

ICT Update

a current awareness bulletin for ACP agriculture

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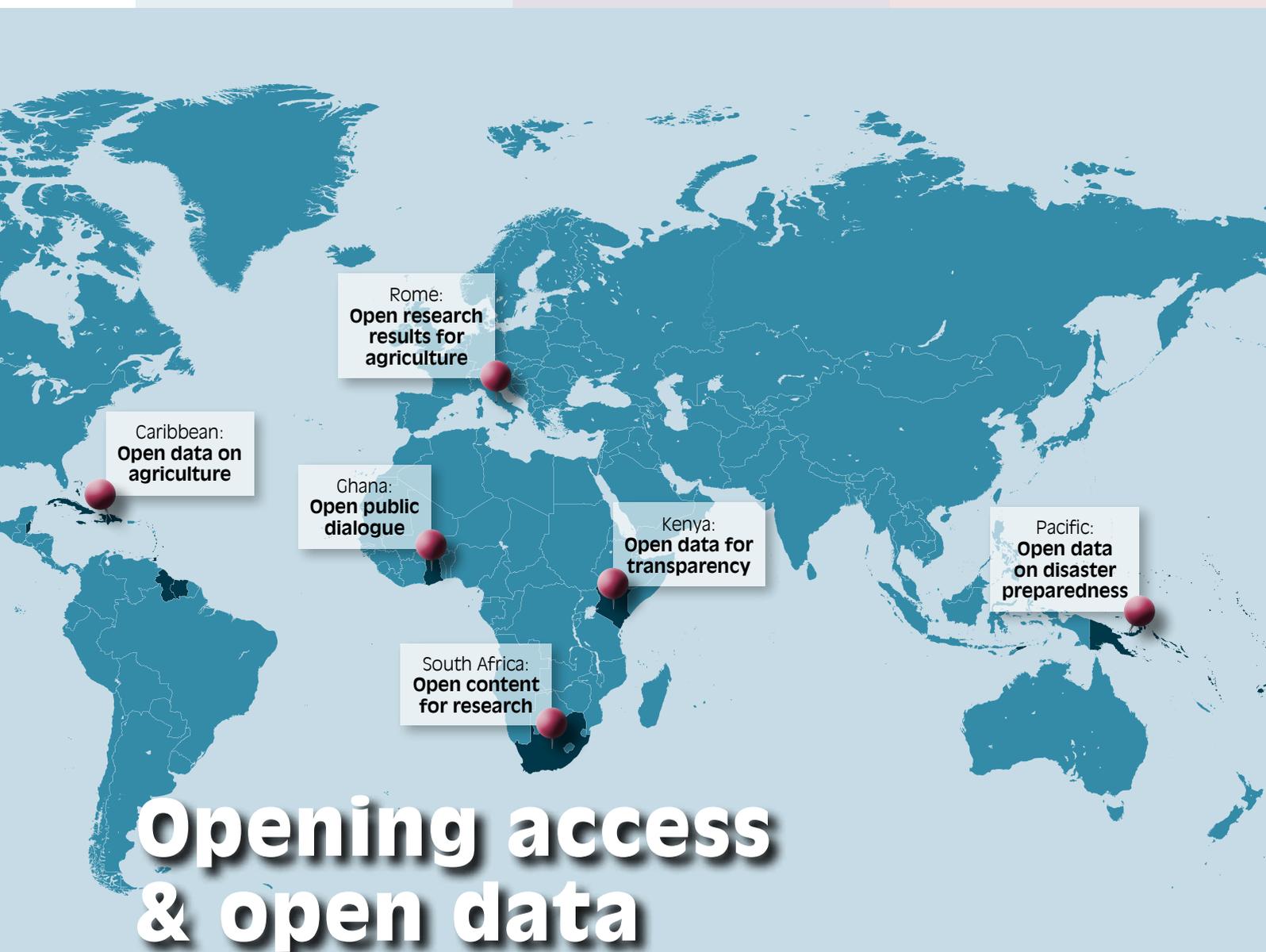


<http://ictupdate.cta.int>

A Kenyan university is drawing attention to its research via its open access strategy

A publisher works with scientists in ACP countries on open access publishing

Open data initiatives in developing countries are triggering local innovations



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ICT Update



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Guest editor

Openness and visibility

ICT Update is not just about technology. This issue's guest editor, Stephen Rudgard from FAO, is a major actor in opening agricultural knowledge online. He has asked a number of experts from different backgrounds to provide their perspective on various aspects of opening access to content.

There has been an increasing focus, globally, on various aspects of the 'openness' of information and knowledge since the early 2000s – open data, open access, open knowledge, open source, and so on. This openness involves, and is affecting, the world of agricultural

the internet of peer-reviewed articles in scholarly journals, while OAI deals with technical aspects of web-based repositories. Two paths to 'openness' emerged in these early days, the 'gold' road and the 'green' road. The gold road refers to open access journals that provide articles online at publication, while the green road consists of online archiving of digital documents (usually digital drafts of peer-reviewed articles) that are freely accessible through an OAI-compliant repository.

The move from subscription-only publishing of scholarly articles to open access journals has been much slower than originally anticipated by many OA advocates, but the trend is clear and has been embraced by all corners of the publishing industry, from for-profit to non-profit. The number of open repositories available online has also been steadily growing with the Directory of Open Access Repositories (OpenDoar) reporting more than 2,200 registrations by May 2013.

Visibility

Openness also means investing in mechanisms that will increase the visibility of research results, which may otherwise remain hidden in the jungle of the internet. Owners of repositories say that they want to make their information fully available, yet most are invisible to search engines such as Google Scholar. The use of international standards for metadata (or data about data, such as library cataloguing systems) to describe the data accessible from open repositories is a major factor for ensuring greater visibility.

Technological changes, including the emergence of 'linked open data', allow open repositories to publish local content globally. Linked data, a method for linking previously unconnected but related data, has huge implications for sharing knowledge. It also allows repositories to participate in a wider

Openness also means investing in mechanisms that will increase the visibility of research results

information as much as any other field of research and development. The impacts are being felt at individual, institutional and national and international levels, from policy development to the day-to-day behaviour of individuals.

Open access

Early moves in this process were made by the Open Access (OA) movement and the Open Archives Initiative (OAI). OA focuses on a more institutional approach to unrestricted availability on

Related links

Directory of Open Access Repositories (OpenDoar)
 → www.opendoar.org

Agricultural Information Management Standards (AIMS)
 → <http://aims.fao.org/>

CIARD
 → www.ciard.net/

Registry of Open Access Repositories Mandatory Archiving Policies (ROARMAP)
 → <http://roarmap.eprints.org/>

community of data providers in which services can harvest content from multiple locations. This will help open repositories to increase the role they play in the academic communication process.

In the agricultural domain, the Food and Agriculture Organization of the United Nations provides the agricultural information management community with standards, tools and good practices to assist owners of open repositories to take advantage of the new generation of web-based technologies to increase visibility. This work is facilitated through the global community on Agricultural Information Management Standards (AIMS).

The institutional dimension

The OA movement and the OAI initiative have been major factors in getting scientists and academics – and their organisations – to accept and promote openness in the research communication process. Most research institutions around the world have to meet national requirements, which change over time.

The national environment strongly influences how institutional initiatives develop. Inevitably, institutions do develop their own information and knowledge environment within this broader national one. In this way they work to meet the specific needs of their stakeholders within their particular environment.

