

TEEAL (The Essential Electronic Agricultural Library): A User Study

Report to the Rockefeller Foundation

“Sometimes we replicate experiments we read in TEEAL articles, maybe changing some aspects of the original experiment. TEEAL is being very useful in preparing our literature reviews. Now we are preparing more articles for publication.”

Researcher, Agricultural Genetics, Vietnam

“You can’t do research out of the blue. You need access to some published literature. Before the introduction of TEEAL, it was really hard to get literature. Some students would have only three citations in an assignment. If I am looking for literature, I go to TEEAL first.”

MSc Student, Agricultural Economics, Malawi

“What I like particularly about TEEAL is that its range of subject matters is enormous. It contains complete articles, not only abstracts. And the selection of titles is pretty good. If you cannot find an article in TEEAL, probably that article is not worth it.”

Professor, Botany, Honduras

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Executive Summary

The Essential Electronic Agricultural Library (TEEAL) was developed by Cornell University's Mann Library, with financial support from the Rockefeller Foundation, to make high-quality agricultural journal literature available to 109 low-income countries. Referred to as a "Library in a Box," TEEAL uses CD-ROM technology to package the contents of 140 journals from 68 publishers with content beginning in 1993. TEEAL was launched in January 1999; today, six years later, there are 98 TEEAL sets in 49 countries.

In 2004, Mann Library, with funding from the Rockefeller Foundation, carried out a TEEAL User Study to evaluate whether TEEAL was meeting its objective of enhancing the quality and effectiveness of agricultural research and teaching by improving students' and researchers' access to relevant literature.

The TEEAL User Study collected both qualitative and quantitative information using several different tools, including: (a) in-depth interviews with TEEAL and non-TEEAL users at 10 institutions in 6 countries; (b) a survey questionnaire of over 1000 TEEAL users at 16 institutions in Africa, Asia and Latin America; and (c) a bibliometric analysis of publications from TEEAL institutions.

Results of the TEEAL User Study indicate that TEEAL is successfully meeting its objective. Data confirm the high value students and researchers place on access to current scientific literature and the positive role of TEEAL in addressing their literature needs. Students, educators and researchers consider TEEAL to be very useful in their work, enhancing both their productivity and the quality of their work. They find the articles in TEEAL relevant and trustworthy, and generally adequate in scope. The study also demonstrates that TEEAL has influenced how scientists search for information. Most users find TEEAL easy to use once provided with a basic orientation. Data show, though, that use of TEEAL would increase dramatically if certain constraints, such as restricted hours of use, not enough computers and printers, and expensive printing charges were ameliorated. Finally, the study confirms that in Africa access to the Internet is limited both on university campuses and at research institutes. Thus, until Internet technology is more widely available and affordable, web-based programs to deliver scientific literature need to be complemented with more reliable and lower-tech systems like TEEAL.

Based on the results of the TEEAL User Study, it is recommended that governments and donor organizations support eligible institutions in their efforts to acquire TEEAL sets and updates and ensure that they have the necessary resources to maximize TEEAL's use.

Further, all institutions with TEEAL are encouraged to review how the system is managed within their institutions to determine what efforts could be made to improve outreach and conditions of use, so that everyone who might benefit from TEEAL knows about it, has ready access to the index and CDs, and enough knowledge to get started.

1. TEEAL User Study: Introduction

1.1 Background

The Essential Electronic Agricultural Library (TEEAL) was introduced in January 1999, when the first TEEAL set was installed at the University of Zimbabwe's Faculty of Agriculture. Developed at Albert R. Mann Library, Cornell University with funding from Rockefeller Foundation, TEEAL uses CD-ROM technology to provide developing countries with inexpensive access to high-quality scientific literature. Referred to as a "Library in a Box", TEEAL contains agricultural and bioscience literature from 140 leading scientific journals, and provides a powerful bibliographic search engine. TEEAL content, which is updated annually, currently spans the period of 1993-2003 and contains over 2 million page images stored on 426 compact discs. When introduced, it provided more complete access to international scholarship in agriculture than any other program previously available. As of January 2005, 98 TEEAL sets have been placed in 49 countries.

The ultimate goal of TEEAL is to increase the quality and effectiveness of agricultural and environmental science research in low-income countries. TEEAL was based on the premise that by providing access to the research literature of agriculture and environmental sciences, scientists and decision-makers in developing countries would have better access to the work of the global scientific community and thus would be better able to incorporate proven scientific knowledge into their research and outreach programs. In 2002, the Rockefeller Foundation encouraged Mann Library to test this premise, and with financial assistance from the Foundation, a broad TEEAL User Study was conducted in 2004.

1.2 Study Objectives

The objective of the TEEAL User Study was to assess whether TEEAL has succeeded in improving access to research literature, and if improved access to scientific knowledge has resulted in measurable positive impacts on scientists' research and teaching. Thus, the study gathered data in several conceptual areas: 1) Who is using TEEAL? 2) Is TEEAL content useful? 3) What impact does TEEAL have on research and education? 4) What conditions are required for optimal TEEAL use?

1.3 Study Framework

The study includes four sources of data: (a) 9 in-country case studies; (b) 1384 completed survey questionnaires; (c) 16 survey questionnaires for TEEAL system operators in host institutions; and (d) a bibliometric analysis of agriculturally related publications prepared at TEEAL institutions.

The study framework was designed by Raul Roman, then a Ph.D. candidate in Communications at Cornell University. Mann Library staff who contributed to the study design, implementation or analysis include Mary Ochs, Barbara DiSalvo, Nicole Joos, Gregory Lawrence, and Olivia Vent. Airen Adetimirin, from the Dominican Institute in Nigeria, helped organize the written comments in the survey booklets. Robert Herdt, TEEAL Advisory Board Member, was consulted periodically on specific issues. Gracian Chimwaza, Director, TEEAL Africa Office, conducted case study interviews in Africa.

2. Research Methods and Procedures

2.1 On-site Case Studies

The purpose of the case studies and site visits was to: 1) inform the development of the survey instrument; 2) understand the institutional, social, and individual conditions of TEEAL use in different sites; and 3) gather qualitative data (observations and informal interviews) that could help interpret the quantitative data gathered through the surveys. Interviews were conducted at the following nine institutions.

Universidad Earth (Costa Rica)

Centro Agronomico Tropical de Investigacion y Ensenanza-CATIE (Costa Rica)

Escuela Agrícola Panamericana Zamorano (Honduras)

Agricultural University of Bogor (Indonesia)

Center for International Forestry Research/CIFOR (Indonesia)

Bunda College (Malawi)

Information Center for Agriculture and Rural Development (Vietnam)

Thai Nguyen University of Agriculture and Forestry (Vietnam)

Africa University (Zimbabwe)

Raul Roman conducted the field visits to Latin America and Asia. Gracian Chimwaza conducted the interviews in Africa. At each institution, they recorded interviews with at least four TEEAL users representing faculty, students, and administrators. They also interviewed non-users. Raul and Gracian also recorded information about the TEEAL set installation and operation routines. The visits to Latin America were conducted in October 2003, Africa in January 2004, and Asia in March 2004. The case studies from Latin America were used in the preparation of the survey instrument. See Appendix A for the list of interview questions and Appendix B for interview notes.

