

Food and Agriculture Organization of the United Nations

GEORGIA

ICT Infrastructure and Use in Agriculture

Agricultural Policy, Research, and Education Organizations

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Table of Contents

Foreword		iii
Abbreviations and Acronyms		iv
Executive Summary		v
Section 1.	Introduction	
	1.1. Statement of the objectives	1
	1.2. Project activities	1
Section 2.	An Overview of the ICT Situation	
	2.1. Institutional developments	2
	2.2. ICT infrastructure	2
	2.3. ICT use	3
	2.4. ICT human resources	3
Section 3.	Method and Data	4
Section 4.	Conceptual Framework	
	4.1. Organization level	5
	4.2. NARS level	6
Section 5.	Assessment of the ICT Situation in Agriculture	
	5.1. At the organization level	8
	5.1.1. Ministry of Agriculture and Food	8
	5.1.2. Georgian Academy of Agricultural Sciences	10
	5.1.3. Research Institute of Horticulture, Viticulture & Winemaking	11
	5.1.4. Research Institute of Farming	11
	5.1.5. Research Institute of Plant Protection	13
	5.1.6. Research Institute for Scientific & Technical Information	14
	5.1.7. Georgian State Agrarian University	15
	5.1.8. Agribusiness University	16
	5.1.9. Biological Farmers' Association	17
	5.2. At the NARS level	18
Section 6.	Needs Assessment	20
Section 7.	Discussion	
	7.1. Agricultural research capacity, efficiency, and appropriateness	22
	7.2. The present IC policies and capacities for knowledge transfer	22
	7.3. The existing communication tools, practices and actors	23
	7.4. Potential partners for developing solutions	23
Section 8.	Conclusions	25
	References	28
	Tables	
	Table 1. Institutional developments concerning ICT	31
	Table 2. The ICT situation in the Ministries and State Departments	32
	Table 3. Areas and relevant organizations for information collection	32
	Table 4. ICT Infrastructure	33
	Table 5. ICT tools, applications, and services	34
	Table 6. Constraints on ICT infrastructure and use	35
	Table 7. Assessment of ICT across agricultural organizations	36
	Table 8. The use of electronic and non-electronic IC tools	37
	Appendix	
	A. Questionnaire	39
	B. List of interviewees	46

Foreword

In order to assess the needs of national agricultural research organization and their partners for innovative, appropriate, and efficient information and communication systems and linkages in Georgia, Food and Agriculture Organization (FAO) of the United Nations commissioned the International Service for National Agricultural Research (ISNAR) to conduct this study.

The study was executed under the supervision of Dr. Tugrul Temel of ISNAR; and the final report was prepared by Dr. Tugrul Temel and Dr. Ajit Maru of ISNAR. The contributions of project assistants, Mr. Alexander Loladze and Ms. Tamriko Jinjikhadze, have been absolutely vital. Without their conducting the interviews, reviewing studies in the literature, commenting on the final report, and providing insights into the workings of the organizations visited, the study would not have been completed.

The study draws on the information gathered by structured interviews with research directors and/or managers, experts, and scientists. For facilitating these interviews in their organizations, we would like to thank Prof. Valarian Metroveli, President of the Georgian Academy of Agricultural Sciences; Dr. David Shervashidze, Deputy Minister of Agriculture and Food; Dr. Oleg Shatberashvili, Director of Research Institute of Scientific and Technical Information; Prof. Tengiz Urushadze, Prorector of the Georgian State Agrarian University; and Dr. Omar Keshelashvili, Rector of Agribusiness University.

We would further like to thank all the interviewees who provided the required information: Mr. Maia Bigvava, Head of Public Relations Department, the Ministry of Agriculture and Food; Prof. Guram Aleksidze, Chief Scientific Academician, the Georgian Academy of Agricultural Sciences; Dr. Nodar Chkhartishvili, Director of the Research Institute of Horticulture and Viticulture; Ms. Natela Khonelidze, Head of Information Department, the Research Institute of Farming; Mr. Irakli Shavliashvili, Director of the Research Institute of Plant Protection; Ms. Nelly Makhviladze, Deputy Director of Research Institute of Scientific and Technical Information; Prof. Tengiz Urushadze, Prorector of the Georgian State Agrarian University; Ms. Lamara Gelovani, Head of Library, the Georgian State Agrarian University; Mr. Revaz Chakhunashvili, Department of Automation and Computer Engineering, the Georgian State Agrarian University; Prof. Omar Keshelashvili, Rector of Agribusiness University; Ms. Mariam Jorjadze, Director of Biological Farmers' Association; and Mr. Koba Kiladze, Deputy Director of Farmers' Information Center. Thanks also go to Dr. Oleg Shatberashvili for his comments on the final report. We also like to acknowledge the assistance provided by Dr. Byron Mook of ISNAR.

Finally, FAO Project Manager Dr. Rainer Krell's guidance and contribution to the implementation of this project is greatly acknowledged.

While acknowledging contributions from a wide variety of people, we bear the sole responsibility for the content of the study.

Abbreviations and Acronyms

AIS	Agricultural Innovation System
AU	Agribusiness University
CAS	Current Awareness Services
CIMMYT	International Maize and Wheat Improvement Center
DFID	Department for International Development
EIS	Education Information System
ELKANA	Biological Farmers' Association
EOIS	Extension and Outreach Information System
FAO	United Nations Food and Agriculture Organization
FTP	File Transfer Protocol
GAAS	Georgian Academy of Agricultural Sciences
GRD	Genetic Research Department
GSAU	Georgian State Agrarian University
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
ICARDA	International Center for Agricultural Research in the Dry Areas
ICSC	German Technical Support Society
ICT	Information and Communication Technology
IDU	Information Dissemination Unit
IPGRI	International Plant Genetic Resources Institute
IT	Information Technology
LAN	Local Area Network
LASU	Library of Agrarian State University
LISU	Libraries and Information Service Units
MCS	Messaging and Communication System
MI	Management Information
MIO	Management Information Office
MIS	Management Information System
MoAF	Ministry of Agriculture and Food
NGO	Non-governmental Organizations
NAES	National Agricultural Education System
NARS	National Agricultural Research System
OMAIS	Organization Management and Administrative Information System
PGR	Plant Genetic Resources
RDMS	Research Data Management System
RIHVW	Research Institute of Horticulture, Viticulture, and Winemaking
RIF	Research Institute of Farming
RIPP	Research Institute of Plant Protection
RMIS	Research Management Information System
SDI	Selected Dissemination of Information
STI	Scientific and Technical Information
STIMS	Scientific and Technical Information Management System
TACIS	Technical Assistance Committee for Independence States
TECHINFORMI	Research Institute for Scientific and Technical Information
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAID	United States Agency for International Development
WAN	Wide Area Network
WB	The World Bank

Executive Summary

This study seeks to assess the infrastructure and use of Information and Communication Technology (ICT), such as radio, television, printing press, telephony, fax, computers, and the Internet, in national agricultural research organizations in Georgia. It also identifies their needs to improve information flow and management.

The specific objectives of the study are:

1. To assess the availability of local, locally adapted, and relevant international information (available electronically or in hardcopy) necessary for the development of improved agriculture research capacity, efficiency, and appropriateness in Georgia;
2. To describe the strengths, potentials, and constraints of the present information and communication capacities (including human resources, knowledge and infrastructures, and relevant communication relationships) and policies and strategies in research and research knowledge transfer (content development, training/education, feedback with society);
3. To compile an inventory of existing and preferred communication tools, channels, and actors; and
4. To identify potential partners for the development of solutions, including, where possible, already active or interested donors.

The study draws on data and information collected through three activities. First, visits were made to the following 9 organizations for evaluating their ICT situation:

- Ministry of Agriculture and Food (MoAF)
- Georgian Academy of Agricultural Sciences (GAAS)
- Research Institute of Horticulture, Viticulture, and Winemaking (RIHVW)
- Research Institute of Farming (RIF)
- Research Institute of Plant Protection (RIPP)
- Research Institute for Scientific and Technical Information (TECHINFORMI)
- Georgian State Agrarian University (GSAU)
- Agribusiness University (AU)
- Biological Farmers' Association (ELKANA)

Second, using a questionnaire, structured interviews were carried out with the representatives of these organizations to gather more detailed data and information on ICT infrastructure and use. Third, along with these interviews, a literature review was conducted on ICT use in agriculture in Georgia.

The main observations of the study are as follows. Georgia has a well-established Radio and Television broadcasting network, but its linkage with agricultural development, especially with extension, is extremely weak. Likewise, the use of print media for agricultural development appears to be weak. Telephones are available but their connectivity is poor and unreliable. Personal computers are only for office use. There is significant lack of skills to use computers. Internet connectivity, wherever available, is unaffordable. The use of the Internet is also constrained by lack of foreign language skills.

ICT infrastructure in Georgian agricultural organizations and agricultural research system is extremely poor compared to that of their Western counterparts. However, there are few organi-

zations, such as TECHINFORMI, ELKANA, and the MoAF, enjoying a relatively better ICT infrastructure.

Available scientific and technical information content related to agricultural research and development is largely obsolete. Flow of hard copy and electronic documents between organizations is limited. Some organizations have linkages to international organizations that enable access to limited international scientific literature. TECHINFORMI, ELKANA, and the MoAF use the Internet for accessing international databases and sharing information through their websites.

Most organizations do not have electronic research data management system. The use of ICT in research management is non-existent. Similarly, ICT is not used for extension, except by ELKANA or for education. Manual systems for office administration and project management information exist in all organizations and can be automated if ICT infrastructure, including new skills, is developed. However, its immediate impact on productivity is doubtful because, along with the introduction of ICT, there will be a need for significant structural reforms in the organizations to use ICT effectively.

With weak ICT infrastructure in the research organizations, ICT use at the national agricultural research system level, except for telephone use in Tbilisi, is non-existent. This precludes information exchange and sharing through ICT use. The MoAF, however, is relatively better served by ICT in this respect.

The Georgian Government has recently prepared an ICT strategy, the implementation of which demands a clear understanding of sectoral priorities and investment. For the agricultural sector, there is still a need to set these priorities. Without these priorities, the focus needed to generate and acquire new information content cannot be established.

Considering the lack of clear priorities, targeted investment in ICT infrastructure and use should be in horticulture, viticulture and wine production because of its immediate impact on vitalizing agro-industries. There are international partners, such as the World Bank, FAO, TACIS, USAID, foreign universities, and bilateral programs already active in these areas.

On the basis of this study, we suggest:

- Setting up an Information Center for Horticulture, Viticulture and Wine Making at the Georgian Academy of Agricultural Sciences with support from TECHINFORMI. This Center should organize scientific and technical information related to these topics and, in future, be an agricultural library with a “virtual”, on-line access component.
- Generating quality human resources with skills in ICT use and management and foreign languages. The Georgian State Agrarian University will need to strengthen its ICT infrastructure and information base to achieve this. It also has to improve access to international information vital to Georgian agriculture through collaboration and networking with the proposed Information Center.
- Encouraging more information platforms for the Georgian agro-industry, such as of ELKANA, that provides market related information to market intermediaries, processors, farmers etc. These platforms should also facilitate linking agricultural research with its public and private stakeholders. This can be done by setting up a fund for capacity development in agricultural information management for the Industry and NGOs.

SECTION 1

Introduction

1.1. Statement of the objectives

This study seeks to assess the needs of national agricultural research institutions and their relevant partners for innovative, appropriate, and efficient information and communication systems and linkages in Georgia. Considering ICT as radio, television, printing press, telephony, fax, computers, and the Internet, the study specifically aims:

1. To assess the availability of local, locally adapted, and relevant international information (available electronically or in hardcopy) necessary for the development of improved agriculture research capacity, efficiency, and appropriateness in Georgia;
2. To describe the strengths, potentials, and constraints of the present information and communication capacities (including human resources, knowledge and infrastructure, and relevant communication relationships) and policies and strategies in research and research knowledge transfer (content development, training/education, feedback with society);
3. To compile an inventory of existing and preferred communication tools, channels, and actors; and
4. To identify potential partners for the development of solutions, including, where possible, already active or interested donors.

1.2. Project activities

To develop initial contacts with the representatives of research institutes under the Georgian Academy of Agricultural Sciences (GAAS), the Ministry of Agriculture and Food (MoAF), the Georgian State Agrarian University (GSAU), Agribusiness University (AU), Non-governmental Organizations (NGOs), international organizations, and donors, an ISNAR expert visited Tbilisi, Georgia, during January 12-18, 2003. The representatives were invited to a meeting on January 15, 2003, within the framework of a separate ISNAR project "Agricultural Innovation System (AIS) of Georgia for Horticulture, Viticulture, and Winemaking" in order to discuss the issues surrounding the AIS and the role of ICT and information exchange networks in agricultural research.

