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## Agricultural Information Management

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### Introduction

This briefing paper aims to raise debate about agricultural information management (AIM) in the CORAF region. It draws attention to initiatives concerned with AIM and sub-Saharan Africa (SSA) from global to local levels. Using these examples, we pose questions as to what AIM is, highlight some key dilemmas, and some promising initiatives that may provide inspiration for debate about information in development.

### What is Agricultural Information Management and why is it important?

Agricultural information management (AIM) is concerned with all activities and resources necessary for acquisition, storage, updating, and making agricultural information and data of all kinds and formats—scientific research reports, growers' testimonies, market information, details of practical crop production technologies, machinery, weather forecasts, sources of credit, production, education and training and other instructional manuals, 'grey zone' literature—accessible to agricultural stakeholders at all levels. AIM considers not only information resources and technologies, but also development of the human resources needed for efficient use of these technologies.

Agriculture, in the medium term at least, is seen as key to reversing worsening poverty in many countries in SSA. If this strategy is to succeed, the relevance, quality and accessibility of information for all agricultural stakeholders must be assured on a wider scale than ever before. Agricultural information and AIM are therefore attracting intensified focus as a critical component of projects, programmes and agreements concerned with economic development and poverty reduction in Sub-Saharan Africa. But isolated approaches to AIM for development may have little chance of success. Several resources need to be in place before information can be acted upon and lead to the changes desired by the individuals, communities, organisations, states (Figure 1). These resources include:

- Data Resources: availability of relevant data.
- Economic Resources: the money, the skills, and the technology in order to access the data.
- Social Resources: the motivation, confidence and knowledge to access, assess and apply the data, and to be able to trust the source.
- Action Resources: the ability to act on the decisions made with the information. This may be hard resources eg money, technology, raw materials or soft resources eg skills and empowerment. This implies a high degree of integration between AIM services and other services, together with policy.

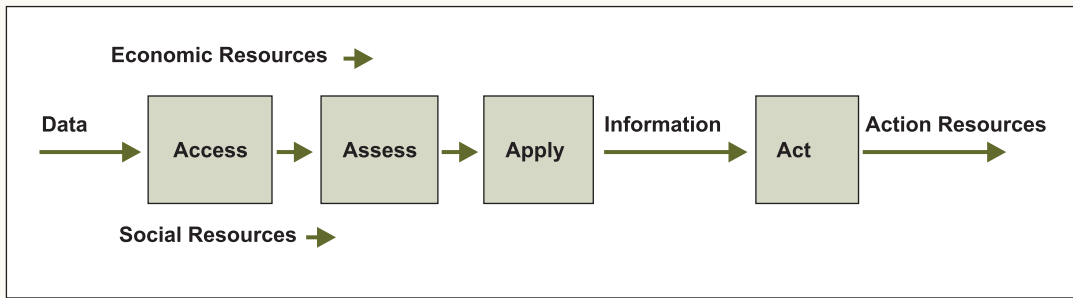


Figure 1. The Information Chain in Development

Source: Heeks, R. (2005)

Due to the considerable overlap of use of the terms data, information and knowledge in different sources, some further explanation of terms is provided in Box 1.

### Box 1. Explanation of terms

As used in the Information Chain above, **data** are considered to be simple facts such as measurements or statistics that can be used by a recipient as a basis for reasoning, discussion or calculation. When organised and placed in a specific context that has relevance for the recipient, data acquires meaning from the perspective of the recipient and is termed **information**. Information may take various forms, such as spoken, written and graphic messages, gestures and even body language. Collections of information messages organised in for example email messages, letters, books, videos, papers in journals and so on, may be considered as information resources. Data, information and information resources can exist outside of the mind, and can be manipulated, stored, shared or transferred between individuals and organisations. The process of transferring information from one source to a recipient is technically known as **communication**; and communication of information serves as the mechanism for information sharing

By contrast, **knowledge** is what we know and can take place only in the mind as the result of mental processes. The knowing mind can use data and information, assimilate and understand these, incorporate them in its own knowledge structures, and use the new knowledge to predict and /or guide action. This process cannot be managed externally, nor shared with others except through uttering new messages.