2.2 TEEAL User Survey

The TEEAL survey, which consisted of a booklet with 31 sets of questions, gathered quantitative and qualitative information about TEEAL users, their patterns of TEEAL use, TEEAL's contribution to their research and teaching activities, and the information technology infrastructure at their institutions (see Appendix C for a copy of the survey).

Sixteen institutions were invited to participate in the survey based on the following criteria:

- Length of time the institution had owned a TEEAL set
- Geographic location
- Institution type (university or research center)
- Institution size
- Expectation that the institution could gather a minimum of 50 completed surveys.

Almost two-thirds of TEEAL sets are located in sub-Saharan Africa, which has been the primary focus of TEEAL outreach activities. The TEEAL project maintains a marketing and training office in Zimbabwe. The User Study thus includes a proportionately larger number of African institutions.

The following institutions participated in the survey:

Latin America

- Universidad Earth, Costa Rica
- Escuela Agrícola Panamericana Zamorano, Honduras
- Universidad La Molina, Peru

Asia

- Institut Pertanian Bogor/Bogor Agricultural University, Indonesia
- Center for International Forestry Research, Indonesia
- Nepal Agricultural Research Council, Nepal

Africa

- Botswana College of Agriculture, Botswana
- Council for Scientific and Industrial Research, Institute for Scientific and Technological Information (CSIR-INSTI), Ghana
- Egerton University, Kenya
- Kenya Agricultural Research Institute (KARI), Kenya
- Bunda College, Malawi
- Eduardo Mondlane University, Mozambique
- Obafemi University, Nigeria
- University of Agriculture, Abeokuta, Nigeria
- Ministry of Agriculture, Tanzania
- Africa University, Zimbabwe

Each institution that participated in the survey received a TEEAL update in return for their participation, although notification of the award was withheld until the completed survey information was returned to Mann Library.

2.3 Survey of TEEAL System Administrators

A survey coordinator was identified in each institution, generally the librarian responsible for TEEAL. This person received instructions on how to implement the survey and two questionnaires that coordinators were asked to complete and return. The first questionnaire (Appendix D) describes how they conducted the survey at their institution, with particular detail regarding sampling. TEEAL operators were also asked to provide information about the local dynamics of TEEAL system uses: estimated number of users per week, types of users, types of uses, hours of operation, and other related data (Appendix E).

2.4 Bibliometric Study

In addition to the survey, the study team reviewed citation data to look for trends in scholarly publishing in Africa. Bibliographic data was analyzed to determine: 1) whether there had been an increase in total African agricultural publications since 1995; 2) whether there was any change in the type of publications being produced over this same period; and 3) whether authors from institutions where TEEAL was available were citing more recent material in 2003 than

before TEEAL was available. These two years were chosen because the former reflected pre-TEEAL publishing and the latter publishing with the longest impact of TEEAL use. A total of 33 institutions that had TEEAL installed for the longest time were chosen for this bibliometric analysis.

The *CAB Abstracts* database was searched for the years 1995 through 2003 for publications produced in TEEAL eligible countries in Africa and for publications with the selected institutions' names in the "author address (AD)" field. All reasonable variations of an institutional or country name were used when searching, with the SilverPlatter software eliminating duplications.

For the detailed article analysis, as many as possible of the articles cited in *CAB Abstracts* were obtained either at Cornell University libraries or through interlibrary loan. Each was coded as follows: EIS (extra-regional or international serial), LRS (local or regional serial), CP (conference proceedings), or M (monograph). Place of publication of serials was verified in *Ulrich's International Periodicals Directory*. To determine whether authors were citing more recent material, the dates of citations in the bibliographies of each article were entered into an Excel spreadsheet. Citations with no verifiable date were coded "n/a" and for those covering a range of dates, the latest date was used. Non-published citations such as interviews were not included. Discrepancies and missing dates were verified whenever possible in the Cornell Online Catalog or OCLC's Worldcat.

3. Results

3.1 Survey and Case Study Data Analysis

Results from the survey and case studies are integrated in the interpretations that follow. Almost half of the 1384 survey booklets returned had handwritten comments at the back of the booklet. These handwritten comments, together with the personal interviews conducted in six countries, provide a rich source of information about TEEAL's use, which illustrate the stories behind the numbers in the survey. All of the interviews and comments transcribed from the surveys are included in the appendices (see Appendix F for transcriptions of comments). Several interviews have been selected for inclusion at the end of this section.

3.1.1 Information about Survey Takers

Table 1 provides a summary profile of the institutions and respondents who participated in the TEEAL survey administered between February and April 2004. The institutions include one international agricultural research center and four national agricultural research organizations. The 11 other institutions are universities, though most encompass research as well as teaching, and several are universities with agriculture as their primary mandate. We found surprisingly similar responses to most questions across institutions; differences on a few key questions are outlined after the main findings.

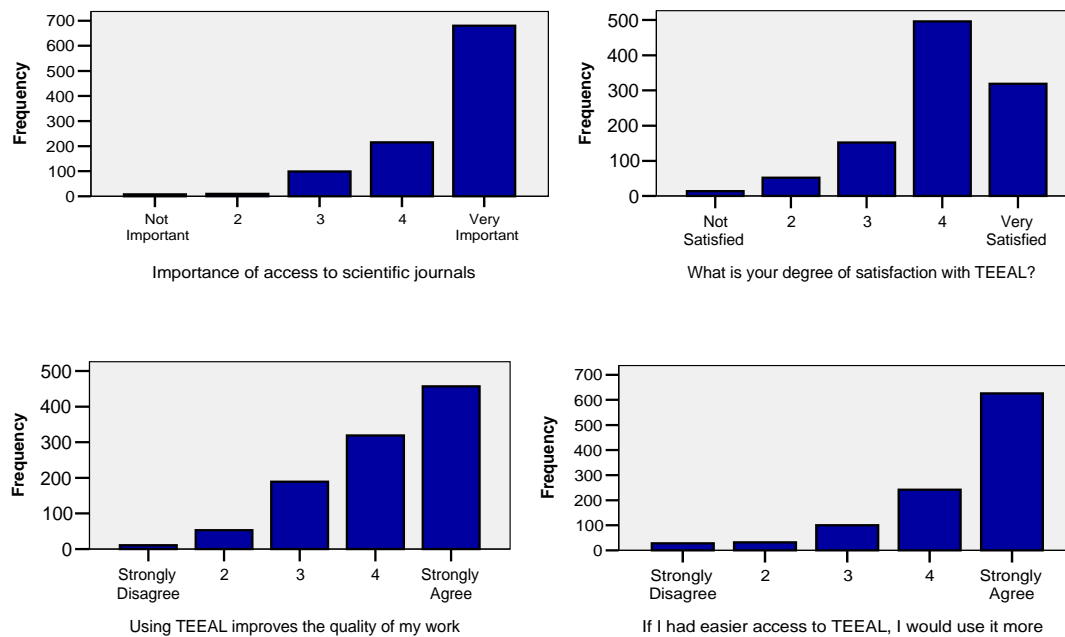
Table 1. TEEAL User Survey: Summary Profile of Survey Takers