During the subsequent days, for the implementation of the present project, individual meetings were held with Deputy Minister of the MoAF, President of the GAAS, Director of Scientific and Technical Information Research Institute (TECHINFORMI), Director of Research Institute of Horticulture, Viticulture, and Winemaking (RIHVW), Director of Research Institute of Plant Protection (RIPP), Deputy Rector of the GSAU, and the representative of CIMMYT. The FAO Project Manager and national experts were then consulted to finally identify 9 organizations for the study, including the MoAF, the GAAS, RIHVW, Research Institute of Farming (RIF), RIPP, TECHINFORMI, the GSAU, AU, and Biological Farmers' Association (ELKANA).

In mid-March 2003, the questionnaire in Appendix A was prepared for carrying out structured interviews with the representatives of the 9 organizations. The interviews and a survey of the ICT literature on Georgia were conducted by the two locally contracted project assistants during April 2003. The information obtained from these interviews and the literature review was analyzed; and a first draft of the report, prepared in May 2003. After consultations with the FAO Project Manager and representatives of the surveyed organizations, a second draft was prepared in September 2003. The final report was submitted to FAO in November 2003.

SECTION 2

An Overview of the ICT Situation

2.1. Institutional developments¹

In Decree No. 456, the President of Georgia stated that ICT is a critical tool to promote and support future economic development, and that success strongly depends on the establishment of ICT infrastructure and its use within a relevant content. Starting from early 1999, the Government adopted various laws and established relevant governing bodies in order to create an environment conducive to the development and implementation of a national ICT strategy (Table 1). At present, regulations that concern the liberalization of the telecommunication sector, the competitiveness of ICT trade, foreign direct investment in ICT, and intellectual property rights are underway in order to pave the way for such environment to develop.

2.2. ICT infrastructure

The ICT infrastructure of Georgia consists of a radio and television network, fixed line and cellular telephony, Internet services and wide and local area computer networks. Georgia has a relatively state-of-art radio and television coverage of the whole country. However, it inherited outdated and costly-to-maintain fixed telephony networks. Telephone penetration is relatively more adequate, but services are slow and maintenance is poor. The waiting period for the installment of a telephone line varies from a month to half a year. Twenty-six percent of telephone lines experience technical problems, and, on average, it takes 2 days to fix a problem. Combined with high international tariffs, these networks discourage Internet Service Providers (ISP) from establishing links with high bandwidths or dedicated Wide Area Networks (WAN). Local Area Networks (LAN) in organizations are emerging at slow pace.

There are no local firms producing computer peripherals (hardware and software). PC equipment is most often imported from Asia. All the existing international companies are in sales business only, with some 32 hardware and/or software sales units. A large majority of people cannot afford hardware and software purchase. About 40 percent of private businesses are also having difficulties to purchase the needed hardware. Accounting and financial software are the only ones available in local language. Almost all other software is imported and none is locally adapted.

Content, an essential component of the national ICT strategy, is developing rapidly. In 2000, there were between 200-250 resident domains in Georgian language and 60 non-resident domains. More than 250 web servers and 4000 hosts were operating in Georgia. At present, the number of domains is 1129. Over 40 online Georgian newspapers are hosted on www.opentext.org.ge. A large majority are electronic versions of the leading Georgian newspapers, supporting only Georgian language. Furthermore, the media in Georgia is developing rapidly as well, including 17 radio stations with 2.4 million listeners, 45 TV stations with 3.6 million audience, and 124 newspapers with around 170 thousand readers.

The Georgian Internet Sector (GeNet) is covered by 12 Internet providers. More than 70 percent of internet connections are provided by 4 major companies: 52 percent by SANET (www.sanet.ge), 9 percent by Georgia-Online (www.rustaviz.com), 8 percent by ICN (www.caucasus.net), and 8 percent Global-1 (www.global-erty.net). Business, trade, compa-

¹ For the data used in Section 2, the reader is referred to studies [5, 25, 29, 35, 36].

nies, and services represent 42 percent, culture and education 20 percent, news 18 percent, sports and entertainment 14 percent, and others 6 percent of the content.

In the 1970s and 1980s, publications related to agro-information accounted for more than 5 percent of all the scientific publications in Georgia. This was over 500 publications per annum, including monographs, articles, patent specifications, reports, and dissertations. In the 1990s, this quantity fell to 50 indicating the decline of public agricultural information in Georgia.

At present, Georgia has about 150,000 computers for a population of 5.4 million, 90 percent of them have Pentium, and 8 percent have 486 and 386 processors. The stock of computers across sectors shows that the education sector ranks top with 9,000 computers, followed by the banking sector with 4,800, and the health sector with 1,050 computers. The stock of computers, the availability of internet services, networks, and web sites across the Ministries and relevant government departments, reported in Table 2, indicate that the Ministry of Foreign Affairs, the Ministry of Interior, the Ministry of Labor, Social Security and Health, the Ministry of Economics, Industry and Trade, and the Ministry of State Property Management rank high compared with other ministries, though the number of computers in each Ministry is not high.

2.3. ICT use

Internet availability, mostly through dial up connections, is low. To date, regular internet users amount to approximately 3.5 percent of the population. Public internet access is provided in some libraries, Internet-cafes, and Internet clubs. With an average monthly income of \$37, Internet is not affordable for the majority of people. Access costs between \$0.30 and \$1.30 per hour. For small businesses, internet is also not affordable.

Almost all the government offices and most of the businesses (especially large ones) have some computers (though older generation computers). In the education sector, the situation is poor, with an average 0.3 computer per school. Of 3,464 schools, only 231 have computer labs with a total 1,059 computers. There is no LAN nor WAN in these schools. Full computer access in universities is usually restricted to staff.

TV is the most popular means of broadcast communications. Phones and faxes are commonly used by almost all the businesses. Ninety percent of accounting operations in government and business are carried out by computers. Typically, a business contact is established and maintained through personal contacts. E-mails are used to communicate with foreign partners.

2.4. ICT human resources

Computer training and education in universities have started only recently. Tbilisi State University and Tbilisi Technical University offer courses in computer programming and informatics. Several private schools, donors, and commercial organizations also offer computer training and education. Mostly located in Tbilisi, there are about 30 organizations specialized in computer services, training, and education. In universities, teachers' computer literacy is elementary.

Georgia enjoys the highest population share of people with higher education degrees, compared to the levels in other countries of the former SU. Therefore, it is more likely for ICT education to rank high in every level of schooling. Currently, demand for labor with ICT skills is high in the health, finance, banking, and accounting sectors.

SECTION 3

Method and Data

This study has gathered data and information on ICT through structured interviews with the representatives of the 9 organizations. The questionnaire in Appendix A was used in these interviews. Section 1 of the questionnaire gathers information on the collections of scientific and technical information (STI) sources. For this, the current status of libraries and information centers of relevant organizations is examined (1st column in Table 3). Section 2 gathers information on the extent to which ICTs are used in storing and analyzing management information, carrying out research projects and experiments, and in accessing all this information (2nd column in Table 3). Section 3 gathers information on the status of ICT infrastructure and use for the development of information exchange networks (3rd column in Table 3).

Section 4 gathers information on an inventory of existing and preferred communication tools and mechanisms among professional staff and between agricultural organizations. Section 5 gathers information on potential partners of national agricultural organizations and the use of ICT tools in linking these partners. Finally, Section 6 gathers information on the strengths, opportunities, and constraints on the present ICT capacity (human, knowledge, infrastructure, and communication) and on policies and strategies in research and knowledge transfer (content development and training/education).

Before, during, and after the interviews, several limitations were encountered. The first was to contact relevant and knowledgeable persons to interview, who could provide a true picture of the ICT situation of the organizations visited. To overcome this limitation, in most cases few persons from the same Institution were interviewed, enabling us to cross check the consistency of the information collected. The second can largely be attributed to the multiple-choice structure of the questionnaire. Some interviewees tended to restrict their answers only to the options available to them, although there might have been other critical factors more relevant to describe the situation they are in. The third limitation is that almost all the organizations visited are in the process of structural changes with weak administrative bodies and with scattered individual departments. Therefore, in some cases, information collected from several persons from the same organization was inconsistent.

SECTION 4

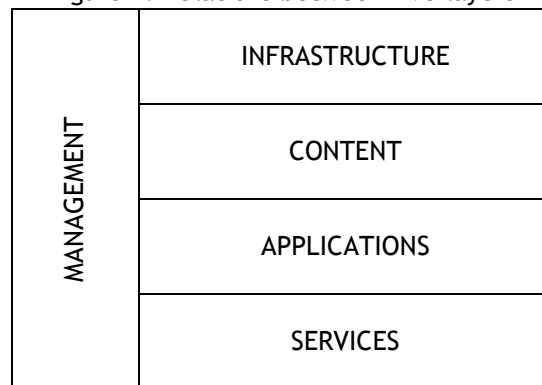
Conceptual Framework

ICT for agriculture is considered as radio, television, printing press, telephony, fax, computers and the Internet. The framework introduced in this section is used to assess the status of ICT infrastructure and application in a sample of 9 agricultural policy, research, education, and development organizations in Georgia. The assessment is done at the Organization and the National Agricultural Research System (NARS) levels.

4.1. Organization level

At the Organization level, five inter-connected layers are discussed, comprising infrastructure, content, applications, services, and management of ICT (Figure 1).

Figure 1. Relations between five layers



1. The ICT infrastructure layer includes hardware, software, skills, and connectivity (Table 4). This is the layer that supports ICT applications and services of the Institute (Table 5).
2. The ICT content layer concerns the generation, dissemination, and use of relevant resources for ICT applications. This layer is essential for the applications and services layers to develop.
3. The ICT applications layer includes 7 basic systems that use ICTs to process data and information. These systems are:
 - Scientific and Technical Information Management System (STIMS) concerns the management of document acquisition and access. STIMS deals with the management of such activities as cataloguing, circulation of hard copies, interlibrary loans, web-based on-line search, and full text access to scientific and technical documents.
 - Research Data Management System (RDMS) concerns the organization and processing of data and information from research experiments by using either personal or networked computers or organized databases.
 - Research Management Information System (RMIS) deals with access, availability, and cost of resources for research programs, projects, and outputs.
 - Education Information System (EIS) covers course ware for on-campus or off-campus and distance education activities through formal, non-formal and open methods.

- Extension and Outreach Information System (EOIS) deals with the provision of agricultural information to a variety of users outside the organization concerned. The information includes weather, market prices, electronic pamphlets, brochures, Frequently Asked Questions, catalogues of technologies, directories of experts, models, knowledge based systems and decision support systems. It would also include the public relations function of the organization such as a website.
 - Organization Management and Administrative Information System (OMAIS) concerns the management of personnel and finance information through personnel databases, accounting and auditing systems, stores, and inventory systems.
 - Messaging and Communication System (MCS) deals with the connectivity among individuals, units and/or departments within the Institute and with the outside world. The ICT use for connectivity would include telephones, faxes, LAN, and Intranets.
4. The ICT services layer includes services derived from the 7 basic systems of the applications layer.
- Services from STIMS - on-line access to search electronic catalogues, selected dissemination of information (SDI), current awareness services (CAS), and access to on-line full text document within the Institute library or information centre.
 - Services from RDMS - access to databases or to a system that connects databases and analysis of the data using analytical software.
 - Services from RMIS - research managers' access to information on resources used for research as per program, project and output.
 - Services from EIS - access to on-line courseware, course registration and schedules of educational resources for on- and off-campus, off-line and on-line courses.
 - Services from EOIS - access to on-line documents, current information such as weather, catalogues, indexes, directories of Institutes, experts, projects, project outputs, Frequently Asked Questions, decision support systems, models, information brokers, and knowledge based systems.
 - Services from OMAIS - access to on-line receipts and payments, applications for accounting, inventory, auditing and personnel management, online personal and administrative help desks.
 - Services from MCS - supporting linkages and interactions between departments and/or persons in a common project cycle.
5. The ICT management layer relates to (i) the establishment, maintenance, and governance of ICT infrastructure, content, application, and services, and (ii) ICT use for linking units and/or departments within-organization to facilitate a structured flow of data and information.

4.2. NARS level

ICT use at the NARS level can also be evaluated at infrastructure, content, application, services, and management layers by examining networks that use ICT to share and exchange data and information.

