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# TEEAL and AGORA: Off- and Online Access to the Scientific Literature of Agriculture for the Developing World

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## ABSTRACT

TEEAL (The Essential Electronic Agricultural Library) and AGORA (Access to Global Online Research in Agriculture) are digital collections of scientific agricultural literature for the developing world. Through both, the agricultural research cycle in the developing world functions more effectively, including in areas where access to the internet is limited, slow, or unreliable, thanks to TEEAL's off-line access. This paper discusses the programs' training, outreach, and usage and barriers to it, and the international partnerships that make them possible. Also profiled is the new AgriKnowledge database, which provides access to key unpublished agricultural content, including reports from the Bill & Melinda Gates Foundation's programs and projects.

## INTRODUCTION

Agricultural research scientists, policymakers, and university educators need access to both internationally peer-reviewed and locally generated agricultural knowledge to do their work, and they must be able to disseminate the results of their work to the wider agricultural research and policy community in order to stimulate innovation and change in agricultural practices. This important scholarly research cycle drives research innovation worldwide, and the cycle must function effectively to ensure evidence-based agricultural policy and successful translational agricultural research.

In the developing world, however, this research cycle is hindered by the barriers that researchers face in accessing the scientific literature. If an agricultural researcher in an American land-grant university needs a journal article, for example, chances are that his or her library either has the

\*The views expressed in this publication are those of the author(s) and do not necessarily reflect the views or policies of the Food and Agriculture Organization of the United Nations.

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article in question or can obtain it through the library's networks in fewer than three or four days. This is not the case for a researcher in the developing world, where libraries have been underfunded for decades and unable to pay for print journal subscriptions. Developing-world agricultural scientists without access to the research literature are severely handicapped in their attempts to conduct research in new agricultural research areas. Sometimes they work diligently for years on a research problem, only to realize that the work had already been accomplished. Several videos on the Research4Life website profile agricultural researchers who have had this experience (Research4Life, 2016a).

That is where TEEAL (The Essential Electronic Agricultural Library) and AGORA (Access to Global Online Research in Agriculture) come in.<sup>1</sup> TEEAL (Cornell University, 2010), launched in 1999, and AGORA (FAO, 2016b), launched in 2003, offer free or low-cost access to developing world institutions in 116 eligible countries to hundreds of leading scholarly journals in agriculture and related fields. AGORA is a program within the Research4Life initiative, a public-private partnership among various UN agencies, universities, and international scientific publishers that provides online access to nearly 70,000 peer-reviewed scientific journals, books, and databases in the fields of health (HINARI), agriculture (AGORA), environmental studies (OARE), and development and innovation (ARDI).

Both TEEAL and AGORA grew out of the development of electronic journals and CD-ROM technology during the 1980s, which suddenly allowed additional ways to obtain journal content at a very low marginal cost. This in turn allowed librarians and publishers to work together in public-private partnerships to meet the challenge of access for the developing world head on, and the agricultural-journal access programs we have today, TEEAL and AGORA/Research4Life, were born.<sup>2</sup> In the case of TEEAL, Cornell University is the lead organization working directly with publishers; for AGORA, the United Nations Food and Agriculture Organization (FAO) is the lead organization for the program, and Cornell University is the supporting academic partner.

The first TEEAL set arrived in Zimbabwe in 1999. It was a "library in a box," with articles from leading agricultural journals contained on hundreds of CD-ROM discs. In 2005 TEEAL moved from CD-ROM technology to the local area networks (LANs) of subscribing institutions. Today, TEEAL is delivered on a small-footprint computer that can be plugged into either a LAN or a stand-alone computer (see fig. 1). TEEAL offers access to over 400 journals with more than 500,000 articles. AGORA, designed to offer much of the same content via the internet, came along four years later and today offers access to up to 6,300 journals (and 6,400 books) to over 2,900 registered institutions in 105 countries.

The predictions were that by 2007, bandwidth in eligible countries would be robust enough that all TEEAL clients could be moved over to



Figure 1. TEEAL development.