	Institutions			Respondents											TEEAL User	TEEAL non-User
	Research - R University - U	Year TEEAL Purchased	Complete set - C Incomplete - I	Gender - M	Gender - F	Undergraduate	Graduate	Professor	Researcher	Other profession	Native English speaker - Yes	Native English speaker - No	English Proficiency (%) Good-very good			
<i>Asia</i>																
Institut Pertanian Bogor (Indonesia)	U	2000	C	14	9	0	14	0	5	3	2	21	52%	20	3	
CIFOR (Indonesia)	R	2000	C	11	9	4	7	1	1	3	2	18	45%	23	16	
Nepal Agricultural Research Council (Nepal)	R	2001	C	29	5	0	0	0	31	5	1	36	97%	37	16	
<i>Latin America</i>																
Universidad Earth (Costa Rica)	U	2000	C	6	4	2	0	5	0	3	1	9	70%	10	1	
Zamorano (Hondoras)	U	1999	I	24	15	27	1	5	2	4	5	35	61%	41	24	
Universidad La Molina (Peru)	U	2000	C	57	42	29	43	9	3	12	1	97	30%	102	45	
<i>Africa</i>																
Botswana College of Agriculture (Botswana)	U	1999	C	22	7	10	3	5	2	9	3	26	93%	29	13	
CSIR-INSTI (Ghana)	R	2000	C	47	13	11	9	4	30	10	14	50	75%	64	25	
Egerton University (Kenya)	U	2000	C	145	33	11	68	28	37	34	23	154	83%	182	36	
KARI (Kenya)	R	2000	C	15	16	0	4	0	25	1	6	25	85%	31	11	
Bunda College (Malawi)	U	2001	C	101	33	95	15	9	3	11	9	123	91%	134	42	
Eduardo Mondlane University (Mozambique)	U	2000	C	6	2	6	0	1	0	1	0	8	50%	8	2	
Obafemi University (Nigeria)	U	2000	I	32	0	3	4	9	11	5	5	27	84%	32	3	
University of Agriculture, Abeokuta (Nigeria)	U	2000	C	149	73	22	77	36	78	30	23	221	88%	247	1	
Ministry of Agriculture (Tanzania)	R	2000	C	47	18	4	1	0	53	3	6	59	86%	65	33	
Africa University (Zimbabwe)	U	2000	C	12	5	7	5	5	1	0	3	15	89%	18	3	

3.1.2 Results Highlights

Figure 1 highlights key outcomes of the survey. It demonstrates that: 1) Access to priced scholarly literature is very important to students and researchers; 2) Users are generally very satisfied with TEEAL; 3) TEEAL improves the quality of their work; and 4) Users would use TEEAL more if they had easier access.

Figure 1. General Satisfaction with TEEAL



3.1.3 Impact and Relevance of TEEAL

The survey asked a number of different questions to verify users' perception of TEEAL and its resources. Figures 2 and 3 confirm that most survey takers strongly agree that TEEAL is useful in their work and has improved their productivity. Almost 80% of respondents said that TEEAL improved their productivity and about 75% agreed that it improved the quality of their work. About 46% of people who use TEEAL, use it several times a month to several times a week. One reason is that most users find TEEAL's resources both relevant to and adequate for their needs (see Figures 4 and 5). Another contributing factor is trust. Fully 90% agreed (63% agreed strongly) that they trusted the articles in TEEAL.

Nonetheless, both written comments and interview questions revealed that many users would like to see the TEEAL updates issued more often than on an annual basis, that they would like more articles from developing countries, and they want broader coverage of topics including aquaculture, poultry sciences, seed storage technology, extension, rural sociology, human nutrition and others. It should be noted that part of users' frustration with the updates stems from the fact that a number of institutions have not been able to purchase updates regularly, so the collection becomes static.

Figure 2

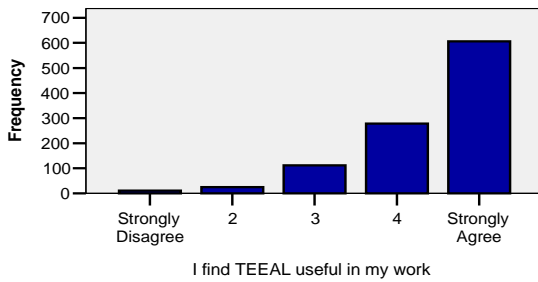


Figure 4

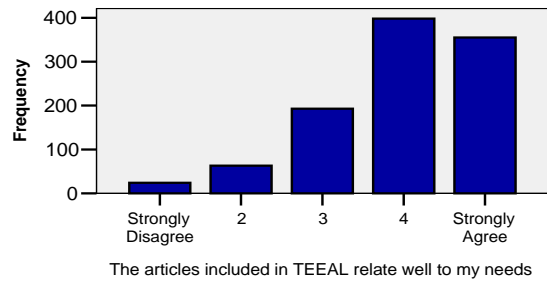


Figure 3

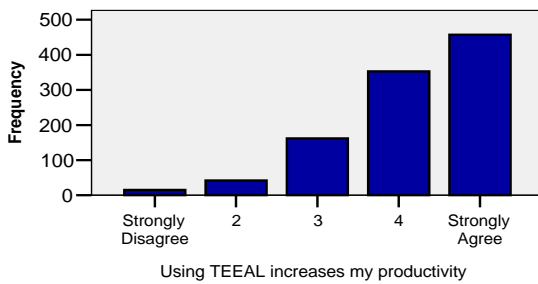
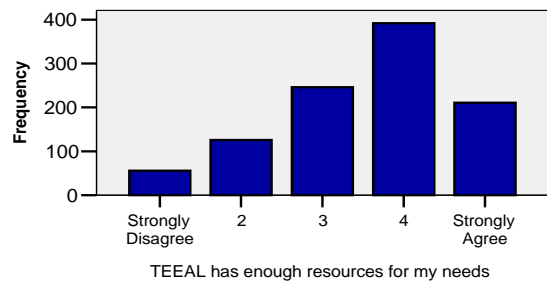


Figure 5



3.1.4 TEEAL and Its Impact on Teaching and Research

The survey included a whole set of questions specifically related to the impact of TEEAL on research and teaching, as this goes to the heart of TEEAL’s objective. Survey takers were asked whether research or teaching was part of their job or academic work. Those who answered “yes” were then asked to answer questions related to TEEAL in their work.

RESEARCH – Almost all respondents (975 out of 1043) said they were involved in research. Of the 975, 80% found TEEAL useful in their research (Figure 6) and 66% (Figure 7) agreed that the literature in TEEAL has influenced their research. Fully 60% of people also felt that TEEAL has influenced *how* they search for scientific literature (Figure 8). About 25% recorded that they strongly agreed with this statement.