At the infrastructure layer, ICT that promotes NARS connectivity is essential. Connectivity can be established by a common directory for the network. This directory would include telephone and fax connections, E-Mail addresses and domains, Websites, FTP sites, a search engine for NARS information on electronic documents, and Wide Area Network.

Shareable ICT content should reflect the needs for successfully implementing agricultural policies and strategies and accomplishing priorities set for agricultural research and development. This layer is a gradient ranging from no ICT supporting and promoting policies and research priorities to effective use of ICT in agricultural research and development.

At the application layer, networks can be established for each of the 7 systems described above. For example, agricultural libraries can be linked through a common WAN or through independent Internet access. This would need a common networked library application with a common (union) catalogue among all libraries and have the ability to exchange through library loans hard copy texts or electronic documents. The network would also need to have a consortium, as an organization, to share acquisition costs, documents, information and/or skills.

At the service layer, the goal is to organize and manage NARS in such a way to produce services that are of interest to all the actors in the system; for example, services derived from a virtual scientific and technical information library.

The management layer concerns the establishment, maintenance, and governance at the NARS level of ICT infrastructure, content, application, and services. This layer also deals with ICT use for linking actors in the NARS to facilitate a structured flow of data and information.

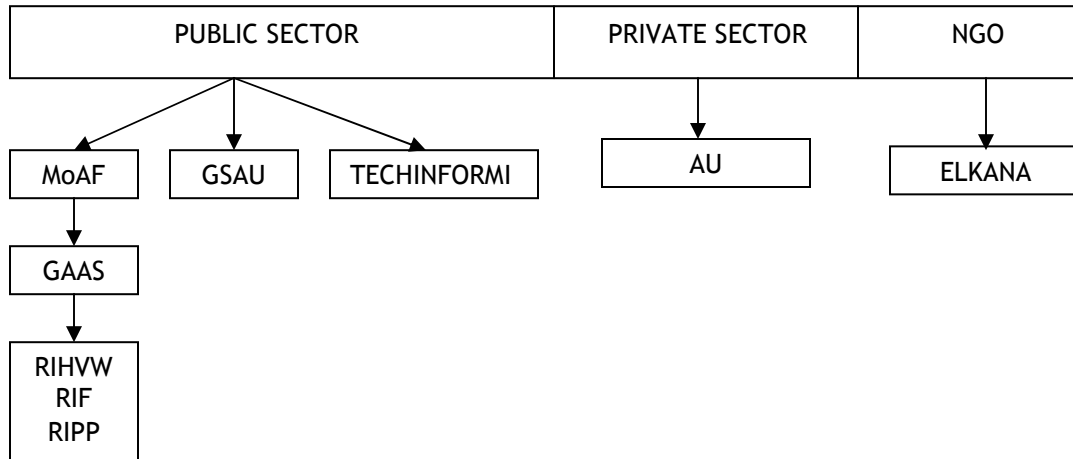
SECTION 5

Assessment of the ICT Situation in Agriculture

5.1. At the organization level

Of the 9 organizations visited, 7 belong to the public sector, one to the private sector, and one to NGO. Figure 2 shows the distribution of these organizations.

Figure 2. The surveyed organizations



5.1.1. Ministry of Agriculture and Food

The Ministry of Agriculture and Food (MoAF) located in Tbilisi consists of about 61 departments. Almost all the departments in the MoAF operate independent of each other for ICT acquisition and use. The ICT inventory of the MoAF was made by visits to selected departments.

Computers and peripherals (printers, CD-ROM drives and scanners) are used in individual departments. The exact numbers of personal computers in the MoAF was not available. Some departments that use computers have their independent databases with a minimal communication or exchange of information across the departments. There is no central data storage facility or process. Staff's access is limited because of senior officers' control over the use of these tools or staff's having poor technical skills. Telephones are available but the number of lines is limited. All ICT hardware and software used are imported and used without any local adaptation. Internet service is available but in most cases lack of foreign language skills especially English is the main obstacle for its effective use. Internet connectivity is through telephone and local area network. There are many operational problems as external technical support though available is of poor quality.

Information sharing and exchange between the departments within the MoAF has been weak. A LAN exists among the top administrative bodies in the MoAF. A plan for establishment of an Intranet is under way but without an information-sharing culture within the Ministry its usefulness may be limited. The Internet connectivity is through a leased line and/or dial up connections. Web access is also available in some departments. In messaging and communication, E-mail use is made in departments that have an Internet connected PC; telephone and fax (local, national, and international) facilities are more commonly used in communications.

There is a telecommunications network within the Ministry but it does not provide connection to every department. There is no telecommunications available for contacting regional departments. There is no direct electronic access to Ministry databases; however, several departments have access to international databases such those of FAO. In general, personal contacts, communications and face-to-face meetings are used to establish linkages within and between the Ministry and its partners.

There is no centralized source collection of scientific and technical information in the Ministry. Each department has its own collection. USAID has a project aimed at establishing a centralized information system. Currently, access to departmental information sources is through department officials. There is no standardized protocol for its access. At present, public ministerial staff's access to scientific information in the Ministry is not possible. Catalogues of documents are not computerized across the Ministry but some departments might have electronic catalogues of available documents. Around 60 percent of staff are qualified to use PCs and can manage access to information resources through PCs. Wherever access to Internet is available, it is possible to access and search international databases but lack of foreign language skills limits this use. The Ministry has a website <http://www.maf.ge>.

The Ministry library does not have any computer facilities. The Ministry does not also have any official arrangement with international publishers for the dissemination of research results or access to scientific and technical literature but several individual departments might have this arrangement. There are no standard procedures such as CAS or SDI services though there is a special department responsible for such activities. The department is not functioning at present.

The library is not properly functional and information flow from the Ministry to and from its regional offices is poorly organized. All information exchange is through paper copies and ICTs are not used in this exchange. There is no central information acquisition service at the Ministry. However, there are some departments financed through various grants possess some information. Since the culture of information and exchange with other departments is non-existent, scientific and technical information flow is poor. The scientists' poor foreign language skills and poor computer awareness also constrain information exchange and sharing within and outside Georgia.

Management information is available in hard copies in individual departments. Information on basic cost/benefit analyses, personnel information like CVs, and projected and actual expenditures in most cases is available only in hard copies. There is no standardized procedure to access this information. Personal contacts are the most common means for exchanging information between the departments.

In conducting research, computers and software, including MS Excel and MS Access are used but inefficiently due to lack of training. In general, only e-mails, faxes and telephones are used in project execution. Joint projects developed with international organizations such as USAID, TACIS, and GTZ etc. are based in Tbilisi. ICT is especially used in coordination and implementation of these project activities.

From interviews with officials of some departments, it was apparent that their need for improved ICT infrastructure and its use especially in the establishment of a national agricultural information system was foremost.

5.1.2. Georgian Academy of Agricultural Sciences

The Georgian Academy of Agricultural Sciences (GAAS) is an administrative body under the MoAF. The main function of the GAAS is to administer 16 research institutes² and set and coordinate research priorities for them. It also funds, on a competitive basis, basic and applied research of these institutes (Morgounov and Zuidema, 2001). Currently, the GAAS employs about 880 scientists. The regular staff at the Headquarters is 36 officers with 21 of them having professional degrees in different fields.

The GAAS has a Department of International Relations responsible for establishing linkages with national and international organizations. International research organizations and donors provide funding for joint projects. E-mail and fax facilities are used for communication in these linkages.

The GAAS has only one Pentium-III computer, one scanner, one copy machine, and a printer. A telephone is available but the service is of poor quality. Dial-up Internet access is available, but the cost of Internet access is not affordable. All ICT hardware and software are imported. Microsoft Office has been used since 2001. Local language software is not available. It was reported that software is upgraded once a year. There is no LAN or a plan to establish one because it requires the purchase of more PCs. At present, no funding is available to purchase computers. There are only 3 officers qualified to use PCs. They have poor foreign language skills therefore use of the computer is curtailed.

Limited scientific and technical information is available as hard (paper) copies in the library. Individual research institutes under the GAAS submit copies of documents. The use of ICT to generate and access content on agricultural research and on agricultural technologies is non-existent in the GAAS. The library receives only selected CGIAR publications, and has very limited link to international information services. Scientists in the GAAS keep personal contacts with the library of the GSAU but there is not much official interaction between the GAAS and the GSAU. The GAAS has no SDI or CAS for scientific publications available to interested researchers. The translation of documents, important for policy makers, is made upon request.

There are no computers available at the library. Researchers in the GAAS, in general, do not have capacity to identify and access the information they need. They are also mostly unaware of opportunities and methods of electronic access to scientific information. At present, the only computer available is used to organize and create an electronic database of these documents. An overwhelming majority of staff is not qualified to use PCs to access international scientific information through the Internet. The key obstacle, in addition to infrastructure, is the lack of foreign language skills. There is no system for communicating by e-mail. The GAAS does not have its own web site.

There is no concerted effort to organize management information on human, financial, and physical resources and research projects in the GAAS. The existing information is kept in hard copies making timely access to it almost impossible. There is no effort to establish an electronic database for sharing management information due mainly to the lack of a felt need for such information. The use of ICT in project management, priority setting, facilitating dissemination of research results etc., is not developed. The ICT infrastructure with only one computer is not adequate to perform these tasks even if there was a felt need. The GAAS does not

² Institute of Plant Protection, Institute of Horticulture, Viticulture & Wine Making, Institute of Farming, Institute of Food Industry, Institute of Agricultural Radiology and Agro-ecology, Institute of Tea and Subtropical Crops, Institute of Subtropical Crop Processing, Institute of Animal Husbandry and Feed, Institute of Apiculture, Institute of Economics and Management, Institute of Mechanization and Electrification, Research Center for Poultry Production, Tobacco Production Experimental Station, Institute of Fodder Production, Institute of Mountainous Forestry, Institute of Soils, Agro-chemistry and Reclamation.

have any procedure nor does policy for gathering and providing management information to interested parties. The existing ICT tools including computer, telephone, fax, etc. are especially used for maintaining contacts with foreign partners.

5.1.3. Research Institute of Horticulture, Viticulture and Winemaking BURADA

The Institute of Horticulture, Viticulture, and Winemaking under the Georgian Academy of Agricultural Sciences is located in Tbilisi. It has 22 departments and 4 regional experiment stations. Of a total of 145 employees, 105 are scientists with various degrees.

Recently, the World Bank and FAO have given priority attention to the Institute as a means to revitalize the Georgian Horticultural and Vinery sector, which has a comparative advantage in contributing to the country's overall agricultural development. Consistent with this priority, the likely research areas to be pursued by this Institute include development of new grapevine cultivars and clones, modern and progressive agronomic techniques, and saplings production by using new germplasm reproduction techniques, identification of pests and the design of appropriate pest management methods. The vinery research is expected to focus on the development of new technologies in alcoholic and soft drink production and improving storage techniques. With donors' fresh interest, establishment of the ICT infrastructure is a key component of the rehabilitation plan of the Institute,

At present, the Institute has no computers. Only telephones are available and that too with poor service. The infrastructure for information sharing and exchange are not developed; staff interacts and exchange information only through face-to-face meetings. The Institute library has a limited collection of scientific and technical information in hard copies of documents. Accessing them is difficult as there are no procedures for collecting and cataloguing. There are very few staff members who can carry out searches of international literature.

The library maintains relations with other libraries only through informal, face-to-face meetings. These interactions are not associated with formal information or physical resource flow. There are no arrangements with international publishers, though several articles have been published by personal initiatives of collaborating foreign scientists from IPGRI and University of Milan. Interested scientists cannot easily reach these publications because there are no circulation and dissemination procedures and mechanisms.

Management information including personnel related information such as staff qualifications and experience, research completed, research in progress, and cost/benefit data is available in hard copies. The Institute has set procedures to access this information.

The Institute has contacts with donors such as the World Bank, FAO, and IPGRI. These contacts are maintained using e-mail facilities of the Institute of Farming. Currently, the Institute, because of the rehabilitation plan, is receiving attention from donors and national counterparts. Generation of shareable digital content should also be taken up with development of ICT infrastructure and capacity building in the Institute.

5.1.4. Research Institute of Farming

The Institute of Farming located outside of Tbilisi under the Georgian Academy of Agricultural Sciences. It has experimental regional stations. With 7 departments, 8 experimental stations, and 1 breeding station, the Institute employs a total of 141 personnel; 60 of which are professional and the rest consist of technical and support staff. The key research areas include crop breeding, agronomy, soil-plant relations, plant genetics, crop physiology, seed production, etc.

