

REGIONAL REPORT

**Information and Communication Management in
Agriculture for Development in Central Asia and South
Caucasus**

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CACAARI-2011

1. Foreword

Agriculture in developing countries is expected to resolve unprecedented challenges. Forecast for food needs is that if agricultural sector is not going to double production in the coming decades, the world may be in dire straits. Rising food prices, increasing pressure on natural resources threaten life conditions of the poor. Climate change increases risks over the next decade.

The CAC region, due to a number of historical, geographical and political factors, in terms of its capacity, is an important place for the world agriculture. Threats are in place here fully, and the need for their mitigation is beyond the scope of national and regional objectives.

At the same time, achievements of modern science and technology, as well as institutional changes present unprecedented opportunities for overcoming the challenges ahead. Along with advanced biological science, the most important of those opportunities are new information and communication technologies.

Based on that, major players that together with national governments in developing countries have responsibility to solve problems of agriculture are making efforts to strengthen ICT sector in the agriculture of developing countries. In recent years FAO, CGIAR, GFAR based on regional groups of research organizations such as CACAARI are focused on intensive advocacy and promotion of ICT/ICM in AR4D, as well as on ICT/ICM training for agricultural scientists and other participants of the agricultural sector.

In 2011 CACAARI has developed and adopted the Regional Strategy for Transforming and Strengthening of Agricultural Research and Innovation Systems for Development in the Central Asia and Southern Caucasus region, in which increasing the impact of ICT on transforming AR4D and agriculture development is considered as one of the priorities.

To increase the effectiveness of advocacy and promotion measures and strategic planning, GFAR conducts monitoring of ICT/ICM development in AR4D on a regular basis. This report contains survey outcomes of ICT/ICM development in AR4D in the CAC region that has been conducted in 2011, comparisons with the data of report for 2007, regional information systems' response to new challenges and proposals for its further development, as well as discuss the issues on ICM stipulated in the Regional Strategy (CACAARI).

2. Acronyms

AG	- Agriculture
APAARI	- Asia and Pacific Association of Agriculture Research Institutions
AR4D	- Agriculture Research for Development
CAC	- Central Asia and Caucasus
CACAARI	- Central Asia and the Caucasus Association of Agricultural Research Institutions
CGIAR	- Consultative Group on International Agricultural Research
CIARD	- Coherence Initiative on Agriculture Research for Development
DB	- Database
FAO	- Food and Agriculture Organization of the United Nations
GDP	- Gross Domestic Product
GCARD	- Global Conference on Agricultural Research for Development
GFAR	- Global Forum for Agricultural Research
ICT	- Information and Communication Technologies
ICM	- Information and Communication Management
IPR	- Intellectual Property Rights
ITU	- International Telecommunication Union
NAIS	- National Agricultural Information System
NARS	- National Agriculture Research System
NI	- National Income
RAIS	- Regional Agricultural Information System
RING	- Road-map to Information Nodes and Gateways
SDTW	- Research, Development and Technological Works
SRF	- Strategies and Results Framework
STI	- Scientific and Technological Information
UNESCO	- United Nations Educational, Scientific and Cultural Organization

3. Summary

The CAC region in terms of agricultural capacity has a significant place in the world agricultural system due to a number of historical, geographical and political factors. Full and effective use of that capacity for poverty alleviation and food security meets both interests of countries in the region and entire world community. AR4D, addressing contemporary global and regional challenges, retains a significant role in disclosure of that capacity. One of the most promising means to achieve the goal is to use information and communication technologies (ICT), as well as information and communication management (ICM) for research and its outcomes dissemination.

Attaching great importance to potential opportunities provided as a result of implementation of ICT/ICM in the AR4D, GFAR makes assessment of ICT/ICM implementation both in each country of the CAC region and in the region itself on a regular basis (every 3-4 years). The previous assessment was carried out in 2007. The assessment outcomes were presented in eight national reports and regional report. Thus, in the present report we are able to track changes in individual components of the RAIS, as well as to note emergence of new trends that were not observed in 2007.

Regional Report 2011 was prepared according to an improved methodology based on more detailed definition of issues to be covered by the report, than in 2007, as well as on the use of formal sociological questionnaire (Appendix 1), which had been filled in by representatives of each country (questionnaire was not used in 2007). Data presented and analyzed in the report were selected based on priorities and challenges set out in the GCARD Roadmap that was adopted by GCARD (Global Conference on Agricultural Research for Development) in Montpellier in 2010, as well as on the Strategy and Results Framework of the Consultative Group on International Agricultural Research (SRF of CGIAR).

The report contains data of the National Reports 2011, published data of international organizations (e. g. ITU and UNESCO), as well as data derived from studies of agricultural sector in the national Internet domains that are available either in English or Russian languages.

Report material is presented according to the scheme proposed by GFAR that ensures certain compatibility/comparability with results of similar reports of other parts of the world.

4. Introduction

The CAC region includes five Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) and three countries of South Caucasus (Armenia, Azerbaijan, Georgia). It covers an area of more than 4 million square Km, which is about 3% of the global land area.

The region's population is more than 75 million people, over 40% of which live in rural areas (the highest percentage - 74% in Tajikistan). Also 70% of the poor population lives in rural areas.

GDP per capita varies greatly country by country - the highest one in Kazakhstan (USD 8,800) and the lowest one in Tajikistan (USD 900).

CAC has a great diversity of activities in agricultural sector, as well as plant and animal species.



Fig. 1

The CAC region in terms of agricultural capacity has a significant place in the world agricultural system due to a number of historical, geographical and political factors. Share of the CAC countries in the world wheat and cotton production is more than 3%. According to estimates, agricultural production in the region can be increased by several times in case of modern technologies are in place. The region covers 3% of the global land area where less than 1% of world population live in.