Figure 6

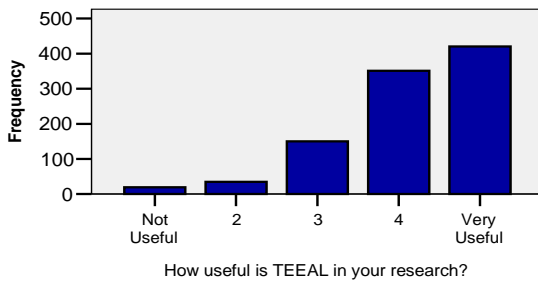


Figure 7

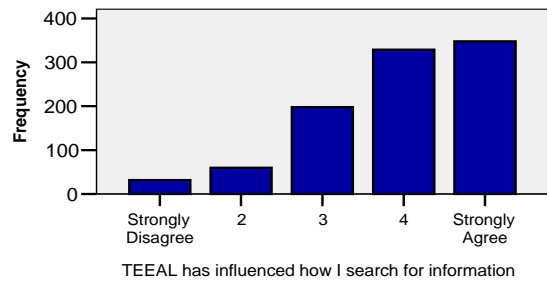
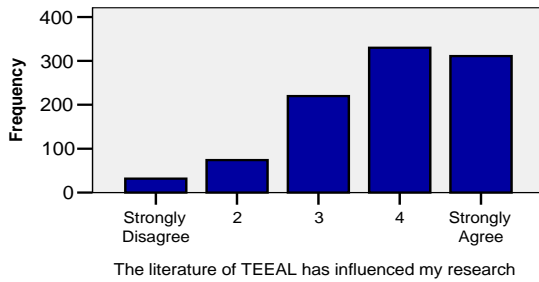


Figure 8



TEACHING – Another key goal of TEEAL is to improve the availability of resources for teaching. Not nearly as many survey takers said they were involved in teaching. Fewer than half of respondents answered the questions related to TEEAL and its impact on teaching. Figures 9 and 10 indicate that TEEAL is not playing as strong a role in teaching as in research. Only 24% of people said that they found TEEAL very useful in their teaching (Figure 9: 5 on a scale of 1 to 5), although just over half definitely felt it was useful (Figure 9: 4 and 5 together). However, almost 60% of respondents thought that having TEEAL has improved the quality of their teaching (Figure 10: 4 and 5 together). All of the teaching professionals interviewed in the case studies said that they used TEEAL and articles from the journals in their classes.

Figure 9

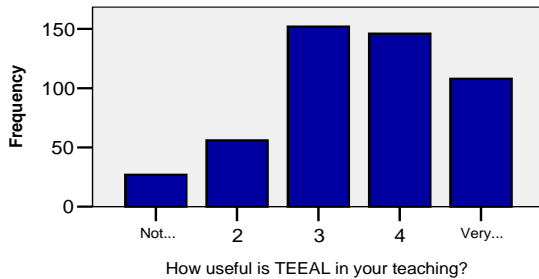
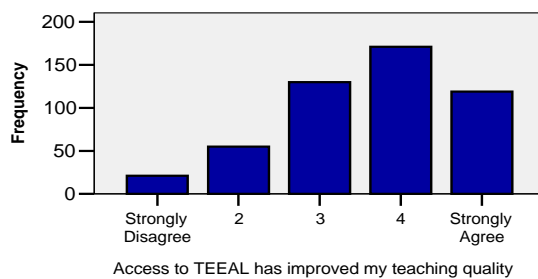


Figure10



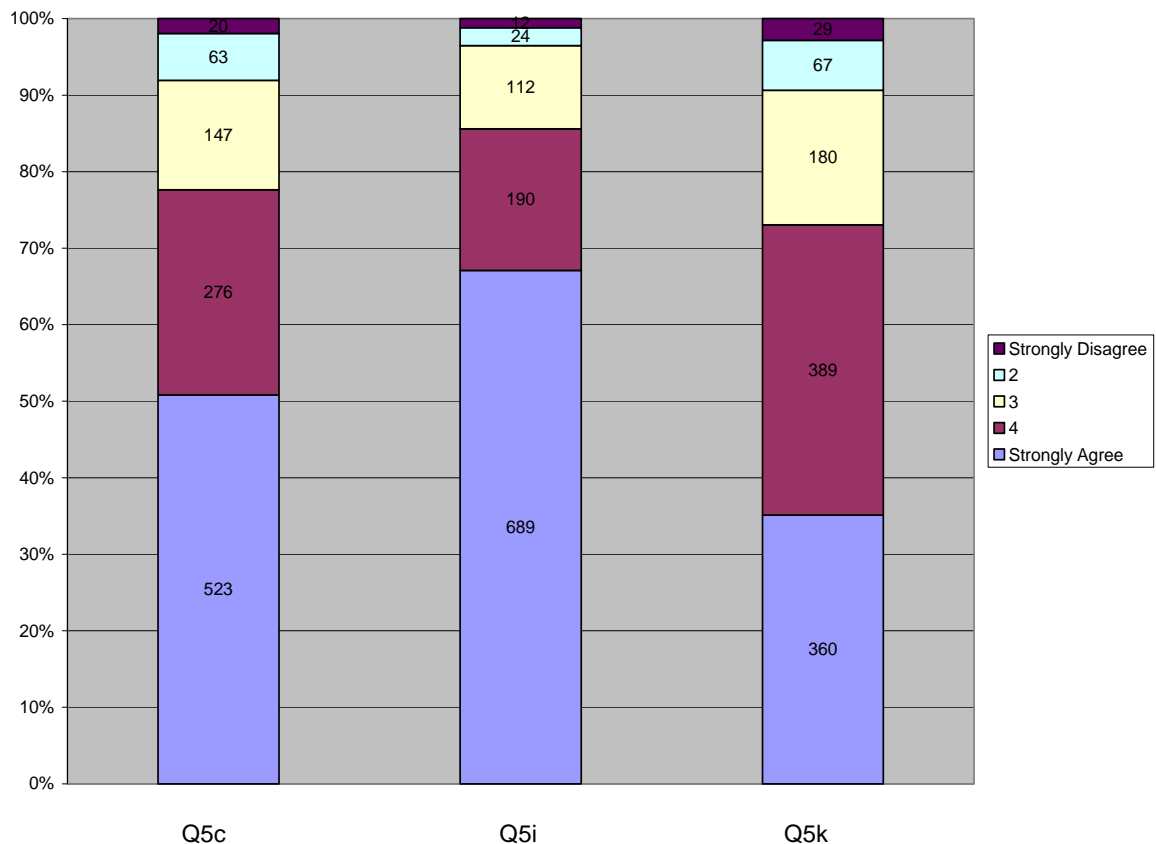
3.1.5 Access and Usability

Access to the content in TEEAL is affected by a variety of factors, including how easy people think it is to use the system, whether they can read and understand English, and how readily they can get access to TEEAL, in other words its physical location and management. The study sought to explore these factors, with the objective of identifying specific issues or conditions that influence TEEAL’s effectiveness and ability to meet its goals.

