

Central Asia and the South Caucasus: Challenges, Opportunities, Priority Needs and Actions Required for Improving Agricultural Research for Development

Surendra Beniwal, Ajit Maru, Zakir Khalikulov and Hukmatullo Ahmadov



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Central Asia and the Caucasus Association of Agricultural
Research Institutions (CACAARI)



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ACRONYMS

AAS	Academy of Agricultural Sciences
AR4D	Agricultural Research for Development
ARS	Agricultural Research System
CAC	Central Asia and the Caucasus
CACAARI Institutions	Central Asia and the Caucasus Association of Agricultural Research Institutions
CACILM	Central Asia Consortium on Initiative for Land Management
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Center for the Improvement of Maize and Wheat
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
F-to-F	Face-to-Face
FGCARD	Global Conference on Agricultural Research for Development
GDP	Gross Domestic Product
GFAR	Global Forum on Agricultural Research
GRM	Genetic Resources Management
GTZ	German Technical Cooperation
IAASTD	International Assessment of Agricultural Knowledge, Science & Technology for Development
ICT	Information & Communication Technology
IFAD	International Fund for Agricultural Development
IFAP	International Federation of Agricultural producers
ISNAR	International Service for National Agricultural Research
JICA	Japanese International Cooperation Agency
JSC	Joint Stock Company
MoA	Ministry of Agriculture
MDG	Millennium Development Goals
NRM	Natural Resources Management
NARI	National Agricultural Research System
NARS	National Agricultural Research System
NARES	National Agricultural Research and Extension System
NGO	Non-Governmental Organization
PFU	Program Facilitation Unit
SIDA	Swedish International Development Agency
SPCB	Socioeconomic, Policy Research and Capacity Building
SRF	Strategic Results Framework of CGIAR
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
UzSPCA	Uzbekistan Scientific Production Center of Agriculture
VASKHNIL	Soviet Academy of Agricultural Sciences

FOREWORD

The Central Asia and the Caucasus (CAC) region consists of five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and three in the South Caucasus (Armenia Azerbaijan and Georgia). The eight countries of the region attained independence after the breakdown of the former Soviet Union in 1991, and since then have undergone tremendous economic and social changes as a result of transition from “centrally-planned” economy systems to the “market economies”.

Agriculture in the region is of paramount importance because of its role in the development needs of its countries. The sector: (i) supports the livelihoods of a large majority of the population in rural areas, (ii) provides employment to a large population, (iii) significantly contributes to the GDP of the most CAC countries, (iv) is a major source of hard currency earnings for some countries in the region, and (v) utilizes the most important components of the natural resources that directly affect the environment, e.g., soil, water and plant biodiversity, and thus assumes special significance in protecting the environment through the sustainable use of these natural resources.

Agriculture in the region, practiced in both irrigated and rainfed lands areas, is characterized by low income, small to medium farms with mono-cropping and low productivity without sufficient financial and technical support and technology transfer arrangements. The region so far has paid insufficient attention to mountain agriculture resulting into land erosion, poor farming communities, outmigration and land abandonment. The region has also not paid sufficient attention to and investments in agricultural research, education and extension systems.

The region has tremendous potential and opportunities for agricultural development because it has the required institutional infrastructure and human resources and, in addition, is rich in traditional agricultural practices and genetic wealth. However, the agricultural research is facing many challenges in the new century, as its key role in addressing such challenges as climate change and food security is being fully recognized.

The GCARD process in Central Asia and Caucasus has been coordinated by the Central Asia and the Caucasus Association of Agricultural Research Institutions (CACAARI), a regional forum in for agriculture, which strives to coordinate and strengthen ARD activities in the region by providing a neutral platform for exchanging opinions, forming collaborative ties and programs and formulating a common stance among agricultural stakeholders.

This bulletin prepared by CACAARI on the CAC region highlights the challenges and opportunities that exist in the CAC region. It also discusses different issues and priorities in agricultural research based on the GCARD process that was carried out in the region in 2009. I sincerely hope that this bulletin will provide useful information on the aspects mentioned above.

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Chairperson, CACAARI, and
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PREFACE

The Central Asia and the Caucasus (CAC) region with five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and three in the Caucasus (Armenia Azerbaijan and Georgia), is a region with tremendous potential for agricultural development. Like the many development challenges facing the world today, as highlighted in the United Nations' Millennium Development goals, the CAC region also faces several development challenges. The regional demands for development do warrant the need for sustainable increases in agricultural production without adversely affecting the natural resources and the environment. This would certainly mean that the region needs to bring about new changes in the approach and mechanism of effectively achieving the development goals of the CAC countries relating to agricultural development through a change in agricultural research for development (AR4D).

The GCARD review process, sponsored by the Global Forum on Agricultural Research (GFAR), was successfully carried out by CACAARI in the CAC region from August-October 2009. The process was organized GFAR to prepare for the first GCARD in 2010 and consisted of several elements which included Regional Reviews, e-Consultations and Face-to-Face Meetings at each regional level and within the international research community around the specific role and purpose of international research and large-scale research programmes. During this review process, the CAC region took action to actively involve different stakeholders for AR4D in the region. To ensure this, two important consortia, e.g., a Consortium for Farmers' Organizations and also a Consortium for the NGO were established in 2009 in the region. Steps are now being taken to organize a Consortium for the Agricultural Universities in the region, which should happen by June 2010. The process helped in identifying the priority needs and areas for AR4D in the region.

During the GCARD review process, excellent support received from the CACAARI Steering Committee is gratefully acknowledged. We also acknowledge the assistance and support from the CACAARI Secretariat located in the ICARDA Office in Tashkent and its Assistant Executive Secretary, Mr. Anvar Rahmetov, and the temporarily recruited secretarial assistance in Ms. Shahnoza Dzabarova. The support received from the Program Facilitation Unit (PFU) of the CGIAR Ecological Program for the Sustainable Agriculture Development in CAC and the Regional Office of ICARDA for CAC and its leadership, first Dr. Christopher Martius and later Dr. Zakir Khalikulov is gratefully acknowledged.

Finally, we express our thanks to GFAR and its Executive Secretary, Mr. Mark Holderness for his support. We also express our special appreciation to Dr. Ajit Maru, Senior Officer in the GFAR Secretariat, for his continued support and guidance to CACAARI and its activities and GCARD process in CAC.

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EXECUTIVE SUMMARY

The Central Asia and the Caucasus (CAC) region, which consists of five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and three in the Caucasus (Armenia Azerbaijan and Georgia), is endowed with a large geographical area of 419 million ha (mha) consisting of irrigated land, rangelands, mountains and deserts. The eight countries of the region attained independence after the breakdown of the former Soviet Union in 1991.

The main development goal of all the CAC countries after independence has been and continues to be to improve the wellbeing of their people. The countries also realized very early the importance of agriculture sector in achieving this development goal as the sector could play an important role in reducing poverty especially in the rural areas, enhancing food security, and improving the ecological environment besides providing sustainable livelihoods for the vast majority of the population that lived in rural areas and mountains and also to some in urban areas in the CAC countries.

The region has tremendous potential for agricultural development in its eight countries because it has the required institutional infrastructure and human resources and, in addition, is rich in traditional agricultural practices and genetic wealth (both plants and animals) and vast arable areas and rangelands that provide enormous potential for future agricultural development in crop production (food and commercial), livestock (both small and large ruminants for meat and milk and milk products), horticulture (fruits, vinery and vegetables), fisheries and agro-forestry.

During pre-independence, there was no system of deciding priorities in agricultural research in the region as the research was conducted based on “orders” and support from the Ministries of Agriculture and from VASKHNIL (The Soviet Academy of Agricultural Sciences). It was in 1995 that research needs in different countries of the CAC region were first identified at the national and the regional levels through the first workshop in the region which was organized by ICARDA in collaboration with GTZ of Germany. Subsequent priority areas in agricultural research were informally done by the countries at the national levels. But formal priority setting exercises for the region were undertaken in September 2001 in Tashkent, Uzbekistan, and in May 2002 in Aleppo, Syria. In March 2007, An Expert Consultation on Regional Research Needs Assessment in Central Asia and the Caucasus was held in which the regional problems requiring the attention of researchers were sorted out from the national priorities on the basis of regional commonalities. In 2009, it is through the efforts of the Global Forum on Agricultural Research (GFAR) that a global process was initiated to identify the priorities in agricultural research for development (AR4D) in different regions of the world for the Global Conference on Agricultural Research for Development (GCAR4D). This exercise in each region was coordinated by its regional forum for agricultural research under the overall guidance of GFAR Secretariat. For the CAC region, it was Central Asia and Caucasus Association of Agricultural Research Institutions (CACAARI) that coordinated this activity with technical assistance from a Lead consultant and overall supervision of the GFAR Secretariat.

The process of identifying the key issues and their priorities in CAC was systematically carried out by first preparation of a Regional Research Review by the Lead Consultant (Dr. Surendra Beniwal) which was discussed and endorsed by the members of the Steering Committee of CACAARI. This was followed by a 3-week e-Consultation with different

stakeholders of AR4D in the CAC region with the Regional Research review as the base document. Finally, a Face-to-Face (F-to-F) consultation with the representatives of the stakeholders of AR4D in the region was organized to decide and prioritise the research issues. The Lead Consultant had prepared summaries of e-Consultation and F-to-F consultation meeting. A brief report on the outcomes and conclusions of the meetings was presented by the Lead Consultant to the Steering Committee of GFAR in Alexandria, Egypt, 13-15 November 2009.

The GCARD review process in CAC region has helped in identifying the priority needs for AR4D in the region which could be grouped into five categories: (i) Institutional issues, (ii) Research issues, (iii) Policy issues, (iv) Environment protection issues, and (v) Socioeconomic issues. Among the institutional issues, agricultural extension was on the top of the list followed by agricultural research and education, and linkages, partnerships and collaboration. Among the research issues per se included improved technology for sustainable crop production; Water and irrigation management; Livestock research including rangelands; Horticulture; Seed systems; Forestry; and Mountain agriculture. Among the policy issues, the need for greater investments in agriculture (including agricultural research, education and extension) was the most important followed by marketing of agricultural commodities and developing suitable agricultural development policies. Conservation of biodiversity and climate and desertification were considered the two important issues under Environment protection issues. Among the socioeconomic issues, attention to gender/women-related issues was considered the most important followed by the study and analysis of livelihoods in rural areas.

The present state of activities, weaknesses and action required under each of these issues has been highlighted in the Regional Research Review Report prepared by the Lead Consultant and under Section 4.2 of this report on How the research needs are being satisfied?

The most important messages that came out strikingly clear from GCARD the process carried out in the CAC region are as follows:

- Assure greater investments in and support to agricultural research, education and extension.
- Restructure and strengthen agricultural research, education and extension systems (NARES) (creating suitable structure and capacity building) and ensure the required collaboration, partnerships and linkages among different stakeholders of the AR4D at the national, regional and global levels, which are vital for the region.
- Ensure that the prioritized researchable issues are addressed by the NARS of the CAC countries.
- Develop favourable policies (creating employment opportunities in rural and mountainous areas, marketing of agricultural commodities, and land tenure and property rights) to create a favourable policy environment in different countries of the region and bridge the “underinvestment gap” by investing more in the rural sector and mountainous areas to speed up the development of rural and mountainous areas to improve the livelihoods of the poor people that live there.
- Address socioeconomic issues especially gender/women-related issues considering their significant contribution to agriculture in all the countries of the region.
- The CAC region, which is going through a transition economy, needs a lot of assistance in strengthening agricultural research, education and extension for

agricultural development from the international community including the CGIAR and GFAR.

The next steps after identifying the priority areas of AR4D in the region have been suggested for the NARES of the CAC countries, which would be required to take lead to initiate actions to implement the prioritized issues. An important step in this would be to identify appropriate development pathways which could be adopted in different countries of the region to get the desired agricultural development. This would require: identification of the requirements, need analysis, consideration of the existing models elsewhere or design new models, test implement them through action research, evaluation, advocating their replication and enlargement, and large-scale adoption. For this, new changes in policy, structures such as coordinating/regulating body, linkages, investment including of the private sector, capacity development, new information platforms, etc. would be required. This could be done as per the steps suggested for the example of improving agricultural extension and advisory system in Section 4.3 Identifying development pathways.

It is now internationally recognized that agricultural research alone has not been able to achieve agricultural development and improve the livelihoods of farmers as shown by the worldwide experience of developing countries. There are a number of basic reasons for this situation. First, there are other essential elements together with the research that play an equally important role in the success of agricultural development and improving the livelihoods of farmers. Second, the NARS have failed to take lead on improving the livelihoods of the farmers and on poverty reduction. Third, there is lack of political will in the leadership of the developing countries. Therefore, an integrated approach must be adopted by the countries themselves if the desired goal of agricultural development is to be achieved in the developing countries. The six essential elements which are important for ensuring agricultural development and improving the livelihoods of farmers include (i) Strengthening innovation system (Research, education and extension), (ii) Making the technology available, (iii) Developing favourable policies to create a favourable policy environment including greater investments in agriculture research and development and rural sector to bridge the “underinvestment gap” and addressing the gender issues, (iv) Increasing farmers’ assets, (v) Income diversification of farmers and people in rural areas, and (vi) Providing services to farmers for post-harvest processes, value addition and marketing of their produce, etc. Thus, an integrated approach by simultaneously ensuring the implementation of these six key elements should result in good agricultural development and improving the livelihoods of farmers and poor in rural and mountainous areas.