Institutional mandates

A global study of researcher attitudes to the openness and communication of research outputs in agriculture was conducted in 2011 by the partners in the CIARD movement. The study revealed that individual views and behaviour in research communication were mainly determined by institutional requirements concerning the communication of research. Researchers also felt that a lack of suitable policy direction significantly hindered their communication activities.

Organisations can enforce policies in various ways that request research outputs to be made 'open'. Research funders such as the Wellcome Trust, for example, can insist that research outputs created as a result of their financial support should be made openly available. Governments or regional bodies such as the European Union can also enforce requests for openness.

The Registry of Open Access Repositories Mandatory Archiving

Policies (ROARMAP) is a service that tracks the development of mandates of all sorts – whether funders, governments or other institutions. In January 2013, ROARMAP had accumulated a total of 162 institutional mandates worldwide. The AIMS community has published a list from ROARMAP showing organisations in agriculture and related fields that have adopted open access mandates including major actors such as CGIAR, the French National Institute for Agricultural Research and Wageningen University in the Netherlands.

Policies governing the deposit of research outputs into an institutional repository, or other ways of making them 'open', such as publication in open access journals, can be voluntary (requesting that deposit or publication should take place) or mandatory (requiring them to take place). The voluntary rate of self-archiving by researchers to make their work openly available in repositories is about 15%–20%, but mandatory policies would increase this percentage. So, although voluntary policies were initially popular, new institutional policies are now often mandatory. Most researchers do not object to being required to make their work openly accessible.

The CIARD movement

In 2008, many international and regional organisations active in opening access to the outputs of agricultural research founded the CIARD movement. In May 2013, representatives of organisational partners in CIARD attended a consultation in Addis Ababa, Ethiopia, where they agreed on a new broader focus of the movement in support of innovation in smallholder agriculture.

A wide range of actors have contributed to CIARD's achievements. A key achievement has been the global registry of open agricultural information resources and services, the CIARD 'RING'. The RING continues to grow and is expected to exceed 500 organisational contributors in the near future.

The partners agreed that their organisations had started to act more coherently, and this is likely to improve as the movement expands. CIARD also reflects a growing international interest in opening access to agricultural knowledge for food security and rural development, including through the G8, the G20 and the Global Conference on Agricultural Research for Development.

The CIARD consultation drew on findings of partner meetings in 2011



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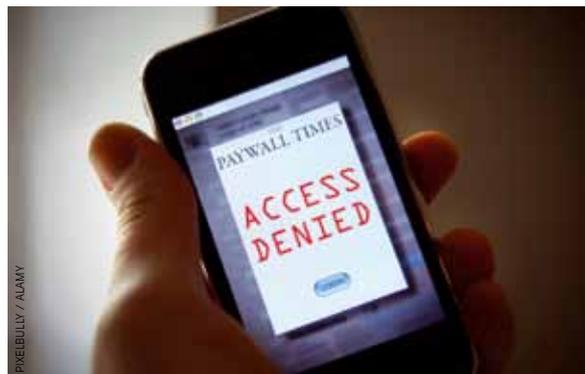
and 2012 and on 'visioning' exercises held during the meeting to identify priority action areas for the coming two years. The principal message in terms of advocacy and communication will focus on openness and integration of knowledge for wider appropriation and use in support of innovation systems aimed at smallholder producers.

CIARD's self-assessment 'checklist' and the associated advisory 'pathways' will be rewritten to address three broad areas: organisational culture and capacity, availability and accessibility of information and data, and knowledge sharing. A mechanism will be set up for continuing collaborative development of the pathways.

Again, sound institutional policies on openness have evolved since the early 2000s to the point where established good practices have been identified. CIARD will now be generating a set of pathways to show how information and knowledge management policy frameworks and strategies can be developed and implemented.

Through CIARD's strategic approach, stakeholders of all types (from policy makers to farmers, NGOs to the private sector) can become a part of this global effort towards information and knowledge openness. ◀

Organisations can enforce policies that open access to research outputs. Research funders can insist that the research outputs that they fund be made openly available. Governments and regional bodies can also enforce requests for openness.



Opening access

Modern science relies on data – lots of data that are complex and diverse. Open science – scientific results, the data that feed them, the software that sits beneath them, or the educational resources that help us teach and learn – can transform every scientific discipline and enable cross-disciplinary research.

Research data became important assets because they result from our continuously improving ability to collect

national funding bodies. The proposed framework will serve as the basis for the next European Framework Programme for research and innovation, called Horizon 2020.

Public sector information

Public bodies produce, collect or hold a wealth of information, ranging from statistical data to archival material, collections of books or works of art. Referred to as public sector information

in which data is produced and used. The boundaries between them are sometimes blurred, because public sector information can be used in the context of research (for instance in the social sciences and humanities), and data collected for research activities can be relevant to governments (for instance for agricultural development and environmental monitoring).

A key principle of the policy framework is the removal of access

Open data and open science

The G8 International Conference on Open Data in April 2013 aimed to make agricultural research more widely available to improve global food security. Carlos Morais Pires from the European Commission discusses the EC's effort to increase access to data and reviews the G8's plans.

facts, measure with unprecedented precision, depth and volume. To reap the advantages of ICTs and to enable global research collaborations, interoperable data infrastructures are essential to allow users to share and exchange data.

For a research funder like the European Commission (EC), which uses taxpayer resources, it is important to ensure that the results of the research are high quality and are openly reusable, taking into account the specificities of the research cultures in different scientific fields.

Indeed, the EC is working to ensure an open data framework and to promote 'intelligent openness' so that research results can be verified and trusted. This requires coordination with European member states through the

(PSI), it includes social, economic, geographical, cadastral, weather, tourist and business information that is crucial for an informed democracy and digital economy.

The European policy framework related to open data was updated in 2011 with the proposed amendment of the PSI directive 2003/98/EC on the reuse of public sector information and the adoption, in July 2012, of the package on scientific data resulting from publicly funded research. Another key piece of the policy framework is the 2007 directive INSPIRE, which stands for Infrastructure for Spatial Information and addresses spatial and geographical information.

The aim of the policy framework is to ensure coordination with EU member states and the European Parliament. Neelie Kroes, vice-president of the EC and responsible for the Digital Agenda for Europe, announced in April 2013 that member states have approved the text of the new PSI directive on the reuse of public sector information, known as open government data.

The various parts of the policy framework address different contexts

barriers to data in order improve transparency and trust. Also, as the PSI directive points out, the digital revolution has significantly increased the value of data as raw material for innovative products or services, and to promote economic development.

As for the package on scientific information resulting from publicly funded research, the EC aims to maximise the benefits of information technologies (the internet, data mining and supercomputing networks) to improve access to scientific knowledge and allow it to be used more easily. 'Open access' policies aim to make scientific articles and research data freely accessible on the web. The EC intends to take steps to promote this access and preserve scientific information, including publications and data resulting from research projects funded by the EU.

By making public information more widely available in Europe for access and reuse, the PSI directive is driving the open science strategy – taking into account legitimate commercial interests and issues such as ethics and privacy – so that scientists can benefit from new

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The views expressed in this article are the author's own and do not commit the European Commission.



JAIN MASTERTON / ALAMY

Data is unlikely to be reused if no one knows that it exists

ways of doing research using high-performance computing and high-speed connectivity.