- **Usability**

Figure 11 shows that users generally find TEEAL easy to operate. They also are comfortable reading articles in English. The preponderance of survey respondents from English-speaking countries undoubtedly influenced these results, as interviews with and written comments by users in non-English speaking countries like Honduras, Indonesia, Mozambique, Peru and Vietnam, indicate that many researchers and students do not use TEEAL as often as they would like to because their English comprehension is not adequate to benefit from TEEAL.

Figure 11. TEEAL Usability



Statements respondents were asked to rank:
 Q5c I find it easy to search for citations and abstracts in the TEEAL index.
 Q5i I feel comfortable reading TEEAL articles in English.
 Q5k I find it easy to get TEEAL to do what I want it to do.

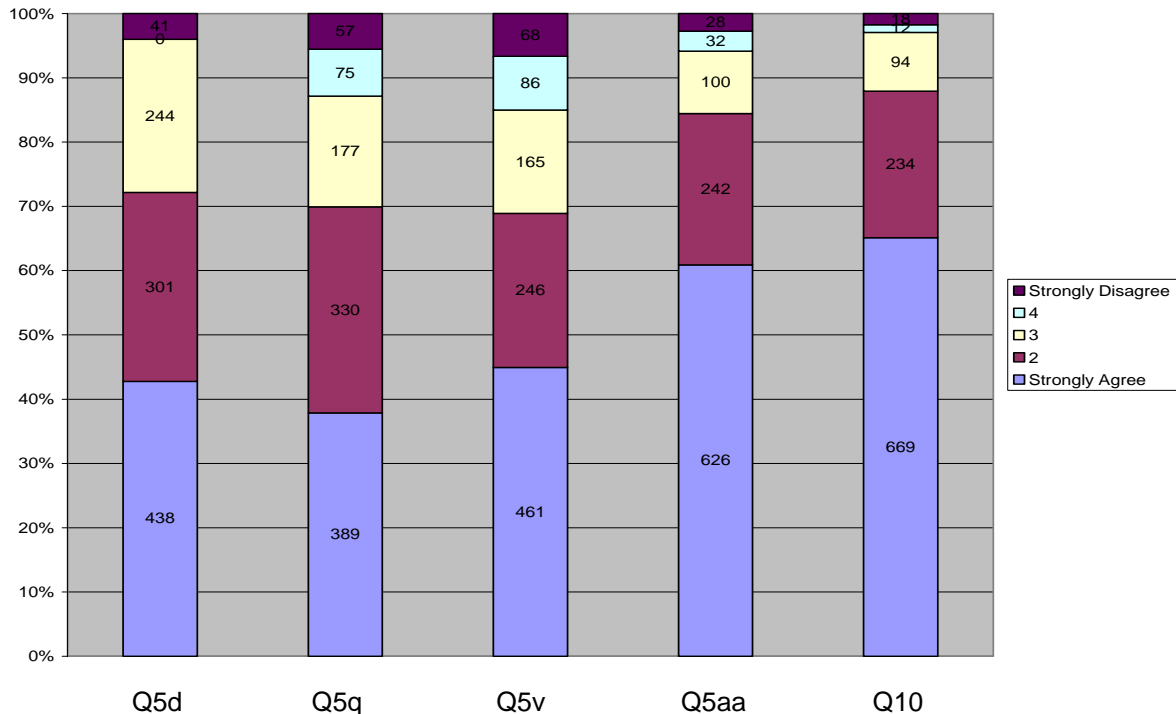
- **Accessibility**

Most libraries keep the TEEAL CD spinners with the image discs in a separate room or space behind the circulation desk in order to supervise use and keep the system secure. Access to the image discs is regulated by library hours and the presence of a librarian to provide assistance. The index disc is loaded onto library and/or faculty computers so users can search the collection independently. However, when they identify an article they want, they must put in a request to the librarian or TEEAL administrator for an image disc or to print the article. There is usually a charge to users for printing articles.

TEEAL administrators were asked in a questionnaire (Appendix E) what they perceived as the main obstacles to access to TEEAL at their institutions. The four major obstacles cited were: 1) cost of printing (users have to pay for the printing of articles and/or bring their own paper); 2) not enough public computers in the library; 3) researchers don't have the time to come to the library; and 4) language barriers. In a few cases, where institutions did not have recent annual updates, they said that people lost their incentive to use TEEAL. All of these observations were corroborated in the written comments by survey takers, with the cost of printing and lack of computers the most frequent complaints.

Figure 12 highlights survey responses to questions about users' perceived ability to get access to TEEAL. Most users indicated that they find it easy to use the system when they need it—with the index marginally easier to access than the CD image discs, which is entirely predictable. Yet fully 90% responded that they would use TEEAL more if they had better access.

Figure 12. TEEAL Accessibility

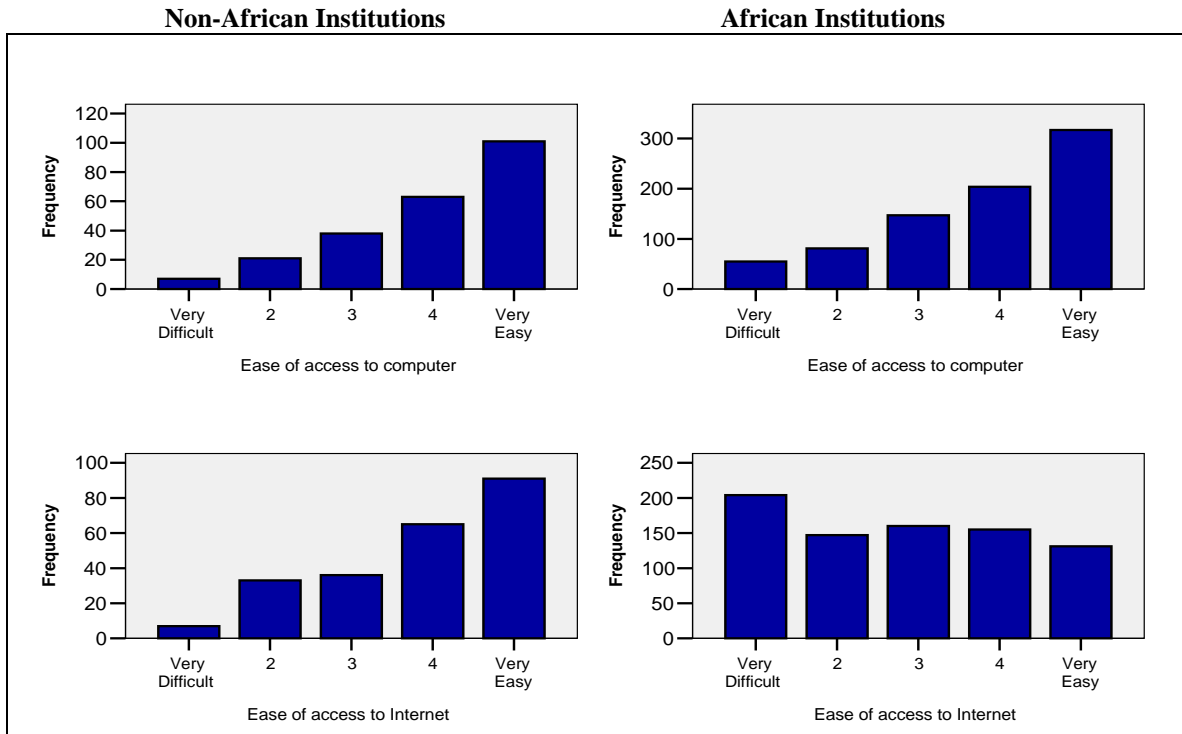


Statements respondents were asked to rank:
 Q5d I am able to use the TEEAL index whenever I need it.
 Q5q I find it easy to get access to the full-text articles on the TEEAL CDs.
 Q5v Printing TEEAL articles is expensive.
 Q5aa If I had easier access to TEEAL, I would use it more.
 Q10 I would use TEEAL more if the full-text articles were available on a local computer network (LAN).