At present, there are only two programs that actively conduct research in collaboration with international organizations. First, the Plant Genetic Research Department (PGR), established in collaboration with ICARDA and IPGRI, collects, maintains, and conserves the plant genetic resources of Georgia. This department has a joint project with ICARDA and IPGRI to establish a gene bank. At the same time, short-term training courses are organized to strengthen research capacity of scientists. Second, the Cereal Breeding program, in collaboration with CIMMYT and ICARDA, conducts wheat and barley variety screening, germplasm testing, and seed multiplication research.

At a regional research station (Mtskheta Plant Breeding Station) a wide range of international plant germplasm (wheat, barley, legumes etc.) are tested annually in collaboration with CIMMYT and ICARDA providing germplasm. Most recently, the station developed a new high yielding wheat cultivar with the CIMMYT/Turkey program.

The Institute of Farming has telephone, fax and e-mail connectivity. The PGR Department of the Institute has its website and one for the Institute itself is under construction. The entire Institute has only one PC (Pentium-III) with a CD-ROM, which is connected to a printer and a scanner. Dial-up Internet access is available. Imported software is used in database creation and data analysis, including Microsoft Access, Fox Pro, and ARCview for spatial analysis of data. Software is upgraded once a year. Technical support for Internet, telephone, and software services provided externally by special firms is poor and unreliable. Qualified personnel are scarce and foreign language skills are needed for effective use of software.

The Farming Institute has a relatively better collection of scientific and technical information sources, compared to two other institutes under the Academy described in this report. All information, however, is in hard copies, with poor access by obsolete procedures. The PGR department is in the process of establishing an electronic inventory of the existing plant genetic resources available. Only limited access is available.

There is no telecommunications network connecting the Institute with other organizations. It appears that there is no telecommunication network in agricultural sector outside Tbilisi. The Institute does not have electronic connections to databases of other organizations. Only the PGR department has access to ICARDA's databases and shares its databases with IPGRI and ICARDA. No other official arrangement is in place with international publishers for the dissemination of scientific and technical information. Available information and research results are still, as in the previous (Soviet) system, kept and disseminated through the Academy. Although the Institute has scientific information unit, CAS and SDI services have not been established. There is no computer service and therefore no automated on-line cataloguing and circulation in the library. There is no electronic library network for agriculture in Georgia, but the library of the Institute maintains informal connections with Georgian Libraries, in particular with the library of Georgian State Agrarian University and with Georgian National Library.

There is no concerted effort to organize management information on human, financial, and physical resources and research projects. The existing information is all kept in hard copies that make timely access almost impossible. A small portion of the information is available in annual reports of the Academy, which are the only standardized sources of the management information. This centralized collection and dissemination of the information is also the only standardized format for such information. The other information sources are scattered, not standardized and not comparable across the Institutes. There is no effort for the standardization of such information sources because there is no demand for it. Even if there is such demand, ICT infrastructure with one computer is not adequate to take up such tasks. E-mail service is used in the preparation, coordination, and exchange of results with CIMMYT, ICARDA, and IPGRI.

The Institute has a very limited interaction with other potential partners except the CGIAR organizations. The existing interactions all evolved around a joint project aimed at breeding and germplasm exchange. The lack of a telecommunications network connecting the Institute with international organizations seriously hampers information and data exchange.

Although ICTs are demanded by scientists for developing research proposals, searching for international/regional partners for research collaboration, writing research papers, and providing information to partners. Presently, there is no specific project to create content for ICT use.

5.1.5. Research Institute of Plant Protection

The Institute located in Tbilisi consists of 7 departments and employs a total of 94 employees, 56 of whom are with various scientific degrees. The Institute is under the Academy. The Institute's mandate is to study crop diseases, develop disease monitoring and control methods, elaborate on the efficient use of new pesticides and the environmental determinants of crop disease, etc. The Institute also holds responsibility for testing all newly introduced agricultural chemicals for their effect on agricultural produce and controlling the distribution and use of such chemicals. The Institute is currently involved in several activities aimed to improve environmental conditions by controlling agro-industrial chemical pollution.

The Institute has only 2 Pentium PCs connected to a common printer. Microsoft Office is the only software used. The PCs also have dial-up Internet connections. Internet services are affordable to the Institute. The computers are poorly used. Few telephones are available but quality of service is poor. ICT hardware and software used are imported. There is no specialized software available, and the ones available are not in local language. There is no central electronic database developed and no procedure to exchange information electronically. The Institute does not have a Website. There is no use of e-mail in the Institute.

The Institute has limited collection of scientific and technical information sources; all of which are in hard copies. Access to them is difficult because of lack of organization. Few personnel are qualified to use ICT tools and neither ICTs nor ongoing activities to use them exist. The Institute does not have any international publication available either on paper or electronically but has relations with Institutes in Israel and China that can be instrumental in publishing scientific information when conditions for doing so arise in the Institute.

The library has no electronic information. Some publications in Russian are available in hard copies but it was reported that researchers never use them. Currently, there is no funding for acquisition of new publications and no real task that requires ICT use. Libraries in Georgia are not networked and the link between the Institute library and others is informal.

Management information is only available in paper copies. This includes research completed and research in progress, basic cost/benefit analyses, qualifications and experience of staff, and projected and actual expenditures. Resource information, including human, financial, and physical resources, is also available in paper copies. PCs and CD-ROMs are poorly used for management information. There is no office procedure for access to this information.

Few technical staff has the capacity to access and make searches from electronic sources, however, neither demand nor content exist for such searches. Information exchange in the Institute takes place in face-to-face meetings or using telephones or faxes. The Institute has no extension services.

The Institute has limited contacts with international organizations such as University of Jerusalem, FAO, and the World Bank. The lack of content is the key obstacle for these contacts to

lead to joint project development. Researchers' individual initiatives are usually the key factor for such contacts to develop. The Institute stressed the need for a national agricultural information system that would support the development of content for ICT use. Possible activities that might be carried out by using ICTs then include on-line access to scientific publications, catalogues, and agricultural statistics.

5.1.6. Research Institute for Scientific and Technical Information

Georgian Research Institute for Scientific and Technical Information (TECHINFORMI), established in 1959, is managed by the Department for Science and Technology at the Ministry of Economy, Industry, and Trade. It is the biggest public information center of Georgia. The principal activity of TECHINFORMI is to provide with analytical, reference, legal, methodical and other information on industry, agriculture, ecology, standardization, certification, protection of consumer rights, military affairs, trade, tourism, advertise in Georgia. The only agricultural information available at TECHINFORMI relates to past developments in the viticulture and wine-making industry. A CD-ROM is available that includes information on widely-distributed and grapevine varieties, trends in grapevine use, production, and processing, grape varieties, processing companies, small-scale market research for winemaking industry, and statistical data.

TECHINFORMI has telephone, fax and e-mail connectivity with its own e-mail domain xyz@tech.org.ge. It has its website at <http://www.tech.org.ge/>. The Institute has 25 computers (a mix of Pentiums, Pentium I and III) on a local area network that shares printers and a scanner. Its Internet access is modem as well as dedicated link through Government Internet Service Provider. It has access to Cable TV services. Hardware and Software used by the Institute are imported. The Institute started using computers in 1978.

The scientific and technical information collection at the Institute is well organized. The catalogues of these collections are in hardcopy and electronic, searchable form. The LAN enables access to these catalogues. Staff at TECHINFORMI is qualified and skilled to carry out their information related activities through use of computers, local area network and the Internet. The Institute has on-line acquisition service and runs a Current Awareness Service for its users. The Institute researches for information on various areas of science, technology and economics important for Georgia. The needs of users in the Institute are related to the Institute's research activities and for publication of its information.

The Institute does not intensively use computers for administration but has a database for research management. The Institute has no separate Extension or Outreach Department. However, the Institute through its website enables access to several databases and links to several International Information Services including UNESCO's Russian Language, FAO and Agroweb. The Institute also uses CD-ROM's for information dissemination. About 15-20 percent of the Staff knows English and this enables them access to search international databases.

The Institute is organized in several departments each of which independently process and manage their information availed from internal and external sources in independent databases and with independent administrators. The entire system is observably not very secure.

The Institute has partnership with the World Bank and the UN, including FAO. It has a plan to develop information service for agricultural research and education organizations. The Institute's major needs were stated as training and capacity development in various areas of information management including foreign language skills, use of new information management techniques, network and web administration.

5.1.7. Georgian State Agrarian University

Georgian State Agrarian University (GSAU) emerged in 1991 out of Georgian Agricultural Institute founded in 1929. The headquarters of the University is located in Tbilisi. It has faculties of agronomy, technology, horticulture, viticulture, economics, forestry, agricultural mechanization, melioration and engineering ecology, and electrification and automation. The GSAU has several regional branches, including State Agrarian Institute of Batumi, Kvemo Kartli Regional Multiprofile Institute, Training-Research Institute of Sericulture, Scientific-Research Institute of Mountainous Agriculture, and Telavi Branch of the University. The University has 85 chairs (departments), 30 research and training laboratories.

The University employs more than 500 scientists and teachers. There are 100 doctorate and professor and 200 Candidates of Sciences and Associate Professorship. The University offers Bachelor (4 years) and Master (2 years) degrees. After completion of the Master's degree, students can enter to the postgraduate and following that, the doctorate programs.

The GSAU has since 1991 developed links with Timiryazev Agricultural Academy, Russia; University of Maryland, USA; University of Agriculture, Czech Republic; University of Dijon, France; Samsun University, Turkey; Agricultural Academy, Armenia, etc.

The availability of ICT facilities varies from department to department. There are also 35-40 computers, scattered in 3 computer labs, of which 2 computers can be connected to the Internet. The personal computers used range from 286 to Pentium-III; the "286" are used for training purposes. The others computers are used by staff and students. The hardware including printers, scanners, CD-ROMs are used quite efficiently. Telephone service is available but the quality of service is poor. Dial up Internet access through use of modems is available but access to Internet is not, in general, affordable. However, there are several departments that have funding through grants that enable use of Internet services. All ICT hardware and software are imported. No specialized software is used. Only MS Office in Georgian is used and no computers are allocated specifically for research. Generally, the existing computers and software are used for typing, printing and scanning documents. About 5 percent of teachers and staff and 10 percent of students use computers. About 15-20 percent of students have computer literacy.

There is no LAN within the University connecting individual departments. The rational for such network at the moment is not there because the Departments are not connected to University wide information flows such as with the Library. The University does not have extension services or online distance education programs.

The University has a very limited number of scientific and technical information sources, including books, scientific journals, and dissertations left from the old Soviet system. Almost all collections and catalogues are in hard copies, out of date, and difficult to access. The University library has no computers and the existing library staff is not trained to use new ICT tools effectively and efficiently. There are no arrangements for International database searches. The staff is also constrained by not having foreign language skills needed to access international literature. There is neither CAS nor SDI services in the library. Personnel contacts with National Library staff are the only means of information exchange outside the University.

Management information is available at each department but only in paper copies. Information on completed research is available in paper copies in the library. However, information is not available on human, financial, and physical resources. ICTs are extremely rarely used for sharing the information available. Departments vary in their staff capacity with respect to ICT use: in some departments the percentage of the skilled staff is high; in other departments there is not a single person trained to use the ICTs.

There is no ICT used in sharing information for administration and management. Usually the information is exchanged through face-to-face meetings. There are no central electronic databases for information sharing between departments and with the administration. Internet is available and dial up connections using modem are used. Currently, the university does not have any website, but preparations are under way to construct one.

Most recently, in collaboration with several donors, international research organizations, and foreign universities, the Agrarian University is planning to organize training and capacity building programs for ICT use. However, poor ICT infrastructure at the University is the key constraint for such programs. Very few University computer users have e-mails accounts; and since the University has no e-mail domain they use free, web based e-mail accounts services such as "Hotmail", "Yahoo Mail" etc.

There are two driving forces behind the University's needs for ICT. First, individual departments' desire to develop joint research proposals with international organizations; and second, the desire to support and promote teaching and learning processes, including distance education through use of ICT. The use of ICT is also expected to be central to developing a National Agricultural Information System.

5.1.8. Agribusiness University

Agribusiness University (AU) is a private university in Tbilisi, where only teaching is performed. It employs a total of 35 personnel, and 25 of which are professional. The University has only one Pentium II computer including a printer, CD-ROM, and a scanner with a dial-up Internet service. The service is affordable and technical support for it is adequate. Around 30-40 percent of teachers and students can use computers. ICT hardware and software are imported. Some office software is available in Georgian. Telephones are used efficiently with satisfactory service quality. The college does not have any electronic databases or its own Web site. It does have an email address.