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4.1. Overview of the previous report (2007)

The following findings have been made in Report 2007. ICT available (developed) in the countries are not widely used in agriculture sector. Computers and Internet are used in research and development institutes, however potential opportunities are not fully utilized because of insufficient level of ICM. The management had been just highlighted as the weakest element. In particular, it was displayed in infeasibility of development of a regional network for agricultural data exchange. It has been emphasized that there is a need to identify at least one organization in each country which would be monitoring over progress of implementation of ICT/ICM in the AR4D on the one hand, and would provide a minimum set of resources and services for agricultural research and practice on the other hand. Seemingly it is a simple task to identify such organizations; however it was difficult to accomplish it. It was explained by insufficient financing of agro research, as well as insufficient awareness of managers of agriculture and agriculture research sectors on the ICT/ICM opportunities. Difficulties in exchange of information were arisen, in particular, because of the absence of agricultural consulting services in countries of the region, that could be significant consumers of ICT in the field, as well as due to liquidation of information centers that could create a basic information resource. Communication in rural areas has been improved through cellular technology, although access to internet has been very limited. Existed modest telecommunication means, as well as local radio networks were scarcely used for the agriculture development. The low level of research expenditures (GERD) in CAC region in general, and in agriculture research as well was named as the main cause of shortcomings (Table 1). Recommendations of the 2007 Report had been aimed at removing those shortcomings.

5. Transformation of challenges in agriculture of the CAC region countries and their impact on the tasks of ICT/ICM in addressing problems.

In 2007-2011 years agricultural production of the most countries of the CAC region was growing at a certain rate. The exception is, perhaps, only Georgia. Most of the governments are concerned with sharp rise in food prices that put at risk a significant part of the population (20-50%, depending on the standards of living in the countries) which falls into the category of the poor

(income less than USD 2 per day). In some countries (Armenia, Kazakhstan) there has been set up a goal to meet the food needs at 80% level through domestic production. However, no country has yet reached a volume of agricultural production that would be equal to the one in 1990. In addition, all countries are net food importers. The food deficit compensated through imports is estimated between 70% (Georgia) and 30% (Armenia, Kazakhstan).

A statement on the need to reduce food shortages in a number of countries in the region are not supported by such measures as increasing the share of public expenditure allocated to development of agriculture and and increasing unacceptably low level of funding of agricultural Sciences (expressed as % of GDP) (see Table 1).

Along with food security, agriculture and rural development programs in the region are aimed at solving of poverty overcoming problem: 60 - 70% of the poor population is living in rural areas. At the same time, development of agriculture using only traditional methods creates threats of exacerbating exploitation of natural resources (soil, water) and exacerbation of problems associated with climate change. A striking example in the region is the Aral Sea, but all territories of countries in the region, in varying degrees, are subject to erosion, salinization, desertification, etc. As part of the former socialist system, the CAC region was fully under shock from sudden, ill-conceived privatization of land and still has not overcome related problems. New technological and organizational solutions are required from research for emerged small farms. The region faces such issues as mountain agriculture, energy supply and communications to remote and isolated areas.

It is important to mention also that the CAC region, in particular, sub-region of the South Caucasus, is one of the richest regions in the world in terms of biodiversity. The conservation of this diversity is not only a regional but a global issue.

Solution of a set of above mentioned issues requires action in all areas listed in the GCARD Roadmap, as well as in SRF of CGIAR. In particular, an action plan proposed in the Roadmap covers following six areas:

1. The need to focus collective efforts on priority areas identified by science and society;
2. The need for true and effective partnership between research and those for whom it serves;
3. Increased investment in order to address expected major challenges as well as ensuring necessary response of AR4D;
4. Increasing capacity to generate, exchange and use agricultural knowledge achieve changes in development of all parties involved;
5. Research to be mainstreamed in a broader scope of activities and content through effective communication;
6. Improved demonstration of development results and impact of agricultural research, and improved awareness about it.

The 4th item of the action plan is the subject of current report. At the same time, we share the understanding that ICT and ICM are important for all the other directions of the GCARD Roadmap and SRF of CGIAR . We consider the most important actions that affect implementation of the plan in general.

It fully meets the challenges that agricultural research faces in the CAC region and, in particular, defines tasks for exchange of agricultural information in the region which are described in the current report.

The above-mentioned low level of research expenditures remained as a trend after 2007 (Table 1). The trend in institutional reorganization of national research systems also remained without changes. Both trends are related in full to agricultural research, limiting development of NAIS and RAIS in general.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Armenia	0.18	0.28	0.25	0.24	0.21	0.21	0.24	0.21	-	-	-
Azerbaijan	0.34	0.34	0.30	0.32	0.30	0.22	0.17	0.17	0,2 (NR11)	0,2 (NR 11)	0,2 (NR 11)
Georgia	0.22	0.24	0.19	0.22	0.24	0.18	-	-	0.16	< 0.2 (eval.)	< 0.2 (eval.)
Kazakhstan	0.22	0.18	0.22	0.26	0.25	0.25	0.28	0.24	0.21	-	0,26 (NR11)
Kyrgyzstan	0.16	0.17	0.20	0.22	0.20	0.20	0.23	0.23	-	-	0.1 (NR11)
Tajikistan	-	0.09	0.07	0.07	0.07	0.10	0.10	0.06	-	-	0.1 (NR11)
Turkmenistan	-	-	-	0.4	-	-	-	-	0.05	0,07	0.1 (eval.)
Uzbekistan	-	-	-	0.2	-	-	-	-	-	-	-

Table 1. General expenditures on research and development, % of GDP

Despite all that, as will be shown below, there has been significant progress on some directions of NAISs and RAISs development. Meanwhile, some setbacks in other directions have been observed. It should be noted also that progress and regression differ from country to country.

Effective solution of the above issues in the CAC region has been dragged on for 20 years already and admits of no delay. On the other hand, the research which should provide new solutions requires to be reorganized to meet new challenges, as well as to use effectively all available new methods and technologies. Among them, one of the most promising and effective tools to achieve new goals is the use of ICT and ICM both in research and in dissemination of the results. The use of ICT/ICM can be helpful, and often an indispensable tool in solving all the above mentioned problems.

6. New regional and global challenges in the field of ICT and ICM that can play an important role in resolving the problems.