As shown in Figure 12, users find printing TEEAL articles to be expensive. According to the interviews and written comments, many users avoid paying for printing by reading the articles on the computer screen. This in turn ties up computers and computer-time. Since the lack of enough computers was mentioned so often in the comments, we were

surprised that almost 70% of survey takers replied that it was generally easy to get access to a computer at their institution (see Figure 13). Results were similar across regions. Access to the Internet, however, was dramatically different among African institutions.

Figure 13. Ease of Access to Computers and the Internet at All Institutions and African Institutions



This confirms that there is still a strong need for non-Internet based information delivery systems like TEEAL in Africa, and helps to explain why over 90% of all respondents said they would use TEEAL more if it was available on a local area network. In Africa, the Internet is also generally more expensive than TEEAL. For example, students at Bunda College pay 5 Malawi Kwacha (MK) (equivalent to US\$.047) per page to print an article from TEEAL. The Internet costs 8.50 MK (US\$.08) per minute and it can take up to two hours to download one journal page.

As the information technology environment improves, researchers and students are experiencing the ease of accessing information directly from their work stations. The need to use TEEAL at library computers (where there clearly is a bottleneck) during library hours and wait for assistance with the CD image discs and printing articles becomes a constraint for many people in taking full advantage of the resource.

Raul Roman carried out a detailed analysis of TEEAL use patterns with special reference to the role of Internet and computers, which is attached as Appendix G. One of his observations is that frequent users of TEEAL are also the most frequent users of the Internet for scientific information, which would drive up the demand for TEEAL in a more convenient form.

It is clear, in any case, that conditions for optimum use of TEEAL are not being met and that issues of access should be more closely examined. The survey did not expressly ask non-TEEAL users why they didn't use TEEAL, however, many respondents wrote in their survey booklets that 1) they hadn't heard about TEEAL before the survey but would like to try it and/or 2) they hadn't received any specific training and lacked the confidence to try it on their own. This suggests that some institutions need to strengthen their outreach and training activities.

3.1.6 SELECTED IN-COUNTRY INTERVIEWS OF TEEAL USERS

INTERVIEW 1: Bunda College, Malawi Final Year MSc Student, Department of Agricultural Economics

This graduate student, who is investigating issues related to bean cultivation, considers access to agriculture related published literature very important. "One can only get to know what others have done after you study their work and as a result it helps improve ones' work," she stated. "You can't do research out of the blue. You need access to some published literature."

During her undergraduate studies, before the introduction of TEEAL, literature she was using was old. "It was really hard to get literature. Those days some students would have only three citations in an assignment." She first learned about TEEAL in June 2002 and has been using it since then. "If I'm looking for literature I go to TEEAL first." She particularly likes the fact that you can find abstracts first and then access the full articles immediately. The only problem she is facing is that the printer connected to the TEEAL station is not currently working. TEEAL updates should also be faster than the first year delay.

Besides TEEAL she consults books in the library, but finds Internet slow and expensive, as "sometimes you would wait two hours for a page to download." TEEAL has improved the quality and standard of the work she produces and is helping her save time. When she started using TEEAL she had already come up with the direction of her research. However, TEEAL influenced the modeling and methodology parts, and is greatly motivating her work. She is planning to develop more proposals and even thinking of going as far as a PhD in her field.

INTERVIEW 2: Africa University, Zimbabwe Lecturer, Animal Science

The lecturer has been on the Faculty of Agriculture for two years. His responsibilities are delivering lectures, carrying out research work and community-based outreach projects. He stated that "it's critical to have access to published relevant literature, if you don't have it you are hitting in the dark. It is the lifeblood of our business." Journals are his main source of information. Before TEEAL, he used to send letter requests for full articles to the Ministry of Lands, Agriculture and Rural Development, the University of Zimbabwe and some South African universities or, if there was an opportunity, travel to the College of Agriculture in Mazowe, which was costly. Requested articles would come sometimes "when you already forgot why you requested the paper altogether." He

remembers frequently consulting old journals in the library. Searching the articles “was difficult and time consuming... some of the copies had pages torn out by students.”

He often uses TEEAL when he is conceptualizing a research proposal and finds TEEAL “very easy to use.” He would like to see more journals, especially in nutrition, added to TEEAL and research articles published by the CGIAR. He subscribes to a number of Internet sites such as the CTA site, which provide useful publications.

He uses articles from TEEAL journals often in his teaching and asks his students to critique different research methodologies as a practical example for their studies. The TEEAL Index is installed on the department’s computers, providing easy access to the 20 or so journals that contribute about 75 percent of the literature he needs in his work. He has seen his published papers appear in journals in the TEEAL collection, which has spurred him on to write and publish more papers. On average he publishes two to three papers but in 2003 he published five papers.

**INTERVIEW 3: Ministry of Agriculture and Rural Development, Vietnam
TEEAL Focus Group, Information Center for Agriculture and Rural Development (ICARD)**

ICARD was established at the Ministry in 1997 and provides information resources on science and technology to policymakers, enterprises, researchers and farmers. The ICARD library purchased TEEAL at the end of 2002, with funds from DANIDA. TEEAL started functioning in May 2003. Currently the library is undergoing a significant transformation, as it is becoming an electronic library. The ICARD library has been using other electronic resources, such as AGRIS and CABI CDs, for the last five years.

“The TEEAL system is very simple and easy to use. We translated the user instructions to Vietnamese to make it easier for some of our users,” says the library director. “People from other provinces that cannot come to Hanoi send us their requirements by phone or email. We send them the relevant abstracts by email. If they want the full text, we send them a hard copy by mail.”

Six TEEAL users came from different units of the Ministry to talk about TEEAL. They considered that TEEAL was easy to use. Generally, what they appreciated most is that TEEAL articles are available in full text: “We are very happy we have full text. In the past we only had abstracts,” said one TEEAL user. “Now we are preparing more articles for publication.” “TEEAL is very useful for writing proposals,” said a researcher in molecular biology. Another user said that “my research topic is maize fertilizers. In the past I had to go to many libraries to find some information, and I only could get the abstract. I have benefited much from TEEAL.” A researcher in agricultural genetics said he used TEEAL to design his experiments.”