The policy frameworks for public sector and scientific information emphasise reusability and ‘readiness of accessibility’. This means more than just removing restrictions – it also means removing the subtle barriers preventing public data from being readily accessible. After all, data is unlikely to be reused if no one knows that it exists. If users are uncertain about the terms of reuse, or the encoding formats, then that in itself may deter people from reusing data. Mechanisms for discovering data and for annotating and curating data with fit-for-purpose metadata must be important components of data infrastructures.

Research data infrastructures

In the case of scientific data, the EC (through the Horizon 2020 programme)

and the EU member states (through national programmes) are committed to implementing the policy framework. This will require new services that citizens, students and researchers can effectively use through open, interoperable e-infrastructures for scientific data.

Data infrastructures should support advanced data acquisition, connectivity, storage, management, integration, discovery and visualisation, and information processing services. But to make that happen, stakeholders need to take responsibility and lead the way. They will need to find the right balance between standardisation and invention, control and freedom, performance and cost, public and private, international and local. This will require the engagement of stakeholders with expertise in a number of areas:

- generators of data, such as large research centres, scientific laboratories and individual researchers;
- technical teams that define disciplinary standards and community service architectures;
- e-infrastructure and technology providers of common data services; and

- researchers who use data for their scientific work, and who are at the centre of the scientific enterprise. High-quality data is indispensable for research. Scientific communities therefore have an important role to play in verifying and reviewing the data to ensure that science is self-correcting and in ensuring that research results can be trusted.

The global context

The challenges of the 21st century transcend national borders, and science will be increasingly global. Data-driven science is made of global collaborations, through which European researchers have an active role in the production of knowledge. Research data itself is global. Examples are agricultural data, biodiversity data and oceanographic data.

In the United States, the White House recently issued an executive order, ‘Making Open and Machine Readable the New Default for Government Information’, which confirmed the US commitment to the open exchange of appropriate government data. It highlighted the

Public bodies produce, collect and hold a wealth of public sector information, including social, economic, geographical, cadastral, weather and business information. This information is crucial for an informed democracy and digital economy.

Related links

Horizon 2020, EU Framework Programme for Research and Innovation:
→<http://ec.europa.eu/research/horizon2020/>

International Collaboration on Research Data Infrastructure (iCordi):
→www.icordi.eu

Coherence in Information for Agricultural Research for Development (CIARD):
→www.ciard.net

Research Data Alliance (RDA):
→www.rd-alliance.org

agINFRA, a data infrastructure for agriculture:
→www.aginfra.eu

European Network on Legal Aspects of Public Sector Information
→www.lapsi-project.eu

Infrastructure for Spatial Information (INSPIRE):
→<http://inspire.jrc.ec.europa.eu>

Open Access Infrastructure for Research in Europe (OpenAIRE):
→ www.openaire.eu

importance of consensus on international standards and the valuable work of the Research Data Alliance (RDA), an initiative supported by the European Commission (through the iCORDI initiative) and the US and Australian governments, to facilitate data exchange at a global scale.

The RDA is led by scientific communities and infrastructure

For a research funder like the EC, it is important that research results are high quality and openly reusable

operators, to promote open science through open infrastructures. It also aims to improve interactions between technology service providers and users, which are essential for ensuring the interoperability of infrastructures across geographic and disciplinary boundaries. The RDA focuses on the needs of



research communities and will seek links with industry. It aims to be the place where practitioners stop discussing ideal solutions and standards, and start implementing solutions for sharing data.

Open agricultural data

Agricultural data is essential for researchers and policy makers concerned with food security and other social challenges that must be tackled at the global level. The European Commission is supporting key initiatives on data infrastructures for open agricultural data.

At the G8 International Conference on Open Data for Agriculture held in Washington, DC in late April 2013, policy makers presented their plans for relevant infrastructure initiatives to make agricultural data streams more easily available. The EC's action plan included agINFRA, an EU-funded initiative to develop a data infrastructure, and openAgris, one of the world's most important bibliographic data repositories, as an agINFRA integrated service.

Another important initiative in this area is CIARD (see guest editor article, p. 3), a global movement working on opening information to support agricultural development. CIARD's objectives include:

- opening access to agricultural data and lowering barriers to information

and knowledge sharing and use;

- building technical infrastructures to serve hundreds of organisations and users; and

- ensuring coherence in order to achieve global interoperability.

agINFRA and openAgris are closely linked to CIARD. The CIARD movement is already supported by over 400 organisational partners, and others continue to join.

Several key European organisations, such as the French National Institute for Agricultural Research, have already taken steps towards open data management, along the lines of the Commission's 2012 recommendation on scientific information. INRA and the Food and Agriculture Organization are leading the working group on agricultural data within the Research Data Alliance, which is in turn linked back to the CIARD movement.

The policy framework supporting open data and open e-infrastructures in Europe will help coordinate global initiatives that address social challenges such as creating a sustainable environment, conserving biodiversity, managing water and land resources, and improving food security. Indeed, Europe's open data framework is a key contribution towards creating international consensus on solutions and best practices for discovering, accessing and sharing data. Improving the knowledge base and the economies of scale through global open collaborations is likely to have a positive socio-economic impact globally and, in particular, in the developing world. ◀

High-quality science benefits all

Open access publishing can help researchers in the developing world to participate more actively in the scientific community. Alexander Brown from Springer shares his experience.

Opening access

On 12 January 2012, a magnitude 7.0 earthquake struck Haiti, laying waste much of the island and its capital, Port-au-Prince. Three million people were affected, and an estimated 220,000 perished. Countless buildings were destroyed, including nine of the country's 11 universities. As the poorest nation in the western hemisphere, Haiti was completely unprepared to cope with the devastation.

As charity fundraising events were arranged, and disaster relief agencies and volunteers descended on the Caribbean nation, Springer Science+Business Media, a major science publisher, threw its weight behind the recovery effort. We became one of the largest partners of Bibliothèques sans Frontières, in cooperation with the State University of Haiti, to provide access to more than 2,000 journals free of charge. This vital research would not only aid in the immediate recovery efforts, but also help Haitian research regain its footing and hopefully even move ahead. The message was clear: access to the scientific literature matters, even in what was then the most devastated place on Earth.

Open access has been a topic of discussion for many years, and Springer now has a portfolio of more than

350 OA journals. OA is an important part of the scientific present and future, and supports efforts to increase access to research, spread knowledge and help move science forward.

Roads to open access

While it is important to provide access to research, contrary to what many believe, making research truly open, usable and understood is not a free enterprise. Far from it. Open access requires a

same quality assurance and value-adding processes that have long been part of academic publishing.

We have also adopted a balanced approach to providing access to important discoveries in places where they are needed, but where people may not be able to afford to pay for them. 'Open access means there are fewer barriers to accessing the latest research for reading, but BioMed Central and Springer also ensure that the publication

Open Access Africa brought together librarians, researchers, editors and funders to share ideas about how OA can support science and medicine in Africa

balanced approach to ensure the integrity of science, to fund continual improvements in the technologies used to publish and discover research, and to make sure that publishers continue to invest in ways to make this process more equitable for all. This is why the gold road to OA – requiring upfront article publication charges – or the green road, with *reasonable* embargo periods tailored to different disciplines, are the ways in which Springer believes that the OA movement should evolve.

