SUSTAINABLE AND RESILIENT AGRICULTURAL PRODUCTION SYSTEMS IN CENTRAL ASIA

Russian – ICARDA Partnership for Research and Capacity Building

The International Center for Agricultural Research in the Dry Areas (ICARDA) acknowledges the financial support provided by the Russian Government to enhance the research and capacity development in Central Asia.

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INTRODUCTION

Since 1991, Central Asian countries have undergone phases of economic transition as they consolidated their independence. Governments have implemented fundamental adjustments and privatization schemes in the agricultural sector. Large state-owned farms, also known as 'Agricultural Cooperatives' have been transformed and fragmented into small private ownerships.

Today, a new generation of farmers has yet to develop the skills and knowledge needed to apply innovative farming techniques and viable farm management practices. Likewise, limited access to financial resources does not allow farmers to invest in modern farming supplies and quality mechanization. Other challenges that contribute to declining productivity include aging infrastructure (i.e. irrigation and drainage systems), decline in soil fertility, the use of crop varieties susceptible to heat, frost, drought, pests and diseases and severe degradation of overgrazed pastures due to inappropriate rangeland management techniques.

Moreover, land fragmentation caused by privatization didn't improve livelihood in many remote areas, and the poverty levels among rural communities remains stubbornly unchanged. Small scale livestock owners struggle financially and cannot afford to implement rangeland technologies that would generate better incomes. The situation mostly impacts women, as men move from rural to urban areas in the hope of finding employment, leaving the women behind to take care of farms, livestock, children and families.

Joint efforts by donors, policy makers, research organizations, extension services and farmers could transform agricultural development ensuring the emergence of sustainable livelihoods and improved incomes, for rural communities in the dry areas. Resource-saving environment-friendly agro-packages that keep-up with the current threats of rapid population growth, water scarcity and climate change are needed to ensure sustainable agricultural productivity.

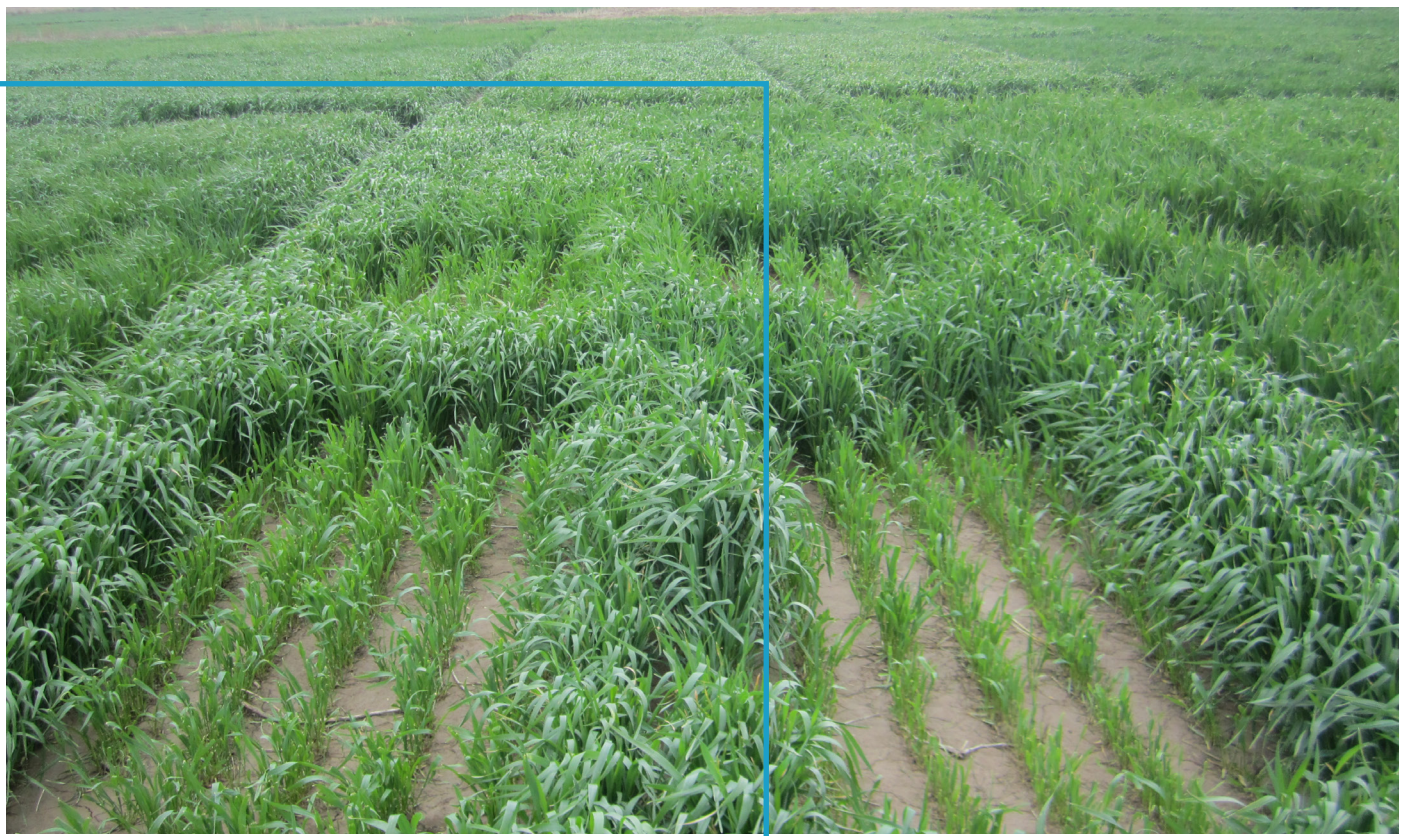
In order to promote innovative agricultural solutions, good relationships between local state development programs and global research initiatives are a pre-condition for synergy among all stakeholders. Partnership development, cooperation, advisory and extension services will also enhance access to quality seeds, farming inputs and innovative agricultural techniques among farmers.

