



**Regional Strategy
for Transforming and Strengthening of Agricultural Research
and Innovation Systems for Development in the Central Asia
and Southern Caucasus region**

ACRONYMS

- AIS - Agricultural Innovation System
- AR4D - Agricultural Research for Development
- CAC - Central Asia and (Southern) Caucasus
- CACAARI - Central Asia and the Caucasus Association of Agricultural Research Institutions
- GDP - Gross Domestic Product
- GCARD - Global Conference on Agricultural Research for Development
- GFAR - Global Forum on Agricultural Research
- ICT - Information and Communications Technology
- MDG - Millennium Development Goal
- M&E - Monitoring and Evaluation
- NGOs - Non Governmental organizations
- NARS - National Agricultural Research System
- R&D - Research and Development

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Executive Summary

The consequences of climate change have a negative impact on agriculture in the region, which has already been affected by the severe outcomes of the recent global economic crisis. In addition projected population growth, particularly of the urban population, will increase demand for food and prices, which in turn will result in even greater use of limited natural resources. Ultimately, these problems are a particular threat to vulnerable groups, including to people with low incomes. Thus, societies face the challenge of solving these problems, and it is necessary to take action to ensure peaceful, sustainable development and food security in the CAC.

Considering these challenges, national AR4D systems set as primary objectives addressing the issues in order to improve agricultural productivity, increase the quality and quantity of food through intensification and diversification of sustainable agriculture and to develop the knowledge for the efficient use of natural resources, mitigating the negative impact of the consequences of climate change. A priority cross-cutting issue is addressing the needs of vulnerable and low income groups minimising projected adverse effects of the above mentioned threats.

In this regard, the AR4D system of the CAC focuses joint efforts on four main goals of agricultural research:

1. Improving the well-being of the rural population, particularly vulnerable groups and those dependent on agriculture;
2. Guaranteed improvement of the quality and quantity of nutritious food through the intensification and diversification of agriculture;
3. Rational use of natural resources;
4. Mitigating adverse effects of climate change.

The Strategy for transforming and strengthening agricultural research and innovation systems in the CAC provides an integrated approach based on (i) need for an integrated regional agricultural policies aimed at achieving the above goals; (ii) the opportunities for bigger impact by strengthening cooperation between national AR4D institutions and multi-stakeholder regional centers and institutions in the field of agricultural research, innovation and education to facilitate actions for development along agricultural production and food chains; (iii) the implementation of collective actions to overcome the common problems at the regional level, such as trans-boundary diseases, use of natural (water, land) resources, and (iv) the further improvement of food security policy, providing for the development and integration of regional markets, enhancement in trade and commercial relations and modernization of communication infrastructure, and others.

Transformation of AR4D in the CAC aligns with the six elements of the GCARD1 Roadmap¹, and suggests strengthening of all its constituent elements: (i) innovative research, (ii) education and capacity building, (iii) extension services; and development of ICT conducive to the transformation.

¹In addition to six principles of the GCARD1 Roadmap a seventh “Increase the impact of ICT on transforming AR4D and agriculture development”, is considered an important component of the CAC Regional strategy, and therefore is described here.

Implementation of agreed actions is not feasible without adequate participation of all stakeholders, and particularly without due government attention and increased investments in agricultural research and innovation.

In the CAC it is proposed that investments to AR4D gradually increase so that in 2025 they should reach 1% of agricultural GDP.

The main actions required for bigger impact from transforming and strengthening AR4D in CAC are:

- establishment of a well-functioning system of strategic forecast and planning in agricultural development to implement:
 - socio-economic, technological and environmental development forecasts, periodically updated and used to set up and revise the priorities and strategic planning in agriculture;
 - national and regional programs and projects aimed at achieving selected priorities in the agricultural sector;
 - formulation of objectively verified indicators for monitoring of strategic plans, national and regional programs;
- assuring that national AR4D systems in charge of setting priorities in agricultural research can:
 - participate in strategic planning of agricultural development, improving food security;
 - involve all stakeholders in addressing the needs of the rural population, agricultural producers, and other vulnerable sectors of the population;
 - effectively combine traditional knowledge, new approaches and technologies to meet urgent needs in agriculture;
 - undertake measures based on available resources and skills, as well as clearly comprehend what technologies and knowledge can be accessed from external sources;
- integration of consumers, customers and other stakeholders in agricultural research and the implementation of its results into production. Improving access to agricultural knowledge;
- conducting a baseline study of consistent patterns between investment in AR4D, innovative development and productivity increase and the role of agricultural research, capacity building and knowledge sharing in the pursuit of development goals at all levels, thus justifying the planned and expected increased investments in AR4D;
- conducting an inventory of all relevant projects and studies, including those studies that are part of programmes currently being implemented;
- assessment of existing and projected needs in agricultural research, and the funds required to conduct them;

- identifying sources of funding for different categories of expenditure for research activities;
- increasing financial recognition of the vital contribution of agricultural scientists to economic growth;
- minimizing taxes on funds for research activities; introducing a system to stimulate and to reward development-oriented scientific achievements; simplifying procedures for obtaining patents and copyrights on scientific developments, and improving rewards and the commission fee system for the use of scientific inventions;
- providing tax incentives for private companies involved in funding activities of research institutions, agricultural consulting agencies and extension systems;
- increasing investments of international and national funding agencies in AR4D, while improving expenditure quality and accountability;
- creation and development of major research centers at agricultural universities, which will include a multi-level system of education, preserving the integrity of AR4D, and individual areas of research, without loss of scientific and human potential, while encouraging contributions of international development centers and universities from developed and fast growing economies;
- training of young specialists in the agricultural universities who will be able to develop and introduce innovative technologies;
- bridging the gap between the curriculum of agricultural education and current trends in production technology and management of innovation systems;
- strengthening and extending logistic facilities for agricultural training and educational institutions;
- increasing investments into modernizing education system;
- stipulation of planning and implementation of result-oriented agricultural research programs and in national development strategies and policies based on documenting the impacts and returns from agricultural innovations;
- development and implementation of large-scale AR4D themes supported by governments and multinational funders on key development issues and solving problems at the regional level;
- closer cooperation between national institutions and international organizations in the planning of agricultural research, exchange and dissemination of knowledge;
- developing and implementing a system of monitoring and evaluation the efficiency of agricultural research, in terms of its relevance and efficiency in agricultural production;
- introduction of a financing system for AR4D based on the results of monitoring and evaluation of the impact of agricultural research and national priorities for agricultural development;

- monitoring of indicators for investment and human capacity to demonstrate the contribution of agricultural research in agricultural and overall economic growth;
- dissemination of the information on achievements in research and on development impacts;
- implementation of comprehensive measures aimed at increasing the impact of ICT on the transformation and strengthening of AR4D and agriculture development.

1. Goals and objectives of the transformation of AR4D

The goal of AR4D transformation is assuring a larger impact on improvement of agricultural productivity, increase in the quality and quantity of nutritious food, minimising adverse impacts on the environment through rational use of natural resources, and mitigation of the negative impact of climate change on agriculture. In addressing these issues the focus should be on the needs of vulnerable and low income groups.

The main objectives are: (i) identifying the main priorities of agricultural research as determined by the needs of society and science at national, regional and global levels; (ii) ensuring equal opportunities for participation and transparency among all stakeholders in the planning and implementation of agricultural research and innovation development aimed at the achievement of the goals set; (iii) increase the funding for development of improved systems for agricultural research, education and extension; (iv) development of the human and institutional capacity required for the generation of relevant agricultural knowledge, and linkage with its users; (v) integration of innovations with the goals of development programmes and policy; (vi) disclosure of the efficiency of measures taken, through monitoring, evaluation and reporting.

The objectives of the AR4D transformation indicate how goals can be achieved, or in other words, what needs to be done so that the agricultural research and innovation system will be able to generate the necessary knowledge linked to challenges in agriculture and meet the needs of agricultural producers, including smallholders.

In order to increase the impact of AR4D systems, "objectives" set should be transformed into "outputs". This process will require the development and implementation of comprehensive measures and investment of the required resources, particularly finance and continuous monitoring of progress.