'We support easy, hassle-free open access publishing,' says Bettina Goerner, director of Open Access & Business Development at Springer. 'OA articles in our journals are immediately made freely available on the SpringerLink platform, and as a service to authors, we send the final articles to repositories and also clarify reuse terms with Creative Commons licences. This is a sustainable way to ensure that research results are openly accessible.'

Just because the technical capabilities in Haiti may not be as advanced as in other countries, that doesn't mean that science does not have to be of the highest quality. While OA would certainly help by allowing Haitian scientists and practitioners to get their hands on important research results, articles are unlikely to be useful if they have not been subject to the

charges don't discourage authors. In 2012 we waived the fees for over 1,100 authors, most of them from developing countries,' explains Bev Acreman, commercial director of BioMed Central.

Open Access Africa

In addition to our charitable efforts in Haiti and membership in organisations such as INASP (see article on page 8) and Research4Life, we are also helping to inform scientists in ACP countries about OA publishing. For example, in 2012 BioMed Central organised Open Access Africa, an event that brought together librarians, researchers, editors and funders to share ideas about how OA can support science and medicine in Africa. The event included sessions on the importance of sustainable funding for African journals and the complementary roles of capacity building in research and journal publishing.

OA is a vital and growing part of our activities to spread the wealth of knowledge we publish to the developing world. This will help to improve human health and society, and foster an environment that is conducive to the development of scientific capabilities at institutions of learning. Like the content made available to Haiti in the aftermath of the 2012 earthquake, we hope that OA will continue to evolve to ensure similar access to high-quality science for all. ◀

Following a major earthquake in Haiti in 2012, Springer Science+Business Media became a partner of Bibliothèques sans Frontières to provide free access to 2,000 journals to aid immediate relief efforts and help Haitian research regain its footing.



CHRISTIAN J. KOBER / ALAMY

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GALLO IMAGES / ALAMY

Opening access – views from the South

Initiatives in Africa to open up access to research results are helping countries there face development challenges and bridge the knowledge gap with industrialised countries.

Opening access

The ability to access relevant research results is essential for countries to solve the many development challenges they face. This is particularly true in the South, where the need for sustainable agriculture to feed a growing population and other challenges require policies and action designed for local needs. Initiatives such as the Journals Online

project, African Journals Online and Research4Life, and conscious efforts to develop open access policies, as the University of Nairobi in Kenya has done, are the first steps in bridging the knowledge gap between industrialised and developing countries.

Two-way street

Developing countries will only fully integrate into the knowledge economy if they also become producers of research and not just receivers of international 'knowledge'. This belief is what prompted the International Network for the Availability of Scientific Publications (INASP) to set up a pilot project called African Journals Online in 1998 to promote the awareness and digital use of African scientific articles. African Journals Online has grown into a platform, both subscription-based and open access, for over 400 journals published in Africa. These journals

represent vital channels for sharing locally generated research.

Building on the success of Africa Journals Online, INASP then established the Journals Online project. It broadened the scope to include journals from Latin America and countries like Nepal, Sri Lanka, Bangladesh and Mongolia. The project helps journals in developing countries, which are often only available in print, to get online to increase their visibility and accessibility. By late 2012, the INASP project counted 240 journals with almost 20,000 articles, of which 88% were open access. There have been over 12.6 million downloads since 2007.

The online journals managed by INASP are multi-disciplinary. However, a key focus is agriculture and related issues such as food security, ecology, and agricultural by-products like foods, fibres and fuels. Developments in agricultural chemistry and engineering, and urbanisation, are affecting the kind of

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research being done in this area. A strong domestic publishing community in developing countries would cover issues that journalists from the North might tend to overlook – strategies to deal with the impact of climate change on subsistence agriculture in resource-poor, rural areas is an obvious example.

Freely accessible information on research results without the obstacle of a paywall makes it possible to achieve practical improvements in the field. Clearly, for developing countries research results in agricultural matters are crucial for development (see box, which shows the percentage of open access journals in the Journals Online system).

The Kenyan example

The availability of open access resources will surely lead to positive developments, not least the opportunity for materials to be reused and distilled into the kinds of practical reference tools that practitioners need. However, simply opening access is unlikely to generate the kind of change that can drive development on its own.

A 2010 study on access to research results in East and Southern African universities by Jonathan Harle of the UK Association of Commonwealth Universities showed that making research freely available does not necessarily mean that it will be used effectively. Open access is most effective when married with academic literacy training, effective signposting, a research culture that supports critical thinking and government policies that advocate the value of research in development and innovation at a national level.

The open access policy established by the University of Nairobi in Kenya is a powerful example of an effective cross-sector approach to open access. It began when the government introduced performance contracts in the public sector in Kenya in 2005, including at the university and its library. The contract essentially set targets that would hold the public agency, in this case the university, accountable for its performance.

The university began to develop an open access strategy to draw attention to the research it produced. It had its library set up a training programme in 2009 for students and academic staff to create awareness of open access and train them how to use e-resources to find freely available articles – and this became a target in the performance contract.

Two staff members of the university library then set up a digital repository

with the ICT department. By December 2012, the university had adopted an official open access policy that has had a major impact on other institutions outside the university, who are now developing their own open access strategies. The Kenyan government has even declared access to information a universal human right.

Other initiatives

There are many other initiatives that address research information needs and give researchers in developing countries access to online articles that once would have been behind expensive paywalls. These include Research4Life – the collective name for AGORA (agriculture), HINARI (medicine and health), OARE (environmental science) and ARDI (technology and innovation), four public-private partnerships that aim to provide the developing world with access to critical scientific research.

INASP runs a suite of programmes designed to strengthen research capacity in developing countries. This includes enabling them to buy cost-effective subscriptions to international scholarly journals and developing the skills of librarians, researchers, ICT staff and journal editors. The resources made available via these access initiatives have been joined by a growing number of open access resources in recent years, which have full texts available online at no cost to the reader. These include those listed in the Directory of Open Access Journals, the Directory of Open Access Repositories, the Directory of Open Access Books and in 2013 the launch of Open Access Theses and Dissertations.

Africa Journals Online will be conducting a survey in 2013 on the state of scholarly publishing in sub-Saharan

Related links

Research4Life

→ www.research4life.org

INASP

→ www.inasp.info

Directory of Open Access Journals

→ www.doaj.org

Directory of Open Access Repositories

→ www.openoar.org

Directory of Open Access Books

→ www.doabooks.org

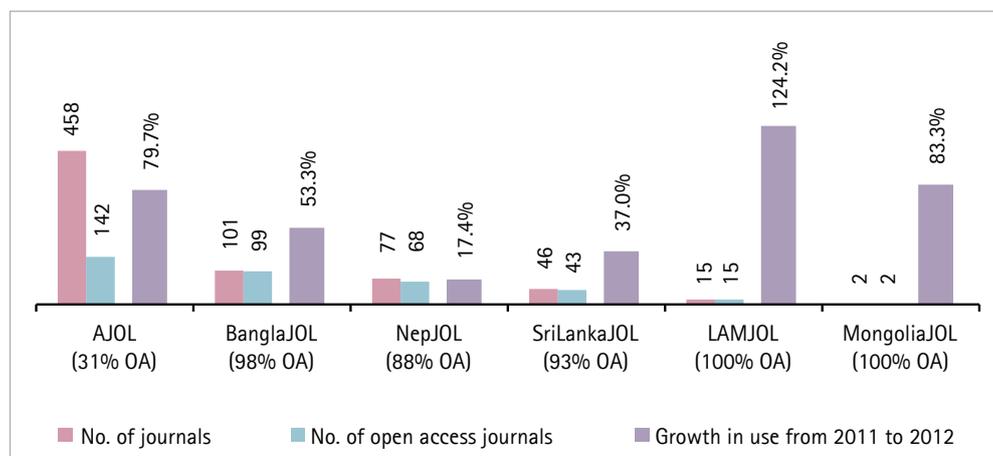
Open Access Theses and Dissertations

→ www.oatd.org

Africa to assess whether it should remain partly subscription-based or join open access, online journals from other countries around the world. The survey also aims to increase awareness of the realities and complexities of being a publisher in sub-Saharan Africa.

