya Forestry Research Institute (KEFRI)	
1.Mr. Paul Tuwei	Information Officer
2.Mr Stephen Mwangi	Communications and Public Relations Officer
3.Ms Gillian Mutua	Head of IT Unit
4.Mr. Joseph Koech	Head Librarian
Ministry Of Agriculture (MoA)	
Mr. John Kimani	Head of Kenya Agricultural Information and Documentation Centre
Mr Steve Rono	Information Acquisition and Processing Officer
Mr Chepkaka	Head Librarian - MoA
Mr. Fabian Muya	Deputy Director, Research Liaison Division
Mr. Herman Wabwoba	Deputy Director, Public Communication Unit
Mr. Kimaile	Deputy ICT Office
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Ms Jane Gikandi	Senior Librarian, ICT Section
Mr Stephen Horo	Senior Librarian
Mr Solomon Maleche	Principal Librarian, Agricultural Information Services
Mr. Boniface Asiligwa	ICT Officer, Networks

Illustrations

Figure 1: Structure of KAINet