2. Strategic components of the Regional Strategy for transforming and strengthening of AR4D systems

2.1. Setting up main priorities and measures of AR4D at national, regional and global levels

Agriculture in the CAC faces problems which are the legacy of past decades, and others caused by the unstable situation in the global economy and the environment. In addition, the volatility of prices for food products and greedy consumption of natural resources, are threats to smallholders and vulnerable populations, including people with low incomes. Population growth will lead to increased food consumption and the use of even more natural resources. These issues require a comprehensive approach to solve the problems.

Given these challenges, national AR4D systems need to define priorities to actively contribute to improvement of agricultural productivity, improvement the quality and quantity of food through intensification and diversification of sustainable agriculture, mitigating the adverse impacts of climate change, while considering the needs of smallholders, vulnerable and low income groups as priority cross-cutting issues. All these require rethinking of the AR4D role in achieving these goals, as well as generation of the knowledge that will facilitate this process.

Considering that conventional agricultural research systems cannot adequately address the existing needs of agricultural and rural populations for reduction of the anthropogenic impact on environment and its consequences, it must be transformed into a system of result-focused agricultural research and innovation.

In this regard, the AR4D system of the CAC focuses joint efforts on three main goals of agricultural research:

Improving the welfare of the rural population, particularly vulnerable groups and those dependent on agriculture.

Improvement of innovations in smallholders' agriculture, the development and transfer knowledge and technologies required to improve efficiency and the profitability of farming to small farmers, agricultural households and vulnerable population, are identified as priorities of AR4D in the region. This process requires the joint and coordinated efforts not only national AR4D systems, but also of international development centers, national governing bodies, and many other stakeholders in agriculture.

In a broader sense, it is required to develop market infrastructure with improved road and transport communications, improved trade and business relations between large and small producers, as well as to strengthen public support and to introduce tax incentives or minimization of the tax burden for smallholders.

Guaranteed improvement in the availability and access to nutritious food through the intensification and diversification of agriculture to protect vulnerable and low income people.

Joint efforts oriented to increase agricultural productivity, the introduction of cost-effective technologies and the diversification of agricultural production will influence availability and access to nutritious food. In this process, quality improvement, productivity increase and

cost reduction are important terms for an increase in healthy food supply especially to vulnerable groups, women and children.

In addition, further development of market relations, increase in social subsidies, observance of price parity in agriculture, disease prevention, monitoring and addressing of population needs.

Rational use of natural resources and mitigating adverse effects of climate change

Rational use of natural resources with minimal negative impact on the environment, mitigation of climate change are complex issues whose solution depends on the consistent implementation of activities not only at national but also at sub-regional, regional and global levels. It requires joint efforts to conduct baseline research which examines all aspects of the use of natural resources: increasing agricultural productivity, reduction of operation costs, conservation of natural landscapes, maintenance of natural diversity, providing a healthy environment, preserving of ecosystems.

In addition, there is a requirement for a gradual transition to international environmental standards of production and processing; establishment of a unified system of monitoring of natural resources and of environment; improvement of environmental education and training, and better disclosure of environmental conditions; coordinated activities between CAC national authorities for environmental management, as well as implementation of environmental of national and regional programs.

To define future priorities and create a clear vision of new challenges the AR4D systems need to establish a well-functioning system of strategic forecasting and planning in agricultural development.

Such system must provide for the implementation of:

- socio-economic, technological and environmental development forecasts periodically updated and used to set up or revise the priorities and strategic planning in agriculture;
- national and regional programs and projects aimed at achieving selected priorities in the agricultural sector;
- formulation of objectively verified indicators for the implementation of strategic plans and national and regional programs².

To achieve the defined priorities of national AR4D should:

- participate in strategic planning of agricultural development, improving food security;
- involve all stakeholders in addressing the needs of the rural population, agricultural producers, as well as the needs of vulnerable populations;
- effectively combine the traditional knowledge, new approaches and technologies to meet urgent needs in agriculture;

² Measuring indicators of the progress of these plans, should be recommended to all parties concerned, but not compulsory for ministries of agriculture and AR4D system

- undertake measures based on available resources and skills, and clearly comprehend what technologies and knowledge can be accessed from external sources.