The college library has poor collection of scientific and technical information sources. Internet and local media are rarely used in accessing other sources. With only 1 computer, catalogues are not computerized and information is not available electronically. The library does not use on-line procurement and acquisition services and does not participate in library networks but it keeps good personal connections with the National Library and the Library of Agrarian State University. Arrangements have been made to procure local journals and media (including Moambe, Kvali, Sakartvelos Respublika, publications of the Georgian Academy of Agricultural Sciences) for dissemination purposes. There is no CAS or SDI service. Only few staff can effectively use computers in to access international databases.

Some information is available on organizational human, physical, and financial resources but all as paper copies. Access, Excel, and other Microsoft Office programs are used only for data storage and analysis. The college is engaged only in teaching but has no relation with any teaching networks, national or international. On a very limited basis, some contacts are maintained with professionals from the Agrarian University.

Computers are not used for on-line distance education. The college does not have any extension service. In messaging and communication, e-mails, websites, and telephone (local, national) are rarely used. The College wishes to acquire more ICT for teaching and research purposes. However, limited budget hampers any investment in this direction. ICT tools are especially demanded for improving access to on-line full text documents, electronic journals, on-line bibliographic indexes and catalogues, and national and international agricultural news.

5.1.9. Biological Farmers' Association

The Biological Farmers' Association - ELKANA, a non-governmental organization, located in Tbilisi was founded in 1993. ELKANA's main objectives are to support the sustainable agricultural development, to promote the development of socially and economically sustainable organic farms, and to improve living conditions in rural areas. ELKANA is actively engaged in three types of activities. First, it provides extension service concerning organic farming, organizing seminars and on-farm training programs on the application of organic farming techniques and disseminating information on the farming techniques. Second, it performs extension services for rural development. Participatory methods are applied for farm-specific problem identification and the development of solutions. Third, it performs public awareness activities concerning organic farming issues facing Georgian farmers. Mechanisms used in these activities include seminars, TV programs, newsletters, etc.

ELKANA has well-functioning ICT infrastructure. This includes 18 computers (Pentiums), 6 printers, CD-ROMs, scanners, and tape backup units. Equipment is used efficiently. Telephone and mobile wireless are available and run satisfactorily. It has an electronic information center for information and data sharing. Internet access is through leased line connection and a LAN as also through dial-up connections. All computers have web access and email facilities. All ICT hardware and software is imported. Some specialized software available in local language, including ORIS, Super Fin, and Fun Drek Account/Report are used by the organization. Upgrading of this software depends on the emerging needs and availability of funds.

ELKANA has its own website (www.elkana.org.ge) and, by itself, handles content authoring and publishing/development. External technical support is often inadequate for problems relating to Internet, telephone services, and network operations. ELKANA has enabled security for safe communication of business information with external partners. The website was checked and found operational during writing of this report.

ELKANA has some scientific and technical information sources, of which some are available electronically. Electronic information is stored in few PCs but procedures to access them have not been formalized in the organization. There are several catalogues and most are computerized. Around 8 staff members can by using PCs make searches from international databases. There are no arrangements with international publishers to allow the dissemination of research results but some articles and data are sent to interested organizations mainly in Germany. ELKANA has a special service providing such information and publishes a journal "Biofarmer" which helps it to disseminate information to its members throughout the country.

ELKANA's activities are mostly driven by internationally funded projects. These projects determine the content for ICT use and the scope of the scientific and technical information required. The National Library is also used to acquire scientific information.

Management information is available both electronically and in hard copies. There are procedures applied and ICTs used (PCs, CD-ROMs, LAN) for access to it. Most staff is qualified to efficiently use Internet, e-mail, and electronic sources (like CD-ROM, scanning machine, fax) for information exchange and documentation. However, meetings, publications, workshops, and seminars play a key role in facilitating flow of the information between partners and members. ICT tools including telephones, web and email are quite satisfactorily used in the process of project preparation, coordination, and exchanging project results.

Extension technicians also use the ICT tools in planning and preparing extension services. There are no dedicated portable/mobile computers for extension service. There is no national extension network for ELKANA extension agents to interact with. For messaging and communi-

cation, individual staff members have access to e-mails, websites and with special authorization, access to telephone and fax (local, national, and international).

So far, ELKANA has been using ICTs especially in extension and consultancy services, developing contacts with international counterparts, and searching for scientific information. Future activities seem to focus on broad agricultural development issues such as poverty reduction and food security, helping develop new content for ICT use. Specific areas for ICT use include on-line full text documents, electronic journals and providing national agricultural statistics and international agricultural news.

The reader is referred to Table 4 for constraints faced by individual Institutions and to Table 5 for assessment of the ICT situation prevailing in the Institutions. Finally, using the information summarized in this section, a quantitative evaluation is given by Table 6.

5.2. At the NARS level

At the National Agricultural Research System (NARS) level, ICT infrastructure is vital in facilitating and promoting the information exchange and sharing across the Institutions in NARS. By connecting the Institutions, this infrastructure further becomes instrumental in the speedy and timely generation, dissemination, and application of information.

Inter-Institution information exchange through ICT hardly takes place in Georgia. The main limiting factors behind this are poor electronic information content, the lack of necessary tools available, and the scarcity of skilled staff. Local demand for new scientific information is driven exclusively by international organizations, except for TECHINFORMI. Most important of all, understanding of the system processes and their benefits at the institute level is poor among the actors in the NARS.

Scientific and technical information collections available in libraries and/or information departments of the research institutes under the Academy and the MoAF are outdated. Most of these collections are in hard copies; rarely, some are available electronically but quality and access are poor. The libraries operate poorly, and there is no procedure for inter-library loans. Face-to-face meetings are the most commonly used means for accessing the information concerned. Relations with international libraries are not established due mainly to the lack of Georgian language content, staff with foreign language skills, and funding. But, international organizations such as the World Bank, FAO, USAID, and CGIAR centers sometimes become instrumental in accessing new information collections. TECHINFORMI has a reasonable collection of scientific and technical information, most of which are available electronically. However, there is no procedure to share and exchange these collections with other Institutions in the NARS. ELKANA has also some collections available electronically, but again exchanging them with others is not possible.

Research data have not been organized electronically for sharing across research institutes. ICT infrastructure is underdeveloped to organize and standardize the existing research data. Among the key constraints are the lack of proper hardware and software, the lack of skilled human resources, and the lack of research priorities. Existing records are available in hard copies but they are not in standard formats. Old administrative procedures are still applied in facilitating the flow of such data between institutes or between departments within an institute. Data management, such as standardization, storage, transfer, and use, has not yet received adequate attention due to the lack of electronic research data. Again, research data that promise immediate use in joint project implementation are organized electronically by international organizations.

Organization management information, including basic cost/benefit data, human resources, projected and actual project expenditures, and physical resources, is also available largely in hard copy precluding its sharing or detailed analysis at the NARS level. Departments have their own databases, which need to be standardized for effective use in agricultural policy making. More importantly, limited information exchange between the Ministry of Agriculture and Food and the Academy of Agricultural Sciences diminishes the contribution of research to the policy design and vice versa.

Institutional linkages with farmers through an agricultural extension are virtually non-existent. Linkages, therefore, through radio, television and print medium are also weak. The existing linkages between foreign partners and research institutes are based on joint project development and implementation. Most recently, the World Bank and the Horticulture, Viticulture, and Winemaking Research Institute have completed preparations for a joint project aimed at the rehabilitation of the Institute, within a much bigger initiative to reform the Georgian agricultural sector. Similarly, ICARDA and the Institute of Farming are currently collaborating to prepare an inventory of plant genetic resources in Georgia. Linkages are also maintained with other international organizations, including USAID, TACIS, FAO, and universities and research centers in Israel, Turkey, Italy, USA, and Russia. Connectivity between national and international organizations is maintained by telephone, fax, and e-mail services. Electronic databases are rarely utilized in information exchange between the collaborating organizations, although databases of many international organizations are in public domain. These linkages facilitate the flow of resources from international to national organizations, including ICT hardware and software, funding, and information and knowledge.

The State Agrarian University has some relations with donor organizations, international research institutes, and foreign universities. These relations concern the organization of training programs and the development of project proposals. Contacts are maintained by free e-mail services, such as "Hotmail" and "Yahoo Mail". Usually, the University receives computers and funding from international organizations and donors.

ELKANA maintains relations with national and international research networks, using telephones, web, emails, and CDs. Its activities and ICT infrastructure are funded through grants and project acquisitions from international organizations, TACIS, DFID, Dutch-Cordaid, Swiss Agency for Development and Cooperation, UNDP, and USAID-supported organizations. In establishing linkages with international organizations, ELKANA usually relies on personal contacts. ELKANA also interacts with national agricultural research institutes, universities, and the Ministry of Agriculture and Food to support and promote biological farming through consultancy and extension services. Workshops, seminars, and newsletters are the commonly used linkage mechanisms. ICT tools are used adequately in developing joint research projects, including telephone, web, and e-mail. ELKANA's activities are based on well-developed content.

TECHNFORMI has electronic connection to FAO, the WB, and TACIS, and in the context of joint project implementation it receives hardware and software applications, computers, and funding from them.

SECTION 6

Needs Assessment

All the Institutions that participated in the Survey indicated that they needed improved telecommunication and more computers with access to the Internet. The reasons indicated for this need were to establish research partnerships with regional, national, and international organizations, promote agricultural extension services, generate and access new agricultural information and knowledge. Among the areas identified for immediate use included access to on-line full text documents, electronic journals, national agricultural statistics, and national and international agricultural information.

Searching for international/regional partners for research collaboration and providing information to partners and supporting training programs, extension services, and agriculture clients were the key reasons for seeking information through ICT use by the Georgian State Agrarian University. Among the most important reasons for ELKANA to demand ICTs are on-line bibliographic searchable indexes and catalogues, on-line full text documents, electronic journals, and national agricultural statistics.

Information gathered by the present study clearly indicates that the Ministry of Agriculture and Food needs to improve ICT use in agricultural research and dissemination of information, broad agricultural development objectives such as poverty alleviation, food security, environmental protection, better health and education, etc, and for collaborative research. Specific areas for immediate use, according to the Ministry, were also on-line bibliographic indexes and catalogues with search facilities, national agricultural statistics, on-line full text documents, and electronic journals.

The use of ICT in agricultural research and development would depend on how fast the telecommunications infrastructure in Georgia develops. At present, this infrastructure appears to be very poor beyond Tbilisi and in connecting various Institutes and organizations. It would also depend on how the national agricultural development priorities are set and a strategy developed. This would take some time to emerge.

There is potential for Radio and Television use for agricultural extension and providing farmers with agricultural information. The National infrastructure is quite developed with quality skills available for Radio and Television broadcasting. However, without institutional structures for generating relevant and useful agricultural content, this capacity cannot be put in use. Specific skills for agricultural journalism that uses audio, video and print medium may be required. Development agencies may be able to contribute significantly in this area of capacity building.

Under the current policy and ICT infrastructure in Georgia, it would be appropriate to focus in investing resources in a targeted manner to improve ICT use in one or more sub-sectors of agriculture, such as horticulture, viticulture and wine-making, so that it has an impact on agricultural development than in initiating a sector-wide program for improving ICT use and information management. This approach would require:

- Building the necessary ICT infrastructure, including hardware, software, skills, and telephony and Internet connectivity, in the Institutes related to the prioritized sub-sector,
- Establishing an information center for the sub-sector, and
- Creating organizational and individual capacity to use information effectively for improving the productivity of the sub-sector.

From this experience, wider ICT use can spread to the entire agricultural sector.

Presently, the poor status of the entire ICT infrastructure in Georgia is a major constraint on rapid improvement even with major financial and human capital investment. Because of this, development should start with building content and equipping the Institutions in the targeted sub-sector with appropriate ICT needed to generate and access this content. Very rapid human capacity building would be required for this endeavor.

SECTION 7

Discussion

This study had 4 objectives, stated in Section 1. Here, in Section 7, we briefly discuss the accomplishments of the study in relation to each objective.

7.1. Agricultural research capacity, efficiency, and appropriateness

Except for TECHINFORMI and ELKANA, the existing local information relevant is outdated, not readily accessible by interested parties, and has limited use in improving research capacity and efficiency at the Institutes. The lack of adequate telecommunication facilities and content worsens the situation further. Most libraries at the institutes concerned do not have up-to-date information sources; in cases where some is available, access is poor due to the lack of effective procedures and communication means. Access to international information is constrained mainly by the absence of adequate ICT infrastructure and personnel with foreign language and computer use skills. Poor relations with international publishers also hinder the access to the international scientific and technical literature.