One of the obstacles for users is the English language. Some users say that they don’t have enough time to use TEEAL as much as they would like to. “There are not enough computers at ICARD, and sometimes we have to wait in line to use TEEAL,” says another user. “When I am too busy I consult the Internet. Internet is more updated, but TEEAL articles have more quality.”

A nutrition specialist at the Department of Extension tells a TEEAL story. “By reading TEEAL articles I came to know about ractopamine, a chemical used in animal nutrition. I found out that this chemical is forbidden in some countries. Ractopamine increases lean meat production, but this substance can contribute to cancer. After reading about it, and knowing about its effects, I wrote a report for the Ministry recommending the ban of ractopamine use in Vietnam and the importation of ractopamine-treated meat products.”

**INTERVIEW 4: Escuela Agrícola Panamericana Zamorano, Honduras
Professor, Botany and Natural Resource Management**

This professor spends 50 percent of his time teaching, 20 percent on his own research, 25 percent on funded projects related to technology transfer, and approximately 5 percent in the “learning by doing” process with students. Library resources are critical for him: “I cannot do my job without the library. ...What I like particularly about TEEAL is that its range of subject matters is enormous. It contains complete articles, not only abstracts. And the selection of titles is pretty good. If you cannot find an article in TEEAL, probably that article is not worth it.”

This professor used TEEAL when it arrived in Zamorano in 1999, and was involved in the design of the TEEAL Forest Science module. However, since the arrival of electronic resources at Zamorano, his library research routine has dramatically changed, mainly due to the Internet. “At this moment, I make very little use of TEEAL; there is so much online. At the beginning I used it six to eight times a year. But now I haven’t touched TEEAL in a year and a half. This campus is big and we don’t have much time to come to the library. It is sad, but that’s the way it is. I want to find the resources I need at my office. I recommend the use of TEEAL to my students. It mainly helps 4th year students, because they have to write a thesis to complete their degree.”

**INTERVIEW 5: Centre for International Forestry Research (CIFOR), Indonesia
Research Assistant, CIFOR Environmental Services Program**

This researcher has been using TEEAL since it arrived at CIFOR and is currently preparing for fieldwork research on logging trees. “I am in the process of finding the scientific background that will support my field study and help me design my research. The first resource I consult is TEEAL. I also use the library catalog and electronic journals and do a search in Google. And finally I ask the librarians about articles and books in our collection. “How often I use TEEAL depends on my research. I use TEEAL before going to the field and during data analysis. In my reports approximately 70 or 80 percent of the references come from TEEAL. What I like about TEEAL is that it has a simple layout and it is easy to use. ...Reading TEEAL articles has helped me in the design of my own research. For example, in my study that measures the damage in trees depending on plot size in East Kalimantan I replicated the design of research conducted in other tropical contexts such as Bolivia and Belize.”

3.3 Bibliographic Data Analysis

Our hypothesis was that from 1995 to 2003, we would see a trend toward increased publication in international journals in TEEAL institutions. We realized that use of 2003 data does not provide the full story because of publishing delays typical of many regional and local serials. Nonetheless, we did observe this trend as shown in Figure 14 for all institutions, and in Figure 15 for African institutions.

Figure 14. Where Agricultural Scientists Are Publishing: Percent of Each Type of Publication for 1995 and 2003

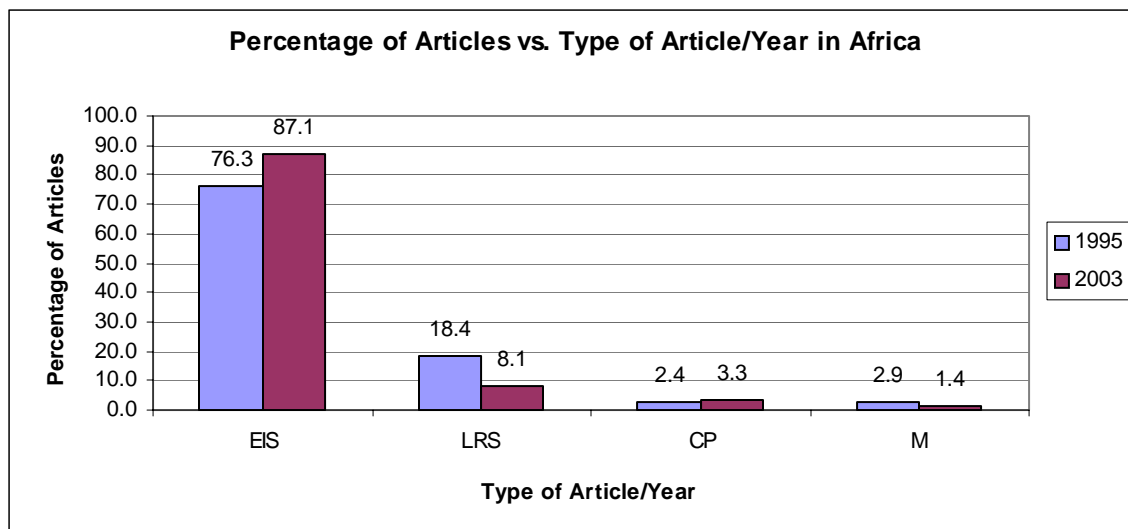
Percentage of Each Type of Publication by Year		
	1995	2003
Extra-regional and International Serials	57.8	78.7
Local/Regional Serials	33.7	16.9
Conference Proceedings	5.5	2.9
Monograph	3.0	1.5

Figure 15. Where African Agricultural Scientists Are Publishing: Percentage of Each Type of Publication for 1995 and 2003

Percentage of Each Type of Publication by Year in Africa		
	1995	2003
Extra-regional and International Serials	76.3	87.1
Local/Regional Serials	18.4	8.1
Conference Proceedings	2.4	3.3
Monograph	2.9	1.4

For scientists, publishing in international journals has a greater level of prestige and impact on the scientific community. And thus, this increase represents a greater inclusion of developing country researchers in the larger scientific research community. Figure 16 below shows this graphically. While we did observe this trend, we do not have information that would allow us to directly attribute this to TEEAL. However, a number of researchers interviewed in the in-country case studies specifically attributed both higher publication rates and acceptance of articles in more prestigious international journals directly to TEEAL (See interviews 2 and 3 above, as examples).

Figure 16. Percentage of Publications of Each Type in Africa



We hypothesized that articles published by researchers in TEEAL institutions in 2003 would have more up-to-date citations than articles published in 1995. We hoped we could show that by having access to TEEAL researchers would be citing the recent material made available in the TEEAL database. However, the data do not show this to be the case. The Average Citation Age for articles published by all researchers reviewed was 11 years in 1995 and 12 years in 2003. Many factors affect the age of citations. In some fields, such as entomology, older taxonomic literature can be very important. Thus, older citations are not necessarily bad. However, when older literature is cited because newer material is not available, researchers are handicapped. Further analysis of this data might uncover some of these nuances. It is possible that it is still too soon in the publishing cycle to show the impact of TEEAL in article citations.