All the global challenges that have been highlighted at the GCARD-2010 are relevant to the CAC region in general, although level of importance of each challenge in different countries and sub- regions is different. Accordingly, all the agricultural research directions and their changes worked out by the international community (see GCARD Roadmap 2010 and SRF of CGIAR) are highly relevant to the region. In particular:

- Adaptation and mitigation of the negative impact of climate change;
- Lack of water resources and desertification;
- Management of trans-boundary diseases;
- Loss of agro-biodiversity/invasion of foreign species;
- Regional and international trade in agricultural products.

It should be mentioned that ICT/ICM is used in solving of all of the listed problems in the region. Another question is the scale and extent of relevant technologies and their applications, as well as technical level of existing systems and services. It is also noteworthy that within the time period covered in the report, alongside with global reorientation of AR4D to new targets which are to be served by ICT/ICM, emergence of the serious changes in ICT/ICM fields themselves become evident. These changes are reflected in the CAC region as well.

During the time passed since the previous Report had been issued, technologies and methods in ICT/ICM emerged till 2007 as trends, have become dominant in the world. Many of new technologies became common in the CAC region as well.

First of all, we should mention *availability and penetration of communication technologies*. Especially *cellular phones, broadband and wireless broadband internet* have been rapidly developed. The first in combination with satellite communication substantially improves telephone communications in rural areas. Below (Tables 2 , 3, 4) are given data on implementation progress of information and communication technologies in the CAC region. Mobile technology of the third-generation (3G) – a set of services that combines a high-speed mobile access to Internet, and radio technology that creates a data transfer channel – is in place in the region at present that did not exist in 2007.

WiMAX mobile Internet technology is rendered throughout the CAC region (there is evidence this service is terminated in Armenia). Territorial coverage with that service varies in different countries and is usual mostly for urban areas, a small part of rural areas is covered also.

There has been observed an increase in the number of computers, their enhanced capacity and *reduced unit cost of memory and processing speed* which allow to store locally and process large amounts of information as never before, at a modest cost. Besides there are new ways to store and process data in the network, when consumer does not even know on which specific servers his/her data and software tools are stored. This is so-called *cloud computing (computing in the network cloud)* which reduces the cost of storage and of processing. This trend has been set up in the CAC region as well: growing number of offers to place data on the network and cost reduction of these services. For example, information in the Turkmen Internet domain is almost completely hosted on Russian servers, although this example can be understood controversially.

Data management is simplified and unified through import and diffusion of effective software tools. For example, several years ago creation of *local databases* and access to it via Internet was a problem for smaller information services in the CAC region. Currently a number of national databases are available at the Internet, including those in the field of agricultural and created by libraries and information centers. The MS SQL Server software is used mainly for this purpose. Software tools for creating *blogs* and *forums* are widely used. Examples of databases and forums are given below (pages 16, 19). Over the past few years, use of GIS (Geographic Information Systems) has been intensified. They were successfully implemented in the CAC region in many areas, including the agricultural sector.

Pronounced trend in the past few years is **transition from Internet ideology, conventionally called as Web 1.0** (a special feature of which is availability of information resources that are created by specialized centers at the network sites and of users searching those resources according to certain rules consistently moving from one resource to another) to **Web 2.0 ideology** (where users themselves develop resources - blogs, forums, as well as services using other services as a source of information) Web 2.0 model supposes creation of the content that can be viewed and disseminated by other users.

Individual Web 2.0 tools are widely used in the region (blogs, forums, RSS Feed). However, their use for purposes of agricultural research and information in general is limited. Selected examples of such implementation are listed below (page 19).

The ideology of **Web 3.0 (Semantic Web)** is not very common in CAC. Very few materials related to Web 3.0 are found in the CAC countries' Internet domains. Also, there is no visible discussion of **Web 4.0 (Symbiotic Web)**.

Overall, we can say that although new ICT tools (social networking, cloud computing, hosting at foreign servers, GIS technology, database management systems, etc.) are well spread in CAC region, some technologies already widely used in the developed world, are just appearing. They are scarcely used in the agricultural research. Many research and development institutions do not even have their own web sites (Armenia, Georgia, Azerbaijan, Kazakhstan). Moreover, some research and development institutions stopped supporting web sites that had previously been maintained.

Scientific communication of last decade experiences a crisis worldwide. Development of Internet, increasing number of scientific publications (particularly in "non-traditional" languages for science), growth of prices in "traditional" publication dissemination channels, a variety of types and forms of information needed to meet development challenges (particularly in agriculture), have led to ideas of a wider sharing of research output. A movement of "openness" has emerged: "open access", "open data", etc. It is supported by many international organizations responsible for development. In agriculture sector it has found particularly strong support from all parties involved in agricultural research for development, including donors.

Among of the most powerful alternatives to "traditional" knowledge sharing are **online social networks**. The next step in development of the idea of openness was *open linked data* that should facilitate easier access to multiple sources in the network, including to less visited sources in national languages which is especially important for the agriculture sector.

Consistent implementation of these ideas should lead to the so-called *Semantic Web* 1 in which Computers will "understand" content of information. In support of the described approach in the information system on agricultural research an initiative of

Coherence in Information for Agriculture Research for Development (CIARD, www.ciard.net) has been set up. National agro information systems (NAISs) and Regional agro information systems (RAISs), including RAIS of the CAC region are invited to participate in CIARD. Despite of many current unsettled simpler problems, it is beneficial for RAIS of the CAC region. A landmark defining technological and organizational activities appears, that will facilitate sharing of information both within the region and with global information system, and eventually will increase visibility of RAIS of the CAC region in the network. As a result, visibility of research output scientific products and scientists themselves).

7. Comparison with previous report on the status of ICT/ICM in RAIS of the CAC region

Environment where RAIS operates and infrastructure on which it relies are very important for its development. This implies connection, hardware, software, training of people, legislation, prices (costs level), etc. In the CAC region data are available not on all infrastructure components. We will limit the discussion to the available ones.

7.1. Penetration and availability of communications

Communication is a key component of the infrastructure ensuring development of information systems on agricultural research. We are primarily interested in the development of mobile communication, which helps cover the sparsely populated and remote rural areas where wired connection is unprofitable.