**Information Management** involves identification of information needs, acquisition, organisation, storage, distribution and use of information defined as above. Wilson (1997) has put it succinctly: "Information management deals with the value, quality, ownership, use and security of information in the context of organizational performance."

The term **Knowledge Management (KM)**, which was developed mainly within the corporate sector, has initially been widely used essentially as a synonym for Information Management. However, a second generation of KM has emerged with a wider and different perspective. Focusing much more on learning processes than on data or information management per se, the goal of these KM strategies is to enhance the capacity of an organisation to think and act creatively.

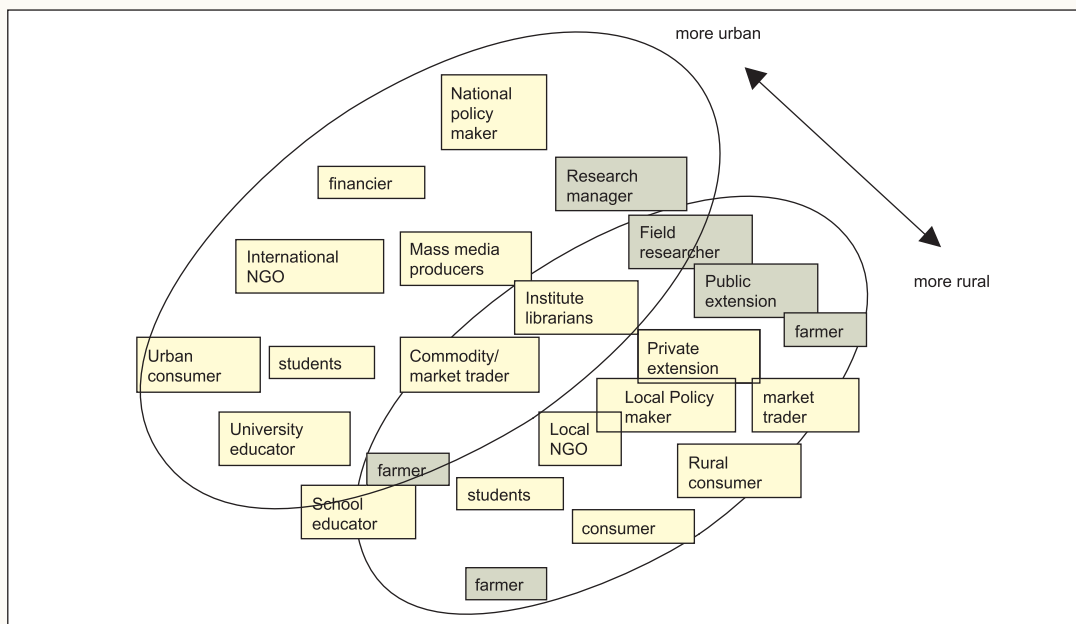
Adapted from, Wilson 1997, 2002; Bouthillier and Shearer 2002.

## AIM in the context of broad agricultural R&D trends

Notions of agricultural development have changed from earlier concepts of one-way supply driven technology transfer to the more inclusive current concepts of innovation systems, synergies, ownership, and the importance of demand. This trend is mirrored by an increasing realisation that although agriculture has global and universal elements, farmers' ability to use and maintain a beneficial agro-ecological environment is linked to local knowledge and biodiversity.

In AIM, a rather comparable development is apparent. There is a trend away from centralized services providing information from Western based information banks to African institutions (the '*communication by dissemination*' model, Rangi et al, 2006). Instead, decentralized information management, south-south and south-north information flow are emphasized. This increased focus on local content and capacity is extending to include not only the traditional academic information producers and users in universities and research institutes, but also farmers, development partners including policy makers, schools, traders and ordinary citizens (see figure 2). It is being increasingly recognized that these diverse stakeholders facing very different information issues and needs have an important role in access, creation and sharing of information. Across these developments, modern electronic ICTs are seen by some as offering immense new opportunities both for capturing and storing information and for rapid sharing and dissemination. They point to the rapid spread of mobile phone use and internet kiosks in many parts of Africa. However, others argue that ICT-based projects have a poor track record and that the technologies promoted have not lived up to expectations (Beardon, 2005) due to a range of factors— accessibility, affordability, inadequate physical infrastructure, non-sustainability (in social and financial terms) and limited relevance of the information supplied. In the case of telecentres, for example, it has been noted that “stories abound of government or NGO sponsored telecentres lying empty, equipment abandoned or stolen” (Beardon, 2005).