The CAC region has tremendous potential for agricultural development in the immediate future. Considering the present state of affairs the region could go two ways:

- CAC region could become be granary of the world, or
- Become a potential hot spot for poverty because of: (i) shortage of irrigated land, (ii) shortage of water, (iii) adverse effects of climate change and desertification, (iv) increased population, (v) shortage of food, and (vi) isolation from the world community.

Therefore, the following are of vital importance to the CAC region:

- Strengthening of the existing potential for knowledge creation
- Strengthening knowledge transfer mechanisms

- Developing collaboration, partnerships and linkages among different stakeholders of AR4D at the national, sub-region, regional and the global levels
- Focus on small to medium-scale farmers, poor in rural and mountainous areas in the region.

Considering the above and the potential that the CAC region has, it is important that the governments of CAC countries make the required investments in and support to agricultural research for development in their countries to meet their goals for agricultural development and satisfy their national development goals. Likewise, the regional and international development banks and international research and development organizations must come forward to help these countries to ensure the needed agricultural research for development in the countries of the CAC region.

1. MAIN CHARACTERISTICS OF THE REGION

1.1. Geophysical Area

The region of Central Asia and the Caucasus (CAC) consists of five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and three in the Caucasus (Armenia, Azerbaijan and Georgia) (Fig. 1). The region has a geographical (total land) area of 410 million ha (mha), of which 33 mha are arable (11.4 mha irrigated) and 256 mha are rangelands, generally used as pastures for livestock (Annex 1). Climatologically, the region is characterized by cold to very cold winters (< 10 to -40 C) and mild to warm summers. The moisture regime can vary from arid to semi-arid, and rainfall is low with variable patterns.



Figure 1. Map of Central Asia and the Caucasus

1.2. Macro-economic Situation

All the eight countries in the region after independence in 1991 underwent tremendous economic and social changes as a result of transition from “centrally-planned” economy systems to the “market economies”. The socio-economic structures developed during the Soviet period collapsed, economies shrank, different development sectors including agricultural faced a serious setback resulting into losses of incomes and adversely affecting livelihoods of people.

1.3. Poverty

As a result of the failure of the inherited socio-economic system from the former Soviet Union, the poverty during the post-independence in the region increased. The GNI (gross national income) per capita in the region declined by an average of almost 50% between 1991 and 2000 compared with an average increase in other low and middle income group countries

over the same period. The percentage of people living below the national poverty line in 2007 has been reduced in most countries compared over the 2005 figures, but it ranged from 15.4 (Kazakhstan) to 74.9% (Tajikistan) (UNESCAP, 2008) (Annex 2). The GDP per capita (in USD) in 2007 increased in a couple of countries of the region due to progress in petrochemical sector, and ranged from 1,656 (Tajikistan) to 10,223 (Kazakhstan) (UNESCAP, 2008) (Annex 2).

1.4. The Agriculture Sector

Agriculture in the region is of paramount importance because of its role in the development needs of its countries. First, the sector supports the livelihoods of a large majority of the population in rural areas (from 36% in Armenia to 74% in Tajikistan) and to some extent in urban areas (FAO, 2007/08). In this, the role of the arable land, especially the irrigated, plays an important role in contributing to food security of these countries. In addition, the farming on rural household plots (*Dehkon* or Christian farming in the region or rural household plots farming/kitchen garden farming/mini-farming) involving several million households (for example, over 4 million in Uzbekistan) on small pieces of land provided around the houses (0-25-0-35 ha), is very common and supports the livelihoods of a large proportion of the rural and urban populations (up to 60% in Uzbekistan, for example), significantly contributes to food security and poverty reduction in the region. Second, the sector provides employment to a large population (10% in Armenia to 30% in Tajikistan and 31% in Turkmenistan) (FAO, 2008) (Annex 3), and urban areas (especially through *Dehkon* farming). Of the total employed the percentage of women ranges from 33.5% in Kazakhstan to 54.4% in Georgia (Annex 4). Thus, it supports the livelihoods of not only in rural but also in urban population of the region. Third, it significantly contributes to the GDP of the most CAC countries that range from 6.3% in Kazakhstan to 31.5% in Uzbekistan (FAO, 2007/08). Fourth, it is major source of hard currency earnings for some countries in the region, and fifth, the sector, as it utilizes the most important components of the natural resources that directly affect the environment, e.g., soil, water and plant biodiversity, assumes special significance in protecting the environment through the sustainable use of these natural resources.

Agriculture is practiced in five agro-ecological zones in the CAC region: (i) cold semi-arid lowland rainfed; (ii) lowland rainfed; (iii) lowland irrigated; (iv) lowland semi-arid rangelands; and (v) mountains (mountain pastures supporting livestock with irrigated crops in the valleys).

Both the irrigated and the rainfed agriculture are practiced; the former covers an area of 11.4 mha, whereas the latter covers a geographical area of 22.3 mha. However, a major portion of the geographical area (256 mha of rangelands) is generally used as pastures for the livestock. Cereals (wheat, barley), food crops (potato), cotton, horticultural crops (vegetables and fruits), livestock (small ruminants, sheep and to lesser extent goat, and cattle that provide meat and milk) are important agricultural commodities. The region has a rich genetic heritage of a large number of fruits, vegetables and nut trees (almond, walnut). Sustenance mountain agriculture also supports livelihoods of small-scale farmers and people living in them.

Agriculture in the region, practiced in both irrigated and rainfed lands, is characterized by low income, small farms with mono-cropping and low productivity without sufficient financial and technical support and technology transfer arrangements; old, insufficient and inefficient irrigation practices and structural systems for delivery of water to farms (e.g. large collapsed irrigation and drainage systems resulting into inefficient water-use, salinization and water-logging); slow process of land privatization land tenure; highly insufficient

opportunities for marketing and income diversification and off-farm income generation; improper attention to livestock and use and maintenance of vast areas of marginal lands leading to their degradation; insufficient attention to mountain agriculture resulting into land erosion, poor farming communities, outmigration and land abandonment, and insufficient attention to and investments in agricultural research, education and extension systems.

The CAC region has tremendous potential for agricultural development since the two important prerequisites, i.e., institutional infrastructure and human resources do exist in the region (PFU/CGIAR-CAC, 2005). In addition, traditional agricultural practices, rich genetic wealth (both plants and animals) and vast arable areas and rangelands provide enormous potential for future agricultural development in crop production (food and commercial), livestock (both small and large ruminants for meat and milk and milk products), horticulture (fruits, vinery and vegetables), and agro-forestry. The region has inherited vast irrigation systems from the former Soviet Union for use in irrigated agriculture. Similarly, the region offers good conditions for livestock production due to vast rangelands. There is a tremendous scope of the use of quality seed of high yielding varieties, fertilizers and pesticides. Also, there is good scope for the conservation of the vast plant and animal genetic resources. Similarly, there is a good potential for diversification of agriculture in the region. Additionally, a large tract of land in Kazakhstan, with potential for agricultural production, is not exploited and kept fallow for various reasons for future use. All of these offer tremendous opportunities for food production and could immensely help in achieving food security and further reduction in poverty, and thus contribute to the regional development needs. In fact, the region has tremendous potential to develop, given its background and resources, and become a leading region in agriculture production in the world.

2. AGRICULTURAL RESEARCH FOR DEVELOPMENT (AR4D) SYSTEMS IN CENTRAL ASIA AND THE CAUCASUS

2.1. Current assessment

All the eight countries in the CAC region inherited from the former Soviet Union high quality agricultural research and education systems with strong linkages with one another and wealth of research experience from the Soviet era. This provided them fairly good foundation to build-on collaborative agricultural research for development. However, during the post-independence, the AR4D systems in each country have suffered due to insufficient support provided to them by the countries in the region. Similarly, the strong linkages that these institutions had with one another have been broken. Thus, the inherited wealth of research experience by these countries from the former Soviet Union, which provided them fairly good foundation to build-on collaborative agricultural research, has been disrupted. They have also lost some of the well-trained scientists as they migrated back to the countries of their origin. Similarly, linkages through which agricultural research could contribute to innovation, the well being of producers and economy of the states have been lost. New forms of extension systems to support small holder farmers and producers, very different from the collective farms of the Soviet period, were also not developed, and have taken their time to emerge lately. As a result, the AR4D has suffered and continues to suffer in these countries.

2.2. Size and stage of development

Currently, the size of the AR4D system in CAC region varies from country to country and ranges from small to medium depending upon the size and importance given to agriculture in the country. It is small in six countries (all the three countries, viz., Armenia, Azerbaijan and Georgia of the Caucasus, and Kyrgyzstan, Tajikistan and Turkmenistan of Central Asia), whereas it is of medium size in Kazakhstan and Uzbekistan.

The AR4D systems in the eight countries of the CAC region are in different stages of development based on the attention given by the countries. Among the eight countries, Kazakhstan and Uzbekistan have paid better attention to their research systems and therefore are ahead of others in terms of investment and restructuring. Between the two, it could be said that Kazakhstan is even ahead of Uzbekistan as it has paid greater attention to restructuring its AR4D system. Since 2007, it has put agricultural research under a Joint Stock Company (JSC) “KazAgro-Innovatsia” with 100% capital share of the state (CAC News, 2009). Compared with these two countries, AR4D in the other six countries has not received as much attention as it should have in terms of investment and restructuring. This has happened even in Azerbaijan and Turkmenistan where the national economy has been fast moving upwards due to petrochemical businesses. As a result, agricultural development has not occurred as much as it should have in these countries.

2.3. Strengths

Because all the countries in the region inherited high quality agricultural research and educational institutions from the former Soviet Union, they are rich in research and educational institutions infrastructure which can still provide good foundation to renew the R4D system. Also, they are still rich in human resources, who with exposure and training to new tools and technologies can significantly contribute to the newly emerging requirements of the R4D. Importantly, a renewed interest in all the countries of the region has been seen

lately for attention and support to agricultural research and education in accordance with their agricultural development goals. As a result, agricultural research systems in most countries of the region have undergone changes to meet their new agricultural development goals. However, one change that has occurred in all the countries is that agricultural research has been put under the ministries of agriculture, which has helped in better coordination and implementation of research programs than in the past. Also, the countries in the region have attempted to restructure their R4D system in which some countries are ahead of others depending upon their financial resources. Some countries have now developed new systems for agricultural research and extension for development. For example, agricultural research in Kazakhstan since 2007 has been put under a Joint Stock Company (JSC) “KazAgro-Innovatsia” with 100% capital share of the state.

2.4. Weaknesses

The CAC region’s AR4D is characterized by the following weakness:

- i. The inherited wealth of research experience by these countries from the Soviet Union, which provided them fairly good foundation to build-on collaborative agricultural research, has been disrupted.
- ii. They have also lost the well-trained scientists as they migrated back to the countries of their origin.
- iii. The present cadre scientists are ageing and the AR4D system is unable to attract bright young students and researchers to AR4D.
- iv. The linkages through which agricultural research could contribute to innovation, the well being of producers and economy of the states have been lost.
- v. New forms of extension systems to support small-holder farmers and producers, very different from the collective farms of the Soviet period, were also not developed and have taken their time to emerge lately. Also, ICT in these countries is presently lacking and not receiving much attention.
- vi. An efficient system of coordination of agricultural research in these countries is very much lacking and so is the absence of a mechanism that could achieve it. Moreover, there is hardly any coordination between research, extension and educational institutions at the national and regional levels in the countries of the region.
- vii. Low investments by different countries in AR4D during post-independence which continue to be so. For example, even Azerbaijan which now has a dynamic and fast-moving economy contributes only 0.0876 % of the GDP to agricultural research and development.

2.5. Opportunities

The AR4D, considering the background and resources in the region, offers excellent opportunities. This is because the region is/has: (i) rich in research and educational institutional infrastructure and human resources, (ii) rich in traditional agricultural practices and biodiversity in plants and animals, (iii) vast arable areas and rangelands, (iv) vast irrigation systems, (v) good conditions for livestock production because of vast rangelands, (vi) good scope for increasing agricultural productivity, (vii) good scope for conservation of the vast plant and animal genetic resources, and (viii) good potential for diversification of agriculture and conservation agriculture in the region. The AR4D in the region could be strengthened and developed rapidly if renewed interest for attention and support to agricultural research and education in accordance with their agricultural development goals is exhibited through increased investments. These opportunities could be utilized further by

developing regional and international linkages as has been amply demonstrated by the efforts of the CGIAR's Eco-regional Program for Sustainable Agricultural Development in Central Asia and the Caucasus since 1998.

2.6. Renewed interest for AR4D in the region

Lately, a renewed interest in all the countries of the region has been seen for attention and support to agricultural research and education in accordance with their agricultural development goals. In most countries of the region, agricultural research systems have undergone changes to meet their new agricultural development goals. In this, some countries are ahead of others depending upon their financial resources. Similarly, some countries have paid a greater attention to developing new systems for agricultural research and extension for development. One change that has occurred in all the countries is that agricultural research has been put under the ministries of agriculture, which has helped in better coordination and implementation of research programs. Other countries are also trying to make changes to improve their research and education and their coordination mechanisms.

2.7. Current Implementation Mechanisms for AR4D

From pre-independence to post-independence in 1990, the implementation mechanisms for AR4d in the CAC region have gone through quite a change. The following describes the mandate and organization of agricultural research, research coordination, institutional resources for AR4D, and the coherence and gaps in implementation mechanisms.

2.7.1 Agricultural Research Systems

Agricultural Research Systems (ARS) in CAC countries have much in common due to their common legacy for the former Soviet Union. However, they have been evolving in different ways according to their internal and external circumstances and influencing factors (ISNAR, 2001).