AGORA. As with many such predictions of the future, this did not prove to be the case. In 2012, when TEEAL conducted a survey of the librarians and information specialists who manage TEEAL in institutions in Africa, the results showed that 100 percent of the responding librarians said they would keep utilizing TEEAL if it continued to be available offline. No institutions surveyed suggested that there was no longer a need for offline access. With the help of the Bill & Melinda Gates Foundation, TEEAL embarked on a rewrite of the software and interface to support a longer lifespan than anticipated.

While seemingly competitors, TEEAL and AGORA are actually very closely aligned, with the former serving the communities best served by an offline program and the latter serving those with adequate bandwidth. In many instances it is ideal for institutions to have access to both programs, and both acknowledge that when bandwidth is finally no longer an issue, TEEAL subscribers will transition to AGORA.

As has been noted, there are many barriers and impediments to research in the developing world; for example, collections budgets for journals are minimal or nonexistent, and internet access is inconsistent at best. While it is impossible to know exactly how access to a particular journal article impacts the food security of a farm community or individual family, it is certain that new agricultural research cannot be carried out effectively without access to the research results of other scientists. Figure 2 shows the potential path from research to ultimately better health and nutrition through food security, with TEEAL and AGORA playing a key role in the highlighted segments midcycle.

While breaking down the barriers to scholarly literature is critical to enhancing the scholarly research cycle in the developing world, it is

Point in Research Cycle	Outcome or Output	Who Makes this Happen?
1. Knowledge of suitable technology, market, or service	Research activity	Funders
2. Research activity	Research finding	Researchers
3. Research finding	Research paper	Universities, colleges, and academic networks like RUFORUM
4. Research paper	Published paper	Journal publishers, researchers
5. Published paper	Distributed paper	Internet, R4L, TEEAL
6. Distributed paper (TEEAL)	Papers read and internalized	Researchers, teachers, academic networks
7. Papers read and internalized	Knowledge applied	Researchers and teachers
8. Knowledge applied	Technology/service used by farmers	Extension/NGOs
9. Technology/service used by farmers	Lower costs/higher production	Farmers and effective markets
10. Lower costs/higher production	Better health and nutrition	Farm families, NGOs

Figure 2. Agricultural research–publication–application framework.

equally important to develop the skills to properly use these resources. Both TEEAL and AGORA have developed extensive training programs, both separately and together in partnerships with developing world institutions, to offer capacity-building and carry out assessment measures that ensure that both projects meet their users' needs and achieve the full potential impact of the programs.

## TEEAL

### *TEEAL User Training*

One vital lesson that the TEEAL project has learned over the past seventeen years is that simply providing access to the research literature is not enough to ensure its use. For many years before the advent of the project, for example, researchers in the 116 low-income countries eligible for it had little or no contact with research literature, which created a knowledge gap in how to effectively utilize this information base and contribute

to it. Further, there are stories of some TEEAL sets sitting unused at institutions that received them.

Overcoming these challenges and developing a set of skilled TEEAL users takes an on-the-ground training effort, and this goes beyond teaching how to use the database itself. In a 2012 survey of factors influencing research productivity, the most productive researchers identified high-level skills, such as scientific writing, computer competency in data analysis, and an ability to synthesize the literature, as essential to their success once literature access becomes available. The survey also showed that when institutions have the opportunity for faculty, researchers, and students to receive training, there is a greater use of TEEAL and increased likelihood of the institution offering its own training programs.

Cornell University's Albert R. Mann Library has a long-standing partnership with the Information Training and Outreach Centre for Africa (ITOCA) to provide on-the-ground support for TEEAL in sub-Saharan Africa see ([www.itoca.org](http://www.itoca.org)). Currently headquartered in South Africa, ITOCA is a capacity-building organization aimed at enhancing information and communications technology (ICT) skills for African librarians, information specialists, scientists, researchers, and students in sub-Saharan Africa. ITOCA was established in February 1999 as the TEEAL Africa office to market and support the project. Now, ITOCA spearheads program support and training for TEEAL and all the Research4Life programs (AGORA, HINARI, and OARE) in the region.