**Figure 2. From '*communication as dissemination*' (research to farmer - coloured boxes) to communication in the innovation process.**



Faced with this complexity it is clear that enhancing the efficiency and effectiveness of AIM in sub-Saharan Africa presents many challenges. These are being addressed through global, regional, sub-regional and national and local actors involved in capacity strengthening services, promoting establishment of communities of practice, networking activities, and managing information resources.

## Global level

African scientists have for decades suffered from limited access to international scientific literature, whilst barriers to their own contributions both within SSA and globally, have been significant. This has been so both for conventional hardcopy scientific journals and electronic journals despite the promise of accessibility offered by the internet. Costs of accessing commercially published literature have exceeded the budgets of African libraries and research institutes.

Internationally, FAO with other global partners such as GFAR and CTA, and with sub regional organizations, is a major player in promoting and supporting global initiatives to manage and exchange information more effectively. Major initiatives to improve African scholars' access to global information include: Access to Global Online Research in Agriculture (AGORA) and the Programme for Enhancement of Research Information (PERI, in association with INASP, especially the AJOL project of INASP). Both provide either free or reduced cost online access to a range of full-text scientific journals on agriculture to developing countries. Intensifying capacity building activities, FAO and partners have developed the new AGRIS strategy (2002) which includes a range of services from: training on new methods of information management, focus on full text documents and promotion of an Open Access (see Box 2) publishing model, and a set of web-enabled standards and tools. Exploiting e-learning opportunities, FAO's Information Management Resource Kit (IMARK), as well as the RAILS programme of FARA are recent initiatives for training individuals in effective management of agricultural information ([www.imarkgroup.org](http://www.imarkgroup.org)). The goal is to empower individual research organizations to directly contribute and share information with the international community (Chisenga et al, 2006; FAO 2004).

### Box 2. Open Access

Open standards and open-source software present many possibilities for reducing and even eliminating entirely the cost barriers to scientific publications faced by African scientists and research institutes. Open Access is information which is digital, online, free of charge, and free from most copyright and licensing restrictions. Users of Open source software are permitted to run the program for any purpose, to study and modify the programme, and to redistribute freely copies of the original or modified programme. The best-known and most widely used open source software for document management are Eprints, DSpace and CDSware. All recent versions of this software are easy to install and allow further re-development according to the user's requirements. Two basic strategies may be used to achieve open access document management:

- Self-archiving: making electronic pre-prints and post-prints available on author home pages or depositing them in digital archives and repositories)
- OA journals: these do not charge readers or their institutions for access. Authors meet the publishing costs and in return retain copyright to their articles.

Lwoga and Chilimo 2006: other sources: Dspace (2006), EPrints.org (2005), CERN (2005)

Challenges faced by these initiatives are: awareness of the existence of these initiatives, limited ICT skills, insufficient facilities and financial support to ensure uptake and use of these electronic systems even after training such as that provided by FAO, CTA and partners through the IMARK initiative; a limited range of journals that are free of charge (AGORA); wide lack of awareness of OA and its possibilities amongst libraries, and hence fear by authors and libraries that if they deposit papers already published in international journals in OA archives, they will be in breach of copyright.

### Regional/Sub-regional level

In SSA as a whole, there are several programmes focusing on information generation and delivery. A major issue being addressed capacity building. NEPAD through its Comprehensive Africa Agricultural Development Programme (CAAADP) Pillar IV, is seeking to intensify agricultural research, technology dissemination and adoption, and capacity building across service providers. NEPAD has designated the Forum for Agricultural Research in Africa (FARA) as its technical arm for advancing these objectives. FARA, aware that national partners (NARS) face inadequate infrastructure, institutional support and human resource capacity, has established the Regional Agricultural Information and Learning Systems (RAILS) to address these issues in close collaboration with the SROs, NARS and international service providers. An important component is Advocacy for improved policies and Capacity building on ICT/ICM Skills, infrastructure and leadership. RAIN is an example of a Sub-regional initiative organised by an SRO (see Box 3).