2.7.1.1. Research mandate and organization and prioritization

In the past, the mandate for agricultural research was primarily vested in the Soviet union Academy of Agricultural Sciences (VASKHNIL) with the Ministries of Agriculture (MOAs) of the republics serving as clients. A few of the agricultural research institutes in these countries were affiliated with the MOAs and some agricultural research was conducted by units of the Academies of Agricultural Sciences (AAS). The Agricultural universities were primarily teaching institutions with quotas for training the required technical staff. Advanced degrees in agriculture sciences were organized by Academic Committees affiliated with the institutes of the AAS.

Upon independence in 1990, much confusion arose concerning the mandate and organization of agricultural institutions which existed in each of the countries and which were formed into national systems. However, the mandates and organization of agricultural research was decided in 1995 in Kyrgyzstan, 1996 in Kazakhstan, Kyrgyzstan and Uzbekistan and in 1998 in Armenia (Annex 5). The situation in 2009 is also indicated in this table.

However, there is a definite problem of ambiguity in the mandate and responsibility for agricultural research. Although, most countries have named the institutions that are responsible for agricultural research at the national level, the issues relating to mandate and responsibilities of agricultural research is still not clear in most countries. For example, (i)

who is responsible for what type of research mandate, (ii) what types of research should different institutions conduct (research planning and institutional responsibility), and (iii) what is the role of agricultural universities in agricultural research. Moreover, there is still ambiguity on several key functions such as the responsibility for (i) formulating agricultural policy (ii) setting agricultural research policy, goals and strategies, (iii) determine agricultural research priorities, (iv) funding agricultural research, (v) coordination and management of research at the national level, (vi) coordination of research programs at the national level, (vii) monitoring and evaluation of research activities, (viii) ownership of research results, and (ix) transfer of research results to farmers (whether public, private or NGOs).

2.7.1.2. Research coordination, linkages and evaluation

Coordination of agricultural research at the national level is done in different ways in different countries of the region (Annex 6). The research is coordinated by MOAs in Armenia, Azerbaijan, Kyrgyzstan, Turkmenistan, whereas it is done by the Ministry of Science in Georgia, by a Joint Stock Company (JSC) “KazAgro-Innovatsia” in Kazakhstan, Tajik Agrarian Academy in Tajikistan, and Uzbekistan Scientific Production Center of Agriculture (UzSPCA) in Uzbekistan. However, there is no mechanism to link and coordinate national agricultural research (done by different organizations), education and extension. There have been talks of creating apex bodies to coordinate all agricultural research in each country but no concrete results are in place except in Kazakhstan, where they have put all the agricultural research under “KazAgro-Innovatsia” but they have also not created any mechanism to put all the agricultural research, education and extension under one umbrella for developing effective coordination and linkages among different institutions.



Another weakness in the research coordination system is the absence of any mechanism to coordinate research at commodity/research areas/discipline levels at the national level. This does not ensure good planning, monitoring and production of outputs and division of labor, and does result in duplication of efforts by different organizations at the cost of meager available resources.

Agricultural universities, which have the privilege of having qualified faculty members, are devoting most of their efforts to teaching, and conduct no or very little research and extension activities. Moreover, the linkages of agricultural universities to agricultural research systems in the countries of the region are non-existent or are very weak except in a few countries, where these linkages have recently been strengthened (Azerbaijan, Armenia, for example).

Another weakness in the research system is a very characteristic lack of any existing evaluation mechanism. Thus, some research goes on without evaluating its merits/demerits and outputs, and may not fit into the priorities.

2.7.1.3. Institutional resources for agricultural research

2.7.1.3.1. Number of research institutes

Most countries in the region have more number of research institutes than what are required. This situation decreases the availability of operational funds and increases the administrative costs to the research system. They also result in narrowly defined research programs and duplication of efforts. The institutes lack planning and monitoring.

2.7.1.3.2. Human resources

All the eight countries in the region enjoy the privilege of having excessive number of researchers in agriculture. This is due to the former Soviet Union legacy that these countries have inherited. This is in spite of the fact the research system lost some scientists as a result of their migration to Russia or their countries of origin. However, there are only few who are academicians or are well qualified with doctors' degrees; most lack advanced degrees and have the degrees of Candidates of Science. Importantly, all, but a select few, are trained by the Soviet Union system of education and have only a limited exposure to and experience in modern scientific techniques. Also, they are not trained in research management and extension activities. They seem to have unequal and improper job responsibilities. Also, the number of support staff per researcher is low. Another factor is the aging scientists in the research system (with average age of about 50 years) and lack of younger scientists in agricultural research. The latter is due to failure of the agricultural research system to attract bright young students and limited job opportunities and low salaries in agricultural research, education and extension system of these countries. Moreover, the English language barrier does not help the scientific staff in communicating the outside world.

2.7.1.3.3. Infrastructure

In general, research institutions have excessive land and building spaces which are really not required considering their present mandates and activities. Considering this, some countries have started the process of downsizing and reducing the physical assets in their research systems. Moreover, some of the building spaces are in poor condition or beyond repairs due to shortage of funds to maintain them. They certainly will need additional funds to restore them and make them functional.

The research institutes have poor and unsatisfactory material-technical base - buildings, machinery, equipment and transportation and communication means and unsatisfactory and insufficient computers and office equipment. Although the laboratory and field equipment are, in general, well cared for in different countries but they are either outdated or in need of parts and repairs and meet only about 10% of the total need. This certainly necessitates greater attention and investment.

2.7.1.3.4. Information and communication

Currently, the agricultural research system is very deficient in scientific information and communication. Limited financial resources do not permit scientific institutions to purchase scientific literature. Also, the good quality scientific journals for agricultural research and development are limited in the region, and thus scientists are not able to publish their research results in good scientific journals. Likewise, the use of computers in agricultural research and development institutions is very limited, and only few of them have access to internet. Some institutes even have the problem of the availability of regular electricity.

In the past, there has been a communication gap, which is a key issue in technology and knowledge transfer to farmers. Thus, the feedback from farmers to researchers was hindered. The situation, however, has improved lately in all the countries although still there is a lot to be desired in developing effective communication mechanisms between research and extension.

2.7.1.4. Linking research to development

Agricultural Extension Systems of the conventional type to support farmers were not developed during the Soviet times. New forms of extension systems to support small holder farmers and producers, very different from the collective farms of the Soviet period, were also not developed and have taken their time to emerge lately. Thus, either lack of poor linkages between research, extension, farmers especially the women farmers, and the policy makers are the norm in the region. Needless to emphasize that the lack of this interaction has diluted the effectiveness of the technology transfer to farmers, who have thus been deprived of the new innovations in agricultural research for improving productivity and production, and led to missed opportunity for increasing their agricultural productivity levels. The absence of any information advisory services have also adversely affected farmers' participation and role in exercises that improve and set agenda for agricultural research and development. It is now imperative that effective linkages at local, regional and national levels are created and an effective extension system is put in place which would help the farming community in more than one way.

2.8. Current Roles of and Relationships of NARS to Different Stakeholders

2.8.1. Universities

Agricultural education systems in the CAC republics during the Soviet era were structured and organized based on needs of the then centrally-commanded systems of agricultural research and production. Post-independence, educational systems have continued to operate mostly in isolation except in Armenia, where there is a close collaboration between the research and the universities. This is one reason that the agricultural universities in the CAC region have not been able to play a significant role in agricultural research and development as they have done in many parts of the developing world. There is now an urgent need to create strong linkages between the agricultural universities and the research and extension systems so that they are also able to contribute to agricultural development in the CAC countries and the region.

2.8.2. Farmers and their Organizations

Pre-independence, the countries in the CAC had effective agricultural research and extension system arrangements that successfully catered to the needs of the large collective and cooperative farms. These arrangements that ensured transfer of the new technology to these farms during the Soviet times. Therefore post-independence, the agricultural research and education systems that were distributed in newly independent countries were of very high quality with required linkages with the farms. But, infrastructure for research became obsolete and linkages through which agricultural research could contribute to innovation, the well being of producers and economy of the state were broken and ceased to exist.

Most of the CAC countries in the initial stages of independence did not pay much attention to the technology transfer aspects and failed to create an effective extension system through which the technology could serve the needs of farmers. Thus, they failed to create any information sharing mechanisms which could connect the research with the newly created independent farmers who needed all sorts of assistance from the agricultural research system. This adversely affected the important interactions between researchers and farmers/farmers' associations that could be mutually beneficial. Similarly, the governments in the region did not pay much attention to develop women farmers' organizations and to improve their involvement in agriculture till lately in Uzbekistan (Alimdjanova, 2009). Thus, the farmers or their associations could not benefit much from the research system and could not provide the useful feedback to the researchers. Also, they could not play any significant role in deciding the regional and national agricultural research and development agendas and goals. However, lately some countries in the region are now paying attention to create effective linkages of research-extension linkages to connect with farmers although much more is required to be done.

It is now (in Oct 2009) that CACAARI under the guidance and support from GFAR has taken initiative to bring together the farmers' associations/organizations of different CAC countries and created a Consortium of Farmers in the CAC Region. This will certainly help better interaction of farmers' organizations in different countries to interact with one another and with the research systems

2.8.3. Non-Governmental Organizations

The interaction of the non-governmental organizations (NGOs) with the research system in the CAC countries has been minimal. First, there are not many NGOs in the CAC countries that deal with agricultural research and development. Secondly, those that are there are trying hard to convince the agricultural policy makers about the role that they could play in AR4D. However, it must be mentioned that some countries such as the three countries in the Caucasus and Kyrgyzstan, Kazakhstan and Tajikistan have encouraged the agriculture-related NGOs to play some meaningful role in agricultural research and development. In this aspect, Uzbekistan is lagging behind and needs to encourage the role of NGOs in agricultural research and development.

It is good to see that the region has lately (Oct 2009) taken steps to create a Consortium of agriculture-related NGOs in the CAC region in which CACAARI under the guidance and support of GFAR has played an important role. And finally, there is a Consortium of NGOs in CAC.

2.8.4. Private Sector

The private sector in the CAC region has so far played a very limited role in AR4D. The role so far has been limited to provision of seeds of European commercial varieties of field and vegetable crops. An example is provision of seeds of potato varieties from Europe



in Uzbekistan. This practice is adversely affecting the development of local potato seed production systems besides farmers getting seeds at higher costs than what the locally produced seeds would cost.

No AR4D of any consequence is currently being supported by the private sector in any of the countries in the CAC region which is contrary to the situation in some other regions where the private sector does support AR4D.

2.8.5. CGIAR Centers

The eight NARS in the CAC region have enjoyed good relationship with the CGIAR Centers since December 1995 when ICARDA brought the agricultural research administrators and scientists of the eight countries in CAC together through a GTZ-supported seminar to discuss priorities for agricultural research and seed production in the CAC countries. This was the first time after independence that these agricultural scientists from the eight countries were gathered at one place to interact with each other. This was followed by starting joint projects on livestock, soil and water management and germplasm collection and documentation by ICARDA, on wheat improvement by CIMMYT/ICARDA in collaboration with Turkey, on water basin management by IWMI. With a great interest from the CAC NARS, CGIAR Centers, CGIAR and the World Bank a Regional Program for Sustainable Agricultural Development in Central Asia and the Caucasus was established in 1998, which was lead by a consortium of nine-CGIAR Centers with ICARDA playing a coordination role through a Program Facilitation Unit. The Program has now successfully completed 11 years and has immensely contributed in different fields of AR4D in the eight countries of the region. The Program was awarded the prestigious King Bedouin Award in 2008 for its excellent contributions to AR4D and for establishing exemplary partnerships with the national programs of the eight countries of the CAC region. The Program even helped the CAC NARS for establishment of CACAARI, a regional forum for supporting agricultural research in the region.

2.8.6. Advanced Countries' NARS

The countries in the CAC region have had fairly good relationships with the advanced countries' NARS. These have mainly included European countries, viz., Germany, Switzerland, Norway, and France, United States of America, and Japan. The countries have benefitted from these advanced countries' NARS through collaboration on research issues where the latter have comparative advantage and have provided financial and technical support. Some of the research areas are wheat and potato seed production, basin water management, plant genetic resources conservation, livestock management, carbon sequestration, rangeland vegetation. The collaborative research grants have come from EU, GTZ, SIDA, USDA, USAID, JICA, etc.

2.8.7. International and Regional Organizations and Development Banks

The CAC NARS have also benefitted from International organizations such as UNDP, FAO and IFAD which have supported research and development activities in these countries. In addition, development banks and organizations such as World Bank, Asian Development Bank have also supported research and development activities in different countries through loans to the governments on bilateral basis. All the loans have a research component which is supported by the research grants provided in the loans.

The region has regional organizations such as Inter-State Water Commission which coordinates work on water issues in the five countries in Central Asia. Also, there is Regional Organization for Work in Mountainous Areas based in Bishkek in Kyrgyzstan.

Another important initiative from ADB has been CACILM (Central Asia Consortium Initiative for Land Management) which has both the loan components and a research component, which was carried out and coordinated by ICARDA in the five countries of Central Asia. Thus, it is clear from the above that the CAC region has and continues to benefit from the assistance provided by the international development agencies and development banks.

3. EXISTING NEEDS AND RECOMMENDATIONS

This section deals with the needs of the region for agricultural development and the research priorities that will fulfill these needs. The section also tries to identify coherence and gaps in the current and projected research priorities that can meet agriculture development objectives. However, at first, the driving forces and challenges that are important at the global level will be looked at followed by the ones that are important at the regional level (for the CAC region). A comparison between the two would help to determine as to how much attention is being paid at the regional level to the issues that are of global significance. Later, the priority areas of research that will help in addressing the challenges will be looked at.