In South Asia, on the other hand, TEEAL has until recently done limited outreach and placed just a few of its sets in institutions in Bangladesh, Nepal, Sri Lanka, and Bhutan. TEEAL user training was only provided occasionally, using professional contacts who volunteered to assist a specific institution. In 2014, however, the project partnered with Sathguru Management Consultants in Hyderabad, India, to provide outreach and training for Bangladesh. Cornell's International Programs office in the College of Agriculture and Life Sciences has had a long-term working relationship with Sathguru for agricultural and education projects in South Asia, and Mann Library has experience working with it through participation in some of these projects, making Sathguru a good partner for TEEAL in South Asia (see fig. 3).

TEEAL user training in sub-Saharan Africa has for a number of years focused on national-level "train-the-trainer" workshops, providing instruction in using electronic databases, especially TEEAL and AGORA, to one or two people from subscribing institutions in TEEAL-eligible countries. This model had mixed success obtaining attendees, especially librarians, to provide real leadership at their institutions to create awareness of the projects, and to provide user training to their faculty, researchers, and students. Surveys have shown that at certain institutions there is awareness of these resources and a substantial number of users, while at others little was



Figure 3. TEEAL and AGORA workshops in Africa and South Asia.

done to build awareness and provide user training. These mixed results stemmed from a variety of reasons, including a lack of support for training at administrative levels of the institution, very limited numbers of professional library staff (and sometimes none), and librarians with little to no experience in providing training. There were even a few cases of librarians limiting access to the resources to themselves or just a few library staff, while providing printouts of articles to faculty, researchers, and students as a way of reinforcing their role as gatekeepers to information. The faculty, researchers, and students in these cases often had no idea that the articles came via TEEAL or AGORA, which was freely available to them.

Beginning in late 2013 a new training program was initiated that develops longer-term relationships with subscribing institutions in seven specific countries: Burkina Faso, Ethiopia, Ghana, Nigeria, Tanzania, Uganda, and Bangladesh. This more intensive program provides training for up to thirty-five faculty, researchers, and librarians at each institution, and has led to the hiring of in-country staff who are experienced trainers to lead the outreach and training in each of the eight focus countries. As part of this approach, a core group of leaders at each institution is identified to lead ongoing awareness-building and training at the institution, and university administrators are engaged from the beginning to ensure their support of the program. The focus of this new training model is to develop new skills, such as effective database searching, identification of appropriate research materials, and use of citation-management software, as well as information for developing awareness campaigns about electronic resources and teaching similar workshops at subscribing institutions that

are both far-reaching and self-sustaining. ITOCA and Sathguru work to assist institutions to begin actively training their faculty, researchers, and students in many of these skills, thus expanding the outreach of the program's in-country efforts.

The current two-to-three-day workshops provide training in the following areas, with an emphasis on training the trainer:

- Introduction to electronic databases
- Developing effective search strategies
- Using TEEAL
- Introduction to Research4Life, with specific training in using AGORA
- Using citation-management software, with specific training in using Mendeley
- Introduction to information literacy concepts
- Marketing electronic resources
- Introduction to developing a training program and conducting workshops

ITOCA has provided much of the leadership in developing the training modules, and both the TEEAL project staff and Sathguru are actively adapting those modules to regions beyond sub-Saharan Africa, specifically in Bangladesh, and developing new modules. These training modules are being shared among TEEAL's project office, ITOCA, and Sathguru, and, when appropriate, with AGORA trainers, and there are plans to enhance this collaboration in the future. Further, small grants, such as through the Elsevier Foundation, have allowed for developing and testing a more comprehensive week-long training program that, in addition to the training currently provided, also addresses scientific writing skills, working with publishers, the peer-review process, and ethics in research and publishing. The goal is to introduce this training to more institutions in the future.