Almost all the Institutes covered by the Survey indicated that they needed improved telecommunication and more computers with access to the Internet (Table 6). The reasons indicated for this need were to establish research partnerships with regional, national, and international organizations, promote agricultural extension services, generate and access new agricultural information and knowledge.

7.2. The present IC policies and capacities for knowledge transfer

Tables 6 present the constraints reported in the Questionnaires. Grey cells in this table represent the areas where the relevant Institute reported to have serious problems. Two key observations are immediate. First, except for RIHVW and TECHINFORMI, all the other public research and policy organizations surveyed indicate that constraints are overwhelming in every field. In fact, it is our view that RIHVW as well is equally subject to the same constraints. ELKANA is the second organization that enjoys a relatively better position with respect to ICT infrastructure and use.

Second, the lack of national networking and cooperation between local and international organizations are perceived by all the Institutes as the two key constraints to be addressed immediately. These constraints, in fact, can be interpreted as a manifestation of a desire for the growth of information sharing culture. Such behavioral change is necessary if networks of experts and organizations and partnerships between public and private organizations are to be developed. Currently, inter-organization information exchange hardly takes place due to lack of content, scarcity of skilled labor, and absence of interface organizations that would facilitate organizational linkages. This, in fact, qualifies international organizations and NGOs (domestic and/or international) to be active in this area. Other important constraints from the same table include poor language skills, scarcity of computers, poor telecommunication facilities, lack of content and political will, low computer literacy, and low level and poor computerization in organizations.

Table 7 draws on the information presented in Section 5. The key observation is that ELKANA, TECHINFORMI, and to a less extent, the MoAF occupy relatively better positions as to ICT infrastructure. In relation to ICT content, applications, services, and management, however, only TECHINFORMI and ELKANA seem to be operating under promising conditions.

For long-term agricultural development in Georgia, research and education institutions need to capitalize on the high level of general education and adapt it to the current needs of the ICT sector before it totally deteriorates or escapes the country.

7.3. The existing communication tools, practices, and actors

The information and communication tools and practices with 3 or more points in Table 8.

MoAF	letters, telephone, fax, post, face-to-face meetings, conferences, e-mails and websites
GAAS	letters, post, face-to-face meetings
RIHVW	face-to-face meetings
RIF	face-to-face meetings
RIPP	face-to-face meetings
TECHINFORMI	periodicals, letters, Journals, Bulletin boards, newspapers, yellow pages, telephone, TV, fax, post, face-to-face meetings, training, exhibitions, conferences, networks, e-mails, electronic newsletters, website
GSAU	post, face-to-face, telephone, fax
AU	Face-to-face meetings
ELKANA	periodicals, letters, Journals, Bulletin boards, newspapers, telephone, TV, fax, post, face-to-face meetings, training, exhibitions, conferences, networks, e-mails, electronic newsletters, website

International organizations within the immediate circle of the institutions

MoAF	USAID, FAO, TACIS, GTZ
GAAS	ISNAR, ICARDA, IPGRI, CIMMYT, the World Bank
RIHVW	FAO, the World Bank, IPGRI, University of Milan
RIF	ICARDA, IPGRI, CIMMYT
RIPP	University of Jerusalem, FAO, the World Bank
TECHINFORMI	UNESCO Russian Language Services, FAO, Agroweb, the World Bank, TACIS
GSAU	Timiryazev Agricultural Academy, Russia; University of Maryland, USA; University of Agriculture, Czech Republic; University of Dijon, France; Samsun University, Turkey; Agricultural Academy, Armenia.
AU	
ELKANA	TACIS, DFID, Dutch-Cordaid, Swiss Agency for Development and Cooperation, UNDP, and USAID-supported organizations.

7.4. Potential partners for developing solutions

Potential partners for developing solutions to ICT problems that hamper agricultural research capacity and research knowledge transfer lie within the Agricultural Innovation System (AIS). In our context the AIS can be defined as a group of public organizations, private firms, NGOs, consumers' organization, farmers' organizations, and external assistance agencies that jointly and/or individually contribute to the generation, dissemination, and use of improved or new

agricultural information and knowledge for agricultural development (Temel, Janssen, Karimov, 2003). This study considers ICT a critical tool to facilitate partnerships or coalitions of:

- Department of Communication, Post, and Information Technologies (within the Ministry of Transport and Communication)
- State Department of Information Technology
- TECHINFORMI (within the Ministry of Economy, Industry, and Trade)
- The Ministry of Agriculture and Food
- Agricultural Research Institutes under the Georgian Academy of Agricultural Sciences
- The Ministry of Education
- Georgian State Agrarian University
- Georgian State Technical University
- NGOs: Biological Farmers' Association-ELKANA
- Farmers' Information Center
- Consumers Organizations
- International organizations (including the WB, FAO, ISNAR, TACIS, GTZ)

SECTION 8

Conclusions

The review of the literature on ICT infrastructure and application in Georgia, carried out by this study, suggests that, to implement the national ICT strategy, there is the need for:

- *Sectoral action plans.* A national ICT strategy has been formulated, and institutions are in progress for its implementation, indicating the Government's commitment at the policy level. However, there has not been significant progress as to the financing of the strategy for actions to be taken on the ground. The absence of sector-specific frameworks and action plans for the strategy to be truly implemented on the ground risks funding possibilities from donors and international organizations and discourages private sector investment in the ICT area.
- *Skilled labor force.* Statistics pinpoints a serious scarcity in skilled labor force. It should be clear from the outset that without qualified human resources, no investment in the ICT area will follow, and besides, the existing arrangements with international companies for modernizing the telecommunication infrastructure are highly likely to fail. The task is one that bears benefits to all segments of the society; therefore, the public and private sectors need to cooperate toward a skilled labor force. Elements of such cooperation are emerging: higher education institutions offer courses on informatics and computer programming and private companies support training of their staff. The Government can further speed up the building of a skilled labor force by providing economic incentives to encourage private investment. Economic instruments, such as tax-exemption of ICT-related education cost, should be utilized aggressively, if individual decisions regarding ICT are to be influenced.
- *Compatible institutional arrangements.* Intellectual property rights and international and national trade regulations should go hand in hand. These are the two sides of the same coin: An effectively operating intellectual property system cannot bring investment in the ICT area if trade regulations are prohibitive; and similarly, effective trade regulations cannot invite private investment in ICT if the intellectual capital is not protected. Such interdependencies among policy instruments are poorly understood; therefore, policy and decision-making capacities in newly established government units need to be improved.

In spite of high expectations from the agro-industry sector as to its contribution to economic development, progress in ICT infrastructure and use of agricultural organizations has been limited due mainly to the absence of agricultural policy directions and the continuing reforms of agricultural policy and research organizations. The current poor content is just a reflection of all these adversities, and it can, to a significant extent, be remedied by:

- *Promoting partnerships or coalitions* of public organizations, private firms, NGOs, consumers, farmers, and external assistance organizations around rural development goals, including improved food security and reduced poverty. At present, many of these organizations operate in isolated domains because critical areas where they can join forces have not been identified yet. ICT infrastructure and use should build on the areas to be determined.
- *Exploiting complementarity between traditional and ICT infrastructure.* Unfortunately, it is an empirical regularity that traditional infrastructure in transportation, electricity, and telecommunication facilities in rural areas, in particular in areas where agricultural activities constitute the main source of living, has been usually underdeveloped. This makes ICT investment in these areas more costly than would otherwise be and increases the divide

between the rural and urban sectors further. A very negligible development in ICT use in agriculture in Georgia can partly be attributed to the lack of such complementarities, which can be boosted by broad-based rural development activities.

- *Promoting investment in human resource development.* It is not enough to put ICT hardware on the ground. It must have an appropriately trained work force to use it. State-of-the-art technologies alone are not enough to attract new businesses. It should be accompanied by work force development.

Analysis of the current study indicates that ICT infrastructure and use in agricultural organizations is slowly developing. The key observations of the study are as follows.

- Georgia has a Radio and Television broadcasting network, but its linkage with agricultural development, especially with extension, is extremely weak. Similarly, the use of print media for agricultural development appears to be weak. Telephones are available but their connectivity is poor and unreliable. Personal computers are only for office use. There is significant lack of skills to use computers. Internet connectivity, wherever available, is unaffordable. The use of the Internet is also constrained by lack of foreign language skills.
- ICT infrastructure in Georgian agricultural institutions and research system is extremely poor compared to that of their Western counterparts. However, there are some institutions, such as TECHINFORMI, ELKANA, and the MoAF, which have relatively better ICT infrastructure.
- Available scientific and technical information content related to agricultural research and development is largely obsolete. Flow of hard copy and electronic documents between Institutions is limited. Some Institutions have linkages to International organizations that enable access to limited international scientific literature. TECHINFORMI, ELKANA, and the MoAF use the Internet for accessing International databases and sharing information through their websites.
- There is no system to manage research data using computers in most Institutions. The use of ICT in research management is non-existent. Similarly, ICT is not used for extension, except by ELKANA or for education. Manual systems for office administration and project management information exist in all Institutes and can be automated if ICT infrastructure, including new skills, is made available. However, its immediate impact on productivity is doubtful because, along with the introduction of ICT, there will be a need for significant structural reforms in the organizations to use ICT effectively.
- With weak ICT infrastructure in the research Institutes, ICT use at the national agricultural research system level, except for telephone use in Tbilisi, is non-existent. This precludes sharing and exchange of information through using ICT. The MoAF, however, is relatively better served by ICT in this respect.
- The Georgian Government has recently prepared an ICT strategy, the implementation of which demands a clear understanding of sectoral priorities and investment. For the agricultural sector, there is still a need to set these priorities. Without these priorities, the focus needed to generate and acquire new information content cannot be established.
- Considering the lack of clear priorities, targeted investment in ICT infrastructure and use should be in horticulture, viticulture and wine production because of its immediate impact on building agro-industries. There are international partners, such as the World Bank, FAO, TACIS, USAID, foreign universities, and bilateral programs already active in these areas.

Based on this analysis, we suggest:

- Setting up an Information Center for Horticulture, Viticulture and Wine Making at the Georgian Academy of Agricultural Sciences with support from TECHINFORMI. This Center should organize scientific and technical information related to these topics and, in future, be an agricultural library with a “virtual”, on-line access component.
- Generating quality human resources with skills in ICT use and management and foreign languages. The State Agrarian University will need to strengthen its ICT infrastructure and information base to achieve this. It also has to improve access to international information vital to Georgian agriculture through collaboration and networking with the proposed Information Center.
- Encouraging more information platforms for the Georgian agro-industry, such as of ELKANA, that provides market related information to market intermediaries, processors, farmers etc. These platforms should also facilitate linking agricultural research with its public and private stakeholders. This can be done by setting up a fund for capacity development in agricultural information management for the Industry and NGOs.

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42. Tbilisi State University
43. Georgian State Technical University
44. Tbilisi State Pedagogical University
45. Tbilisi State Medical University
46. High Energy Physics Institute of TSU
47. Open Society - Georgia Foundation

TABLES

Table 1. Institutional developments concerning ICT

February 22, 1999	The Strategy for Attracting Investments and Developing Telecommunication Sector placing ICT within the general economic development goals.
July 26, 1999	Coordinating Council for the Development of ICT aimed to coordinate all ICT activities.
December 21, 1999	Georgian State Department of Information Technology aimed to manage information technology processes and carry out the coordination and state supervision in all spheres of state activity (www.georgia-gateway.org/gsdit or www.it-department.gov.ge).
July 25, 2000	Department of Communication, Post, and Information Technologies (within the Ministry of Transport and Communication) aimed to implement the policy set by the Ministry, and manage and control of activities in the area of communication and post (www.mtc.gov.ge).
August 17, 2000	State Commission for the Development of Information Society aimed to provide Internet access to all strategic state agencies and to promote the development of information society.
September 18, 2000	Georgian National Communications Commission aimed to promote legislative basis and institutional capacity in the area of communications and post (www.gncc.ge).
July 8, 2001	State Council on ICT to develop national ICT strategies (www.georgia-gateway.org).

Source: E-Government (2001).