3.1. Global Development Goals and their Linkage to Agriculture Development

The United Nations (UN) has identified eight Millennium Development Goals (MDGs) to renew and refocus global efforts to meet the needs of the world's poorest people, which have been embraced by all UN member countries and all the leading development institutions of the world. Of the eight, three are related to and thus are linked to agriculture, viz., eradicating extreme hunger and poverty, improving the rural livelihoods and human health, and facilitating equitable, socially, environmentally and economically sustainable development (IAASTD, 2009). Thus, agriculture becomes important for playing a multiple role of increasing agricultural production and meeting development and sustainability goals.

3.1.1. Challenges at the Global Level

Different reports dealing with agriculture development (IAASTD, 2007; WDR, 2008; CGIAR-SRF, 2009) have highlighted a number of important challenges facing agriculture, that are dictated by driving forces (drivers), that will influence the future of agriculture and indirectly agricultural research over the next few decades. Those that are related to the CAC region will be highlighted here.

IAASTD (2007) identified the main drivers as increasing global population, changing world of urbanization and human migration, growing inequities, changes in dietary and trade patterns, land and land use competition, environmental degradation, increases in agricultural labour productivity, a trend towards biofuels, climate change, and demands for agriculture to provide ecosystem services. Except the trend towards biofuels, all other are relevant to and important for the CAC region.

The World Development Report (WDR, 2008) also emphasizes poverty and hunger, rising uncertainties about the availability of food at the global level due to growing population, concentration of smallholders and poor in rural areas, rising competition for land and water, environment, uncertainties about future adoption rates for new technologies, trade globalization, and growing energy requirements,

The CGIAR-SRF Report (CGIAR-SRF, 2009) identified three major issues of global concern, which include food for people, environment for people and policy for people. GFAR Triennial Conference (GFAR, 2006) emphasized hunger, rural poverty and health as the major challenges in the world that agriculture must address in order to fulfill its role in meeting the important MDGs relevant to agriculture.

These forces will pose challenges to agricultural development in the world and also to research that will be needed to address by adopting suitable and appropriate research priorities. Based on the documents review, the following drivers at the global level have been identified (Table 1). Also included in the same table are the challenges that they pose to ARD and agricultural research at the global level.

Table 1. Common drivers and challenges for ARD and agricultural research at the global level

Driving force	Challenge
Growing population, poverty, hunger, increased food needs	Food security
Degradation of the environment	Natural resource management (biodiversity, soil, water, rangelands)
Rising competition for land and water	Efficient land and water use
Climate change	Adaptation to and mitigation of climate change
Globalization	Improved trade
Widespread plant and animal diseases	Animal/plant/human health; food safety
Changes in dietary patterns	Nutrition: malnutrition, human health, organic farming
Scarcity of fossil fuel and bio-energy development	Energy security

3.2. CAC Regional Development Goals and their Linkage to Agriculture Development

The main development goal of all the governments in the CAC region during post-independence has been, and continues to be, to improve the wellbeing of their people. To achieve this, the countries needed to provide fast and effective economic growth and implement social reforms and programs. For the former, they needed suitable economic, fiscal and monetary policies and reforms to create a stable macroeconomic environment and maintain low inflation rates. For achieving the social wellbeing of the people, they needed to spend a considerable share of the state budget (may be up to 1/3 of budget) for restructuring public infrastructures (water, roads, transport, telecommunication, etc.), either by improving the existing ones or by creating new ones, and creating effective institutions/ensuring reforms for social and development programs (education, health, environment, knowledge creation and sharing, poverty reduction, gender equality, etc.) for both the urban and rural populations. In this, the role of reducing poverty especially in the rural areas, enhancing food security, and improving the ecological environment was considered vital. And to achieve this, greater attention and investments, compared to the past, were required to increase the effectiveness and development of agriculture sector and its commercialization, enterprises for processing agricultural products, and management of natural resources (land, water, forestry, rangelands, etc.). The importance of agriculture sector in achieving the development objectives was also realized considering the fact the sector provided sustainable livelihoods for the vast majority of the population in the CAC countries that lived in rural areas and also to some in urban areas. This was a good enough reason to convince the policy makers in the governments that attention to and investments in agriculture sector were essential if the food security was to be achieved, the export trade was to be enhanced, ecological environment was to be preserved, the rural livelihoods were to be improved, and the reduction in poverty was to be achieved.

3.3. Current and Potential Contributions of ARD to Overall Development Goals

3.3.1. Current Contributions

Agriculture is of paramount importance in the CAC region because of the role it plays in the development needs of its countries. First, the sector, as emphasized earlier, supports the livelihoods of the large majority of the population in rural areas (from 36% in Armenia to 74% in Tajikistan), and to some extent in urban areas (FAO, 2007/08). In this, the role of the arable land, especially the irrigated, plays an important role in contributing to food security of these countries. In addition, the rural household farming (called *Dehkon* or Christian farming in the region or rural household plots farming/kitchen garden farming/mini-farming) involving several million households (for example, over 4 million in Uzbekistan) on small pieces of land provided around the houses (0-25-0-35 ha), is very common and supports the livelihoods of a large proportion of the rural and urban populations (up to 60% in Uzbekistan, for example), significantly contributes to food security and poverty reduction in the region. Second, the sector provides employment to a large population in rural areas (33.5% in Kazakhstan to 54.4% in Georgia) (UNESCAP, 2008), and urban areas (especially through *Dehkon* farming), and thus, supports the livelihoods of not only in rural but also in urban population of the region. Third, it significantly contributes to the GDP of the most CAC countries that range from 6.3% in Kazakhstan to 31.5% in Uzbekistan (FAO, 2007/08). Fourth, it is major source of hard currency earnings for some countries in the region, and fifth, the sector, as it utilizes the most important components of the natural resources that directly affect the environment, e.g., soil, water and plant biodiversity, assumes special significance in protecting the environment through the sustainable use of these natural resources.

Thus, the current contributions of agriculture assume special significance for ensuring food security, poverty reduction, and protecting the environment through sustainable use of the natural resources; all three important in the region's overall development needs. In addition, the region has a large area (256 million ha) of rangelands which provide the vital feed resource for livestock, important in biodiversity conservation, and could play important role in environment protection.



Cereals (wheat, barley), food crops (potato), cotton, horticultural crops (vegetables and fruits), livestock (small ruminants, sheep and to lesser extent goat, and cattle that provide meat and milk) are important agricultural commodities. The region has a rich genetic heritage of a large number of fruits, vegetables and nut trees (almond, walnut), which serve as good and stable sources of food supplies to the region's population and support their food security.

3.3.2. Scope for Potential Contributions

The CAC region has tremendous potential for contributing to agricultural development since the two important prerequisites, i.e., institutional infrastructure and human resources do exist in the region. In addition, traditional agricultural practices, rich genetic wealth (both plants

and animals) and vast arable areas and rangelands provide enormous potential for future agricultural development in crop production (food and commercial), livestock (both small and large ruminants for meat and milk and milk products), horticulture (fruits, vinery and vegetables), and agro-forestry. The region has inherited vast irrigation systems from the former Soviet Union for use in irrigated agriculture. Similarly, the region offers good conditions for livestock production due to vast rangelands. There is a tremendous scope of the use of quality seed of high yielding varieties, fertilizers and pesticides. Also, there is good scope for the conservation of the vast plant and animal genetic resources. Similarly, there is a good potential for diversification of agriculture in the region. Additionally, a large tract of land in Kazakhstan, with potential for agricultural production, is not exploited and kept fallow for various reasons for future use. All of these offer tremendous opportunities for food production and could immensely help in achieving food security and further reduction in poverty, and thus contribute to the regional development needs.

3.4. Challenges for Agricultural Research and Development in the Region

Of the eight challenges emphasized at the global level in Table 1, seven, namely, food security, protecting environment through natural resource management (biodiversity, soil, water, rangelands), efficient land and water use, climate change, improved trade, animal/plant/human health and food safety, nutrition: malnutrition, and human health are relevant and important challenges for the CAC region also. The energy security in the region, however, may be a lesser challenge in near future.

The review of the important reports of the region indicates that agriculture sector in CAC is presently facing many problems and challenges that have been caused by the breakdown of the former Soviet Union. The task has been, and continues to be, to address them to make agriculture sector sustainable and more responsive to the needs of the farming community and rural poor to improve their livelihoods, and to meet the agricultural development goals of the CAC countries. These challenges are driven by the needs for agricultural development in the region. Based on the review of different reports on CAC region, six major challenges have been identified for the CAC region in the Regional Research Review prepared by the Lead Consultant. These include:

1. Food security
2. Improving the declining living standards and improving livelihoods
3. Protecting the environment
4. Achieving structural reforms
5. Meeting the special challenges (both existing and future)
6. Strengthening national agricultural research systems

Four of these challenges are similar to the challenges which are important at the global level (Table 1). The challenges of structural reforms and strengthening national agricultural research systems in the region become highly important for the region which is passing through a transition phase.

3.5. Review and Synthesis of the Existing Research Priorities in Agriculture and Food

Pre-independence, there was no system of deciding priorities in agricultural research in the region as the research was conducted based on “orders” and support from the Ministries of Agriculture and from VASKHNIL (Soviet Academy of Agricultural Sciences) (ISNAR, 2001). These orders were focused on the achievement of production goals assigned to the republics. Post-independence, some confusion existed on the type of research that should be conducted and the responsibility of conducting the research. Thus, the choice of research was decided by the agrarian academies, institutes and agrarian universities till the responsibility of agricultural research was delegated in 1996 to agriculture ministries, agrarian academies, institutes or the newly created centers of agriculture research (Morgounov and Zuidema, 1998).

In 1995, research needs in different countries of the CAC region were first identified at the national and the regional levels through the first workshop in the region in which seven of the eight countries had participated (ICARDA, 1996). The regional needs could be clustered into six groups: (i) genetic resources conservation, (ii) germplasm enhancement, (iii) farm resources management, (iv) rangelands and livestock management, (v) seed production, and (vi) capacity building. These research needs were validated in the Meeting of the CGIAR Task Force on the involvement of the CGIAR in CAC region in 1996 in which all the eight NARS of the CAC region had actively participated.

Subsequent priority setting exercises were undertaken in September 2001 in Tashkent, Uzbekistan, and in May 2002 in Aleppo, Syria (Belaid et al., 2003). In these exercises, earlier identified research needs were revisited to find a global context and integrate them into CGIAR agenda for research. Based on revised analysis of constraints and opportunities for agricultural research and development in the CAC region, identified priorities were grouped into four thematic clusters (Germplasm management, Natural resource management, Socioeconomic and policy, and Cross-cutting issues) under three priorities (Annex 6) (Belaid et al., 2003; Paroda, 2007).

A review of the Final Report of the Expert Consultation on Regional Research Needs Assessment in Central Asia and the Caucasus jointly organized by GFAR, CACAARI, ICARDA-CAC in Tashkent in March 2007 showed that the regional problems requiring the attention of researchers were sorted out from the national priorities on the basis of regional commonalities (Paroda et al., 2007). Three broad thematic areas were identified: (i) Genetic Resource Management (GRM), (ii) Natural Resource Management (NRM), and (iii) Socioeconomic, Policy Research and Capacity Building (SPCB). Sub-sets of researchable priorities were identified the three thematic areas along with recommendations for partnerships (Annex 7).

3.6. Key Issues in the AR4D in Central Asia and the Caucasus

Key issues in the AR4D in Central Asia and the Caucasus were identified through three types of activities. These included:

- (1) A Regional Review Report prepared by the Lead Consultant for the CAC region
- (2) Electronic Consultation (e-consultation)
- (3) Face to-Face Meeting of the representatives of stakeholders in CAC.

3.6.1. As Identified in the Regional Review Report

The Regional Review Report “Key Issues in Agricultural Research for Development in Central Asia and the Caucasus”, prepared by the Lead Consultant for the CAC region, identified six key challenges for AR4D in CAC (Section 1.3 above). These are: (1) Food security, (2) Improving declining living standards and improving livelihoods, (3) Protecting the environment, (4) Achieving structural reforms, (5) Strengthening national agricultural research systems, and (6) Meeting the special challenges (both existing and new). The Review, based on the synthesis of gaps in six different challenges, identified 23 key issues in the six challenges. The full Regional Review Report is presented in Annex 9. A table summarizing the research needs including the research activities for CAC from this Regional Review is presented in Annex 10. The six different challenges identified in the review are depicted in Fig. 1.

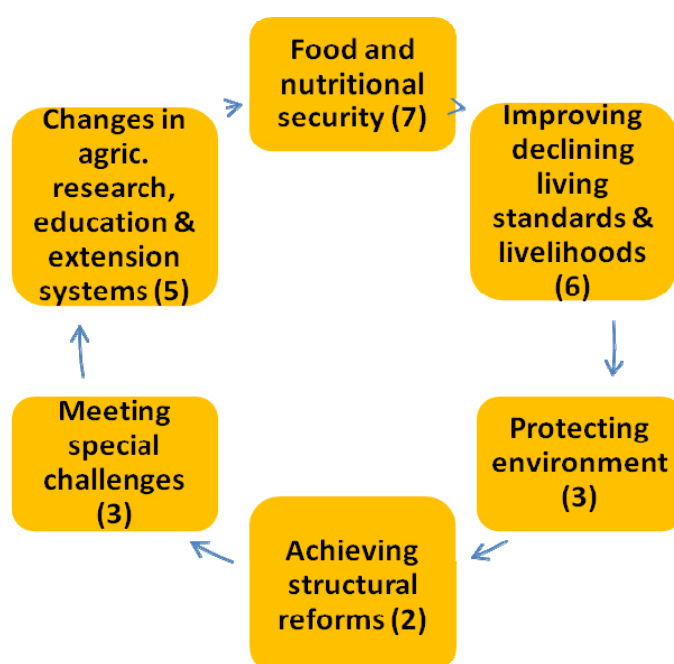


Fig.1. Six different challenges together with researchable issues under each category identified for Central Asia and Caucasus in the Regional Research Review.