By October 2016 ITOCA and Sathguru will have conducted or assisted with approximately 145 workshops in the seven focus countries, and 494 local training sessions of various sizes held at the participating institutions. At the conclusion of this project period, over 22,000 faculty, researchers, students, and policymakers will have received training. In non-focus countries, training for institutions depends on the availability of funding, since there are costs for ITOCA, Sathguru, and TEEAL staff members to travel to an institution and conduct training. While the needs are far greater than available resources, the group is working to expand the training information included as part of TEEAL and develop online training programs and tutorials that will be available on the TEEAL, ITOCA, and Sathguru websites or made available via DVDs and flash drives. Further, staff members work with professional volunteers interested in providing information about TEEAL and training in using it and other electronic



resources, such as AGORA. The goal of all this is to extend the reach of training efforts.

### *Usage Statistics*

The current version of TEEAL includes features that allow for gathering better usage statistics, including the ability to track journal titles and the number of articles viewed from each. Additionally, a registration system allows for tracking the number of unique TEEAL users from each institution, and the number of times such users access it. Also gathered is basic information, such as the user's status at the institution (faculty, researcher, or student) and their gender. The statistical package removes any information that would connect the user-registration number to an actual person, thereby maintaining privacy; the system also does not monitor the specific searches that a user performs or journals/articles viewed. The sole interest here is in determining the number of users and the frequency of use of TEEAL rather than specific user behavior.

However, because TEEAL is an off-line system, there are many hurdles to obtaining reliable and accurate usage statistics. While it is possible to automatically collect statistical data locally, it is not possible to automatically relay this information to the TEEAL office, since many subscribers do not have the reliable internet connectivity needed to support an automatic reporting system. Rather, TEEAL relies upon a contact person at the subscribing institution to download a report package and email it as an attachment. Currently under consideration are plans to develop an incentives program that would provide a discount of the cost of the annual update for those regularly providing the statistical reports or undertaking other desired activities, such as instituting a training program for incoming graduate students. Points would be awarded for each successfully completed activity from a list, and total points accumulated since the last update would determine the size of the discount. Initially, the incentive program would be only in focus countries, but could expand later as funding permits.

### *Monitoring and Evaluation*

TEEAL has an active monitoring and evaluation (M&E) program for its current focus countries that aims to determine whether the project is on track to enhance access to and the effective use of agricultural information, including both the international journal literature and non-journal research collections. These M&E activities also guide project implementation and identify course correction as needed. Such monitoring activities determine

- when TEEAL was installed in each participating institution and the challenges associated with acquisition and installation;

- the number of researchers and scholars using TEEAL at each institution;
- the intensity and proposed purpose of use by faculty, researchers, students, and policymakers;
- the challenges of using TEEAL; and
- TEEAL's perceived value.

The three strategies for gaining feedback are usage statistics, surveys of researchers and librarians, and site visits. By their nature, monitoring activities require feedback from users, which in a connected world can be obtained from internet-based instruments like Survey Monkey. TEEAL subscribers, however, often lack reliable internet access, so such feedback must come from field surveys of TEEAL users, librarians, and country representatives, along with nonusers where feasible. TEEAL also takes advantage of its location at a world-class research university—Cornell. Applied economics and management professor Mark Conostas assists TEEAL in the development of an overarching plan for the monitoring and evaluation program; the Cornell Survey Research Institute works with the project team to develop questionnaires, process the data, and conduct analysis of the results; and Janet McCue, a retired Cornell associate university librarian and former director of Mann Library, works as an outside consultant to conduct site visits to identify barriers and issues with TEEAL implementation, interface usability, training effectiveness, and usage statistics collection. The regular monitoring and evaluation of TEEAL in non-focus countries are more difficult due to the cost of such programs and their financial limitations. Over the course of TEEAL's existence, surveys of the project's subscribing institutions and users in many, though usually not all, eligible countries have been undertaken, and over time the TEEAL team compares these data to those gathered in focus countries.