7.1.1. Cellular telephony

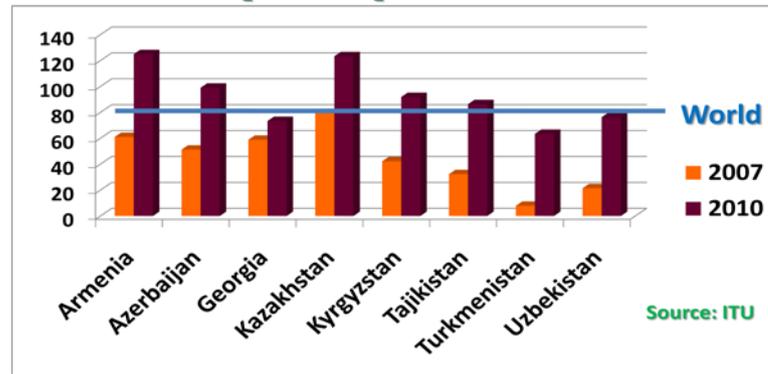
Table 2 and Figure 2 show the growth of mobile communications since publication of the previous report.

Country	Ratio of mobile cellular per 100 Inhabitants		
	2007	2010	2011
Armenia	61.04	125.01	-
Azerbaijan	51.23	99.04	-
Georgia	58.87	73.36	102
Kazakhstan	79.62	123.35	-
Kyrgyzstan	42.19	91.86	-
Tajikistan	32.29	86.37	-
Turkmenistan	7.86	63.42	-
Uzbekistan	21.47	76.34	-

Source: International Telecommunications Union (www.itu.int)

Table 2. Development of cellular telephony

Cellular phones per 100 inhabitants



World 77 **Arab States 80**
Europe 120 **Former USSR 130**
Asia & Pacific 70 **Africa 41**

Figure 2.

Mobile communications now cover almost the entire territory of the CAC region. At present in all countries of the CAC region has been introduced mobile technology of the third generation (3G), which is a set of services that combines both high-speed mobile access with Internet service and radio technology, which creates a data transfer channel. That did not exist in 2007.

7.1.2. Internet

Table 3 and Fig. 3 and 4 show development of Internet since publication of the previous report. We see that Internet penetration rates were mainly ensured with broadband Internet which is a positive trend. In a number of countries of the CAC region Internet connection through dial-up is not used any more.

	Fixed Internet subscriptions per 100 inhabitants		Internet Users per 100 inhabitants			Fixed broadband subscriptions per 100 inhabitants		
	2007	2010	2007	2010	2011	2007	2010	2011
Armenia	...	3.11	6.02	37.00	...	0.13	2.69	...
Azerbaijan	2.46	...	14.54	35.99	...	0.17	5.4	...
Georgia	1.99	...	8.26	27.00	35.0	1.06	5.09	7.0
Kazakhstan	4.41	5.28	4.02	34.00	...	1.75	5.28	...
Kyrgyzstan	0.39	...	14.03	20.00	...	0.06	0.29	...
Tajikistan	...	...	7.20	11.55	...	0.06	0.07	...
Turkmenistan	...	...	1.41	2.20	...	0.06	...	...
Uzbekistan	7.60	...	7.49	20.00	27.0	0.07	0.32	...

Source: International Telecommunications Union (www.itu.int)

Table 3. Internet penetration rates

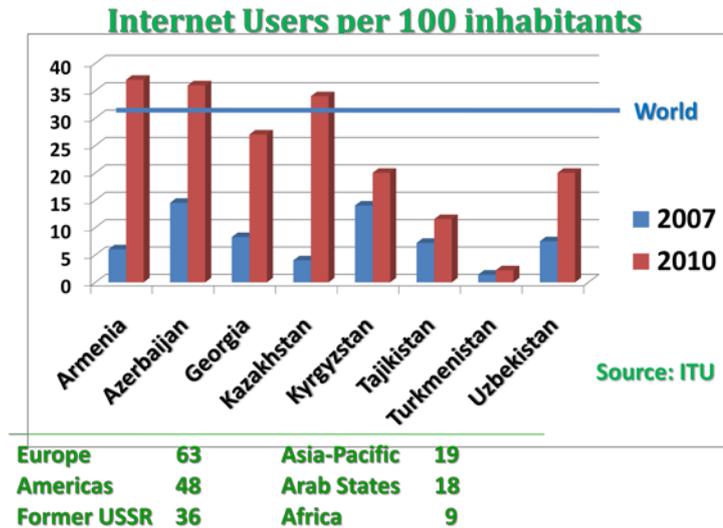


Figure 3.

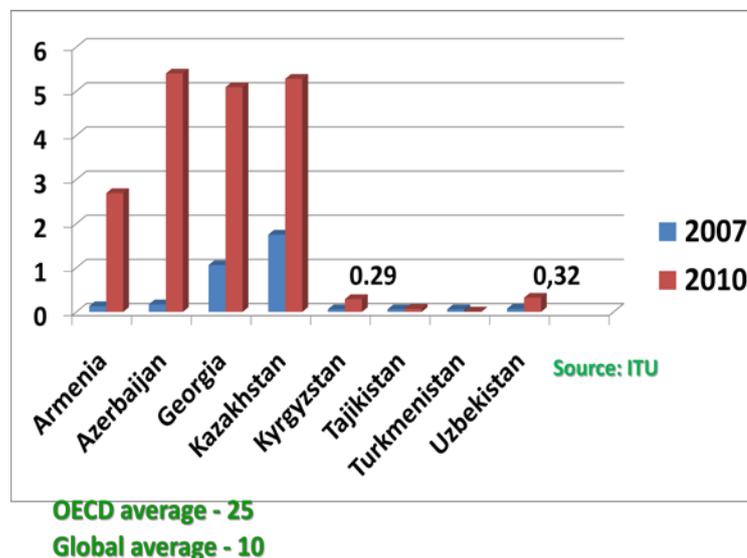


Figure 4. Fixed broadband subscriptions per 100 inhabitants

However, Internet penetration in urban areas is much higher than in rural areas. For example, in Georgia the number of Internet users per 100 inhabitants in 2010 at country level was 27, in the rural district centres - 17, in villages - 10. This corresponds to the average ratios for the former Soviet countries.