The 23 key issues in six different challenges identified in the Regional Review are indicated below:

1. Food security

Key Issue 1: Provide effective financing of agriculture and farms to support newly-emerged small-scale farmers and *dehkon* (rural household farming/kitchen farming/mini-farming) in the region

Key Issue 2: Enhance the sustainable productivity of agriculture in the irrigated or rainfed/less-favored or “lagging” areas while protecting the natural resource-base

Key Issue 3: Need to explore the full potential of livestock sector in the region

Key Issue 4: Need to pay a much greater and special attention to horticulture sub-sector

Key Issue 5: Need to emphasize on research on fisheries and aquatic production systems

Key Issue 6: Need to pay attention to trans-boundary animal and plant diseases and pest

Key Issue 7: Need to develop and manufacture machinery for use by small-scale farmers

2. Improving the declining living standards and improving livelihoods

Key Issue 8: Study and analyze the declining living standards and livelihoods in rural areas and develop opportunities for household income generation

Key Issue 9: Improving the livelihoods of small-scale subsistence farmers in the mountains of CAC region

Key Issue 10: Organize and promoting the role of rural women in agriculture, and agricultural research and development

3. Protecting the environment

Key Issue 11: Enhancing efforts on protecting the precious land and water resources

Key Issue 12: Protect the much useful forests from degradation and embark on afforestation and agro-forestry programs

Key Issue 13: Enhance efforts on protecting precious vast natural biodiversity present in the region

4. Achieving structural reforms

Key Issue 14: Developing legal frameworks for land tenure, access and property rights

Key Issue 15: Improve the structures for irrigation to make irrigated agriculture to improve efficiency of the irrigated agriculture

5. Meeting the special challenges (both existing and future)

Key Issue 16: Aligning agriculture research and development to meet the challenges of global warming, i.e., adaptation to and mitigation of climate change

Key Issue 17: Need to address the issues that relate to Aral Sea problem considering its great importance and serious implications in environment and agriculture

Key Issue 18: Need to address the issue of desertification

6. Strengthening national agricultural research systems

Key Issue 19: Need for greater investments in agricultural research and restructuring of the research system to coordinate the national agricultural research system and to meet the national agricultural development goals

Key Issue 20: Introduce changes in agricultural education system in line with the goals of agricultural research and development

Key Issue 21: Creating an effective extension system for the country to create linkages with farmers, researchers and civil society organizations, and to facilitate technology transfer

Key Issue 22: Need for capacity development in research infrastructure and enhancing research capabilities of the researchers and technicians

Key Issue 23: Need to strengthen agricultural research and development linkages at sub-regional, regional, inter-regional and global levels.

3.6.2. As Identified in the E-Consultation

The e-consultation process in the CAC region was conducted from 3 – 23 September with active support from CACAARI and GFAR Secretariat. A total of about 200 messages from 120 participants were exchanged during the e-consultation process. Detailed report is given in Annex 11.

Key issues identified for AR4D

The CAC e-consultation participants endorsed the Regional Research Review Report and the key issues identified in the Report, which was shared with the participants. The key issues

highlighted by the participants to improve productivity and production and incomes and livelihoods of small-scale farmers during the e-consultation process are summarized below:

Food and nutritional security

- Improved technology for increased productivity and production of field (including cereals, pulses and potato) and horticultural crops (fruits and vegetable for which tremendous scope exists) in a sustainable manner in both irrigated and rainfed situations without affecting natural resource balance and environment
- Increased investment in agriculture and agricultural research, extension, and education and their restructuring
- Access to inputs including small farm machinery, fertilizers, credits, etc.

Emphasis on livestock sub-sector

- Livestock (both small and large ruminants) management in irrigated, rainfed areas and mountainous areas, where it supports livelihoods of large populations of subsistence farmers/herders in the region
- Forage and feed availability
- Rangeland regeneration and conservation
- Improved breed, insemination, livestock health, and transboundary diseases
- Processing and marketing of milk and milk products

Emphasis on and support to small farmers including women

- Education, training and learning opportunities
- Access to improved technology/innovations and inputs (improved seed, small farm machinery) through strengthened extension system
- Favorable policies on land tenure, access and property rights, micro credit, market accessibility, value addition, income diversification and taxation laws
- Socio-economic studies to understand their problems and constraints

Environmental issues

- Land and water degradation and management
- Soil fertility, Soil salinity, soil drainage
- Irrigation water and use
- Conservation of agriculture and crop diversification
- Climate change – adaptation and mitigation
- Carbon sequestration

Investment & support to agriculture and agricultural research

- Greater investment in agriculture and agricultural research by the governments and the private sector
- Support to repair the vast irrigation systems present
- Restructuring of research, extension and education systems
- Collaboration and linkages at institutional, national, sub-regional and regional levels
- Use of ICT in science, education and extension systems

Strengthening seed production systems

- Effective seed production systems for field (including potato) and horticultural crops and for forest trees at national levels
- Private seed enterprises

Protecting biodiversity

- Study, conservation and use of vast biodiversity in plants and animals of the region
- Gene banks for medium and long-term storage of PGR

Desertification problem

- Methods to control desertification
- Afforestation

- Agro-forestry
- Paying attention to fisheries
- Support to fisheries, an important source of food in the region and with tremendous potential for exports, to improve the incomes and livelihoods of fisher folks in the region
 - Research on fresh water and pond fishing and market research

3.6.3. As Identified in the Face-to-Face Consultation

A Face-to-Face consultation meeting was organized in Tashkent, 16-17 October 2009, and was attended by about 90 participants that represented research and educational institutions, farmers and farmer organizations, NGOs, policy makers, and private organizations. A detailed report is given in Annex 12.

Group discussions

Following presentations on CGIAR Strategy Research Framework (by Dr. Mohammad Roozitalab representing the CGIAR), GCARD Process (by Dr. Ajit Maru of GFAR) and the Regional Review and Results of e-Consultation (by Dr. Surendra Beniwal, Lead Consultant for CACAARI for the CAC region), group work under two Sessions were initiated. A guide to the Facilitators was provided to guide the Group work which had seven groups in each session. The participants actively participated in the discussions around these topics in both groups which were exciting. The group discussions and Plenary Sessions where the group discussion results were presented with follow up discussions took more than 75 per cent of the time of Workshop. The discussions on the various topics continued during tea/coffee breaks, lunches, bus trips to the venue and during reception and dinner.

In each group session there were seven groups that discussed the following:

Session I Groups

- Researchable Issues to support Dehkon Farmers
- Researchable Issues to support Small Farmers
- Researchable Issues to support Small to Medium Farmers
- Researchable issues to support Large Farmers to produce food and Agro-forestry
- Researchable Issues to support Mountain Farmers
- Researchable Issues to support Pastoralists and Livestock production
- Researchable Issues to support Forest dwellers

For this group a matrix of issues as identified during the regional review phase and e-consultations for various categories of farmers as the subject of development and various objects around commodities that farmers produced were listed for discussion about their importance, the priorities for research to be undertaken based on their importance and the time by which the research should make an impact were sought to be identified. The results on priority commodity areas/commodities and researchable areas were identified for different groups of farmers.

For crop producers, mixed crop/livestock production was recognized as a very common practice. Important crops considered were cereals (wheat, barley, maize), potato, vegetables and fruit crops, whereas cattle and sheep were important livestock. Cotton was considered as important for small-medium-large farmers. Forage crops were considered as important as animal feed. Among priority researchable areas for mixed crop/livestock production system

were access to inputs (seeds/saplings/breeds, fertilizer, credit, farm machinery, etc.), pest management, productivity increases at whole farm/ production system level, water/soil management, post-harvest processing, access to markets, access to knowledge and favorable policies for agricultural development.



For pastoralists, important researchable issues considered were livelihoods analysis improved technology for animal production, feed and forage supply, breed improvement and insemination, water access, preventive health care, processing and marketing of milk/meat products, organization of animal producers into cooperatives. Also considered important were use, renewal and conservation of rangelands including biodiversity conservation, innovation technologies and effective extension linkages.

For smallholder farmers in mountains, mixed crop/livestock farming was considered important. Access to inputs (seed/saplings/breeds, farm machinery and soft credit), land tenure and erosion, soil conservation, conservation agriculture on slopy lands, post-harvest processing, access to markets, capacity building and extension services.

For forest dwellers, soft and hard timber and non-timber products, rangelands and livestock, forest ecosystem and tourism and favorable forest development policies were considered important commodities. Among researchable issues, reforestation, integrated forest/livestock/fisheries production systems, access to improved seeds/saplings, harvesting, post-harvesting and marketing of non-timber products, indigenous knowledge, land degradation, capacity building and education through an improved extension system were considered important.

Session II Groups

- Investments in agriculture and agricultural research and change in agricultural research and innovation systems including capacity development
- Change in agricultural education, extension and advisory services including information and knowledge sharing through ICT

- Linkages, partnerships and collaboration at national, regional and International levels
- Biodiversity
- Climate change, land and water degradation
- Agro-forestry and afforestation
- Market-oriented, and socio-economic research for agricultural development

The seven group discussions provided good insights into the important researchable issues of different cross-cutting issues. The results of each group discussion were presented in Plenary Session which was followed by general discussion. The information on researchable issues was included in the exercise on the final voting.

Plenary Session

The final Plenary Session of the Workshop was based on voting on the key researchable issues identified during the two working groups using 16 flip charts and a sticker-based voting system where each participant was given 8 votes to choose farmer categories and themes, and 14 votes to choose from more than 100 researchable issues. These votes were counted and results summarized by the CACAARI Secretariat.

Based on the results of voting on different farmer (producer) categories and themes, the priorities could be summarized as follows:

Category	Priority
Producer	
Crop producers	1
Forest dwellers	2
Pastoralists	3
Horticultural producers	4
Fisher folks	5
Cross-cutting issues	
Improving agricultural extension & advisory system	1
Improving agricultural research and education system	2
Extension, knowledge sharing and ICT use	3
Marketing of agricultural commodities;	
Climate change	4
Gender/women issues	5
Biodiversity	6
Desertification	7
Land-related policies	8
Rangelands	9

The priorities on researchable issues (top five) under different categories of producers as rated by the participants could be summarized as follows:

Producer	Researchable issue
Crop producers	New improved varieties Improved seed Farm machinery Integrated pest management
Horticulture producers	Soil fertility Marketing services/advice Post-harvest processing New varieties Integrated pest management Machinery
Pastoralists (Animal producers) microenterprises	Formation of cooperatives, private Animal feed Improved breeds, insemination service, etc. Processing and marketing Animal health/disease prevention
Smallholders in mountains	Access to inputs (improved seeds/saplings/breeds, small farm machinery, credit) Soil erosion and conservation Conservation agriculture, crop rotation, organic farming Post-harvest processing, marketing Access to knowledge and extension services
Forest dwellers	Forest trees/improved plant varieties Livestock management Rangeland management Marketing of forest products Tourism and recreation

3.7. Most Important Researchable Issues in CAC

Based on the voting results and an overall assessment during e-consultation and the F2F consultation, the most important researchable areas and their corresponding researchable issues, on priority basis, in the CAC region are summarized as follows:

Major area	Researchable issues
Agricultural extension	New type of extension services, farmer advisory services, use of ICT, improving capabilities of extension agents, greater investment
Agricultural research and education system	Reorientation, greater investment, capacity building including information management technologies, changes in agricultural research management and funding systems

Crop production	Stress-tolerant improved varieties, improved seed, integrated pest management, soil fertility, conservation agriculture
Water resources & irrigation management	Soil salinity, irrigation management, crop management & diversification
Climate change and desertification	Drought management (adaptation & mitigation), rain water harvesting, agro-forestry
Livestock Research	Animal feed, health management and productivity increase in small, mixed farm systems, animal producers cooperatives, milk/meat processing
Horticulture	Especially fruits, vegetables and vinery, marketing, post-harvesting, new varieties, integrated pest management, organic production, improved seed
Mountain agriculture	Access to inputs (seeds/saplings/breeds, farm machinery, credit), soil erosion, soil conservation, conservation agriculture, crop rotation, organic farming, post-harvest processing, access to markets, extension services
Biodiversity	Conservation of PGR & AGR, documentation, utilization, Gene banks
Seed systems	Seed production systems (public & private), availability of improved seeds of crops (cereals, potato, pulses, fruits, vegetables, forest plants and trees, etc.) and also animals and fisheries
Marketing of agricultural commodities	Linking farmers to markets, market-related information, price information, building market organizations (cooperatives, private companies)
Gender/women-related issues	Learning and education opportunities, capacity building for innovation, farm management, microfinance, access to markets
Rangelands conservation,	Degradation management, renewal & Conservation of biodiversity, water access
Forestry	Reforestation, forest trees/improved plant varieties, livestock and rangeland management,

	marketing of forest products, tourism & recreation, non-timber products
Agricultural development policies	Investment in agriculture, land tenure, access, ownership and land-related issues, promotion for availability of small farm machinery, marketing policies, income diversification opportunities.
Linkages, partnerships, collaboration	At national, regional and international levels: Between government, private entrepreneurs, donors and beneficiaries, between MoA and other ministries and research and education, among different counties and their research and educational institutions in common interest areas, with international organizations

The identified 16 priorities could be grouped into the following five categories:

1. Institutional Issues
2. Research Issues
3. Policy Issues
4. Environment protection Issues
5. Socioeconomic Issues

4. ACTIONS REQUIRED TO SATISFY THE NEEDS

4.1. Research Priorities Identified for the Region

The GCARD review process in CAC region has helped in identifying the priority needs for AR4D in the region which could be grouped into the following categories:

Institutional Issues

Agricultural extension and advisory services
Agricultural research and education system
Linkages, partnerships, collaboration

Research Issues

Improved technology for sustainable crop production
Water and irrigation management
Livestock research including rangelands
Horticulture
Seed systems
Forestry
Mountain agriculture

Policy Issues

Marketing of agricultural commodities
Agricultural development policies

Environment protection Issues

Biodiversity
Climate and desertification

Socioeconomic Issues

Gender/women-related issues

4.2. How the Research Needs are being Satisfied?

It is important to know as to how the identified research needs are being satisfied by the NARS? In other words, are the identified priorities being addressed to properly or additional actions are required to achieve the desired outputs. The objective is to ensure that these priority needs are receiving due attention from the researchers, research administrators and/or policy makers, and to suggest the ways to satisfy them better.