#### *AgriKnowledge: Beyond Access to Journals*

While TEEAL has always provided access to agricultural research journals, there are other important sources of agricultural research that have not been part of the collection. AgriKnowledge, launched in September 2015, was developed as an online partner to TEEAL to provide access to key information in agricultural development that has not been published in peer-reviewed journals. The AgriKnowledge collection focuses on “gray” literature—including strategy documents, policy briefs, white papers, manuals, and presentations—which is an important source of agricultural research information that often has not been published and is therefore difficult to identify and access (Cornell University, 2016a). Unlike TEEAL, AgriKnowledge is available to researchers in all countries. While these research collections are primarily available online on the AgriKnowledge website, they are also being added to the TEEAL collection, so that the

documents are easily accessible to those institutions without robust internet connections. At the time of press, over a thousand documents are in the system, and more are being added on a regular basis.

AgriKnowledge's first and largest collection is material produced in conjunction with programs and projects sponsored by the Bill & Melinda Gates Foundation; for example, "Comprehensive Landscape Report on the Capacities of Tissue Culture Laboratories to Produce High-Quality Pre-Basic and Basic Planting Materials of Banana, Cassava and Sweet Potato in Ethiopia, Tanzania and Uganda" and "Counterfeiting in African Agriculture Inputs—Challenges & Solutions: Comprehensive Findings" (Cornell University, 2016b, 2016c). Other collections include documents from the Ethiopian Agricultural Transformation Agency (ATA) and the Alliance for a Green Revolution in Africa (AGRA). Since AgriKnowledge is designed as an important resource for those seeking knowledge on agriculture in the developing world, the development team is open to broadening and expanding the library. And because sharing resources across development partners will prevent redundant funding and drive synergetic efforts while simultaneously creating a valuable resource for the broader public, AgriKnowledge project staff members are actively seeking new partners and opportunities to build on the collections. Ongoing growth is expected over the next several years.

#### *Research4Life User Training*

Research4Life provides developing countries with free or low-cost online access to academic and professional peer-reviewed content. AGORA, one of the four Research4Life libraries, covers the same basic subject areas as TEEAL, and like TEEAL it is committed to providing appropriate long-term support of the use of their resources. For librarians and researchers to make the best use of resources available through Research4Life, training and effective promotion are key—just as with TEEAL, it is not enough to simply provide access to these valuable resources. The objective is to develop the capacity of eligible institutions to make use of the latest scientific literature and research. The training used has generally been a train-the-trainer model, with facilitated participatory sessions: presentations, group discussions, interactive sessions, and practical sessions with exercises. To supplement this in-person training, Research4Life also provides extensive online portal-training modules covering the training specific to each of the four programs, as well as on general topics, such as authorship skills and reference-management tools.

Who is eligible for AGORA and this training? The countries, areas, and territories covered by Research4Life, including AGORA, fall into two groups, with eligibility determined by GNI, GNI per capita, the UN Least Developed Countries list, and the Human Development Index. Eligible institutions in Group A countries are provided with access to content free

of charge, while in Group B countries each eligible institution pays an annual fee of USD1,500, following a free trial period of six months. These funds are collected by the World Health Organization (WHO) and used for training, promotion, and outreach activities.

ITOCA is also AGORA's key Research4Life training partner in Africa, and in 2015 they conducted fifty-six Research4Life workshops in six focus countries: Tanzania, Uganda, Ethiopia, Ghana, Burkina Faso, and Nigeria. Of these workshops, ten received central Research4Life funding. The workshops were usually hosted by local universities and research centers, and the courses were tailored to meet the needs of the participating professionals. Additionally, almost all covered a single country and single program (AGORA, HINARI, OARE, or ARDI), with regional and multi-program courses being far less frequent due to challenges of logistics and funding.

AGORA and the other Research4Life programs rely upon partnerships with a variety of groups for their training. The materials are developed and delivered by librarians and information-management professionals, both national and international, and local trainers are used whenever possible. The AGORA Short Course, the program's first training module, was launched in 2011 as a collaborative effort of ITOCA and the Librarians without Borders®/Medical Library Association (USA) "E-library Training Initiative" that was funded by the Elsevier Foundation.