WiMAX mobile (wireless) internet technology has been implemented throughout the CAC region (there is evidence that the service is terminated in Armenia). Coverage of this service varies in different countries. Coverage of agricultural areas is still insignificant. However WiMAX is developing very rapidly.

Mobile network operators in some countries provide access to Internet via mobile phone and modem. For example, in Georgia, MAGTICOM company using standard HSDPA across its network has provided access to Internet in rural areas, including mountain areas (with few exceptions). Download speed is low and the download cost is quite high (1 GB of information costs about USD 6).

7.1.3. Prices for communications services

A very important factor defining development of agricultural information systems is the price for communications services. Table 4 shows the ranking of the CAC countries on that factor according to the methodology of International Telecommunication Union. Unfortunately, more recent data are not yet published.

Rank	Economy	ICT Price Basket		Fixed telephone sub-basket as a % of GNI per capita		Mobile cellular sub-basket as a % of GNI per capita		Fixed broadband sub-basket as a % of GNI per capita		GNI per capita, US\$, 2008 (or latest available year)
		2009	2008	2009	2008	2009	2008	2009	2008	
51	Kazakhstan	1.82	N/A	0.38	N/A	1.71	N/A	3.36	N/A	6,140
94	Armenia	4.94	7.98	1.46	2.30	2.08	3.80	11.28	17.84	3,350
99	Azerbaijan	5.82	16.02	0.78	1.14	1.39	7.16	15.27	39.77	3,830
110	Georgia	8.62	11.96	1.70	4.14	3.68	4.80	20.49	26.93	2,470
125	Kyrgyzstan	28.21	N/A	2.05	N/A	4.65	N/A	77.93	N/A	740
130	Uzbekistan	34.30	N/A	1.50	N/A	1.41	N/A	263.03	N/A	910
134	Tajikistan	35.83	N/A	1.77	N/A	5.71	N/A	727.27	N/A	600

Source: Measuring the Information Society 2010. International Telecommunication Union. (http://www.itu.int/newsroom/press_releases/2010/pdf/PR08_ExecSum.pdf)

Table 4. Price basket and sub basket of telecommunications services, 2009-2008

In 2010-2011, a sharp drop in the cost of communication and Internet has been observed in a number of countries of the CAC region (Azerbaijan, Kazakhstan) where prices were high before. For example, cost of high-speed Internet in Azerbaijan in 2009 was USD 60-75, and in 2011 was USD 18-25. This is consistent with the world trends in developing countries.

Table 4 shows that Kyrgyzstan, Uzbekistan and Tajikistan were left behind in the ranking due mainly to the high cost of broadband Internet.

7.2. Computer implementation, cost of storing and processing of data

For assessment, we used two indicators – number of Personal Computers per 100 inhabitants (it implicitly contains description of computational power and memory for data storage) (Table 5) and the cost of hosting on local servers.

Number of Personal Computers per 100 inhabitants						
	2004	2005	2007	2008	2010	2011
Armenia	6.6	-	6	6.6 (estim)	8 (estim)	-
Azerbaijan	-	2.3	4.1	8	12	16
Georgia	4.2	4.24	5.46	6 (estim)	7 (estim)	-
Kazakhstan	3.7 (2001)	-	-	10.2	~ 11-12 (estim)	-
Kyrgyzstan	-	1.9	-	-	-	-
Tajikistan	-	1.3	-	-	-	-
Turkmenistan	-	7.2	-	-	-	-
Uzbekistan	-	2.4	-	-	3.2 (estim)	-

Estonia	-	-	-	-	25	-
OECD countries	-	-	-	-	60	-

Table 5

As can be seen in the table, data are quite difficult to find. In some cases data is calculated on the basis of published figures on computers growth rate.

Ranking	Country	Memory capacity on hard disc, Gb	Traffic	Database allocation	Cost of domain name/month, USD	Cost of hosting/month, USD	GDP per capita, USD (PPP)	Coefficient
1	Armenia	5	Unlimited	5	Free	7.4-9.8	5,360	1.39
2-3	Georgia	5	Unlimited	5	Free	10.0-10.3	5,030	1.98
2-3	Kazakhstan	2	Unlimited		Free	8	12,050	1.67
4	Kyrgyzstan	5	Unlimited	Unlimited	Free	6.2	2,260	2.76
5	Azerbaijan	1	Unlimited	25	18	16.5	10,050	17.25
6	Uzbekistan	2	4 Gb/ Month	>1	Free	25.9	3,090	21
7-8	Tajikistan	1	Unlimited	No data	No data	14	2,090	33.5
7-8	Turkmenistan	5	Unlimited	5	Free	13	7,600	1.71

Table 6. Cost of hosting on local servers

Data in Table 6 was obtained through studying of description of services by local hosting providers. The coefficients in the last column (which define ranks) are calculated as the ratio of cost of hosting to the GDP per capita (taking into account purchasing power parity) with adjustment linked to rendered memory volume and traffic limits.

It should be mentioned that although Turkmenistan has the highest coefficient (1.71), eventually it is placed on the last place because hosting of the national Turkmenistan domain is fully rendered in Russia. In fact, Turkmenistan occupies a special place in this list. Overall, the applied methodology should be further improved.

In many countries of the CAC region offers of cheap hosting abroad (primarily in the U.S.) is growing. There are specialized companies offering such services.

7.3. ICT Development Index

The International Telecommunications Union publishes the ICT Development Index, calculated taking into account the above and other data characterizing telecommunications sector. It also ranks countries by that index. The results for the CAC region are shown in Table 7. More recent data is not yet published.

Economy	Rank 2007	IDI 2007	Rank 2008	IDI 2008
Kazakhstan	70	3.17	69	3.47
Georgia	80	2.87	80	3.22
Azerbaijan	82	2.77	81	3.18
Armenia	89	2.66	88	2.94
Kyrgyzstan	96	2.52	99	2.65
Turkmenistan	106	2.27	108	2.38
Uzbekistan	113	2.06	110	2.25

Table 7. Development Index

The data shows that despite some progress countries in the CAC region are not among the advanced ones in the field of ICT. The development of ICT for dissemination of

agriculture research results, despite of objective difficulties associated with current status of ICT in the countries as a whole, face more difficulties related to underfunding of the agricultural research (Table 1). The natural consequence of that is non-competitive salary which makes it difficult to attract highly qualified ICT professionals, lack of funds for equipment and licensed software, as well as for communications expenses (especially in those countries where communication costs are unreasonably high (Table 4)).