4.2.1. Institutional Issues

4.2.1.1. Agricultural research and education system

Agricultural research and education systems in the former Soviet Union were of very high quality during the Soviet times. Post-independence, the newly independent countries could not maintain these research and education infrastructures and thus became obsolete. Also, the linkages through which agricultural research could contribute to innovation, the well being of producers and economy of the state were broken and ceased to exist. This was due to inability of the CAC countries to invest heavily in agriculture research which was required to maintain

them. The problems associated with the research system are indicated in Section 2.7.1 of this report.

Agricultural education systems in the CAC republics during the Soviet era were structured and organized based on needs of the then centrally-commanded systems of agricultural research and production. Post-independence, education systems failed because (i) the CAC countries could not sustain them because of lack of investment, (ii) they were dominated by the ageing academicians trained in the Soviet period, and (iii) could not attract students for want of opportunities for employment in the agriculture sector. The important issues that were identified for improving agricultural research and education system are reorientation, greater investment, capacity building including information management technologies, changes in agricultural research management and funding systems.

Actions required. The most important thing to do on priority basis by the CAC countries for agricultural research is to heavily invest in agricultural research and education to improve the existing research and education infrastructure and to create the required new infrastructure. Efforts by all the stakeholders of AR4D must be made to mobilize political support to achieve this. It must be emphasized that the returns for investments in agricultural research, education and development in countries, where agriculture is a key element of the livelihoods and welfare of the rural populations and significantly contributes to national GDP, are well documented and accepted internationally.

There is also a need to improve agricultural research and its innovative systems in accordance with the new rapid developments in agriculture sector of these countries. These will include (i) Reorientation of AR4D to satisfy the needs of smallholder producers and the market chain, meaning that the system has to become more inclusive in the research cycle and contributory to agricultural innovations at national, regional and even global levels, (ii) Reforms in the structure of the research system especially its accountability and reward systems so that it can attract active, young people with new skills and capacities for modern research of global standards, and (iii) Increased investment in infrastructure especially in knowledge generation and exchange infrastructure such as libraries and research publications. This will also require changes in funding the agricultural research.

There is a definite need for capacity development for effectively carrying out and achieve the set objectives of the agreed research agenda. It involves developing good infrastructure (buildings, facilities, equipment, etc.) for research and building scientific capacity of the scientists and technicians to carry out the required research activities to accomplish the set research objectives. The research areas that may need special attention are: use of biotechnology (including molecular markers) in crop and animal breeding, and plant genetic resources conservation and utilization; disease-resistance breeding; establishing seed systems; conservation agriculture; salinity management; agricultural engineering and farm machinery; policy and marketing reforms; competitiveness and trade; adoption and impact assessments.

Restructuring of the agricultural research system may also necessitate creation of an apex body in each country of the CAC region to effectively link and coordinate national agricultural research, education and extension. Placing all the agricultural research, education and extension institutions and programs of each country under this apex body would ensure effective linkages, coordination and collaboration among research, education and extension institutions. The advantage of having such an organization has been amply demonstrated in many of the developing countries.

The changes in research system would also involve strengthening innovation in agriculture using innovative approaches for this region. This would mean strengthening institutions (capacity building) for research in agricultural policy and investment, revamping farm investment support systems, seed systems, water management systems, land asset reforms especially around lease of land to small holders, Intellectual Property Rights, farmer organizations and ushering in new forms of farmer aggregation (not around cooperatives of the Soviet times but new types of farmer organizations, which aggregate farmers for input support and market participation), etc. This may also necessitate reorganization of the existing research institutions and modification of their mandates.

Action may also be required in introducing the coordinated research improvement programs for each of the major commodities and research areas/disciplines in each country headed by senior scientists/professors belonging to the commodities/research areas/disciplines. Such arrangements have paid heavy dividends in some of the developing countries that have used such arrangements. Another area which would require attention is formulating and enhancing cooperation at regional, inter-regional and global levels. Changes would also envisage empowering the civil society organizations (farmers organizations, NGOs, women's organizations, private organizations, agri-universities, etc.) to play an active role in deciding the national and regional agricultural research agendas and development goals.

The educational system in the CAC countries should be renewed to attract bright young people, train them appropriately according to world standards to meet national needs for research, extension and agricultural education to contribute to agricultural development in the CAC countries and the region. Also, agricultural education needs to be redesigned to focus on training in the use of biotechnology, ICT and material science for agricultural innovation and development. Moreover, education should be directed towards increasing market participation in the country, with region and with littoral states, and with the global markets. Additionally, the education system needs to be integrated with the needs of agricultural research, extension and development. In line with these, the curricula of the agricultural faculties will need to be updated to meet the needs of the new agriculture in the countries and the region, and in line with the world markets. Like in many other developing countries, education system in CAC countries also has to be involved in and share the responsibility of agricultural research and extension

4.2.1.2. Agricultural extension and advisory services

Agricultural Extension Systems of the conventional type to support farmers were not developed during the Soviet times. New forms of extension systems to support small holder farmers and producers, very different from the collective farms of the Soviet period, were also not developed and have taken their time to emerge lately. Thus, either lack of poor linkages between research, extension, farmers especially the women farmers, and the policy makers are the norm in the region. Needless to emphasize that the lack of this interaction has diluted the effectiveness of the technology transfer to farmers, who have thus been deprived of the new innovations in agricultural research for improving productivity and production, and led to missed opportunity for increasing their agricultural productivity levels. It has also adversely affected farmers' participation and role in exercises that set agenda for agricultural research and development. Important issues that have been identified in agricultural extension are new type of extension services, farmer advisory services, use of ICT, improving capabilities of extension agents, and greater investment

Actions required. It is now imperative that an effective extension system is put in place in all the countries of the CAC region which would help the farming community in more than one way. The new system would also need to develop an appropriate extension system that links to agricultural innovation systems and support smallholder agriculture and market participation. Thus, there is an urgent need to establish institutions to facilitate transfer new innovations to farmers for their use. These may include Farm Advisory Services Centers at district levels which would be staffed with trained personnel. There is also a need for a greater use of ICTs and for transforming extension for the emerging needs in AR4D in the CAC region. Special attention should be given to train extension agents to improve their capabilities and to make them efficient links between researchers and the farmers. To achieve all this, it is essential that the governments of different countries in the region make greater investments in extension system, a point which has been emphasized earlier as well.

4.2.1.3. Linkages, partnerships, collaboration

In addition to strengthening the research systems at the national level, linkages, partnerships and collaboration among them have to be developed at the national, sub-regional, regional, inter-regional and with the global research systems considering the merits of these linkages. Issues that have been identified as important include linkages, partnerships and collaboration at national, regional and international levels; among government, private entrepreneurs, donors and beneficiaries; between MoA and other ministries and research and education; among different counties and their research and educational institutions in common interest areas; and with international organizations and donor agencies.

Actions required. The linkages, partnerships and collaboration mentioned above are important and, therefore, it is important to establish and formalize these through the government channels and requirements to make them officially recognized and sustainable. At the national level, effective linkages and partnerships are required between research, education and extension and also with different AR4D stakeholders and among different research institutions. Joint sub-regional/regional actions could address and provide good solutions to complex natural resource management problems and trans-boundary domains (hydro-salinity, rangeland management, livestock production, water-use efficiency, conservation agriculture, diseases and pests, mechanization for small-scale farming, climate change, and issues relating to vegetables and fruits and biodiversity. ICARDA and the CGIAR program for sustainable agriculture in development in CAC have been playing an important role in establishing and strengthening these linkages since 1995. In this, organizations such as CACAARI, AARINENA, and APAARI through GFAR support can also play important roles in establishing and assisting in these linkages at the regional and global levels.

4.2.2. Research Issues

4.2.2.1. Improved technology for sustainable crop production

Production of crops is considered a high priority in the region to achieve food and feed security (wheat, barley, maize, etc.) and to earn hard currency (in case of cotton) especially in the irrigated areas. In the CAC region, there is enormous potential for sustainable crop production by using the existing crops. The key researchable issues identified in improved technology for crop production are stress-tolerant improved varieties, improved seed, integrated pest management, soil fertility and conservation agriculture.

The CAC NARIs are paying attention to all these five important researchable issues in order to provide an improved technology for crop production in the irrigated areas. The crop germplasm improvement programs in all the countries are receiving improved germplasm of wheat, barley, maize, rice, food legumes from the CGIAR Centres involved in the improvement of these crops. Countries are trying to supply improved seeds to farmers. The three other researchable issues, namely, integrated pest management, soil fertility and conservation agriculture are presently receiving much less attention than what they need.

Actions required. The CAC NARS should pay a greater attention to strengthen their major crop improvement programs. Likewise, they need to pay a greater attention to production of improved seeds, integrated pest management, soil fertility and conservation agriculture. In the CAC region, there is also enormous potential for sustainable crop production by introduction of new crops in the crop production systems (crop diversification). There is also a need to increase production in the rainfed or “less-favored” or “lagging” areas (World Bank, 2008), where agricultural production, which is significantly limited by factors such as moisture due to low and variable rainfall, recurrent droughts, extreme temperatures, short cropping season, shallow and nutrient-depleted soils, socio-economic factors and lack of infrastructure, is always lower than the irrigated areas as they generally receive less and variable rainfall. However, it should be remembered that the irrigated areas are very limited in the countries of the CAC region, and thus, the efforts on sustainable increases in productivity must ensure that the inputs, especially the scarce water, are judiciously and efficiently used, and that the natural resource-base is protected. Another important action that the governments need to take up is to encourage the local production of small machinery for use by the smallholders including those on the mountains.

4.2.2.2. Water resources and irrigation management

Water and irrigation management becomes important especially in Central Asia because of the presence of the two major rivers Amudarya and Sirdarya. Although water presently seems sufficient but predictions are that the sub-region may face water shortage if the available water is not properly managed and used. Moreover, it should be remembered that the irrigated areas are very limited in the countries of the CAC region, and thus, the efforts on sustainable increases in productivity must ensure that the inputs, especially the scarce water, are judiciously and efficiently used.

The important researchable issues include soil salinity, irrigation management, crop management and diversification of which soil salinity and water and irrigation management are important issues are receiving attention of the NARS. Crop management and diversification are not receiving as much attention as they deserve.

Actions required. Soil salinity and water and irrigation management must receive much greater attention as they are important issues. Similarly, crop management and diversification must receive a much greater attention than what they are presently receiving. Together with these, the governments in the region must pay attention to restoring/repairing the large irrigation systems that they inherited from the former Soviet Union, which have deteriorated over the years for want of financial resources to repair them.

4.2.2.3. Livestock research including rangelands

Pre-independence, the CAC republics had rich diversity in livestock populations which were productive and were supported by well managed and grazing-controlled large rangelands for

grazing and by other feed resources, which were also well organized. Post-independence, the system could not be sustained for want of grazing controls and lack of feed resources. As a result, the livestock productivity and production significantly fell, and even the livestock populations dropped significantly. All this adversely affected the availability of meat and dairy products in the countries of the region and also the income of the livestock farmers. Similarly, overgrazing, mismanagement and use of the rangelands for barley cultivation has led to irreversible degradation of rangelands, and also irreversible loss of precious biodiversity. The region has huge demands for livestock products internally and also huge potential to produce for the international market.



The important researchable issues identified in livestock research are animal feed, health management and productivity increase in small and mixed farm systems, animal producers cooperatives, milk/meat processing. The issues in rangeland management include degradation management, renewal & conservation, conservation of biodiversity and water access. The work on animal feed has received attention in Central Asia. Also, there is good scope for work on increasing productivity in small and mixed farm systems. Very little work has been done on organizing animal producers' cooperatives and milk/meat processing. Some work on rangeland degradation management, renewal and conservation, conservation of biodiversity and water access have been done

Actions required. The CAC NARS need to pay much greater attention to animal feed and to increasing productivity in small and mixed farm systems. There is a tremendous scope of work on organizing animal producers' cooperatives and milk/meat processing. Similarly, work on rangeland degradation management, renewal and conservation, conservation of biodiversity and water access must receive much greater attention considering the importance of rangelands in livestock production.

4.2.2.4. Horticulture

The region has a rich heritage of different types of vegetables, fruits and vinery production. The region has tremendous potential to develop horticulture, which is very important for providing nutritional security to the people in the region. There is a huge local demand and also the capacity to compete in International markets. The researchable issues include vegetables, fruits and vinery, marketing, post-harvesting, new varieties, integrated pest management, organic production and improved seed. The research priorities developed so far have not really been deeply considered in this area for the region. Therefore, this area deserves special attention.

Actions required. The identified priority researchable issues must receive urgent attention from the researchers and research administrators in order to improve the horticulture sub-sector which has immense potential for improvement. In vegetables, The World Vegetable Center, which has been having successful collaborative research program on vegetable improvement in the region, could further play an important role which the region must take advantage of.