Looking to the future, there are plans to deliver AGORA-specific workshops that expand beyond the basics of discovery and access and the content provided under the programs themselves to also highlight new trends in open science, open access, and open data in agriculture. Of course, due to limited funding and delivery capacities, only a certain number of requests for Research4Life workshops can be met. Geographic and programmatic balances are sought, as are opportunities to work with strong national or regional partners: universities, research institutions, and/or country/regional offices of UN partners. Given these needs and limitations, there are plans to complement the current face-to-face training workshops with more online materials.

As previously mentioned, Research4Life already provides a number of free online learning modules. Each Research4Life program has a free basic course for use in training or self-study; the AGORA Basic Course, for example, which debuted in 2015 and is based on the original Short Course, has a series of training modules for individual users, with presentations and hands-on exercises (FAO, 2016a). HINARI, Research4Life's collection of health sciences literature, also has a free Advanced Course; and in the cross-program Research4Life Training Portal (Research4Life, 2016c), there are links to course materials for HINARI, AGORA, OARE (environmental literature), and ARDI (technical literature). Research4Life interdisciplinary training materials can also be downloaded without cost, covering

subjects like authorship skills, reference-management software tools, marketing, and resources on information literacy. Research4Life training videos have also been developed in partnership with Africa Interactive, a media production company based in the Netherlands, with support from major publishing partners. All of this content found on the Training Portal is aimed at a wide audience: librarians, information specialists, scientists, researchers, and students.

Basic distance-learning courses on AGORA have also been offered on the ITOCA Moodle platform. Here, introductory courses covering the baseline skills necessary to effectively and efficiently use the programs are offered for AGORA (in English and French), as well as for HINARI (in English, French, and Portuguese), OARI, and TEEAL. There are plans to offer on-demand versions of these online courses once the materials are updated and translated. Finally, AGORA also offers webinars that provide an overview of the program (FAO, 2016c).

## AGORA

### *Usage Statistics*

AGORA and the other Research4Life programs maintain basic statistics on system use. The server log files are collected by WHO, which hosts the Research4Life journal portal, and are currently processed by Cornell's Mann Library. Every month, the server logs are processed to pull out the login data for each unique user name, which represents one institution. The login data are then loaded into a database for use in creating monthly, yearly, and other ad hoc reports. This information aids AGORA and the institutions in gauging general usage. Some of the questions answered by this login data include: Are there registered institutions not actively using their subscription to AGORA? Have user logins increased as a result of recent AGORA training or outreach? When is AGORA most heavily used?

The number of user logins over the 2015 fiscal year decreased slightly when compared with the same period the previous year. This may be explained by the recent change in how the server logs are processed—another year of consistently collecting logins should help provide an answer. In addition to login statistics, the publishing partners maintain statistics on the use of their publications, at the level of program, country, and journal. More granular metrics, such as journal downloads by institution, are not easily extracted, given that an IP address is shared by an entire country.

There are also statistics from the Research4Life Customer Relationship Management (CRM) system, which show that AGORA added 193 new institutions during the last fiscal year, bringing the institution total up to 2,951. These institutions are in 105 countries (out of the 115 eligible countries). This is less than the previous year's 476 registrations, which was unusually high due to processing a huge backlog.

Looking forward, Research4Life would also like to have access to website statistics, such as the following:

- What training material is being used and in what languages?
- What marketing pages are being hit?
- How are people finding Research4Life?
- Where are research4life.org users coming from geographically?

The Research4Life partners are keenly interested in reviewing the impact and use of content. However, these metrics are much more complex, involving other socioeconomic factors like changes in the levels of research funding, and extrapolating the data would be almost impossible.

#### *Program Review*

In addition to usage statistics, Research4Life also conducts periodic reviews on user experience and infrastructure via an RFP (request for proposal), most recently in 2015. The partners had already agreed that the Research4Life programs should continue to at least the end of 2020, so the purpose of the 2015 review was strategic. Research4Life needed to assess the effectiveness of the programs from a user perspective, and to provide information to the partners about infrastructure and administrative and technical support. In other words, are the programs, including AGORA, viable?