CORAF/WECARD is also in the process of establishing an agricultural information programme to address these issues in West and Central African countries. Adding impetus to regional efforts to improve agricultural information management, African agricultural information specialists were responsible for an important meeting in 2006 in Nairobi under the aegis of the International Association for Agricultural Information Professionals (IAALD — see Box 4). The meeting “*Managing Agricultural Information for Sustainable Food Security and Improved Livelihoods in Africa*” led to the launching of an African chapter of the IAALD. The Chapter provides a collective lobbying platform on agricultural information and can furnish inputs to NEPAD and other organisations. The IAALD African Chapter will provide a forum for generating African solutions to the many challenges facing effective management of agricultural information, for priority setting, and constitutes an informal networking base. The meeting drew attention to many challenges connected with information management in

#### Box 3. The Regional Agricultural Information Network (RAIN)

RAIN is a project of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). Starting in 2003, RAIN is a new network of agricultural information organizations and professionals in 10 countries in eastern and central Africa – Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda.

RAIN collaborates with other regional organizations and the Forum for Agricultural Research in Africa (FARA) to promote client-oriented agricultural information throughout the region and assist NARS institutes to obtain IT hardware and software. The network supports new initiatives aimed at enhancing information and communication management (ICM)/ICT skills; improving access to existing agricultural information; generating new content; and harmonizing agricultural information policies. RAIN has public relations materials in English and French, and a bilingual website.

SSA, including infrastructure, policies, computer and ICT skills, awareness of standards. Major recommendations point to keen interest and willingness to exploit global opportunities such as AGORA and Open Source AIM solutions, and to intensify focus on information needs of users.

#### **Box 4. The International Association for Agricultural Information Specialists**

IAALD was established in 1955 in Gand, Belgium and is committed to ensuring creation, capture, access and dissemination of information to achieve a more productive and sustainable use of the world's land, water, and renewable natural resources. IAALD's guiding principles are to:

- Connect agricultural information specialists world wide;
- Convene meetings and catalyse dialogue among stakeholders;
- Communicate and advocate the value of knowledge and information;
- Collaborate with members and other partner organisations, facilitating educational and other opportunities.

IAALD provides a platform for agricultural information specialists worldwide for information dissemination, exchange, dialogue among agricultural information stakeholders, improving the status and practice of agricultural information management and dissemination, and facilitating educational and other opportunities across agricultural information communities.

### **National and local level**

National researchers, public and private extension services and other stakeholders in the agricultural sector continue to suffer wholly inadequate access to information.

The new information and communication technologies (ICTs) such as the Internet appear to offer unimagined opportunities and hope to countries and citizens in SSA at last to gain access to sources of expertise, information and markets necessary for development. ICTs and the internet have rapidly become core elements in training programmes and information systems development supported by international, regional, sub-regional, and national organisation in Africa.

African initiatives that are taking up the challenge of developing ICTs with a special African focus include the CILSS RESADOC facility at the Institute de Sahel, (INNSAH) in Bamako for the Sahelian countries, the CSIR/INSTI (Council for Scientific and Industrial Research Institute of Scientific and Technological Information) of Ghana as well as the recently established Ghana-India Kofi Annan Centre of Excellence in ICT (AITI-KACE). This Centre works with other institutions located in six continents, Africa, Asia, Australia, Latin America, Europe and the United States. With a special focus on nurturing ICT competence and development, AITI-KACE's Technology Transformation Seminars (TTS) give stakeholders a platform to share experiences and technical know-how. Bi-monthly stakeholder meetings equip participants with knowledge on recent innovative IT technologies and create the forum for clients and the public to effectively discuss cutting-edge issues on ICT. Outreach and training includes specialized training for decision-makers and parliamentarians, and other courses to demystify ICT with students and other important groups in Ghana such market women, taxi drivers.

A model for which there have been great hopes is the telecentre. Telecentres generally combine phone and preferably also internet access and range from small privately run internet cafés common in

African countries to larger networks of telecentres set up by government, parastatal, university, NGOs and other donor supported initiatives. A major problem is establishment and running costs and the level of end-user costs that can be acceptable. Small family-run individual telecentres are for this reason virtually all in urban centres where paying customers are assured.