Table 2. The ICT situation in the Ministries and State Departments

Name of the Ministry & Department	Number of Computers	Network	Internet	Web-Site
Ministry of Foreign Affairs	200	+	+	+
Ministry of Interior	200	+	+	-
Min of Labor, Social Security & Health	100	+	+	+
Min of Economics, Industry and Trade	97	+	+	-
Min of State Property Management	92	-	+	+
State Statistics Department	70	+	+	
Ministry of Defense	59	-	+	-
State Customs Department	54	+	+	+
Min of Natural Resources-Environment	45	+	+	+
Min of Transport & Communication	36	+	+	+
Ministry of State Security	35	+	+	-
Ministry of Education	30	-	+	+
State Dept on Land Management	24	+	+	-
Ministry of Justice	23	+	+	+
State Department of Roads	17	+	+	-
Ministry of Culture	9	-	-	-
State Dept of Tourism and Resorts	6	-	-	-
Min of Construction and Urbanization	4	-	+	-
State Department for Youth Affairs	4	-	+	+
Ministry of Refugees	3	+	+	-
State Dept of Geodesy & Cartography	2	-	-	
State Department of Sports	2	-	-	-
State Archive	2	-	+	-
State Dept of Material Resources	1	-	-	-
Ministry of Finances	1	-	+	-

Source: President's Office (2001). (+) indicates the availability of and (-) unavailability of the service concerned. Ministry of Foreign Affairs, for instance, has 200 computers, a LAN, Internet services, and a Ministry Website.

Table 3. Areas and relevant organizations for information collection

Scientific and Technical Information	Management Information	Information Technology
<ul style="list-style-type: none"> • National agricultural statistics in Min of Agriculture • Int'l literature databases • National literature databases • Current awareness services • CD-ROM searches & document delivery in research institutes 	<ul style="list-style-type: none"> • Project Planning, Monitoring, and Evaluation Bureau • Budgeting Dept. • Accounting Dept. • Research inst. administration • Researchers 	<ul style="list-style-type: none"> • National telecoms policy • Allocation of tel. lines • Current and future Internet connectivity • Dial-up experience • LAN and WAN experience (univ., research inst) • Software expertise & cost

Source: ISNAR (1999).

Table 4. ICT infrastructure

Hardware	<ol style="list-style-type: none"> 1. Equipment (Tel, Fax, Radio, TV, PCs, Servers, Peripherals including Printers, Scanners, CD-ROM/DVD Drives and Rewriters) 2. Electricity Supply (Stabilizers, Back-up Generators) 3. Connectivity (Tele-Conferencing, Video-Conferencing, Local Area Cabling or Wireless Access, Switches and/or Hubs, Routers, Ethernet, VOIP facilities)
Software	<ol style="list-style-type: none"> 1. Operating Systems <ol style="list-style-type: none"> a. Single User - Microsoft DOS/Windows, Mac OS, Linux b. Network - Windows, Unix, Linux, Novell Netware, Any Other) 2. Applications <ol style="list-style-type: none"> a. Scientific and Technical Information Management <ol style="list-style-type: none"> i. Library or Information Centers (Acquisition, Cataloguing, Classification, Circulation Management, On-line access) ii. Personal Bibliographic Information Management b. Research Data Management <ol style="list-style-type: none"> i. Research Data (Ind. Databases, Project Databases, Institute Databases) ii. Analytical Software (Off-the-Shelf such as SPSS, Custom made) c. Research Management Information d. Outreach, Extension and Education (Web design and Multi-media software) e. Administration and Organization Management <ol style="list-style-type: none"> i. Financial information systems (Accounts, Audit, Stores and Inventory) ii. Personnel Information System iii. Management Information Systems f. Messaging (E-Mail , Web-Browsers) <ol style="list-style-type: none"> i. Individual users or Networked
Skills	<ol style="list-style-type: none"> 1. Individual User <ol style="list-style-type: none"> a. Telephone, Fax and Copier Machine use skills b. Basic computing skills (switching on, using the operating system to access user account/application, back-up on external media) c. Basic application use skills (Word-processing, Presentation graphics, Spreadsheet use for simple calculations, Database access and search skills) d. Internet use skills (Access/send e-mails, Subscribe to e-mail discussions, Web URL, Search the web by search engines, Access documents by FTP) e. Skills to use a computer securely 2. Network / System Administration <ol style="list-style-type: none"> a. Switch on and switch off a Networked System safely b. Create, renew and stop accounts for network use of applications c. Backup networked systems data d. Report security violations & network failures to network support engineers e. Provide help to individual and network users 3. Content Development and Management <ol style="list-style-type: none"> a. Develop web compatible documents (HTML, PDF, XML) b. Host Web sites safely and securely 4. Information Management <ol style="list-style-type: none"> a. Manage Information Systems for highest uptime b. Plan update of hardware, software, skills and implement plans for updates c. Liaison with Institute Management on ICT use in the Institute
Connectivity	<ol style="list-style-type: none"> 1. Telephone 2. Internet (Modem based, leased line, satellite, and wireless connectivity) 3. Radio and TV 4. Printing

Source: This study.

Table 5. ICT tools, applications, and services

ICT Tools	Applications	Services
Telephone	Telephonic Messaging	Connectivity within and outside Institutes and Organizations
Fax	Document Transmission	Sharing and Exchanging Official Documents
Teleconferencing Equipment such as Telephone Bridges	Using Telephones for Conference Calls	Tele-Conference
Personal Computers	Scientific and Technical Information Management	Procurement of Documents Catalogues, Circulation, Current Awareness Service Selected Dissemination of Info.
	Research Data Management	Research Databases Data Analysis
	Research Management	Research Management Information System for Programs, Projects, Resources and Outputs
	Extension and Outreach	Preparing Extension Documents
	Education	Computer Based Training Distance education
	Institute Administration	Accounting, Personnel Information, Stores and Inventory
Local Area Network	Scientific and Technical Information Management	On-line Catalogue Full Text Document Access
	Research Data Management	Shared Databases
	Research Management	On-line, shared Research Mngt Information System for Programs, Projects, Resources and Outputs
	Education	On-line, shared CBT
	Institute Administration	On-line Accounting On-line Personnel Information On-line Stores and Inventory
Personal Computer with Internet Connectivity (either Modem based or through LAN)	Messaging	E-Mail
	Intranet	Sharing Info. within Institute
	Scientific and Technical Information Management	Accessing Websites & FTP sites for Scientific & Technical Information
	Hosting Websites with information and databases	Publishing Institute Information On-Line for Global access
Radio	Info. Distribution, Extension & Outreach, Education	Connectivity within NARS, Training, Public Awareness
TV	Information Distribution, Extension and Outreach, Education	Connectivity within NARS, Training, Video-conference, Public Awareness
Printing	Scientific-Technical Information Management, Education, Extension and Outreach	Connectivity within/outside Institutes, Dissemination of general & extension Information, Printed Catalogue, Public Awareness

Source: This study.

Table 6. Constraints on ICT infrastructure and use

	MoAF	GAAS	RIHVW	RIF	RIPP	Techinfo	GSAU	AU	ELKANA
Lack of national networking									
Lack of cooperation between local & int'l orgs to establish an ICT infrastructure									
Poor language skills									
Scarcity of computers									
Poor telecommunication facilities (unreliable and inaccessible)									
Lack of content & political will to initiate content generation									
Low computer literacy									
Low level & poor computerization in organizations									
Lack of Internet bandwidth & many users in narrow channels of bandwidth.									
Limited number of local tel lines									
Inadequate skilled personnel for network activities									
Small number of potential users									
Lack of guidelines for customer service									
Inadequate local service for ICT equipment									
Expensive int'l and/or locally supplied products									
Lack of national network information centre for guidance of emerging Internet Service Providers									
Telecommunications monopolies and overly restrictive regulations and high costs									
High import duties for ICT equipment									
Expensive Internet service & absence of local Internet providers									
Limited e-mail and Internet access									

Source: This table reports the interviewee's answers to relevant questions in the Questionnaire. Gray colored cells indicate the constraints; blank cells indicate that corresponding items are not perceived as constraints.

Table 7. Assessment of ICT across agricultural organizations

	MoAF	GAAS	RIHVW	RIF	RIPP	Techin- formi	GSAU	AU	ELKANA
Infrastructure									
Hardware	3	2	1	1	1	3	2	1	3
Software	2	2	1	1	1	3	2	1	3
Skills	2	1	1	2	1	3	2	1	3
Connectivity	3	1	1	2	1	3	1	2	3
Applications									
STIMS	2	1	1	2	2	3	1	1	3
RDMS	2	1	1	1	1	3	1	1	1
RMIS	2	1	1	2	1	3	1	1	1
EIS	1	1	1	1	1	1	1	1	3
EOIS	1	1	1	1	1	1	1	1	2
OMAIS	1	1	1	1	1	2	1	1	1
MCS	2	1	1	1	1	3	1	1	1
Services									
STIMS	2	1	1	1	1	3	1	1	3
RDMS	2	1	1	1	1	2	1	1	1
RMIS	2	1	1	1	1	2	1	1	1
EIS	1	1	1	1	1	1	1	1	3
EOIS	1	1	1	1	1	1	1	1	2
OMAIS	1	1	1	1	1	2	1	1	1
MCS	2	1	1	1	1	2	1	1	1
Management	2	1	1	1	1	3	1	1	3
Content	1	1	1	1	1	3	1	1	3

Source: This assessment draws on the authors' judgment of the information in Section 5 of this report.

- Key:
- 1- Very Poor/Non Existent
 - 2- Poor/ Limited availability, access, organization
 - 3- Weak but with greater availability, access, organization
 - 4- Satisfactory
 - 5- As in a Developed Country Organization

Table 8. The use of electronic and non-electronic IC tools

		MoAF	GAAS	RIHVW	RIF	RIPP	Tech informi	GSAU	AU	ELKANA
Non-Electronic IC Tools and Mechanisms	Printed Docs									
	Periodicals	1	1	1	1	1	4	1	1	4
	Brochures	2	2	1	1	1	4	1	1	4
	Letters	3	3	2	2	1	4	2	1	4
	Journals	1	1	1	1	1	4	1	1	4
	Bulletin boards	2	1	1	1	1	3	1	1	3
	Newspapers	2	2	2	2	2	3	2	2	4
	Yellow pages	1	1	1	1	1	4	1	1	2
	Audiovisual									
	Broadcasts	1	1	1	1	1	1	1	1	1
	Voicemails	1	1	1	1	1	1	1	1	1
	Videos	1	1	1	1	1	3	1	1	1
	Audiotapes	1	1	1	1	1	1	1	1	1
	Telephones	3	2	1	1	1	4	3	1	4
	TV	2	1	1	1	1	3	1	1	3
	Radio	1	1	1	1	1	1	1	1	1
	Fax	3	2	1	1	1	4	3	1	4
	Post	4	3	2	2	2	4	4	2	4
	Face-to-face meetings	4	4	4	4	4	5	4	4	5
	Training	1	1	1	1	1	4	1	2	4
Exhibitions	1	2	1	1	1	3	1	1	3	
Conferences	3	2	1	1	1	3	1	1	3	
Workshops	2	1	1	1	1	4	1	1	4	
Networks	2	2	1	1	1	3	1	1	3	
Electronic IC Tools	E-mails	3	1	1	1	1	4	1	1	4
	Electronic newsletters	1	1	1	1	1	3	1	1	4
	Website	3	1	1	1	1	4	1	1	4
	Networks	2	1	1	1	1	3	1	1	3

Source: This assessment draws on the authors' judgment of the information in Section 5 of this report. The observations and views of the two Project Assistants have also been considered in the assessment.

- Key:
- 1- Very Poor/Non Existent
 - 2- Poor/ Limited availability, access, organization
 - 3- Weak but with greater availability, access, organization
 - 4- Satisfactory
 - 5- As in a Developed Country Organization

APPENDICES

Appendix A

Questionnaire

Information and Communication Technology Needs Assessment
of Agricultural Research, Education, and Extension in Georgia

Study Goal

To describe and analyze information and communication technology (ICT) needs of agricultural research, extension, and education institutions in Georgia.

Objectives

- i. To assess the availability of local, locally adapted, and relevant international information (available electronically or in hardcopy) necessary for the development of improved agriculture research capacity, efficiency, and appropriateness in Georgia;
- ii. To describe the strengths, potentials, and constraints of the present information and communication capacities (including human resources, knowledge and infrastructures and relevant communication relationships) and policies and strategies in research and research knowledge transfer (content development, training/education, feedback with society); and
- iii. To compile an inventory of existing and preferred communication tools, channels, and actors; and
- iv. Identify potential partners for the development of solutions, including, where possible, already active or interested donors.