The results of the 2015 Research4Life user experience and infrastructure reviews were presented at the Research4Life General Partners Meeting in July 2015. The reviews confirmed that Research4Life is an “effective and highly valued provider of access to research publications in subscribing institutions,” and is the “primary means of access to research publications in developing countries for a majority of users” (Gaible, 2015, p. 9). However, in light of respondents’ descriptions of their need for research information, the use of materials available through Research4Life could be much higher.

For the 2015 user experience review, the key objectives were to gather information about the rate at which programs are used, the views of users about the value of the programs, the impact that the programs have had on the scientific productivity of users, and factors that constrain the wider use of the programs. Information was collected via face-to-face interviews with thirty institutions in six-to-eight countries and online user surveys in multiple languages (Research4Life, 2015b, pp. 1–2).

The result of the most recent user review was a 110-page document describing the characteristics of respondents and providing recommendations for improvement. Problematic access to the full text of research articles is the single most critical challenge cited by users. Barriers to full-text access include login challenges, publishers’ exclusions, internet bandwidth issues, and users’ search strategies. The primary recommendations

from the review were to update the user-content portal, improve the functionality of the programs, increase the awareness and use of the programs, and expand the support team's engagement with users and participation in training (Gaible, 2015, pp. 11–12).

For the 2015 infrastructure review, on the other hand, the key objectives were to establish the broad financial costs incurred by the partners and make recommendations for the future organization and management of the program (Research4Life, 2015a, p. 1). This information was gathered via in-depth, structured interviews with core partners, and an online survey of the remaining partners. The result of this review was a fifty-nine-page document outlining the key developments since the last review, as well as a long list of other issues and concerns: partners' motivations and benefits; usage statistics; communications, marketing, and training; open access initiatives; technical and administrative infrastructure; resources and costs; organization and management; and possible program developments and risks to be addressed (Research4Life, 2015a, p. 1). Overall, the programs are seen as success stories that should be promoted more widely; although the usage levels have been rising, they remain lower than they could be. The publishing partners are concerned that access from the Research4Life programs in total is less than 1 percent of their business. Based on the number of potential Research4Life users, this percentage should be much higher. Publishers who make their materials available for free in developing countries have an expectation that those same materials will be heavily marketed in countries with access. To assist Research4Life in attracting more usage, the review recommends that the team do more outreach and training, and it provides details on how this should be done. The review also acknowledges that the inability to collect statistics at the institution level prevents knowing exactly where usage is low and how outreach and training impact usage for an institution (Research4Life, 2015a, pp. 2, 13–14).

### *Strategic Plan*

As mentioned above, Research4Life is currently in the process of producing a new strategic plan. The first strategic plan for it as a whole, "The Path to 2015," was produced in 2006 and based on the findings and recommendations of the 2005 user and infrastructure reviews. The most recent plan, "Beyond the 2015 Horizon," was published in 2011 and once again built its content and structure from the findings and recommendations of detailed external reviews that were conducted in 2010. In addition to outlining the strategic goals that form the core strategy for the next five years, the document also summarizes in one place a wide range of basic information about Research4Life, its provenance, mission, and *modus operandi*. The new strategic plan was made available on the Research4Life website in late 2016 (Research4Life, 2011a, pp. 11–14).

*Monitoring and Impact*

Because Research4Life programs are unable to collect journal download data at the institution level, it is not possible to quantify the impact of outreach and training on AGORA use at a given institution, or how the use of AGORA has impacted the work of researchers and their publishing. There are, however, statements and stories from AGORA users about how it has helped them. For example, agronomist Sami Hyacinthe Kambire from the University of Ouagadougou in Burkina Faso learned from AGORA that his research was not as original as he had thought. This knowledge assisted him in “lifting his work to international standards” (Research4Life, 2011b, p. 4). Another example is that of Shehu Abdulahi, vice chancellor of Ahmadu Bello University in Zaria, Nigeria, who worked on an experiment for surgical operations of some livestock animals some years ago. He and his coauthors thought that it was excellent research, therefore they submitted an article on the findings for publication in a journal. However, a reviewer for the journal commented that “the drug which we used as anesthesia for the animals had been banned about five years earlier. Had we had access to up-to-date published literature through such resources like AGORA this would not have happened” (Research4Life, 2006, p. 2).