Some of Africa's first telecentres were in Uganda, with donors such as IDRC working in collaboration with the government and local NGOs to supply information to farmers. Experience from these showed that low patronage was linked to lack of awareness about the centres and their potential, and a lack of information on critical areas of interest to farmers such as markets, prices, inputs, weather and credit. Interest in internet and email was low.

This experience has led to testing of more innovative ICT solutions with a firm basis in potential users needs and with a view to some degree of commercial sustainability. In Kenya, for example, one promising telecentre's (or rural knowledge centre) idea is to offer a range of other services in addition to internet/email in order to generate sufficient revenue (Box 5).

#### **Box 5. Piloting sustainable information services - Kenya**

A pilot agricultural knowledge centre was established in Machakos town, Kenya. The centre has both traditional and modern ICTs including computers with internet and email, telephone, fax, scanner, digital camera, TV, VCR, DVD and satellite radio. The information provided covers mainly agricultural production and marketing, natural resources but also public health and other topics.

Information is obtained mainly from Kenya-based institutions such as NGOs, national and international research institutions and extension agencies and targets smallholder farmers and traders, intermediary organizations e.g. extension workers. The centre is an access point for the Open Knowledge Network (OKN) which promotes use of ICTs to enable communities share local content to support development.

Sustainability of the centre has been the driving force behind the introduction of many services namely, the trading floor for agricultural commodities, outreach programmes and the provision of demand driven services such as photocopying and typing which generate income for the centre. Income generated currently from the centre remains low but has shown a steady increase.

The centre is working to increase the participation of the partners in the activities through contributions in terms of membership fees, content development and management, in ways which will promote sustainability. Decentralization of activities is high on the agenda and it is hoped that this will increase access to remote areas in the region and increase the number of users and revenue generated.

The centre is sensitizing and training its users on ICTs through partnerships with NGOs, research institutes, government ministries, training institutions and CBOs. This has enhanced the community's involvement in identifying and prioritizing developmental activities and needs, and wide publicity has been achieved. Usage is monitored and shows increasing use by women since its establishment.

Adapted from Asaba J et al., (2006) .



The experience of the Kenyan agricultural knowledge centre provides some useful ideas about how to improve local level access to information. These include: supportive communication policy, technical solutions to the problem of distance and costs, partnership between different stakeholders, and most importantly, dialogue with information users, to ensure a range of valued services are provided.

The mobile phone is one form of ICT that has already achieved a large measure of success and commercial viability in SSA. This has resulted from a mix of supportive policy and commercial entrepreneurship on the one hand, whilst rural development programmes and farmers themselves have been quick to see the benefits of rapid access to information such as market prices. In Uganda, the telecommunications company MTN through a licensing agreement with the government has provided coverage even in remote areas. Farmers now have access to price information provided via amongst others the Foodnet project, since this kind of information can easily be sent as text messages.

### **Local content and context**

Related to the discussion on ICTs, minimal local content (language, themes, news, information connected to and relevant for particular communities where they live), and also in some places lack of traditions for information seeking, are major issues for AIM. This has enormous bearing on the interest in and use to which information services, from university/library based information systems to near-rural or rural telecentres/kiosks are put. ICTs, particularly the internet, have the potential to open a gateway to a huge wealth of information, but this may be of little relevance, nor even accessible, if there are few local messages and little local information in accessible languages.

Several information services are recognising this and setting in motion a move away from serving only traditional academic information users (see Box 6).

#### **Box 6. Ghana Agricultural Information Service**

GAINS was established in 2000 as part of a decentralisation trend from a CTA supported Q & A system designed to increase ACP member countries' access to world scientific literature, supported by advice, training, networking and information handling skills. The service is run from the Institute for Scientific and Technological Information (INSTI). It became popular with researchers and students making requests for information, but surveys showed minimal use by extension services and farmers.

Recognising a falling off of traditional users by 2005 and continuing low use by farmers and others, GAINS shifted tactics towards a more proactive role and initiatives using radio and the Agona Swedru agricultural information centre as intermediaries to spread information to farmers. Since 2006, Radio Peace of Winneba has been used to broadcast agricultural programmes with indications that many more people have been served through the radio. Documentaries shown from village to village by the Agona Swedru Agricultural Information Centre have led to demands from farmers for field based training. GAINS has also been distributing posters as part of its promotional strategy. During the pilot phase two national dailies were used to raise awareness about how to contact and use the service.