In the future, to ensure that open access initiatives will truly benefit people in developing countries, they need to be fully included in global debates so they can voice their own needs – exploring the impact of article processing charges, for example, or the different needs of social science and humanities research compared to science, technical and medical. Open access developments are positive on the whole. There are more and more examples of the constructive impact open access can have – so the next step is to build on these and keep up the momentum. ◀

Percentage of open access journals in the Journals Online system.



No longer 'publishing as usual'

Despite the spread in the use of ICTs in agricultural research (see *ICT Update 70*), information is still constrained by the way it is published and the degree to which it is open. Piers Bocock of CGIAR shares how his organisation is addressing this.

Opening access

CGIAR is recognised as a global leader in producing research that contributes to a food-secure future, particularly for the poorest of the poor. But the results of our research are not consistently available on an open access basis to the agricultural community. If all of the data produced by research organisations could be made available to those trying to improve agricultural efficiency in the developing world, their contribution to addressing the world's most pressing challenges could be dramatically improved.

CGIAR research is carried out by thousands of scientists across 15 international research centres and partner institutions via 16 global research programmes. Our work is funded by governments and foundations aiming to tackle today's most pressing challenges: poverty, food security, nutrition and health, and climate change. Our research results are cited widely, and we have been collecting and analysing valuable data, producing research papers and developing critical agricultural breakthroughs for over 40 years.

But times have changed. Today's networked and ICT-driven world provides new opportunities for scientists

and entrepreneurs to leverage open data to create important breakthroughs. And donors are no longer satisfied with a research paper in a prestigious journal – they want the knowledge to be widely shared, as swiftly as possible. This means that CGIAR's approach to publishing research needs to change too. If research results are to be seen as a global public good, then they need to be available to the wider scientific community and those working on the ground to put scientific breakthroughs into practice.

Open access has been in discussion at CGIAR for years, and our commitment to providing 'open access' to our knowledge and data is not new. Five of our research centres already have open access policies. But what has changed in the past year is the action we have taken to formalise this commitment across our network in our open access and open data policy.

This policy will take time, but in the end it will constitute a significant swing away from 'publishing as usual'. It will mean making commitments, establishing realistic policies and following through. So where is CGIAR in this process?

The impact of availability

Examples of open data and open access across the CGIAR Consortium already exist. Take 'Cassavabase', an online database where large volumes of valuable cassava data have been made openly available through a joint initiative between the International Institute of Tropical Agriculture (IITA–Nigeria), Cornell University in the United States and other partners with support from the Bill & Melinda Gates Foundation and the UK Department for International Development.

Cassavabase features all phenotypic and genotypic data generated by cassava breeding programmes in the NEXTGEN Cassava project, and makes the data immediately and openly accessible to all users prior to publication. There are other examples of open data, but a more comprehensive approach is needed so that research results are stored, communicated and accessed in a consistent and sharable manner.

Since 2009, key reforms have been transforming the way CGIAR generates and shares knowledge, technologies and policies for agricultural development. A key milestone was our adoption in 2012 of CGIAR Principles on the Management of Intellectual Assets, which envisions prompt dissemination and full, open and free access to all of our research results and development activities. In September 2012, leaders from across the consortium gathered to identify future priorities for knowledge management and knowledge exchange, and our open access policy was identified as the lynchpin.

Work began on drafting that policy in November 2012, and it has since been discussed by all of our centres and research programmes. A final open access policy – which dictates a standard approach to opening up data and knowledge within very specific time frames – is expected to be approved by our centres and our board in late 2013.

But it is not all about policies. It is more about fundamentally changing how that research is published. Instead of focusing on safeguarding data, we need to be thinking about making it available (while maintaining appropriate use and credit). Instead of focusing on limited-access 'high impact' journals, we need to be thinking about the potential impact of making our information much more widely available.

This won't happen overnight, but scientists, data managers and publishers need to step in time with the open access movement. Clearly, research results reach a far broader base of readers when barriers to access have been removed.

CGIAR hopes to have a policy in place sometime in 2013 that will establish a reasonable time frame to implement its requirements. The next phase will be to develop a toolbox for implementation, and adopt clear and logical standards that will make the network's research outputs machine-readable, harvestable and open. CGIAR researchers know they are sitting on a wealth of agricultural knowledge and data. Now it is up to them to improve how they share that with the world. ◀

Cassavabase is an online database that has made large volumes of data on cassava openly available. The initiative is a joint effort between the International Institute of Tropical Agriculture (IITA–Nigeria), Cornell University and other partners.



JOERG BOEHLING / ALAMY

Piers Bocock (p.bocock@cgiar.org) is director of knowledge management and communications at the CGIAR Consortium based in Montpellier, France.

Open data for agriculture

Most of the research results published by agricultural researchers in journals are in English. So the vast majority of farmers and extension workers in developing countries – who do not speak English or often do not have access to libraries – cannot retrieve these research results. Information that would otherwise be useful to farmers is not reaching its potential beneficiaries.

Opening access

To build a bridge between agricultural research and farmers, Philip Parker and his team at INSEAD, a business graduate school with campuses in France, Singapore and Abu Dhabi, is developing Toto Agriculture with partners such as the Bill & Melinda Gates Foundation, the Grameen Foundation, Farmer Voice Radio and Farm Radio International. Toto Agriculture is an online collection of localised agriculture-related information such as weather forecasts, soil health, planting tips and pest management. It uses more than 750 sources of agricultural knowledge to produce on-demand information in as many as 60 formats.

Most importantly, the mix of structured and unstructured data available in various formats – text, audio, video, calendar, charts and maps – on Toto Agriculture has also been translated into over 100 languages. Farmers, community knowledge and extension workers, rural radio hosts and agricultural call centres can use Toto Agriculture from any desktop computer with an internet connection and extract data for any of the 180 countries represented. It is even possible to filter some data themes by state or province or other smaller entities.

The dashboard

Entering www.totoagriculture.org in your browser's address bar loads the website homepage, known as the dashboard. The column on the left side is divided into agricultural data themes such as weather, soil, plants, livestock and aquaculture. Each category has links leading to specific data and formats. Clicking on a link opens a new page (the column will stay) where data attributes, such as language, localisation or size of package, are set to refine the search.

The dashboard was developed with rural radio and agricultural extension call centres in mind. It is used as an interface to search and display data that will help prepare radio programmes (a requirement by Farmer Voice Radio) or give timely information to call centre operators (a requirement by Grameen Foundation).



The Toto Agriculture project is developing an app to help community workers disseminate data in the field.