7.4. . Information and Communication Management (ICM). Integration of information systems

To characterize progress made in ICM the National ICM/ICT Reports, as well as results of a study of national Internet domains related to agriculture sector are used. Currently, while the infrastructure of RAIS is not fully established, the latter is a possibility to learn about products and services in the area of agricultural information and to evaluate them. Using this approach some progress compared to 2007 has been observed. As it was shown in the Report 2007, the closure of the STI centers in several countries of the CAC region (almost everywhere except Georgia and Kazakhstan) interrupted a long tradition of divers processing of agricultural data, including computer processing and work with different groups of information consumers. For some period there was a vacuum in this area. However, during the time passed university libraries and information centers (Armenia, Azerbaijan) have been strengthened, as well as new agricultural information services have been established (including those outside of the National systems of agricultural research).

7.4.1. Content generation

Currently, a number of libraries and information services have created bibliographic databases available at the Internet:

Azerbaijan State Agricultural University

- Database of Digital Library.

Georgian Institute of STI at the Georgian Technical University (TECHINFORMI)

- Database of Georgian scientists' publications in international ranked journals;
- Database of doctoral thesis;
- Database of research projects;
- Database of innovations;
- Database of Georgian Abstract

Journal. Kazakh National STI Center

- Database of Kazakh scientists' publications (includes 4 sub-bases on Agriculture: "Agriculture and Forestry", "Animal breeding", "Veterinary Treatment", "Mechanization and electrification of agricultural production"; 2 sub-bases for environment protection: "Anthropogenic air pollution. Air protection", "Anthropogenic pollution of water basins. Protection of water basins"; and one sub- base "Food-processing industry". There are over 100 thousand abstracts of scientific publications in total).
- R&D Database;
- DB "Experts of Kazakhstan".

Most of the above mentioned databases are multidisciplinary. They are containing, among others, information on agriculture and related industries.

Most of National libraries in the CAC region have posted at Internet online electronic catalogues containing agricultural and other related information.

It should also be noted appearance of thematically specialized information portals - "All about grain", "Large-scale livestock breeding" (Kazakhstan), "Botany" (Plant diversity) (Uzbekistan).

A new phenomenon emerged – agricultural information resources for development that have been created out of the National systems of agricultural research. E.g., such are "All about grain" and "Agro marketing" in Kazakhstan. The first one has been developed by private non-research company under support of the Administration of North-Kazakhstan region, the second one - also by a private commercial company.

All abovementioned databases and resources are usually developed in 2-3 languages (National-Russian, National-English, National-Russian-English), but there are also some resources only in national language. Some of the resources are publicly available, while to others access needs authorization. This will be discussed in the section concerning the CIARD initiative.

7.4.2. Information management

A number of agricultural libraries and information centers in Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan and Uzbekistan organized access to foreign free and paid-for databases (mainly through consortia) over the past years since 2007. In some countries there are several such organizations (Georgia, Kazakhstan). Access is organized to the well-known international databases. Access to local information and information exchange within each country, as well as within the CAC region are poorly organized. NAIS structure in each country is not fully defined. Information needs of different groups of users are poorly studied.

In recent years, officials at all levels in the CAC countries increasingly express their concern about weakness of national agricultural advisory systems, that could become one of the most effective channels for dissemination of research results. However, according to our data, only in Armenia, Azerbaijan and Kazakhstan the issue is solved at the Government level. The advisory services in CAC countries are in the process of formation, and their relationship with information services is not developed.

Radio and television are not actively used for agriculture knowledge sharing, the same as it was in 2007.

Microsoft Access and Microsoft SQL Server software are primarily used to manage databases in the region. To a lesser extent – Oracle and Informix.

Different classification systems and tools are used for indexing: UDC, Russian GSNTI Classification, IPC, AGROVOC, Thomson ISI Classification, etc.

Several countries are involved in making input into international information systems. Basically these are AGRIS (FAO) and AgroWEB (FAO SEUR) systems. Table 7 shows participation of the CAC countries in AGRIS.

Table 8. Number of documents entered in AGRIS by country

Country	Number of documents
Azerbaijan	No centre of entry
Armenia	ASAU - 99
Georgia	Techinform i - 447
Kazakhstan	KazNCNTI - 119
Kyrgyzstan	No centre of entry
Tajikistan	No centre of entry
Turkmenistan	No centre of entry
Uzbekistan	No centre of entry

Only three out of eight countries are involved in this most common international agriculture information system. This may indicate also that in the rest 5 countries, there is no mechanism for collecting national agriculture research and development output. All the countries have AgroWEB sites. However, the same as in 2007, they are not updated regularly. For example, AgroWEB Kazakhstan (<http://www.agroweb.unesco.kz/>) has no links to a very useful Kazakh resources www.kazakh-zerno.kz ("All about grain") and www.plem.kz ("Large-scale cattle breeding").

In general, integration degree of individual institutions into NAISs, NAISs into RAIS and into the global systems is extremely low. Moreover, it seems that level of ICT/ICM application in the agricultural research institution has lowered during recent years. For example, 1.5 years ago in Georgia each institution had developed its own website. Now that sites do not exist. In Kazakhstan, agricultural research institutions instead of their own web sites (as it used to be), have pages at the web site of "KazAgroInnovation" that contain very little information about each institution. There is a similar situation in Azerbaijan and Armenia.

The GCARD Plan 2010 noted that many countries have reduced the work activities. There is an impression that countries of the CAC region are among them. The main source of it is underfunding of research (see Table 1 and Section 5.1, D), as well as incompetent and hard administration which is not acceptable in the research management.