GAINS has a dedicated website [www.gains.org.gh](http://www.gains.org.gh) which contains information on the service and its partners, contacts and links to agricultural websites, how to use the service, the GAINS newsletter,



an online information request form, and three databases—Ghana Agricultural Research Information (GHAGRI), Ghana Science Abstract (GHASAB) and Agricultural Experts in Ghana (AGRIEX). The website promotes the service, with 4184 people visiting the site between May 2004 and March 2005.

Source: Sam and Verster, 2006. For another experience form Kenya see Juma, Esther Kahinga (2006).

Encouraging though these examples are, the challenge to increasing local content in new ICT mediated information flow is substantial. Furthermore, the notion of communication as dissemination (meaning essentially an information flow from recognised professionals and centres to farmers) is likely to be more firmly entrenched than the view that people at the most local level, for example farmers', own expressions of knowledge can have immense value. Local content faces immense competition from foreign sources. As Peter Ballantyne (2002) puts it, "*With a few exceptions (phones, community radio, or indigenous knowledge systems), most formal content and communication 'channels' in developing countries help to push 'external' content into local communities. Counter efforts to push local content on to global stages, such as African film, African research publications, 'southern voices' in the media, or the e-trading of crafts face an uphill struggle.*" Some interesting recommendations in support of local content that resulted from a consultative process funded by DfID to explore action point 8 under the DOT Force Plan of Action are shown in Box 7.

As costs and complexity decrease, it is becoming increasingly possible for local people, including farmers, who are not professional media persons, to make their own media and tell their own stories and experiences through use of modern digital ICTs such as digital video. These media, in contrast to media made by professional outsiders, can have major advantages in that they capture farmers' own perspectives and experiences within a context and in a language that other farmers can recognise. For a discussion on the topic of participatory video see for example CTA's webbased newsletter ICTUpdate issue no. 34.

#### **Box 7. Some recommendation for promoting local content in ICTs.**

Invest resources in a wide spectrum of local initiatives, using a variety of media, that create or communicate genuine local content, clustered around high priority sectors like health, education, rural livelihoods and the environment, and involving a wide range of actors.

Work with existing eContent, networking producers and intermediaries to exchange and deliver development-oriented content.

Provide incentive financing for local content. An example is the 'script pitching' notions in the African television and film sector that can link owners of local content with content producers and financiers. Organised in a series of workshops at the local, regional, and continental level, local content project proposals can be 'pitched' and winners selected for financing or to receive other prizes. In a simple form, such an initiative might simply provide prizes and funding for digital content development ideas.

Source: Ballantyne 2002

## Market for information

The liberalisation agenda prevailing in the reform of services in many SSA countries is likely to influence the attitudes and knowledge sharing strategies of the main actors, shaping elements of the “rules of the game” for knowledge innovation and sharing. Conversely, the other elements of the rules of the game influence the implementation of liberalization policies.

Most agricultural research undertaken in East Africa is in the public domain and has public-good characteristics. Information—whether derived from formal R&D systems or from local knowledge—is in principle a public good once it is in the public domain, making it difficult for the providers to make a profit from this information to pay for future knowledge generation. However, information products (books, brochures, training materials) and tailored advice have private-good characteristics. They are commodities that can be sold, thus excluding those who cannot afford to purchase them. Information access can be skewed by both wealth and gender and some forms of extension service delivery can effectively exclude some potential users. Currently, information on agricultural technologies and services is, in principle, available free of charge from research institutes funded by the national governments and donors. However, these organisations are under increasing pressure to commercialise their operations. From the service user perspective, even if no charges are made, accessing information involves transaction costs.

Where publicly funded extension services have been out-sourced to private sector providers, farmers are expected to become more skilled and experienced in quality control so that service providers will need to regularly update their knowledge in order to secure future advisory contracts. This should result in an emerging market for information, training and specialist advisory services. However, despite the increasing number and range of service providers, there is little to suggest that a functioning “agricultural information market” exists. At field level, many of the advisory service providers are also poor, working for low salaries, as volunteers and in the case of Uganda competing for short-term contracts. Recent research in Uganda (Mubangizi et al. 2005) showed that private service providers generally rely on course notes and information obtained from colleagues as a basis for advisory services provided to farmers, rather than more up-to-date sources (journals, Internet, research organizations).