In addition to making researchers aware of the latest developments in their fields, AGORA has assisted them in the completion of their doctoral research. Edward Oyekanmi, a lecturer at Wesley University of Science and Technology in Ondo, Nigeria, and a doctoral student at the University of Ibadan had, has had access to AGORA for six years. During that time he published ten articles in respected national and international journals (Research4Life, 2011b, p. 7). Onan Mulumba, the agricultural librarian at the College of Agricultural and Environmental Sciences of Makerere University in Uganda, reports that AGORA has “helped boost the quantity and quality of the faculty’s publications as well as student dissertations. It has also fueled scientific innovations” (Research4Life, 2016b, n.p.).

One example of innovations resulting from research using AGORA is the work of Paul Kimurto of the Department of Crops, Horticulture and Soil Science at Kenya’s Egerton University and his fellow scientists. They are working to establish community-based research on drought-tolerant crops—chickpea and sorghum—using information gathered from AGORA. The preliminary results could “hold the key to unlocking the great farming potential in the Arid and Semi-Arid Lands (ASAL) of Kenya” (Research4Life, 2016b, n.p.). Another example comes again from Makerere University, where researchers “have developed a new bacteria-resistant tomato; bred four soybean varieties that are high yielding, early maturing, and resistant to leaf rust disease; developed new technology to increase beef production; and established new protocols for banana tissue cultures” (Research4Life, 2016b, n.p.).

AGORA is also used to supply information to farmers and extension



workers. Geoffrey Salanje, the head librarian of Bunda College of Agriculture, University of Malawi, says that AGORA has allowed the library to “easily respond to requests for information from farmers, researchers, teachers, extension workers and students” (Research4Life, 2011b, p. 13). He is convinced that providing AGORA content to all in Malawi who want information on agriculture has improved farmers’ produce. All of these statements indicate the value of AGORA and the many ways it has impacted researchers. Going forward, Research4Life needs to remove the barriers to access that users identified in the 2015 user-experience review. This will allow AGORA to have an even bigger impact on agriculture-related research throughout the developing world.

## CONCLUSION

*Capacity-building* is defined as developing and strengthening the skills and resources that communities need to survive and grow in a fast-paced, ever-changing world. And by this definition, both TEEAL and AGORA are excellent examples of building capacity in the developing world. They have the resources: the scholarly agricultural literature, which the programs provide access to for thousands of researchers across the globe. The free or low-cost availability of the latest scientific literature, which would normally cost millions of dollars, ensures the success of the scientific research cycle in these countries, and with that the innovations and discoveries that ensure food security. TEEAL and AGORA offer the necessary skill development—the on-the-ground and online training sessions and modules that ensure that the available journals and other valuable resources actually get used. Perhaps most importantly, the programs have the partnerships that ensure the collaboration and support necessary to maintain these resources.

Another important part of capacity-building work, however, is realizing that it needs to constantly evolve and adapt to keep up with the ever-changing world in which it exists. The hundreds of CD-ROMs that TEEAL originally came on now fit on a flash drive the size of a finger. Both TEEAL and AGORA recognize this need to keep evolving and are planning to expand and develop both the content and training available to ensure the continued viability of both programs. TEEAL, for example, will be looking to expand the content of AgriKnowledge both online and as part of its offline program as more reports and regional journals are added. And both TEEAL and AGORA are looking to expand their training programs to include information on such subjects as scientific writing and trends in open access and open data in agriculture. And there are, of course, always more researchers, institutions, and countries that could be taking advantage of the literature offered in both programs. As always, funding is and will remain a key issue in the all of this. That said, with the continued support of its key partners—the funding agencies, publishers, research

universities and librarians, and NGOs—both TEEAL and AGORA should remain vital parts of the efforts to build both economic and scientific capacity throughout the world.

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## NOTES

1. See the project history of TEEAL on its website at <http://teegal.org/about>.
2. Olivia Vent (2005) describes the histories of these two programs in more detail.

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