CHAPTER 22

INFORMATION AND COMMUNICATION TECHNOLOGY IN REFORMING NATIONAL AGRICULTURAL SYSTEMS IN CENTRAL ASIAN COUNTRIES: THE CASE OF GEORGIA[1]

Tugrul Temel
Food and Agriculture Organization, Rome

Ajit Maru
Hyderabad University, India

Rainer Krell
Food and Agriculture Organization, Rome

INTRODUCTION

Role of Information and Communication Technologies (ICT) in enabling technological, organizational, institutional and policy innovations has been highly recognized in developing countries. Yet, in transition economies such as Central Asian countries, the development and use of ICT in research and innovation systems remain unexploited. In poorer developing countries such as South Asia and Sub-Saharan African ICT has shown to have contributed to fostering development by increasing the access of information and knowledge to the decision-makers and end-users. In this chapter we present a case study of the role of ICT in Georgian agricultural sector in promoting technology generation, adoption and institutional and policy reforms.

It 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 chapter specifically aims:

- 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;
- 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);
- To compile an inventory of existing and preferred communication tools, channels, and actors; and
- To identify potential partners for the development of solutions, including, where possible, already active or interested donors.

A brief overview of ICT situation as they relate to the agricultural development and policy is given in the next section. A conceptual framework of ICT applications for agricultural research and policy reforms is given in section three. Section four presents an assessment of ICT in the agricultural sector in Georgia. Results of the needs assessment exercise and the discussions are presented in section five. Concluding remarks form the last section.

AN OVERVIEW OF THE ICT SITUATION IN GEORGIAN AGRICULTURE

Institutional Developments

In order to understand the role of ICT in enabling agricultural and policy reforms it may be useful to review the current ICT situation in Georgia. 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. 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 (GSDIT, 2002).

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). Personal computer 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 the web at <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 television 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, companies, 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 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 (Ministry of Economy, Georgia, 2000).

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.

Television 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.

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 Soviet Union. 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.

CONCEPTUAL FRAMEWORK FOR ASSESSING ICT IN AGRICULTURAL SECTOR

In this chapter, 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.

Organization Level

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

1. The ICT infrastructure layer includes hardware, software, skills, and connectivity. This is the layer that supports ICT applications and services of the institution.
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 counting, 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.

National Agricultural Research System (NARS)

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.

ASSESSMENT OF THE ICT SITUATION IN AGRICULTURE

At the Organization Level

Of the 9 organizations visited for the assessment of the ICT in the agriculture sector 7 belong to the public sector, one to the private sector, and one to NGO. Figure 2 shows the distribution of these organizations. The ICT situation in only two organization is presented here to exemplify the situation.

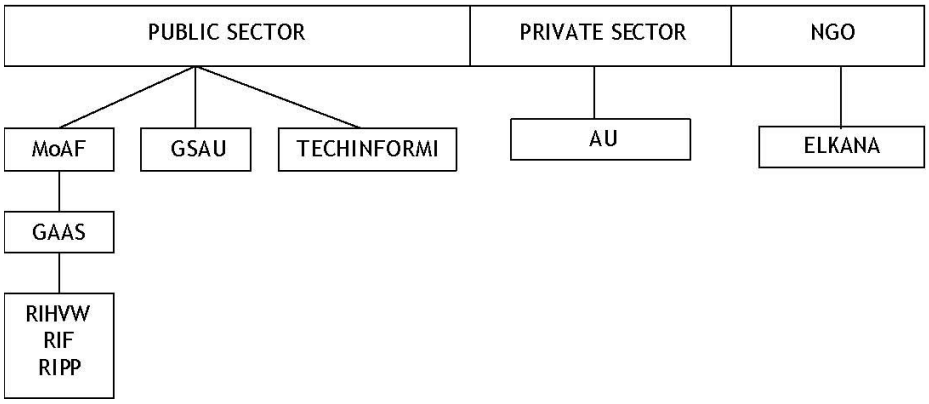

Figure 1. The Surveyed Organizations

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 posses 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 sys tem was foremost.

The National Agricultural Research Systems

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 the Research Institute for Scientific and Technical Information. Most important of all, understanding of the system processes and their benefits at the institute level is poor among the actors in the NARS (Morganov and Zvidema, 2001).

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. Research Institute for Scientific and Technical Information 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. The Biological Farmers Association (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 plan 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.

The Biological Farmers’ Association 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. It 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. The Association's activities are based on well-developed content.

The Research Institute 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.

Implication of ICT Needs Assessment for Agricultural and Policy Reforms

All the institutions that were contacted for the study 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 the Biological Farmers' Association 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.

CONCLUSIONS

Almost all the institutions covered by the study reported in this chapter 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.

The lack of national networking and cooperation between local and international organizations is 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 (UNEC, 2002; and Temel et al., 2003).

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.

Potential partners for developing solutions to ICT problems that hamper agricultural research capa city 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).

The review of the literature on ICT infrastructure and application in Georgia, 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 inter-dependencies 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 and policy reform 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.

Agricultural and policy reforms among the Central Asian countries including Georgia, requires a sharing of information on the successes and failures of the reform process. Information sharing is also essential between the countries and institutions in Central Asia and those in other regions. Given the weak ICT infrastructure it becomes a major challenge for the institutions

to learn, innovate and adapt to new policies and practices. This has major implication for the nature and speed of policy reform process in the region. Along with improving human capacity increasing the capacity exchanging knowledge is important for the successful design and implementation of agricultural and policy reforms.

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[1] This study draws on a joint FAO-ISNAR project entitled "ICT Infrastructure and Use in Agriculture: Agricultural Policy, Research, and Education Organizations in Georgia." The reader is referred to the following website for the original report, http://www.fao.org/sd/dim_kn4/docs/kn4_040902d1_en.docentire