At the regional level close cooperation is required among all stakeholders, to strengthen interactions among national, regional and international organizations to increase the number and quality of regional programs and initiatives aimed at addressing common problems and cross-cutting issues by enhancing existing and creating new, more effective, multi-stakeholder approaches in cooperation are required.

2.2. Ensuring equal opportunities for participation and transparency among all stakeholders in the planning and implementation of agricultural research and innovation for development

The current reality makes it clear that problems in agriculture, the potential threat of instability in the economy and environment, projected impacts of climate change and population growth are problems not of any single group of the population or any single economy sector, but a situation that is a challenge for all, not only at national but also at regional and global levels. Accordingly, solution of these problems is the responsibility of not only managers, researchers and investors, but also many others, especially those who will be directly affected, namely, consumers and smallholders.

Therefore, in the process of developing necessary innovative knowledge, and passing it to farmer and smallholders, all stakeholders should be involved, especially those who are the ultimate beneficiaries of reforms achieved under the stated objectives. Such full participation in the transformation processes by consumers and rural producers, especially smallholders, ensures an enabling environment for generating and utilizing the innovative knowledge required for overcoming difficulties.

Integration of farmers and the increasing participation of interested customers in the process of agricultural research and implementation of its results into production and improving access to agricultural knowledge will increase the practical value of scientific developments and will facilitate their integration into innovation system.

These goals cannot be achieved only by a structured transformation of agricultural research systems aimed at generating necessary knowledge and innovation. It also requires development of a favourable environment and the ensuring of all necessary resources, political support and promotion of agricultural research.

The CAC countries require to take a more holistic approach which takes into account not only productivity factors but also issues of food security and nutrition, livelihood and environmental sustainability based on coordinated activities among countries and the need to reach acceptable compromises.

The joint efforts of all stakeholders should be concentrated on this process: public and private sectors, including producers, intermediaries and consumers of agricultural knowledge and innovation, and the international development institutions of AR4D at national, regional and global levels.

2.3. Increasing investments in agricultural research and innovation

Synthesis of national reports shows that in the CAC region the average share of investments in agricultural research in agricultural GDP is 0.1%³. This indicator is expressing how significantly AR4D systems are funded to enable them to address existing issues in agriculture.

“... Average agricultural research investments as a percentage of agricultural GDP in developing countries⁴ are 0.58%, compared with 2.4% in developed economies...”

GCARD1 Road Map

CGIAR is calling to triple the global investments in AR4D in the next 15 years⁵ to ensure the achievement of development goals, considering the huge backlog in investment caused by underfunding in the past twenty years.

Along with AR4D financing it is necessary to increase public investments in rural development (e.g. rural infrastructure, improved access to water and education), as well as on the food supply system. Maximum impact of these investments will depend on adequate funding of the AR4D system.

In the CAC investments to AR4D are proposed to gradually increase so that in 2025 they should reach 1% of gross agricultural GDP.

Although increased investment in agricultural research is not the only requirement for its strengthening, it remains the most significant factor in successful transformation processes.

Funding for agricultural research is sourced both from the public and the private sectors, and includes projects and programs funded by donors where this is possible.

Despite the positive impact of donors' aid, its effect could be much higher with improved coordination of activities.

Nowadays many international donor organizations and research and development centres are operating in the region. In addition, many projects are funded by governments of developed and rapidly developing countries and international financial institutions. Money of foreign taxpayers is disseminated in national development processes, including in agriculture, and satisfying in various degrees the needs of agricultural research, capacity building/education and extension systems. However, these efforts are fragmented, and majority of implementing activities are based on a programme approach. It is therefore necessary to focus efforts in the region on improving mechanism of donor coordination.

Creating a mechanism for coordination and coherence among donors would greatly increase expected outcomes, bridging between segments of agriculture.

³ more precise figure is 0.096%.

⁴the less economically-developed countries

⁵ A Draft Strategy and Results Framework for the CGIAR. for discussion at the Global Conference on Agricultural Research for Development (GCARD) 20 March 2010, CGIAR <http://alliance.cgiar.org/strategy-and-resultsframework-and-mega-programs>

Creating mechanisms of aid coordination within all sectors of a national economy is quite challenging, while its creation for a particular sector, such as agriculture is quite feasible and appropriate, where coordination role of aid flows⁶ should be exercised by the Ministry of Agriculture of each particular country.