Country-specific versions of the dashboard can be accessed using a sub-domain. In Uganda, for example, people using Toto Agriculture are advised to use the country's sub-domain site: <http://uganda.totoagriculture.org>. Replace Uganda with any other country name to access localised content available in different dialects. Localised content is marked by an icon representing the country's flag in the left column on a sub-domain site. The globe icon points to information relevant to any world region.

The crop calendars are one of the most popular tools. A radio station can open the interactive calendar and see what should be the most relevant topic to discuss at a particular time of the year. Colours are used to distinguish between phases of the planting season for the major crops: clicking on one of the colours will bring up a window with additional information and tips for that particular phase.

The dashboard can be also used to prepare interactive voice response systems, send videos to smartphones or share tips via SMS.

The universal app

Partners of the project are developing an app for Android devices to help community knowledge workers disseminate information in the field. The app will carry only the agricultural information specific to the country in which the community worker is active in order to save storage space.

Preliminary tests made during the development of the app, currently in its beta phase, have shown that weather data and the soil diagnostic tool were popular. The

device's GPS enables users to extract the geographical coordinates of their location to find the best weather polling station and share accurate weather forecasts. The app also features a step-by-step guide to soil type identification that also shows useful tips and factsheets.

Toto Agriculture is a work in progress. Its development is guided by its partners' requirements, and anyone can use the dashboard. People are encouraged to provide or validate translations: just click the volunteer button on any page and choose what you would like to contribute. In terms of adding or removing content, only partners have access to the engine, and you first need to contact the developers to receive the necessary permission. A 2.0 version is currently being developed. ◀

Related links

G8 – Open Data for Agriculture webcast featuring Phil Parker speaking about Toto Agriculture (see 1:04:45)
 → mms://wbmswebcast1.worldbank.org/TWI/2013-04-29/G8_Conference_on_Open_Data.wmv

G8 – Open Data for Agriculture website
 → <http://goo.gl/Us00w>

Toto Agriculture homepage
 → <http://goo.gl/pBYfT>

Documents

Open source evolution

Opening access



WILL WRIGHT / FLOKOR

According to an analysis of disaster management technologies by IRIN, a service of the UN Office for the Coordination of Humanitarian Affairs, a growing number of governments and NGOs are warming to open source alternatives. Open source services generally do not charge a license fee to download software. The downside is a potential lack of expert support, but the idea is that once the open source software is downloaded, used and redistributed, there will be what Stuart Gill, co-founder of Random Hacks of Kindness, calls 'explosions of innovation'. Like evolution, only the best user improvements to the software will survive.
→ <http://goo.gl/TiyXe>

Web resources

OpenStreetMap editor

The new OpenStreetMap editor 'iD' makes editing easier for new mappers who want to contribute local knowledge to maps. The intuitive interface lets users click on the type of vector GIS data they want to create (point, line or area). After digitising the object onto the base aerial map, the user can then select descriptive attributes from a list of data types. The editor is open source and the code is available on GitHub. The new interface will help community knowledge workers in agriculture, for example, rapidly map fields and contribute data.
→ <http://goo.gl/Ho4Ng>

Open access cassava database

Cassavabase is a database of phenotypic and genotypic data generated by cassava breeding programmes within the Next Generation Cassava Breeding (NEXTGEN Cassava) project. The database makes breeding data immediately available, thereby providing cassava researchers and breeders a key reference data source.

Data can be accessed through the web interface and also various tools are available to view the datasets.
→ <http://bit.ly/13eTMON>

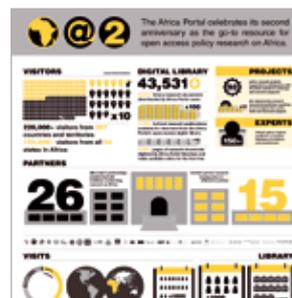
Mobile phones for nutrition

Mobile phone technologies can help the systematic and periodic collection of information on nutrition. The benefits these technologies offer include lower data collection and transfer costs, faster data transmission, analysis and dissemination, higher-quality data and more transparent and inclusive data collection processes with the possibility of immediate feedback to households and communities.
→ <http://goo.gl/8BZXI>

Open online courses

OnlineCourses.com offers over 750 free and open college courses for students and professionals, all in a conveniently searchable online courseware platform. The courses span videos, audio lectures and notes and are given by professors from renowned universities such as Harvard, Princeton and MIT. Subjects vary from biology to accounting, and foreign languages to science. People can watch or listen to these courses for free – anywhere, anytime.
→ www.onlinecourses.com

The Africa Portal



The Africa Portal is an online knowledge resource for policy-related issues on Africa. The portal offers open access to an online library, an opinion and analysis section, an experts directory, an international events calendar and a mobile technology component. The online library features over 5,000 books, journals, and digital documents. The entire online repository is open access and available for free full-text download. The Africa Portal is an initiative of the Centre for International Governance Innovation and the South African Institute of International Affairs.
→ www.africaportal.org

Projects

Fiji app workshop

A workshop on mobile apps organised by the International Trade Centre and the Fiji Crop and Livestock Council highlighted their importance as an agricultural tool. Participants were introduced to a range of mobile phone apps specifically designed for farmers, agri-food processors and exporters as well as produce buyers in the tourism and retail industries. Some of these apps included Fiji Makete, a market trading facility that enables farmers to sell their products to potential buyers, and Alerts, an information distribution system that allows users to reach multiple parties via SMS text messaging.
→ <http://goo.gl/uvWUP>

Modernizing extension and advisory services



AFRICANCE / FLOKOR

According to Karen Vignare of Michigan State University, ICTs have to be designed with the end user in mind if they are going to effectively support extension and advisory services. They must consider factors such as literacy levels and access to various types of technology. In a brief written for Modernizing and Extension and Advisory Services, Vignare covers key design considerations for effective ICT-supported extension and advisory services, highlighting example projects and high-priority issues.
→ <http://goo.gl/IORzv>

e-learning food security

The Africa Lead database features a detailed listing of upcoming trainings and open education resources for anyone interested in food security in Africa. It is relevant for government officials, farm leaders, entrepreneurs, innovators and policy leaders in agriculture. The courses and resources include materials from African institutions, training providers and universities, governments and NGOs from around the world. The database is sure to make the courses highly visible to ensure their widespread dissemination and use.
→ <http://goo.gl/AjRnd>



Pete Cranston (pete.euforic@gmail.com) is an ICT, communication and new media specialist, with long experience as a facilitator and trainer. For the past 14 years he has worked mainly in international development. His most recent research has been into global social media trends, with special reference to health communications, and the impact of convergent mobile technologies in rural development.

Does opening access to research have special importance for the development sector?

→ I think we are on the edge of a quite dizzying range of possibilities for doing development differently if we think imaginatively about how we might connect islands of data. I've written elsewhere about a scenario, for example, where data already collected in northern Kenya for the Hunger Safety Net Programme could act as a trigger for extension workers in northern Kenya, providing them with alerts via

with iHub Research in Nairobi to develop prototype mobile applications that might be used to exploit data on agriculture and nutrition, and connect people and share knowledge.

Open Nepal is another example of an initiative that is exploiting the levelling effect of globally available open data. Open Nepal is the latest in a series of recent initiatives from a group of organisations including Freedom Forum, the NGO Federation of Nepal, YoungInnovations and the aidinfo programme. Open Nepal focuses on catalysing and supporting an ecosystem around transparency and access to information.