The table below shows publication numbers for all TEEAL eligible countries. Some countries show an increase in publications indexed in the CAB database over the 1995 to 2003 period. Others show a decrease. Periods of civil unrest or economic problems in individual countries can be often be identified by significant decreases in publication output. Many other factors affect the number of publications produced and indexed. Thus, we were unable to show specific upward trends, and we could not link any of the upward trends directly to the availability of TEEAL. Note that the numbers for 2003 generally show a decrease, but this is most likely due to delays in publication and subsequent indexing.

Table 2. Agricultural Publishing in African Nations as Found in the CAB Database

Publishing Statistics for African Countries with TEEAL									
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Angola	0	2	2	2	4	4	6	3	1
Benin	35	31	39	59	34	42	42	54	40
Cameroon	92	105	121	105	151	111	167	172	143
Cape Verde	4	2	1	0	0	0	0	0	0
Cote d'Ivoire	53	61	101	80	74	57	57	63	49
Egypt	1315	1231	1336	1449	1436	1260	1218	1080	996
Ethiopia	152	154	162	152	199	217	162	258	213
Ghana	77	88	117	74	104	92	103	100	88
Guinea-Bissau	0	0	1	0	5	3	3	4	9
Kenya	408	386	386	339	337	339	397	379	292
Lesotho	6	6	3	1	3	5	8	5	6
Malawi	41	65	49	48	32	42	51	28	34
Morocco	172	175	160	158	223	211	233	180	208
Mozambique	7	11	15	19	17	24	33	14	13
Namibia	6	21	19	26	22	20	15	22	31
Nigeria	577	668	630	737	842	871	858	885	733
Sao Tome e Principe	0	0	0	0	0	0	1	0	0
Senegal	78	78	103	118	111	84	83	93	93
Sierra Leone	11	13	7	6	7	4	6	6	3
Swaziland	10	10	4	8	13	5	18	4	13
Tanzania	118	141	122	174	102	95	107	108	102
Uganda	45	91	62	86	99	100	129	112	95
Zambia	25	43	45	60	40	23	39	35	26
Zimbabwe	182	197	158	182	146	157	143	122	94
Total	5409	5575	5640	5881	6000	5766	5880	5729	5285

4. Conclusions

Analysis of both quantitative and qualitative data collected through the TEEAL User Study indicates that most users in the developing world are satisfied or very satisfied with TEEAL. The system is being used by students, researchers and teaching professionals alike. They report that it has had a positive effect on how they gather scientific information for their research and has improved their teaching. Based on the results of the study we can conclude that TEEAL is meeting its objectives.

It is evident that some constraints to optimum use of TEEAL exist due to language barriers, inadequate infrastructure (computers, electricity, paper, toner cartridges, etc.), the cost of printing of articles, limited access (library hours) and the need for ongoing training. The surveys and case studies will allow the TEEAL team to identify more specifically those institutions struggling with these issues and arrive at a more targeted approach to help them overcome the problems they've identified. Addressing these issues should increase the number of individuals who can take advantage of TEEAL's resources. Successful strategies can be extended to institutions that did not participate in the survey as needed.

5. Recommendations and Follow-Up

The TEEAL User Study demonstrates the high value that students and researchers place on access to current scientific literature. It also illustrates how they are using such resources to enrich their work, address agriculture-related problems, and enhance their participation in international peer-reviewed publications.

Despite the availability of TEEAL, there remains a large unmet demand for access to scientific literature throughout the developing world, though most particularly in Africa. In mid 2003, as part of a public awareness initiative directed at current and potential TEEAL donors, the TEEAL Office estimated that there were almost 100 institutions in Africa alone that were interested in acquiring a TEEAL set based on the number of direct approaches to the office with requests for funding support for base sets or updates.

Most of these institutions still have not been able to purchase TEEAL sets. Over the past year, many have registered for AGORA (Access to Global Online Research in Agriculture), the online portal to free agricultural journal literature launched in late 2003. However, based on the findings of the TEEAL User Study, most researchers and students in Africa do not have reliable access to the Internet. AGORA usage statistics for Africa bear this out. In October 2004, of the almost 250 institutions registered for AGORA in sub-Saharan Africa, only 51 downloaded any PDF article files through AGORA. Many institutions that are located in more remote areas have not even attempted to register for AGORA.

Recommendation: Continue Funding for TEEAL Sets

Governments and donors are urged to invest in TEEAL in eligible developing countries to address the continued and unmet demand for access to journal literature. This includes helping institutions purchase new sets and current TEEAL clients purchase the annual updates.

Recommendation: Support LAN-Based TEEAL

In mid 2005, TEEAL will be beta-tested for operation over institution-based Local Area Networks, which will help reduce accessibility bottlenecks. Governments and donors should further support institutions in taking advantage of this upgrade to the TEEAL system.

Recommendation: Invest in Hardware, Connectivity and Peripherals

To ensure that institutions can take full advantage of available information systems like TEEAL, AGORA and others, investments are needed to upgrade information technology so that universities and research institutions have adequate computer facilities and dependable and affordable access to the Internet.

Recommendation: Help Institutions Publicize TEEAL

Data from field interviews and the survey suggest that there is still a strong need to publicize TEEAL in many hosting institutions. The TEEAL Project Office should consider ways to help these institutions strengthen their outreach and training activities to ensure maximum use.

Recommendation: Help Institutions Increase TEEAL Use in Research

Acquiring TEEAL is in many cases an important impulse to research efforts in hosting institutions. However, TEEAL availability does not necessarily translate into effective usage of this resource for academic purposes such as publishing. For this reason, we recommend that donors consider mechanisms or incentives, such as small competitive grants, for researchers at TEEAL institutions to provide further inducement to use TEEAL. This could be a very effective way for policymakers and donors to see specific examples of how TEEAL resources are actually being used for academic and outreach purposes.

5.1 TEEAL User Study Follow-up Activities

1. TEEAL institutions and TEEAL donors alike are urged to share the results of the TEEAL User Study with their respective stakeholders to demonstrate the importance and impact of making current scientific scholarship more available to users. A summary of the results of the study will be distributed to all participating institutions and TEEAL stakeholders. A presentation discussing the results is currently scheduled for the annual meeting of the AAAS in Washington, D.C., in February 2005. Additional presentations and publications are planned.

2. Most institutions in Africa that acquire a TEEAL set receive as part of the purchase an initial orientation training conducted in-country by a staff member of the TEEAL Africa Office. These visits are followed up periodically in person and via email. Institutions are then expected to take the initiative in informing their patrons about and training them in the use of TEEAL. The TEEAL Project Office will explore the creation of a resource kit to help librarians better publicize TEEAL and orient patrons in its use, and possible incentives to further strengthen application of TEEAL content in research and teaching activities.

Appendices

- A. Interview Guidelines
- B. Notes from In-Country Case Study Interviews
- C. Survey Booklet with Survey Letter
- D. Completed Questionnaires about Survey Administration
- E. Completed Questionnaires about TEEAL Management
- F. Transcriptions of Written Comments
- G. Technology Adoption Analysis by Dr. Raul Roman