4.2.2.5. Seed systems

There is immense potential to develop proper seed system in the region for which there is huge scope and demand. The current seed systems in different countries of the region are not well developed either in public or private sector. The potato seed system in most countries of the region is in the hands of the European countries, which provide potato seeds at higher costs. This situation also does not allow the local potato seed systems to develop and compete. The identified researchable issues include seed production systems (public & private), availability of improved seeds of crops (cereals, potato, pulses, fruits, vegetables, forest plants and trees, etc.) and also of animals and fisheries. If paid proper attention the results of the work on the issues will certainly help improve productivity and production of different crops and also animals and fisheries in the region.

Actions required. There is an urgent need to take steps to address the identified researchable issues. First task is to encourage and assist in the development of local seed systems in all the countries of the region as it will contribute to the sustainable crop, animal and fisheries production. Also, actions are required to establish a seed delivery system which would allow the availability of improved seeds at proper times and costs. The identified issues must receive attention of the researchers and research administrators.



4.2.2.6. Forestry

Forests are a valuable resource in all the countries of the CAC region. In the past, they were given utmost attention to nourish and protect them. Now, signs of forest degradation are visible in most countries of the region. Protection of forests and encouraging agro-forestry becomes important in view of advancing desertification and climate change in the region. Considering this, there is an urgent need to protect forests from further degradation. The identified researchable issues include reforestation, forest trees/improved plant varieties, livestock and rangeland management, marketing of forest products, tourism & recreation and non-timber products.

Actions required. Concerted efforts are required by all to protect forests from further degradation and embark on appropriate afforestation and agro-forestry programs/campaigns in the region. Attention needs to be paid on other researchable issues such as developing stocks of forest trees/improved plant varieties for use in afforestation and agro-forestry programs. Marketing of forest products and tourism and recreation also deserve special attention. And so does marketing of non-timber products.

4.2.2.7. Mountain agriculture

Mountain areas in CAC region, important especially in Azerbaijan, Georgia, Tajikistan, Turkmenistan, and Kyrgyzstan, support the livelihoods of significant proportion of the region's population. The productivity of the subsistence farming systems in mountains on sloping lands, mainly dryland, is low, thus, making the population as one of the poorest in the

region. This, together with the harsh living conditions, promotes out-migration and land abandonment. Barley and potato cultivation and migratory small ruminant production are the main sources of subsistence to the population. Soil erosion by water run-off, managing slopy lands and degradation of grazing lands are major problems. The researchable issues identified for the mountains include access to inputs (improved seeds/saplings/breeds, small farm machinery, credit), soil erosion and conservation, conservation agriculture, crop rotation, organic farming, post-harvest processing, marketing, and access to knowledge and extension services.

Actions required. Serious attention to mountainous agriculture is required in all the mountainous countries in the region to improve the livelihoods of their people. Sincere actions are urgently required by the governments and the donor countries/organizations to attend to the important issues in these areas to ensure overall development of the mountainous areas. To achieve this, research/development work on resource conserving, more productive methods of land use, availability of inputs including small farm implements and machinery, assistance in post-harvest processing and marketing and access to knowledge and extension systems. There would be a strong need for activities on diversification of income sources. All this mean that the task is huge but achievable.

4.2.3. Policy Issues

4.2.3.1. Agricultural development policies

Designing suitable agricultural policies and decision-making processes suited to country's socio-economic conditions are a prerequisite to develop and implement an appropriate research system for development. The important issues that have been identified in agricultural development policies for the CAC region include investments in agriculture; land tenure, access, ownership and land-related issues; promotion for availability of small farm machinery; marketing policies for agricultural commodities; and creating income diversification opportunities.

Actions required: The prerequisite for achieving success in important policy-related issues is to design suitable agricultural policies and decision-making processes. It should be remembered that the policies should be designed to suit the country's socio-economic conditions. The best possible policy issues for different governments of the region would be to (i) increase investments in agriculture (including research education and extension) and rural sector, (ii) increase the assets of the poor households, (iii) make farm households and agriculture more productive, and (iv) create opportunities in the rural non-farm economy for the farmers and rural poor to supply to modern food markets in their countries and the region.



The most important policy issue is to increase investments in agriculture and rural sector without which much progress should not be expected. For this, there is an urgent need to strengthen the advocacy role which presently is weak. Best results could be achieved by reaching the policy makers in developing countries outside agriculture, e.g. planning, finance and rural development ministries and other sectors dealing with science departments. This is achievable by mobilizing the political support in which different stakeholders of AR4D in the countries of the CAC region and also the international organizations dealing with AR4D including the CGIAR should play a pivotal role.

After dismantling large collective/cooperative farms after independence, the countries in the CAC region allotted their farm lands to prospective farmers who were earlier workers in the large farms. Some countries in the region made arrangements to lease lands to the farmers on long-term basis while the others gave ownership rights to the farmers. Although some countries have done it, now it is time and need for all the countries to make reforms and develop legal frameworks on land tenure, access and rights to the properties. Land ownership is known to go a long way in providing stability to the small famers, and indirectly help land improvements and their protection from land degradation

It is important to adopt policy actions that would make farm households and agriculture more productive. This would mean developing opportunities for the farm households to be more productive by providing them training and opportunities for different skills (e.g. for value addition to their products) so that they could diversify their household incomes. Likewise, agriculture must be made more productive by improving their farm productivity by diversification of the farming systems. For this, the governments in the region will have to ensure the availability of inputs including improved seeds, fertilizers and small machinery to the smallholder farmers. And above all, the governance of agriculture would have to be improved.

The governments should also take necessary steps to create opportunities for the rural and mountain non-farm economy for the rural poor to improve their skills and capabilities so that they are able to supply products to the modern food markets in their countries and the region. This will require increasing access of the rural and mountain poor to assets, improving the asset use by creating and supporting rural institutions for competitiveness with emphasis on territorial development to improve the nonfarm economy, and providing social assistance. This will also require improving the skills of the farmers to provide them access to the jobs in the new non-farm economy. In this, involvement of private sector will be required.

It will be required that the governments in the region now should develop suitable policies for marketing of agricultural commodities. These should include reforming trade, price and subsidies, bringing agriculture to the markets and support smallholder competitiveness through institutional innovations (innovations through of science and technology). The small farmers will need to be organized and prepared by providing the required support to prepare their products for new food markets that are fast emerging in the region.

4.2.3.2. Marketing of agricultural commodities

Marketing of agricultural commodities in the CAC countries is done through informal systems developed basically by traders. Under this arrangement, farmers supply their produce to traders according to the process and prices determined by traders based on market supply and demand.

In this process, farmers generally get lower price for their produce than what they should be getting and are thus losers. The important issues identified in marketing of agricultural commodities that need priority attention are linking farmers to markets, market-related information, price information, building market organizations (farmers' cooperatives, private companies).

Actions required. Some required actions to improve marketing have been discussed above in Section 4.2.3.1 Agricultural development policies. In addition, policy issues on marketing of agricultural commodities will need to focus on providing farmers the services on market-related information, price information, and to build their cooperatives and small enterprises.

4.2.4. Environment Protection Issues

4.2.4.1. Protecting biodiversity

The CAC region has rich heritage of diverse vegetables, fruits, vinery and nut trees. It is visibly seen in any local markets even in the rural areas. In addition, there are diverse plant



species in the vast rangelands of the region. In the erstwhile Soviet Union, the Vavilov Institute of Plant Genetic Conservation in Tashkent used to serve as a regional repository for PGR of field crops, vegetable crops and grapes for the whole of Central Asia. Similarly, the Grapes Research Institute and Vine Making in Tbilisi was the repository for grape varieties for whole of the Caucasus. The region has made good progress on establishing gene banks in each of the eight CAC countries due to ICARDA's efforts. Also, the region has made a good progress in germplasm documentation and utilization from their gene bank collections. Similarly, efforts in breed characterization of the prevailing small ruminants in the region have provided some very useful information. Moreover, characterization of the prevailing biodiversity in range vegetation and its conservation is important in the region. The CGIAR Program for Sustainable Agriculture Development in CAC has significantly contributed, and continues to do so, to biodiversity collection, conservation (both *ex-situ* and *in-situ*), evaluation, documentation, maintenance and utilization of field, fruit and nut crops, vegetable crops through their collaborative work with the CAC NARS through ICARDA, Biodiversity International and The World Vegetable Center. Work is also in progress on conservation of field crops with the Norwegian Gene Bank in Tajikistan and Kyrgyzstan.

Actions required. Although, the CAC countries are currently paying attention to biodiversity conservation through in collaboration with the CGIAR Program and the Norwegian Gene Bank, but considering its importance the work needs much greater attention from the CAC countries. For this, investments are required by the respective governments to support and facilitate this important work of conservation (both *ex-situ* and *in-situ*) of the precious plant genetic material for future use. Efforts on capacity building for collection, conservation, evaluation and utilization will be required.

4.2.4.2. Climate and desertification

Considering the phenomenon of global warming, the problem of climate change which is already adversely affecting agriculture and its production especially in the drier regions of the world, is expected to be a recurrent phenomenon in future. Therefore, the CAC region should also prepare itself to face the consequences of the climate change.

Similarly, desertification is a major issue in Central Asia sub-region of the CAC region, which is associated in some ways to salinity and water-use issues. If not addressed properly, it can have devastating consequences in reducing the cultivated area and adversely affecting agriculture in Central Asia.

Actions required. To successfully face the problem of climate changes, a better understanding of the effects of climate change on agriculture would be required. Also, measures for adaptation to the climate change will have to be developed for plant and animal production, which will involve development of new plant varieties and agricultural practices in case of plants, and efficient animal husbandry practices in case of animals. The region would also need to be prepared for the mitigation measures to handle the ill effects of climate change.

Similarly, it is now time that to take appropriate actions to arrest desertification in Central Asia. Researches on how it is affecting agriculture and how to arrest its further spread need to be undertaken and implemented on an urgent basis.

4.2.5. Socioeconomic Issues

Although the region's agriculture lately has shown some recovery and is now heading for a stabilized situation (although at a level much lower than the potential), it would be useful to study the socioeconomic issues including analysis of the livelihood patterns in rural areas and the gender-related issues.

4.2.5.1. Gender/women-related issues

Although the region's agriculture has shown some recovery and now heading for a stabilized situation, it would be useful to study and analyze the livelihood patterns and the poverty levels in rural areas. It would also be useful to augment their income if their standards of living are to be improved.

Actions required. It would require a serious study and analysis of livelihoods patterns and the poverty levels in rural areas. The income of farmers could be improved by increasing their earned income in agriculture by diversifying of the activities with the agricultural products that they produce and by improving the rural non-farm economy. This will require increasing access of the rural poor to assets, improving the asset use by creating and supporting rural institutions for competitiveness with emphasis on territorial development to improve the non-farm economy, and providing social assistance. In this, involvement of private sector will be required. In the context of CAC region, small farmers will need to be organized and helped by providing the required support for new food markets that are fast emerging in the region. This will also require improving the skills of the farmers to provide them access to the jobs in the new non-farm economy.

4.2.5.2. Analysis of livelihoods patterns

Rural women play a recognizably active and important role in small-scale farming in the CAC region. They also add to the income of their households by actively participating in the farming of the small pieces of land around their homes and selling the produce to local markets. This role contributes to achieving their household food security and also to the urban food security. However, these women have no voice in decision-making processes.

Actions required. It is time to recognize the importance women in contributing to agriculture and the household income in all the countries of the CAC region. Thus, there is an urgent need to help them organize and promote their role in agriculture and decision-making, including the role in setting priorities in AR4D. Since the women in the region play a significant role in marketing of farm produce they need to be trained in market-related issues to make them more efficient in marketing of their produce and dealing with the traders in local markets.

4.3. Identifying Appropriate Development Pathways

The GCARD review process has provided some very useful information on the priorities for AR4D in Central Asia and the Caucasus. Now, the NARS should take lead to take steps to initiate actions to implement the prioritized issues. An important step in this would be to identify appropriate development pathways which could be adopted in different countries of the region to get the desired development. For an example, for improving agricultural extension and advisory system, which was considered as the most important researchable issue for the CAC, would require different steps in the development pathway. This would require: identification of the requirements, need analysis, consideration of the existing models elsewhere or design new models, test implement them through action research, evaluation, advocating their replication and enlargement, and large-scale adoption. For this, new changes in policy, structures such as coordinating/regulating body, linkages, investment including of the private sector, capacity development, new information platforms, etc. would be required. The process is depicted below:

Action required	Researchable issue
Identifying requirements	New type of extension services, Farmer advisory services, Use of ICT, Improving capabilities of extension agents
Need analysis	Existing system and needs for the new type
Researching	Existing models elsewhere or design new models Test implementation them through action research Assessment and evaluation Advocate their replication and enlargement Large-scale adoption
Policy changes	National policy (for telecom) New structures such as a coordinating/regulatory body Linkages between research, extension and education Investment including private sector Capacity development New information platforms

Such development pathways will need to be worked out for all the prioritized researchable issues identified for Central Asia and the Caucasus.