7.4.2.1. Change in ICM and feedback

The movement of "*open access*", "*open data*" widely supported in recent years by all stakeholders in agricultural research is little known in the region. Though, we can say definitely that there are no fundamental obstacles to the movement in the region, as the bulk of available resources is non-commercial. The problem may be in scarcity of resources, as well as in technological base of "*open access*" rather than in principal reasons to reject the movement. Though, on the other hand, "market" approaches prevailing on the post-Soviet area supposing naively getting direct monetary benefit from any product or service may become some obstacle.

Development of *social networks* quickly found an echo in the CAC region. Their increasing popularity is immense. Table 9 presents data on Facebook. Georgia is the leader, about 13.8% of the population (nearly half of Internet users) uses Facebook. In other countries of the region Russian social networks have more popularity. In Kazakhstan, 64% of Internet users are users of social networks. Social networks are already being used as a method of communication in the field of agricultural information. Specialist agricultural

forums and blogs as well as agricultural topics in the general forums and blogs have been created. However, participation of researchers and farmers/peasants in these activities is limited – information exchange takes place primarily between players of processing industry (Georgia), between government and producers/consumers – blogs of akims (heads of regions), of prime minister and of president (Kazakhstan).

Social networks

Country	Facebook users 2011	Penetration rate, %
Armenia	180,100	6.1
Azerbaijan	411,840	4.9
Georgia	630,840	13.8
Kazakhstan	293,040	1.9
Kyrgyzstan	49,820	0.9
Tajikistan	20,260	0.3
Turkmenistan	13,000	0.3
Uzbekistan	82,900	0.3

Table 9

The trend of Web 2.0 technologies implementation is reflected in the CAC region. There are companies in Armenia, Georgia, Kazakhstan running Web 2.0 technologies.

We would like to highlight some services and systems developed after 2007 which are interesting in terms of technologies, topics, users' involvement in development of information resources, as well as funding sources.

Kazakhstan

- Kazakh Grain – contains: information on the grain market in the Commonwealth of Independent States and the World; trade platform; a forum; information and analytical publications on a wide range of agricultural problems (<http://www.kazakh-zerno.kz>);
- «Large-scale cattle breeding" – information and analytical system, in which 832 players of the sector take part (91% of the total registered in the country). Users: Ministry of Agriculture of Kazakhstan, JSC "KazAgroInnovation" and its scientific and research organizations, relevant education institutions, a network of independent experts, laboratories for assessment of the milk and food quality, mobile groups of embryos transplantation, etc. Administrator: Research and Innovation Center for Animal Production and Health - (<http://www.plem.kz>);
- AGROPROM.KZ - marketplace and directory of services, goods, organizations (suppliers, dealers, manufacturers). (<http://www.agroprom.kz>).

Uzbekistan

- Botany – plant biodiversity in Uzbekistan (<http://www.botanika.uz>).

Armenia, Georgia

- Multidisciplinary forums, including agriculture sector alongside with others.

These resources, as well as databases identified in Section 7.4.1. should be studied and possibly included in the CIARD RING (a tool of the CIARD Initiative which involves resources into effective mechanism of international exchange of agricultural data for development). Development of the CIARD initiative is one of the most significant changes since 2007.

Evaluating products and services that exist in the CAC region in terms of compatibility with the CIARD guidelines, we can make a few comments.

As it already was pointed out (Section 7.4.1), above mentioned DBs and resources, usually are created in 2-3 languages (national-Russian, English-national, national-Russian-English), though there are also resources developed only in a national language as well. Some of the resources are in the public access, while others need access authorization. Cases when prepaid registration is required for access to research materials (scientific publications, reports) emerge not because of real financial reasons, but because of lack of understanding of the pros and cons of restricted access. We consider that at the current stage scientists and managers of agriculture in the CAC region would prefer an increased visibility of their results on Internet rather than ephemeral incomes from publications sale.

Resources are not created with taking into account reasons of mutual exchange, so the ideas of Linked Open Data and Linked Open Information Objects are not implemented.

Overall, products and services, as well as depositaries existing in the CAC region need to be studied further in terms of compatibility (or achievement of compatibility) with ideology and guidelines of the CIARD in part of: a. Used standards, rules and regulations; b. Organization of data and information sets; c. Arrangement of access to data (use of metadata, etc.). In the framework of preparation of this Report, these studies could not be done with due depth.

8. Actions to achieve ICM in AR4D goals in the CAC region

Further development of NAISs and RAIS in CAC (perhaps in relation to the latter it is better to speak about its formation) should be carried out taking into account above mentioned challenges and changes that are clearly understood in the professional community. Success will depend on involvement in this process of all the key players (stakeholders): Government, agricultural and other related information services, all groups of consumers, donors, etc.

In the CAC region, it is impossible to maintain the development process without substantial capacity building of involved organizations and services. There is also a need to make significant efforts to promote the objectives of NAIS and RAIS. In this respect, very favorable factor is that major donors (FAO, GFAR, the European Union) not only support the systems' response to changes, but they are the initiators of major positive changes and of specific development goals. Another positive factor is the appearance of the CIARD initiative which took into account all the key challenges discussed above and provided professional services and organizations with long-term objectives.

The essence of the CIARD initiative is promotion of development of information products and services based on modern technologies of information processing that enable effective information exchange within CAC countries, as well as at the regional and global levels. This coincides fully with interests of information services, national and

regional systems of the CAC region. The CIARD offers the guidance and best samples of products and services that can be followed. Attractiveness of the CIARD Initiative ideas helps to develop NAISs and RAIS. In particular:

- Calls for such improvement of policies, strategies and structures of information exchange, which takes into account new technological opportunities and challenges faced by agricultural research;
- Provides guidance on the need to create a depositories and follow the practice of Linked Open Data and Linked Open Information Objects;
- Facilitates appropriate and effective description of resources (based on standards, rules and regulations) that increase the visibility of local resources at the national, regional and international levels;
- Promotes better organization in the region own sets of data and information as well as their interaction with other data and information in order to better represent data and provide information to own users;
- Helps intense transition to the use of Web 2.0 technologies and, therefore, prepare for the gradual utilization of Web 3.0 technologies.