Expected Benefits

Identify critical needs for improved infrastructure and use of ICTs in agricultural research, extension, and education, and develop projects to address these needs.

Information Management. *All data and information gathered for this study will be summarized for analysis and contribute to the preparation of an ISNAR report focusing on the stated goal and objectives of this study. Both the summarized information and the final research report will be submitted to FAO.*

Box 1. Organization data

Name and title of respondent
Name of organization Address Telephone Fax E-mail
Type of organization (mark those types that best describe your organization): <ul style="list-style-type: none">• Research Institute• University• Government Department• Non-Government Organization• Private Sector• Other
Function of organization (mark those functions that best describe your organization): <ul style="list-style-type: none">• Administration/Management• Policy and Planning• Research• Information• Management• Other
Number of employees: <ul style="list-style-type: none">• Professional• Support

SECTION 1. Scientific and Technical Information and ICT Use

Questions in this section aim to gather information to identify scientific and technical information (S&TI) available and to access that. To accomplish this, the current status of libraries & information service units of relevant organizations will be examined using the sources listed in the 1st column of Table 3.

1. Are there reasonable collections of S&TI sources?
2. Are there procedures and ICTs for accessing and handling of S&TI available?
3. Are these procedures and technologies difficult to use?
4. Are catalogues computerized where a Personal Computer is available?
5. Is staff qualified to carry out tasks by using computers?
6. Are technical and human resources available to search international databases?
7. Are there arrangements with international publishers to allow the dissemination of search results?
8. Are there efficient means of transmitting these results to scientists interested in?
9. Are there Current Awareness Services (aimed at informing scientists of new bibliographic materials in their fields) or "selected dissemination of information" service on:
 - a) Book and journal acquisitions (general).
 - b) New titles (books and/or articles) in a particular discipline or crop/commodity or agricultural research in a particular location.
10. Do scientists have capacity to identify and access the information they need?

11. Does your library use on-line procurement and acquisition services?
 - a) Automation in on-line cataloguing and circulation?
 - b) Information through on-line access to abstracts, full text, Web?
12. Does your library participate in library networks? Does it utilize agricultural libraries in other institutes and/or universities, national library? Does it have access to international libraries and international information centres?

SECTION 2. Research and Management Information and ICT Use

Questions in this section aim to gather information necessary to identify the extent to which ICTs are used in storing and analyzing management information, carrying out research projects and experiments and in accessing to all this information. Management information offices, information service units, computer service units, and research units of relevant organizations will be used to accomplish this. The sources listed in the 2nd and 3rd columns of Table 3 will be examined.

1. Are there information on:
 - a) Research completed and research in progress
 - b) Basic cost/benefit analyses
 - c) Qualifications and experience
 - d) Projected and actual expenditures
2. Are there information on:
 - a) Human Resources
 - b) Financial Resources
 - c) Physical Resources
 - d) Research Projects (including data on both content & the three resources)
3. Are there procedures and ICTs (PCs, CD-ROMs, LANs, and WANs) for accessing and handling the available MI?
4. Are these procedures and technologies difficult to use?
5. Are staff able to use computers, Internet, e-mail, and electronic sources (like CD-ROM, scanning machine, fax) to search international databases?
6. Are there efficient means of transmitting these results to management or from management to policy makers or other relevant parties?
7. In conducting research, are computers and software for data analysis, disciplinary/multidisciplinary databases used at projects and experiments? If so, please provide us with names of software applications and hardware used.
8. To what extent are ICT tools used in developing joint research projects?
9. Is there any interaction with research networks? If so, what kind of ICTs are utilized?
10. Are ICT tools used in extension services? If so, how.

SECTION 3. ICT Infrastructure for Network Development

Questions in this section aim to gather information necessary to assess the status of ICT infrastructure and use for the development of information exchange networks. Typically, there are two types of information and communication networks: Local Area Network and Wide Area Network.

Such networks are expected to be instrumental in:

- Developing a sense of shared purpose among the participating bodies.
 - Improving the quantity and quality of information resources.
 - Providing quick and efficient means for the flow of data and information nationally and, where appropriate, internationally.
1. Is there a LAN within your organization or a WAN which your organization is a part of?

- a) If yes, what *ICT tools* are used?
 - b) If no, is your organization interested in one?
2. How efficiently are hardware peripherals used (printers, scanners, tape backup units)?
 3. Are telephone, mobile wireless, and cable TV services available? If yes, in what quality?
 4. What type of Internet access is available? Dial up or Dedicated Lines Connections?
 5. Are Internet rates affordable?
 6. Is ICT hardware & software imported/locally produced? If imported, are locally adapted?
 7. Is imported specialized software available in local language?
 8. Is technical support for problems regarding Internet, tel services, network adequate?
 9. Access to computers:
 - a) How many computers?
 - b) How many computer labs?
 - c) What is the hardware used (Pentium 1 and 2, etc)?
 - d) How many computer labs with Internet connectivity?
 10. Computer use in university education:
 - a) What percent of teachers, of students, and of staff uses computers?
 - b) What percent of students have computer literacy?
 - c) Are computers used in on-line distance education, if it exists at all? If yes, how many students are involved in such activities?
 11. In extension and/or outreach services, does your organization:
 - a) Use electronic material (web pages, CDs)?
 - b) Use websites hosted by other institutes or by persons?
 - c) Use call centres or extension units with telephone access?
 - d) Interact with extension networks?
 12. In messaging and communication, how is your organization's access to
 - a) e-mails, discussion lists, websites or web sites
 - b) telephone and fax (local, national, and international)

SECTION 4. Communication Tools and Mechanisms

Questions in this section aim to gather information necessary to compile an inventory of existing and preferred communication tools and mechanisms.

1. Are computers used in your organization? If yes, how many of them are interconnected with common resources such as printers?
2. Is central electronic file storage used for sharing information with each other?
3. Is there Internet access? If yes,
 - a) How many computers are with access?
 - b) What type of access is available (dial-up or modem, broadband, LAN, leased line)?
4. Is there an internal web site (so called intranet) for publishing information of interest for members of your organization?
5. Are there protocols for safely communicating business information by e-mail to external partners?
6. Does your organization have own site content residing on the Internet? If yes, please provide the hyperlink addresses (www...). What aspects does your own staff handle (content authoring, publishing/development, hosting/administrating web server)?
7. Understanding the nature of your *custom software and database solutions* and the needs for automation would help us determine compatible common infrastructure and pave the way for effective networking of agriculture-related organisations. Please give us information on the following questions for each system already in use, under development or already identified for future:
 - a) Name and purpose of application/solution?
 - b) Underlying technology in use/development?
 - c) Developed/integrated, installed, administered/maintained by?
 - d) Date of envisaged availability/start of operational usage?

- e) Stand-alone usage/access within network/remote access from abroad?
- f) Web interface to data? Designed for access via the Internet?
- g) Where the application's data are physically stored?
- h) The data content originate from and is owned by the own organisational unit? If no, please describe the data origin.
- i) The data regularly submitted for merging/pooling them with other systems? If yes, please name the partner system(s).
- j) Secured access desirable?
- k) Other organisations running similar/identical systems?
- l) Specific problems or needs still to address?

SECTION 5. Potential Partners and Connectivity

Questions in this section aim to gather information necessary to identify potential partners of national agricultural organizations and to assess the use of ICT tools in linking these partners.

1. Many organizations use or are willing to use ICT of potential relevance to agricultural organizations, including donors and international organizations:
 - a) Who are they?
 - b) What are they doing?
 - c) What do they plan to do?
 - d) What do they have to offer to AREEO (and *vice versa*)?
2. Information can flow between organizations only if they are linked. This link can be established by use of ICTs:
 - a) Is there a *telecoms network* connecting your organization with other relevant organizations?
 - b) Does your organization have *electronic connection* to others' databases?
 - c) Does your organization have *e-mail* capabilities via another organization?
 - d) Does your organization share ICT tools or human resources with others?
3. Donors and international organizations are instrumental in exposing national organizations to relevant content and hence create proximity between the related local organizations. ICT tools can be used in linking these organizations:
4. Does your organization have a link with others through an international organization? If yes, through which ICT tools?
 - a) What was the role of the international organization in this linkage?
 - i. Providing technical service for ICT use
 - ii. Providing hardware and software applications
 - iii. Providing computers, financing, capacity building

SECTION 6. Current ICT Capacity, Constraints on and Opportunities for Effective Use of ICT, and Content Development

Questions in this section aim to gather information necessary to assess the strengths, opportunities, and constraints on the present ICT capacity (human, knowledge, infrastructure, and communication) and on policies and strategies in research and knowledge transfer (content development and training/education). Box 2 provides questions to be answered for the assessment of the ICT situation within organization.

Box 2. Within organization assessment of the current ICT situation

Areas	Issues	(Yes,	No)
Policy	ICT policy framework?	(Yes,	No)
	ICT hardware/software standardization/coordination?	(Yes,	No)
	Contact with external sources of support?	(Yes,	No)
Management	Clear decision-making authority over ICT ?	(Yes,	No)
	Clear rules regarding PC use?	(Yes,	No)
	Regular support services?	(Yes,	No)
	Regular acquisitions procedures?	(Yes,	No)
	Regular maintenance procedures?	(Yes,	No)
Resources	Trained users?	(Yes,	No)
	Variable annual expenditure?	(Yes,	No)
Hardware	Standard PC configurations?	(Yes,	No)
	Widespread virus infestations?	(Yes,	No)
	Regular backup procedures?	(Yes,	No)
Software	Mostly unlicensed copies?	(Yes,	No)
	Regular upgrades?	(Yes,	No)
	Manuals?	(Yes,	No)

For the identification of critical constraints the list given below will be used. Please tick (☒) those constraints that you think hinder the use of ICTs in your organization.

- a) Lack of national networking
- b) Lack of cooperation of relevant local and international organizations to establish an adequate ICT infrastructure
- c) Lack of content, lack of organizations necessary for the content creation, and lack of political will to initiate content generation activities.
- d) Poor telecommunication facilities (unreliable and inaccessible)
- e) Lack of Internet bandwidth, linking Internet service providers in different countries, causes crowding too many users into narrow channels of bandwidth.
- f) Limited number of local telephone lines
- g) Telecommunications monopolies, associated with overly restrictive regulations and high costs
- h) Expensive internationally and/or locally supplied products
- i) High import duties for ICT equipment
- j) Inadequate local service for ICT equipment
- k) Lack of guidelines for customer service
- l) Inadequate skilled human resources for network activities
- m) Low computer literacy
- n) Poor language skills
- o) Low level and poor computerization in organizations
- p) Scarcity of computers
- q) Expensive Internet service and absence of local Internet providers
- r) Limited e-mail and Internet access
- s) Small number of potential users both skilled and taking advantage of access to electronic information networks
- t) Lack of national network information centre for guidance of emerging Internet Service Providers (ISPs)

For the assessment of the current situation with content development, use the questions below.

1. What are your organization's reasons for seeking information?
 - a) Develop research proposals
 - b) Formulate agricultural research policies or strategies
 - c) Search for international/regional partners for research collaboration

- d) Write research paper
2. Which areas should be prioritized for content development by using ICTs?
- a) Vocational opportunities in the agricultural sector
 - b) Teaching and learning processes in agriculture (on-campus or distance education)
 - c) Agricultural organizations' research and dissemination activities
 - d) Broad agricultural development processes (poverty alleviation, food security, environmental protection, better health and education, etc)
3. Indicate whether your organization would want a national agricultural information system to provide information on scientific and technical issues related to agricultural research and development. If yes, rank the following choices as (1-Highest Priority: 4-Lowest Priority).
- a) On-line bibliographic searchable indexes and catalogues
 - b) On-line full text documents
 - c) Electronic journals
 - d) Others: please specify and rank them

Appendix B

List of Interviewees

Name	Institute	Address	Tel and Fax	E-mail
Natela Khonelidze Head, Information Dept	Institute of Farming	Tserovani Mtskheta Georgia 383400	Phone:26-13-26	tamrikoj@yahoo.com
Irakli Shavliashvili Director	Institute of Plant Protection	380079 Chavchavadze avenue #82, Tbilisi, Georgia	Phone: 995-32-23-03-88; 22-01-72	
Mariam Jorjadze Head, Public Relations Unit	ELKANA	III Delisi, str nakveti16, 0177 Tbilisi, Georgia	Phone:+ 995 32 536485/87/89; Fax:995 32 536484	biofarm@elkana.org.ge pr@elkana.org.ge
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