Moreover, a market model presumes that incentives to “trade” information and advice exist. Service providers’ willingness to pay for information will also depend on their ability to pass on information costs to their service users, whose willingness to pay will depend on the perceived benefit from the information, and the likeliness of obtaining it elsewhere), for example through informal channels. Another issue is the quality of information for distribution, influenced by policies on quality assurance for privatized delivery. How information should be packaged, disseminated, presented, and differentiated needs to be considered, including the cost implication of different alternatives and accessibility to the different user categories.

## Some concluding points

A whole host of conditions need to be in place along the information ‘chain’ if information is to be acted on.

**Diversity of stakeholders and perceptions of AIM**— ‘Communication as dissemination’ is still a prevalent view based on policies of regional organizations and programmes (eg NEPAD’s pillar IV on dissemination and transfer). FAO and others are enthusiastic about the internet as the main ICT to

break the AIM deadlock, and are investing in training of academic cadres. On the ground, it's clear that there are a wide range of AIM needs and practitioners are finding out that farmers and other stakeholders may need a lot of other services before really taking an interest in the internet. Rural people are accustomed to accessing information in specific ways - farmers tend to attach high value to the experiential information from other people like themselves. Trust and relevance are key.

There is a need to break away from the top-down, technology-centred and supply-led approach to information-related projects that are supposed to benefit farmers and rural people in general. Instead, what is needed is a people-centred, demand-led approach that focuses on developing the capacity of disadvantaged groups to identify and articulate their information needs and preferred media, access the required information, through whatever media and sources are most appropriate, and then manage and use it effectively to improve their livelihoods. Experience has highlighted the need for a wide range of media in managing and supplying information, and the importance of traditional as well as modern media. Radio is a popular and widely accessed medium in rural Africa that could receive higher priority from development agencies; and mobile phones have considerable potential.

**Capacity strengthening**—there are a host of capacity strengthening issues associated with AIM. These need to be identified with stakeholders at all levels. This ranges from how African scientists can more effectively contribute to “content” (eg effective writing of agricultural research information to various audiences, contributing to the information database and management of agricultural journals and other publications, including electronic publishing and capacities in editing, etc.) to opening up new approaches to two-way communication and sharing information eg participatory video.

**Enabling environments**—effective national agricultural information policies need to be in place and acted upon. These include eg stable power supply and introduction of ICT in primary secondary and tertiary educational programmes. Some countries have progressive enabling policies (eg in Tanzania computer equipment is imported duty free)—with Ghana appearing to be a lead player in the CORAF region. However, it's still expensive to get bandwidth in Africa, and technically difficult to take electronic ICTs out to people (mobile phones are an important exception, e.g., Space Phone in Ghana, MTN in Uganda).

**Information management, organisational change and the rules of the game**—how information is managed has a major influence on organizations and their associated institutional environment (rules of the game). Information management, organizations and the institutional environment co-evolve. An effective and efficient AIM system should improve the performance of organizations and influence the ‘rules of the game’. Conversely, AIM systems need organizations and institutions which operate transparently, motivate people, offer appropriate incentives, encourage trust and commitment. This co-evolution is key to rural development and poverty reduction.

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EPrints for digital repositories. <http://www.eprints.org>

CERN Action on Open Access <http://open-access.web.cern.ch/Open-Access>

### **SSA AIM Websites**

African Journals Online <http://www.ajol.info/>.

AGORA –Access to Global Online Research in Agriculture <http://www.aginternetwork.org/en/>.

Ghana Agricultural Information Network System <http://www.gains.org.gh/>.

Ghana India Kofi Anan Centre of Excellence in ICT <http://www.aiti-kace.com.gh/>.

Information Management Resource Kit (IMARK) [www.imarkgroup.org](http://www.imarkgroup.org).

International Association of Agricultural Information Specialists. <http://www.iaald.org/>.

International Network for the Availability of Scientific Publications. <http://www.inasp.info/>.

Networking in Africa: using ICTs to exchange research and policy knowledge. <http://www.id21.org/id21ext/s8bpb1g1.html>.

Regional Agricultural Information Network <http://www.asareca.org/rain/>.

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