Thus, it is recommended that there be annual regional meetings of investors, donors, ministries of agriculture, national AR4D systems regional fora and other stakeholders operating in agriculture in one CAC country on rotating basis. The following points might be included in agenda of the regional donors' meeting:

- inventory of implemented and ongoing projects and programs;
- roadmap for Agricultural Development;
- challenges and needs of agriculture development at national and regional levels;
- offered projects and programs;
- areas of agricultural research and innovation suffering from under-resourcing;
- agricultural education and vocational training that require the support of international educational and research centers;
- group discussions and round tables, etc.

In addition, it is useful to disclose information on implemented and ongoing projects and programs on appropriate web sites.

As a result of coordinating donors' activities, the return on financial and technical assistance will be sharply increased and the gaps between agricultural production, research, education, and extension will be reduced.

In line with the projected increase in investments in AR4D, the following actions should be undertaken:

- assessment of existing and projected needs in agricultural research, funds required to conduct them;
- identifying sources of funding for different categories of expenditure for research activities;
- Increasing financial recognition of the vital contribution of agricultural scientists to economic growth;
- minimizing taxes on funds for research activities; introducing a system to stimulate and to reward development-oriented scientific achievements; simplifying procedures for obtaining patents and copyrights on scientific developments, and improving rewards and the commission fee system for the use of scientific inventions;
- applying tax incentives for private companies involved in funding their activities of research institutions, agricultural consulting agencies and extension systems;

⁶ Ministries of agriculture of the CAC should also coordinate the flow of external loans, as a majority of investment projects have research components that are usually regarded as grants (research expenses are not paid back).

- increase investments of international and national funding agencies in AR4D, while improving expenditure quality and accountability;
- introduction of a financing system for AR4D based on the results of monitoring and evaluation of the impact of agricultural research and the national priorities of agricultural development.

2.4. Strengthening human and institutional capacity required for the generation of relevant agricultural knowledge, and linkage with its users

In the process of strengthening and transforming the system of agricultural research and innovation, issues of human development in agriculture of the CAC have enormous significance, and therefore they are the most important priorities in agricultural policy. The aim of transformation of agricultural education is capacity development in agricultural sector to a level that is adequate to meet the needs for its innovative development.

The current weak correlation between agricultural education and innovative technologies defines the urgency of transformation and strengthening of agricultural education system. A great demand for innovative technologies in agriculture hinders its development. To solve this problem, the following actions have to be undertaken:

- improving professional knowledge of specialists in modern agricultural industry who are involved in promotion of development of innovative systems;
- training of young specialists in the agricultural universities that are able to develop and introduce innovative technologies;
- bridging the gap between the current curriculum for agricultural education and current trends in production technology and the management of innovation systems;
- strengthening and extending logistical facilities for agricultural training and educational institutions;
- development of modern mechanisms of human resource management in agriculture adequate to effectively balance supply and demand on agricultural labour market.

Measures for strengthening the institutional capacity for the generation, access and use of agricultural knowledge for development should involve the creation and development of major research centers at agricultural universities, which will include a multi-level system of education, and thus integrating the functions of education, research and consulting institutions with educational programs and motivating systems of rewards.

In the long-term the agricultural universities should be transformed into educational-research centers generating new agricultural knowledge and innovative technologies which are in demand. Therefore such institutions should have: sufficient funds for education and research activities, a modern learning system, appropriate logistics, etc.

Creating a mechanism for the interaction between agricultural education and the private and public sectors will strengthen innovation-focused research by establishing direct relations with large agricultural producing and processing enterprises. As result of this arrangement fundamental research will be intensified, as well as applied research based on it, and thus the overall agricultural research system will be enhanced.

Therefore, it is necessary to carry out a large-scale but thoroughly considered transition of agricultural education to a new level which meets the need of prompt recovery and further innovative development of agricultural sector. That will also require institutional transformation of the AR4D system. The process of transformation may go in two ways: evolution – development of the system and necessity of its transformation at a new level; or

revolution when many elements of the system not ready for transformation may not stand up to those transformations.