In the time period between publications of the two Reports (2007-2011), as it was in the period before 2007 as well, CACAARI with support of the GFAR and FAO was the main advocacy agency promoting development of ICM in AR4D in the CAC region. The use of ICT/ICM in AR4D has become one of the main CACAARI activities:

- Two Regional Reports on the status of ICT/ICM in AR4D in the CAC region have been published. Within framework of the Regional Reports' elaboration, the National Reports of all countries in the CAC region have been elaborated twice as well;
- The participation of ICT/ICM specialists of the agricultural research system of the CAC region in international (regional and global) forums where they primarily discussed ICT/ICM in AR4D has been ensured (Moscow, Hyderabad – 2009, Montpellier - 2010, Beijing - 2011, Bangkok - 2011).
- A number of regional workshops and seminars discussing ICT/ICM in AR4D have been conducted in Tashkent and Ashgabat (2007-2010) for:
 - CACAARI management;
 - University Rectors;
 - Farmer Organizations,
 - NGOs;
 - Heads of information services in the field of agriculture.
- In 2010, all stakeholders came to an agreement on the further development of RAIS;
- Nodal information points of the RAIS in each country of the CAC region have been identified;
- Mechanism of inter-regional cooperation has been utilized in which APAARI (Asia-Pacific Association of Agricultural Research Institutions) provided effective support to the CACAARI in preparation of a regional report and training for professionals in the field of ICT/ICM.

Since 2007 CACAARI overcame and still overcomes significant organizational difficulties associated with reorganization of agricultural research systems in the CAC region.

As a result, CACAARI had to create RAIS from elementary level. In 2011 several events have been planned to improve use of ICT/ICM, in particular:

- Workshop/training to support and promote the CIARD and action plan related with the CIARD has been held in Tbilisi, December 12-16, 2011, as a measure to strengthen the capacity of RAIS' National Nodal Information Points;
- Current Report that has been developed based on advanced methodology, for the first time, specialists from the National Nodal Information Points have been involved for preparation of the National Reports as well.

Currently CACAARI is focused on promotion of the CIARD initiatives in the region.

8.1. Actions implemented by CACAARI Secretariat

- Development of RAIS advocating allocation of additional funds by donors (including those working at country level), as well as by Governments in the CAC region;
- Continuous advocacy activities to make the NARS' managements involved in development of NAIS and RAIS which are an integral part of NARS' in the CAC region;
- Involving management of research institutes, universities, associations of farmers and entrepreneurs and NGOs in support activities for development of NAIS and RAIS;
- Strengthening the CACAARI website and electronic infrastructure (organization of e-discussions, of document depository, of databases: on institutions, experts, projects, farmer and non-government organizations, universities, consulting services, etc.);
- Enhancing collaboration of the National Nodal Information Points for development of RAIS according to scheme (Fig. 5) in which all NAISs interact with each other and with global agro information system, as well as with CACAARI headquarters.
- The headquarters conducts monitoring of these activities, as well as creates in partnership with Nodal Information Points a set of databases mentioned in the previous item;

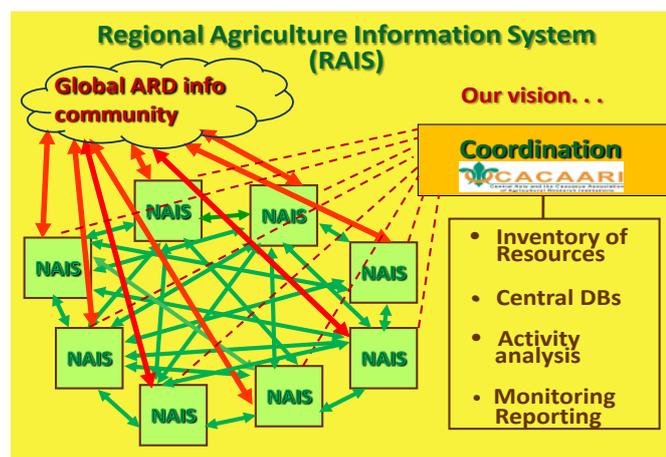


Fig. 5

8.2. Plan of action of National Nodal Information Points (NNIP)

- Advocate allocation of funds for development of NAIS at the local level and from international donors;
- Develop national agro information resources (products, services);
- Ensure access to resources and their interoperability with a view to achieve goals of the CIARD Initiative;
- Involve more agricultural organizations in information exchange in the framework of the CIARD Initiative by spreading the word about the initiative;

- Jointly (with other NPs) create regional databases on institutions, experts, projects, farmer and non-government organizations, universities, consulting services, etc., promoting development of the databases at the CACAARI server;
- Improve services for local organizations associated with agriculture using local, regional and international information resources;
- Enhance interest of those users and groups interested in agricultural, which do not belong to community of researchers and farmers (processing industry, suppliers, etc.);
- Continue study of national agricultural information resources in terms of their involvement in information exchange within the CIARD Initiative, referring to the assessment of:
 - Availability of information;
 - Access to Information
 - Applicability of information;
 - Relevance of information;
 - Usefulness of information;
 - Transformation of information into useful knowledge, skills, and technologies to be received by communities/farmers/farm households;
 - Availability of training of user communities in effective use of information;
- Concentrate not only on the agricultural scientific and technical information, but on GIS information resources, marketing resources, etc., as well.

9. Conclusion

In accordance with key international documents (*GCARD Road Map and The Strategy and Results Framework of the Consultative Group on International Agricultural Research Farms*

– *CGIAR SRF*) that define prospects of AR4D, the status of ICT/ICM use in AR4D, as well as in dissemination of research results have been studied in the CAC region.

Overall, there is a lack of funds for research in the CAC region, part of which is the ICT/ICM development. This fact predetermines the low level of information activities in the field of agricultural research, both in ensuring information for research and dissemination of the research results.

Despite that, after 2007 when the previous report was published, some progress in ICT/ICM technological and organizational infrastructure has been achieved with support of international organizations (FAO, GFAR, EU). Significant funds have been spent on integration of agricultural information communities of the CAC countries into the world community. New information products have been created using modern information technologies. The organizational pre-conditions for further development of RAIS have been created. The National Nodal Information Points (NNIP) has been identified, as well as the NNIP's capacity building measures have been undertaken. The CIARD Initiative is identified as landmark and mainstream for further development of NAIS and RAIS.

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