Earlier this year, I interviewed Bibhusan Bista from YoungInnovations, a startup that was involved in an early Nepal country study by aidinfo.org. The success of YoungInnovations' recent Hackathon, organised to coincide with a worldwide series of hackathons, and described in an aidinfo blog, is an indicator of how the scene has been developing since then. Developers experimented with data exposed on Open Nepal, producing simple but effective applications that addressed hot local issues, such as the app that compared fuel prices in India and Nepal.

I keep hearing about hackathons. What exactly is a hackathon?

→ A 'hackathon' (also known as a hackfest or hack day) is an event in which computer programmers join forces with a number of other experts, such as designers, investors and project managers, and spend a short intense period together to develop technical ideas and solutions. An example I was involved in this year is the Research to Impact Hackathon, held at the Nairobi iHub in January 2013, part of the CABI/IDS/iHub research project mentioned earlier. It focused on research data related to agriculture and nutrition from R4D, ELDIS and other relevant sources, including those from Kenya such as KAINET.

We brought together experts in the subject matter and technical developers to explore and create innovative prototypes, and increase the use and impact of research in development. iHub Research led the event and are managing the follow-up – which is unusual in hackathons. Funds were available to support winning entrants in taking their ideas further and developing working models. More information is available on the Euforic Services wiki, which we used to support the event. CTA is organising a hackathon focused on youth at the ICT4Ag conference in Rwanda later this year. ◀

A new resource for agriculture

Opening access

Why is open access to research and other data important?

→ Every year institutions, researchers and practitioners generate thousands of datasets, reports and articles about development issues. Yet much of this knowledge remains underused, locked away in silos. I am particularly interested in open data. Two of my expert colleagues, Tim Davies from the University of Southampton and Duncan Edwards from the UK Institute of Development Studies, believe that open data means not only publishing data freely but allowing reuse and putting it online as linked data to create a web of connected datasets.

Open data on the web makes it possible to take information on research from many sources, for example, and generate 'mash-ups', which make it available in different places, on different platforms, and in ways that support action and impact. Open data can be remixed to answer key questions in ways that were not possible before.

mobile phones of new research findings for families whose livelihoods depend on camel herding (providing, of course, that the suppliers of data first need to give permission for it to be shared across government departments).

Who is at the forefront of the effort to open up data?

→ The World Wide Web Foundation, started by Tim Berners-Lee (who invented the WWW) is a central organising node. The Food and Agriculture Organization and the World Bank were early pioneers, and there is a growing band of organisations that focus on open aid data such as Publish What You Fund and Open.AidData.

The rapidly growing government portal, Kenya Open Data portal, is a great example of an initiative in a developing country that is acting as a trigger for local innovation and experiments in how government data could be used to increase transparency and accountability. The project to watch is called Exploring the Emerging Impacts of Open Data in Developing Countries, a multi-country, multi-year study funded by IDRC to understand how open data is being used in different countries and contexts across the developing world.

What are some examples of ongoing open data initiatives?

→ First of all, it's important to have a sense of the scale of the resources that could be made available. The Department for International Development (DfID) in the United Kingdom, for example, funds £200 million worth of research every year. Yet much of this knowledge remains locked away in online repositories such as DfID's own R4D database and IDS' ELDIS. That's why IDS and CABI are collaborating on a project to open up the research data through open APIs and a collaboration

Every year institutions, researchers and practitioners generate thousands of datasets, reports and articles about development issues. Yet much of this knowledge remains underused, locked away in silos.



SCIENCE PHOTO LIBRARY / ALAMY



Smart phone pilot

The Ministry of Food and Agriculture in Ghana is planning to use smartphones to provide agricultural information to farmers to increase productivity. The aim of the initiative is to address the lack of extension workers in the country, a situation that could potentially worsen in the coming five years. According to the website Modern Ghana, the northern regional director of the Ghanaian Ministry of Agriculture, William Boakye-Acheampong, has expressed concern that almost all the extension officers in Ghana are due to retire by 2018. This situation would clearly affect how agricultural information reaches farmers.

The smartphone initiative is going to be piloted in selected districts in the Northern Region of the country and is part of the West Africa Agricultural Productivity Programme Two (WAAPP-2). Emmanuel Alorigiya, communication officer of WAAPP, describes the aim of the e-extension platform as an attempt to provide farmers with agricultural information in the languages that farmers use. Farmers would be introduced to an e-extension hub through a central portal that will serve the nation with data and information.

WAAPP is a World Bank-funded project, the first phase of which ran from 2007 to 2012 at the cost of US\$15 million. The second phase started in 2012 and ends in 2017. This phase cost US\$60 million as a loan to the country. According to Modern Ghana, the project shares knowledge and technology aligned with regional priorities to address poverty and food insecurity through regional cooperation and integration.

→ Original article <http://ht.ly/l201r>

Bus tracker

In the west, we are accustomed to using realtime bus trackers to see whether we have missed a bus or how long it's going to take until it arrives. Not everyone has this luxury, however, as BBC reporter Michel Millar discovered. Many developing countries lack the mobile infrastructure

for such apps, and many people cannot afford smartphones. Mastek, an Indian outsourcing provider, has found a solution to this problem. It has developed a GPS-enabled mobile device and installed it in the buses that pick up the company's employees. A server pinpoints the location

BRCK, modem for Africa

A modem designed specifically for Africa has been announced at the 2013 TEDGlobal conference in Edinburgh, Scotland. The modem was developed by Kenyan tech firm Ushahidi, who refer to it as 'your backup generator for the internet.'

Ushahidi developed the modem to cater to the need in Africa for a modem that addresses the problem of getting – and staying – connected. In an interview with the BBC, Juliana Rotich, co-founder of Ushahidi, said that 'while Africa may have joined the digital revolution and mobile is becoming ubiquitous, internet connectivity is not always reliable.'

The answer is a smart, rugged device that connects to the internet in different ways – by hopping from one network to another, creating a hotspot for multiple devices, while plugged in or running on battery power (if the AC power fails, BRCK falls back automatically on its 8-hour battery).

BRCK works much like a cell phone, switching between Ethernet, WiFi and 3G or 4G mobile phone networks. Plug in an ordinary SIM card and BRCK will provide a fully functioning network anytime and anywhere in reach of cell service. It also operates in the cloud with its own website so users can check how WiFi and electricity are performing, or manage alerts and applications.

→ Original article <http://goo.gl/uNOsc>



of the bus and relays this information to the mobile app. Employees don't need to download an app on a smartphone to figure out where their bus is. Instead, they receive an SMS telling them how many minutes the bus is from their location.

→ Original article <http://goo.gl/5s7x7>

Tablet café in Dakar



CHARVIER / FELCER

Google is sponsoring the Equinox cybercafé in Dakar, Senegal to try out a new concept: the tablet café. Equinox, located in Médina, the city's cultural centre, has replaced all of its computers with 15 tablets. Because tablets are easy to use and have broad appeal, Equinox hopes that this new concept will introduce new users to

the internet. Tablets also consume less power than desktops or laptops, and do not require ventilation. The savings in electricity can be reinvested in faster connectivity.

Customers can use the tablets for the equivalent of US\$0.60 an hour. They will be able to use the device comfortably seated on a couch, go to a private booth for a video chat or set their tablet on a dock and type away on a wireless keyboard. Each tablet will already have popular applications installed on them, and users can download other applications as well. At the end of every session, a staff member will help the customer perform a factory reset so that all of their private data on the device is fully erased.