In the CAC with its specific features, establishment and development of large research centers under agrarian universities, which will include a multi level system of education,⁷ must be based on a rational approach, with a view to maintaining the integrity of the AR4D programme, and individual areas of research without loss of scientific and human potential. These processes require more involvement of the public and private sectors, and other AR4D components, as well as the contribution of international development centers and universities from developed and fast growing economies. This will provide an opportunity to develop the research capacity of agricultural universities in the CAC, and to integrate into it only those of the existing research institutions which will benefit from this merger in order to maintain and enhance scientific and human resource capacity, and to improve logistic capacity.

⁷ High schools, bachelor degree, master degree, postgraduate study, post-doctoral study, as well as professional trainings.

2.5. Integration of innovation into national and regional development programs and policies

Interventions in agriculture aimed at improving its productivity is impossible without the encouragement and support of the agricultural science and innovation system, introduction of modern technologies, and the mobilization of actors of agricultural research and innovation. It is necessary to implement major changes in the system of agricultural research, to create enabling environment for development of national innovation systems and to develop effective mechanisms of innovation promotion. Thus, transformation of the system of agricultural innovation is focused at three major interrelated issues: (i) generation of outcome-based knowledge and technologies, (ii) increasing receptivity to innovation of agriculture itself, and (iii) strengthening linkages between developers and users of innovative knowledge.

The process of transforming and strengthening the system of agricultural research and innovation focused on improving agricultural productivity and wellbeing should conjugated with intellectual and human capacity building and with development of strong communication links between academic institutions, regional (provincial) scientific and research organizations, experimental stations, testing centers, agricultural enterprises, farmers, smallholders and other users of scientific information. Establishing a systemic connection between research institutions and producers will provide an opportunity to put of research results to productive use and to disseminate best practices.

Development of innovation systems in the region is considered as a necessary condition for protection from crisis situations and enhancing agricultural productivity. Promoting innovative activities in the agricultural sector will enhance not only the production chain, but also significantly improve investment climate in agriculture.

In the agriculture sector five main areas need to be transformed in innovation systems: (i) breeding and genetics, (ii) production and processing, (iii) management, (iv) socio-economic development, and (v) environment that more specifically acts as a factor really impacting on development of agriculture-based food systems and reflecting their multi-functionality. Therefore, the integration of agricultural science into the overall strategy of agricultural development is of increasing importance and urgency.

The main measures for the integration of agricultural research for development in processes enabling agricultural development are:

- planning and implementation of result-oriented agricultural research programs and national development strategies and policies based on responses to documenting the impacts and returns from agricultural innovations;
- development and implementation of large-scale AR4D themes supported by governments and multinational commitments on key development issues and solving problems at the regional level;
- closer cooperation between national institutions and international organizations in the planning of agricultural research, exchange and dissemination of knowledge.

2.6. Systematic monitoring, evaluation and reporting of measures

Introduction of monitoring and evaluation systems is required to track AR4D impacts on achieving development goals and to provide relevant information to investors. Such system should monitor the impact of investments in AR4D on improvement of agricultural productivity, increasing quality and quantity of food, minimizing negative impacts on the environment through rational use of natural resources and mitigating the negative effects of climate change on agriculture. Priority cross-cutting themes are the requirement to take into account needs of vulnerable and low income groups and to minimise projected adverse effects of economic and climate change threats.

However, the benefits of an objective monitoring and evaluation system in the AR4D transformation process are not limited only to assessment and disclosure of investment performance. It helps keeping track of whether reforms carried out are in the right direction are and what measures we need to take and what needs more attention in order to the goals set in a timely and effectively manner. Monitoring and evaluation systems provide information on the extent to which "outputs" and compliance with "objectives", "outcomes" with "purposes" and "expected impacts" with the "overall goal".