4.4. Need for an Integrated Approach for Satisfying the Needs

The experience in different parts of the world has clearly shown that agricultural research alone has not been able to achieve agricultural development and improve the livelihoods of farmers. There are a number of basic reasons for this situation. First, there are other essential elements together with the research that play an equally important role in the success of

agricultural development and improving the livelihoods of farmers. Second, the NARS have failed to take lead on improving the livelihoods of the farmers and on poverty reduction. Third, there is lack of political will and in the leadership of the country. Therefore, an integrated approach must be adopted by the countries themselves if the desired goal of agricultural development is to be achieved in the developing countries. The six essential elements which are important for ensuring agricultural development and improving the livelihoods of farmers include (i) Strengthening innovation system (Research, education and extension), (ii) Making the technology available, (iii) Developing favourable policies to create a favourable policy environment including greater investments in agriculture research and development and rural sector to bridge the “underinvestment gap” and addressing the gender issues, (iv) Increasing farmers’ assets, (v) Income diversification of farmers and people in rural areas, and (vi) Providing services to farmers for post-harvest processes, marketing, etc. Thus, an integrated approach by simultaneously ensuring the implementation of these six key elements should result in good agricultural development and improving the livelihoods of farmers and rural poor.

Details on the five key elements are discussed in Sections 4.1 and 4.2, whereas Figure 2 shows the components of the integrated approach.

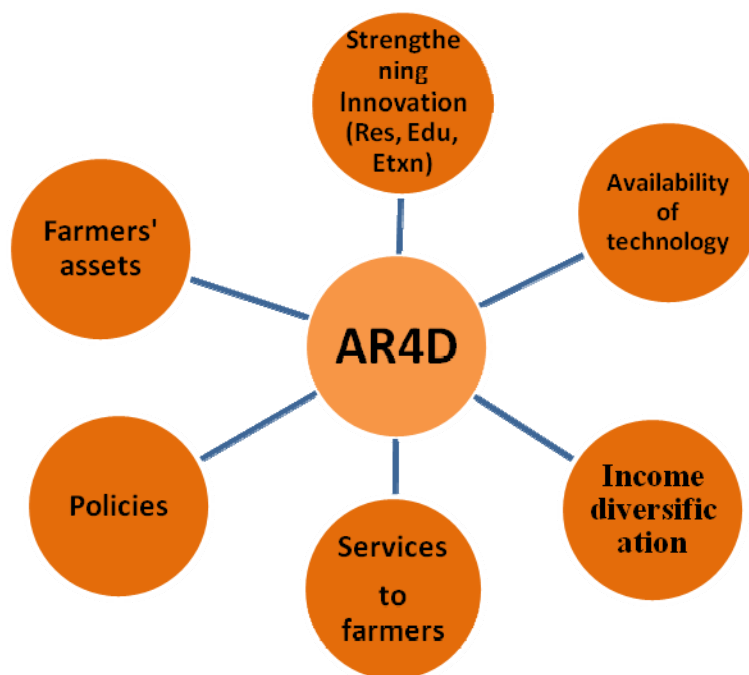


Figure 2. Important components of the integrated approach to ensure agricultural research for development in Central Asia and the Caucasus.

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ANNEXURE

ANNEX 1. Land use (1000 ha) in the countries of Central Asia and the Caucasus, 2006

CAC country	Total land	Pasture lands	Arable Land
Armenia	2820	1155	402
Azerbaijan	8264	2694	1841
Georgia	6949	1940	462
Kazakhstan	269970	185098	22700
Kyrgyzstan	19180	9376	1284
Tajikistan	13996	3768	750
Turkmenistan	46993	30700	1880
Uzbekistan	42540	22000	4350
Total	410712	256730	33669

Source: FAO, Statistical Yearbook 2007 – 2008.

ANNEX 2. Poverty and GDP in Central Asia and the Caucasus

Country	Population living below \$1.25 (2005 PPP) a day				Population living below the national poverty line		GDP per capita (PPP US\$)
	Percentage				Percentage		
	1990	1996	2002	2005	2005	2007	2007
Armenia	- ^a	17.5	15	10.6	55.1	50.9	5392
Azerbaijan	-	15.6	6.32	0.03	68.1	49.6	7058
Georgia	-	4.5	15.1	13.4	52.1	54.5	4405
Kazakhstan	4.21	5	0.51	3.1	34.6	15.4	10223
Kyrgyzstan	18.61	31.8	34	21.8	47.6	43.1	1869
Tajikistan	-	44.5	-	21.5	-	74.9	1656
Turkmenistan	63.53	24.8	-	-	-	-	4826
Uzbekistan	-	32.1	42.3	46.3	-	27.5	2308

^aData not available.

Source: World Bank, PovcalNet (online database, accessed on 12 November 2008).

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ANNEX 3. Population and importance of agriculture in Central Asia and the Caucasus region, 2006

CAC country	Total population (mln)	Percent of rural population of total	Percent share of agriculture in total GDP	Agricultural employment
Armenia	3.010	36	17.7	10
Azerbaijan	8.406	48	9.0	24
Georgia	4.433	47	14.6	17
Kazakhstan	15.314	43	6.3	15
Kyrgyzstan	5.259	64	32.0	22
Tajikistan	6.640	74	25.7	30
Turkmenistan	4.899	52	21.2	31
Uzbekistan	26.298	63	31.5	24

Source: FAO, Statistical Yearbook 2007 – 2008.

ANNEX 4. Proportion of women and men employed in agriculture sector, 2007

Agriculture						
Country	Female		Male		Share of women in agricultural labor force %	% of total employment
	Percentage					
	2001	2007	2001	2007	2007	2007
Armenia	- ^a	-	-	-	21.4	46.9
Azerbaijan	53.7	45.2	54.8	33.4	52.4	39.3
Georgia	50.6	50	50	26.7	39.8	54.4
Kazakhstan	46.4	46	54	28.7	26.2	33.5
Kyrgyzstan	45.9	42.5	57.5	33.9	36.1	48.0
Tajikistan	-	-	-	-	52.2	49.8
Turkmenistan	-	-	-	-	51.9	-
Uzbekistan	-	-	-	-	45.4	41.4

^a Data not available;

Source: Calculated by ESCAP using data from International Labour Organization, Key Indicators of the Labour Market Fifth Edition (online database, accessed on 21 May 2008).
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ANNEX 5. Agricultural Research Institutions, CAC countries

Country	NARS Organization 1997	NARS Reforms	NARS Superior Body	Situation in 2009 ^a
Armenia	Ministry	1998	MoA	MoA
Azerbaijan	Inst. Agr.	-	MoA	MoA
Georgia	Agr. Academy	-	CoM	MoS
Kazakhstan	Ctr. of Agr. Res.	1996	MoS-Acad. Sci.	MoA
Kyrgyzstan	Agr. Acad.	1995	CoM	MoA
Tajikistan	Agr. Acad.	-	MoA	MoA-Agr. Acad.
Turkmenistan	Inst. Agr.	1996	MoA	MoA
Uzbekistan	Ctr. of Agr. Res.	1996	CoM	MoA-Ctr. of Agr. Res.

Source: Morgounov and Zuidema (1998).

^a = Based on the present situation

MoA = Ministry of Agriculture

MoS = Ministry of Science

CoM = Council of Ministers.

ANNEX 6. Research priorities for Central Asia and the Caucasus

Priority	Germplasm Management	Natural Resource Management	Socio-economics	Cross-cutting Issues
Priority 1	Germplasm Improvement and biotechnologies	Water, Soils, Rangelands	Marketing, commerce and trade, Post-harvest technologies	Human resource development, Capacity building, Information &
Priority 2 rights, management	Genetic resource conservation Seed production, Diversification	Biodiversity	Quality & added value, Institutional policies	Intellectual property Crisis & risk
Priority 3	Integrated pest management	Integrated crop management	Impact assessment	Biosafety & quarantine, Indigenous knowledge

Source: Belaid et al. (2003); Paroda (2007).

ANNEX 7. Thematic areas and sub-sets of researchable priorities identified for Central Asia and the Caucasus in a Needs Assessment Workshop, Tashkent, 2007

Thematic Sub-sets of priorities area	Researchable priority in each sub-set
GRM ¹	<p>Exchange of Genetic Resources</p> <ul style="list-style-type: none"> - Adoption of SMTA as by ITGRFA-FAO for speedy exchanges - capacity building for sanitary and phytosanitary regulations in PRA (Pest risk Analysis) -Development of unified quarantine standards and testing programs for new breeding/germplasm materials <p>Documentation of Information on Genetic Resources - Capacity building in GIS, DNA-finger printing, etc.</p> <ul style="list-style-type: none"> - Documentation of germplasm and publication of catalogues <p>Conservation of Genetic Resources</p> <ul style="list-style-type: none"> - Accelerate the pace of germplasm collection missions to make up for existing deficiencies/gaps in priority crops, especially for their wild relatives and landraces -Strengthening ex situ conservation in Gene Banks -Capacity building for PGR conservation, evaluation and use -Strengthening in situ conservation in selected priority crops -In vitro conservation practices (tissue/cell culture, micro-propagation, cryo-conservation) - Monitoring and regeneration of valuable collections/old varieties/landraces -Evaluation for resistance to biotic and abiotic stresses under epiphytotic conditions, genetic potential <p>Germplasm Enhancement</p> <ul style="list-style-type: none"> - Strengthening of crop improvement programs in economically important crops for quality, early-maturity, salt, drought, and cold tolerance, resistance to diseases and pests in wheat, food legumes, potato, tomato, cucumber, pepper, grapes, and alfalfa -Exploitation of heterosis (hybrids) for cotton, rice and maize for better productivity Figure 6. Clonal selection in potato in CAC -Testing, identification and use of salt-tolerant plants (alfalfa, rice, sorghum, pearl millet, barley, amaranth, salt bush (Atriplex) and tree species) - Capacity building for use of marker-assisted selection and other advanced biotechnology tools and methods Policy advocacy for strengthening current breeding efforts (plants and animals) <p>Need for a Regional Strategy on Use of Biotechnological Tools in Crops</p> <ul style="list-style-type: none"> - Cotton, soybean, potato - Biosafety regulations in partnerships with national and international research organizations - Clear regional strategy/positions relating to testing and use of GM crops -Partnership and collaborating mechanisms among Gene Banks, PGR, research institutes, botanical gardens, animal farms, breeding stations, universities, international centers and support of international organizations (FAO, CGIAR Centers, etc.), NGOs, funding agencies (such as GCDT, Sida, ACIAR, USAID, etc.), private sector etc. - Capacity building of national systems <p>Conservation, Documentation, Enhancement and Utilization of Animal Genetic Resources - Especially small ruminants</p> <ul style="list-style-type: none"> - Documentation and conservation of unique breeds of sheep, horse, camel and yak
NRM ²	<p>Management of Saline Environments secondary salinization in saline seep</p> <ul style="list-style-type: none"> - Geo-referenced soil salinity assessments and prognosis of salinization in saline seep areas/irrigated areas - Assessment of cyclic salts/aerosols from Aral Sea - Crop losses due to salinity in river basins - Water quality standards for different cropping systems - Land Reclamation <ul style="list-style-type: none"> -Role of Rice-Wheat (R-W) systems and salt leaching -Crops, cropping systems, crop cultivar choices -Need for amendments -Biodrainage, halophytes and crops (alfalfa, rice) -Screening of salt-tolerant crop species <p>Water Management, Water Use- Optimizing and determining improved irrigation systems: design Efficiency and Water Quality in parameters for various conditions</p> <p>Irrigated and Dryland/Rainfed Areas</p> <ul style="list-style-type: none"> - Cropping system choices (crop selection and selection of water stress-tolerant crops) - Deficit irrigation

	<ul style="list-style-type: none"> - Conjunctive use of surface, ground and drainage waters - Irrigation scheduling for multi-quality waters - Supplementary irrigation in rainfed areas - Management of crop residues in Conservation Agriculture for soil/water conservation, fine-tune irrigation and fertilizer practices.
Crop Diversification	<ul style="list-style-type: none"> - Introduction of agri-horticulture/forestry - Introduction of legumes and new crops -rice, soybean, mung bean, alfalfa, rapeseed, chickpea, field (dry) peas, safflower, etc.
Land and Water Degradation - Biodiversity and Soil Fertility	<ul style="list-style-type: none"> - Assessment of wind and water erosion and geo-reference 'hot spots' Loss of and other critical areas for priority treatments - Assessment of the dynamics of river water quality -salinity, other pollutants - Assessment of traditional conservation technologies and improving them for enhanced efficiency - Introduction of conservation agriculture (zero till, raised-bed planting, contour, etc) - Crop residue management, controlled traffic, etc., and fertilizer practices) - Agro-forestry/agri-horticultural, cover crop systems for improved livelihoods and soil and water conservation - Role of legumes in soil fertility – including fertilizer practices in presence of crop residues, conservation agriculture
Pastures and Range Management	<ul style="list-style-type: none"> - A geo-referenced assessment and monitoring of pastureland Degradation - Rangeland management grazing, etc. - Rehabilitation of rangeland (residuals, water harvesting, protection) - Increase productivity of rangelands for integrated livestock production (fertilizer use, agri -forestry/horticulture and livestock, etc.)
Environmental Quality Concerns	<ul style="list-style-type: none"> - Assessment of cyclic salts/aerosols from Aral sea and its effect on environment - Assessment of crop losses due to salinity in river basins and salinity management - Water quality standards for continental dry areas for different cropping systems - Reuse of low quality water (saline, drainage and sewage) - Greenhouse gas (GHG) emissions through residue burning - Carbon sequestration potential of CAC role of shelter belts and forage grasses.
SEPCAB ³ -Capacity building	<ul style="list-style-type: none"> - Extension and knowledge transfer - Legal frameworks - Gender research - Livelihoods and poverty analysis - Adoption and impact assessment - Enabling policy options - Land tenure - Local institutions - Marketing, competitiveness and trade - Reorientation of agricultural innovation systems

¹GRM = Genetic Resources Management

²NRM = Natural Resources Management

³SEPCAB = Socio-economic, Policy Research and Capacity Building.