→ Original article <http://goo.gl/t7ZIA>

Bundled mobile service



KIWANUA / FELCER

According to the website e-Agriculture, a unique 'bundled' mobile service, called Agri-Fin Mobile, is changing the way smallholder farmers conduct business. Agri-Fin 'bundles' local financial services, market information and agricultural tips into a single comprehensive package by partnering with mobile tech

companies, financial institutions and research organisations. The potential for bundling technology is enormous, given that even in remote areas most farmers have access to mobile phone technology and service.

Agri-Fin Mobile was developed by Mercy Corps, a global aid agency with headquarters in Portland, Oregon. Rural farmers in Indonesia, Uganda and Zimbabwe are using it to increase crop yields, boost food security and enhance economic prospects. Agri-Fin keeps farmers connected wherever they are by providing up-to-date market pricing information, weather forecasts, mobile banking and direct links to market activity, such as daily market prices and fertilizer information.

→ Read the full article <http://goo.gl/ikLz3>

African information highway

The African Development Bank (AfDB) has launched data platforms in an additional 10 African countries as part of its 'Africa Information Highway' initiative. This brings the total number of African countries connected to the Open Data Platform to 40. Work is underway to complete platforms in the remaining 13 African countries by July 2013.

AfDB initiated the Open Data Platform in response to concerns about access to high-quality, reliable and timely data needed to manage and monitor development results throughout Africa. The platform includes data on development topics such as climate change, food security and gender equality as well as socio-economic indicators. By providing quality data, the platform aims to support evidence-based decision making, good governance and public accountability. AfDB also hopes that the platform will promote international statistical standards across all African countries.

The platform can be used to collect, analyse and share data among countries and with international development partners. It is a unique opportunity for various users, such as policy makers, analysts, researchers, business leaders and investors around the world, to gain access to reliable and timely data on Africa.

It is hoped that African countries will use the Open Data Platform to share data with the AfDB and other international development partners, such as the International Monetary Fund, the EU Commission, the World Health Organization, the UN Food and Agriculture Organization, the African Union Commission and the UN Economic Commission for Africa. The African Information Highway initiative could potentially revolutionise data management and dissemination in Africa, and reposition the continent for more effective participation in the global information economy.

→ Original article <http://goo.gl/4ikAa>



TAI STRIETMAN

7 OA repositories exist in Kenya, while Tanzania has only 2 and Uganda 3. These countries have a total of 13 OA journals. <http://goo.gl/XWYzi>

42 virtual and physical site locations for the University of the West Indies' Open Campus serve over 16 countries. <http://goo.gl/vTkly>

7 out of the 8 satellites in the Landsat programme reached orbit. Landsat 8's data is already available to download. <http://goo.gl/o8IEO>

The benefits of e-learning

I have been a lecturer in computing and information systems at the Fiji Institute of Technology and Fiji National University for over 12 years at the technical, vocational educational training and higher education levels. We have 22 lecturers and tutors in the department, and class sizes vary from over 150 students to less than 40. Even though Fiji is a small country, with about 850,000 inhabitants, it produces qualified graduates in a number of fields, including ICT. These people usually end up working in the private and public sectors, or at universities.

Websites

The first thing I do when I start up my computer is check my emails and open Firefox. I usually visit local Fijian news sites, just to tune in to what's going on in my environment but also elsewhere in the world. There are the online versions of the *Fiji Times* and *Fiji Sun*, and Fijilive, an online newspaper and website for business and culture.

There are also sites like Facebook and LinkedIn that I visit every day for personal and professional reasons. I use them to socialise with IT colleagues, friends and family. We have a staff and student association page for Fiji National University on Facebook.

I use LinkedIn, Google and YouTube for work. I do research on Google and use that and YouTube for educational purposes. For example, I use videos in my classes to demonstrate how certain programs work and for practical work. LinkedIn is useful for professional contact. I use it to follow research papers and give students at Fiji

National University advice. I also regularly check my work website on my laptop when away from my desk, even on weekends.

Research

There are some open access resources that I regularly use, such as the digital libraries at Fiji's two universities, the University of the South Pacific and Fiji National University. I sometimes use World Bank Open Data, which is freely accessible, and sometimes Wikipedia is a good starting point for gathering information.

There are some sites that have been particularly important for my work. My university's library is using a trial version of the research site ProQuest at the moment, and we have a full subscription to EBSCOhost, a research database service. And I am a member of both the Australian Computer Society and IEEE, a professional association for the advancement of technology that helps me find current IEEE publications and participate in the association's activities.

E-learning

An emerging field in Fiji is internet governance, especially in telecommunications, which is a sector that has gone through major changes. Regulations have turned the focus onto the importance of having better internet access and bandwidth at a cheaper cost. Training in internet governance by the DiploFoundation has helped to create better awareness of internet governance in Fiji and also in other areas of the Pacific region.

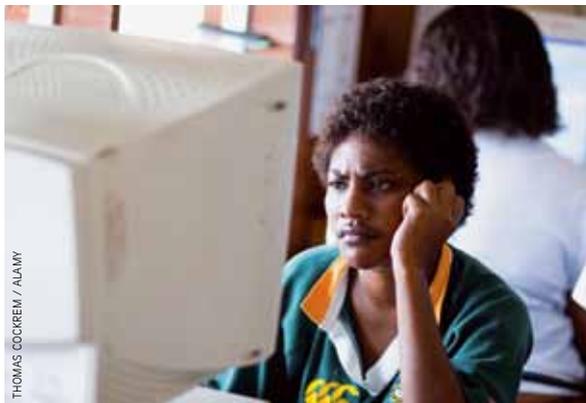
Internet governance introduced me to e-learning, and I immediately saw its potential for my university. I did an online course where I did research on ICT strategies. I then wrote a proposal to develop and test e-learning systems for the university. The idea was to introduce remote learning – which is especially useful in the vast Pacific region – so that people would not have to necessarily sit in the same room to learn.

I use an e-learning medium called Moodle for what I like to call student-centric learning. Moodle is an open source platform that can be used to manage student materials. Moodle allows me to use different modes of classroom teaching, such as day, evening and off-campus lecturing. It lets me upload and download



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Internet governance is an emerging field in Fiji. Regulations have turned the focus onto better internet access and bandwidth at a cheaper cost. Training sessions have helped to improve awareness of internet governance in Fiji but also in other areas of the Pacific region.



files, assignments, notes, lectures and tutorials. I can give online quizzes on the platform, manage calendars, post announcements and moderate forums.

Moodle also makes it possible to remotely group students from different locations, and I can maintain my teacher-student relationship even when I am away from work since student comments, submissions and queries are stored in the system. All I have to do is log in to the system, and I can interact and collaborate from anywhere.

Besides Moodle, I use tutorialspoint, which is a free site that offers tutorials in technical and non-technical fields, and Polycom, which produces software for video-conferencing. Skype is good for lecturing students remotely, and it's also great for keeping in touch with friends and colleagues who are off-campus for whatever reason.

The next step is to develop a proper technological infrastructure for e-learning. But so far developments are very promising. I look forward to working more with other organisations like the DiploFoundation in the future. They have made it possible for me to explore e-learning for my university, and to involve policy makers in e-developments through capacity building workshops. ◀