Demonstration and reporting of results requires:

- baseline research on the correlation between investments in AR4D, innovation development and productivity growth, as well as on the role of agricultural research, capacity building and knowledge dissemination in the achievement of development goals at all levels⁸;
- inventory of all implemented projects and studies that are currently relevant, and those studies that are part of programmes being implemented;
- monitoring of indicators for investment and human capacity to demonstrate the contribution of agricultural research in agricultural and overall economic growth;
- implementation of monitoring and evaluation of the efficiency of agricultural research, in terms of its productive use;
- dissemination of information on achievements in research and development impacts.

⁸ Such studies are widely available internationally. Similar research in the CAC region would justify greater government attention to AR4D and help in justifying increased investments.

2.7. Increasing the impact of ICT on transforming AR4D and agriculture development

Naturally, the process of development of agricultural science is integrating with development of other fields of science and technology. Undoubtedly, the progress in information and communication technologies (ICTs) has tremendous impact on development of agricultural innovation systems. The ICT serve as useful tools for development, transfer, application and dissemination of agricultural knowledge intended to increase agricultural productivity, which in turn has a significant impact on socio-economic development.

Apart from that, ICT is replacing, where it is effective, human resources, particularly in the area of exchange, receive, transfer and dissemination of information. Mobile connection and Internet services have a significant impact on the speed and stability of flows of agricultural information from producers to consumers. The ICT developments are predicted to have huge impacts on intensification of agriculture and the stability of its operation.

To Increase the impact of ICT on transforming AR4D and agriculture development, it is necessary to develop and implement a set of interrelated activities aimed at:

- improving the mechanism of funding projects directed to increase the impact of ICT on transforming AR4D and agriculture development;
- improving the national legal frameworks in the promotion of investment in ICT sector in relation to agriculture;
- increasing investment in capacity building in information system management and developing sustainable ICT projects;
- strengthening regional cooperation and multilateral partnerships among stakeholders, especially by creating incentives for building regional backbone ICT infrastructure;
- providing affordable access to ICTs by reducing the cost of international adherence to the internet charged by backbone providers, as well as facilitating the creation and development of regional ICT backbones and Public Internet access centers to reduce the interconnection cost and broaden network access;
- development and implementation of government programs aimed at reducing investment risks and transaction costs for operators entering the less attractive rural areas and market segments with low income;
- assisting the acceleration of the development and implementation of national financial mechanisms, including funding of pilot ICT projects, microfinance, etc.;
- increasing the opportunities for access of the public and private sectors in financing mechanisms to accelerate the funding of ICT infrastructure and ICT-based services;
- revitalization of the support of multilateral, regional and bilateral development organizations for national ICT systems through their involvement in the planning of agricultural development and the ICT sector.

3. Conclusion

Science-based agricultural development strategy should obviously take into account multifunctional modern agriculture, and its influence on implementation of key social, demographic, environmental and political activities. In this comprehensive approach AR4D should justify budget expenditures for agricultural development, demonstrate the contribution of agricultural sector in the national economy and lay the foundations for its innovative growth.

Transformation of extension systems should be a priority in the short term development of AR4D. Enhanced extension systems will assist farmers in making economic and innovative decisions on improving productivity, introducing new technologies, and enhance resilience to food and economic crises and climate change impacts through improved information management, application of R&Ds.

The transforming and strengthening of AR4D requires participatory coordination and awareness by research institutions and organizations of the ongoing AR4D activities and creating enabling environment for continuous improvement of scientific and professional capacity material and technical resources for development and promotion of demand-driven innovations in agriculture and in associated areas of science and economics.

AR4D as well as entire scientific and educational community always should remain a benchmark of civilized relations for society, tolerance, patriotism and commitment to ideas of humanism, and self dedication to prosperity and bright future of present and future generations.

The negative impact of climate change on agriculture will exacerbate already severe consequences of the global economic crisis. The expected population growth, with an urban bias will increase demand for food and its price which in turn will necessitate even greater use of limited natural resources. If agriculture develops without the "required actions", challenges of agriculture will turn into economic ones, and perhaps even into political issues, which may become a trigger for civil unrest. "Taking necessary measures" is thus a requirement for ensuring a peaceful, stable and prosperous future in the CAC and the "transformation" of systems of agricultural research and innovation for development is one of the most important requirements of this process, in which "all" should be acting as "one".