Governments and donors are increasingly recognizing the role of agricultural development and research innovation in contributing to sustainable livelihoods. The Russian Federation has contributed significantly to the agrarian sector in Central Asia through strategic investment. The four-year program Collaborative Research and Capacity Building Program for the Development of Sustainable and Resilient Agricultural Production Systems in Central Asia under the Conditions of Changing Climate was initiated by the Russian Government. It was implemented by the International Center for Agricultural Research in the Dry Areas (ICARDA) within the framework of the CGIAR Research Program (CRP) for Dryland Systems in partnership with the Eurasian Center for Food Security (ECFS) at Lomonosov Moscow State University, and in collaboration with the International Maize and Wheat Improvement Center (CIMMYT), International Winter Wheat Improvement Program (IWWIP), the World Vegetable Center (WorldVeg), International Center for Biosaline Agriculture (ICBA) and National Agricultural Research Systems, operating in Central Asian countries.

MAIN RESULTS OF THE COLLABORATIVE RESEARCH PROGRAM

The program Collaborative Research and Capacity Building Program for the Development of Sustainable and Resilient Agricultural Production Systems in Central Asia under the Conditions of Changing Climate supports research on integrated land and water management. The approach seeks to attain solutions for sustainable growth in dry areas and selected action sites and to strengthen agricultural research and capacity-building efforts in Central Asia. The program's outcomes include better technologies and capacities for dryland and salinity management with the aim to improve sustainable land productivity, food security and better livelihoods in dry areas.

STRESS TOLERANT CROP VARIETIES — TO IMPROVE PRODUCTIVITY



Effecct of climatic parameters on crop growth and regrowth

Food production in the cold and arid zone of the Aral Sea face several challenges, such as frost and soil salinity. Constant temperatures below -30°C, recorded during 2012-2013 winter, resulted in wide-scale damage of winter crops in Uzbekistan, Tajikistan and Turkmenistan. Around 800 improved experimental crop lines and cultivars were evaluated through the project in the Aral Sea Action Site of Karakalpakstan and Khorezm provinces of Uzbekistan, Dashoguz district of Turkmenistan and Sughd region of Tajikistan. Three of the best high yielding winter wheat varieties ("Aral" and "Amudarya" in Uzbekistan and 'Davletle' in Turkmenistan) demonstrated excellent tolerance to salinity, frost, and heat. The improved varieties were submitted to the State Variety Testing Commission in Uzbekistan to undergo final release processes.

Other project findings showed that frost can also be managed by changing seeding depth. Planting wheat at 4 cm depth protects winter wheat against frost damage better than seeding at 2 cm depth, a technology which is currently used by farmers. Overall, the seeding at 4 cm depth resulted in 70% winter survival as compared to 40% at a 2 cm depth.

In the Sugd province of Tajikistan, 212 farmers were involved in the project's seeds production for two new varieties

of wheat ("Alex" and "Ormon") and one new variety of barley ("Pulodi"). Farmers saved USD 130 per hectare on fungicides by growing yellow rust resistant varieties without spraying the crops, while producing more than 500 tons of wheat quality seeds and around 40 tons of barley for the next growing season. Using quality seeds of yellow rust resistant varieties, without using fungicide, has already seen an increase by area from 65 hectares in 2014-2015 to more than 200 hectares in 2015-2016.

The introduction of new varieties of mungbean allowed diversification of the cropping systems. The mungbean improved not only land and water productivity but also the soil health – and they substantially increased farmers' incomes. Four improved mungbean varieties were introduced in the production system, all of them maturing at different periods. This diversity allows farmers to adjust the rotation and improve the management of available land. Since 2013, three farmers' trainings on cultivation and seed production of mungbean were organized.

The project started in 2013 with 2150 kg of mungbean seeds suitable for 100 ha, and culminated in 2016 with 1000 ha cultivated with the new varieties. The government of Uzbekistan has already decided to introduce the new mungbean varieties in their crop diversification priority plan.

In 2015, the "Korakul Seed Producers Network" (KSPN) was established within a project in Karakalpakstan aiming to facilitate the development of new crop varieties and to maintain high quality seed delivery systems. Eleven farmer households, members of the network, produced 2,580 kilograms of forage seeds in 2015 and 8,161 kilograms of winter wheat, barley and rye seeds in 2016, while the average production capacity of private farmers is only about 800 kilograms per hectare of seeds.

CONSERVATION AGRICULTURE — TO REDUCE FARMING COST AND RECLAIM SOILS

In Central Asia, land degradation in croplands and grazing pastures is a major development challenge. In the Aral Sea region, the project team conducted an evaluation of the potential measures for improving cereal-legume productivity and increasing feed unit per hectare in forage crop rotations under conservation agriculture. After harvesting winter wheat, double-cropped, no-till mungbean increased land use efficiency and provided a 20% yield advantage after the no-till wheat.

New crop rotations with forage crops were recommended to farmers to ensure feed for livestock during the winter period. Another essential achievement of the program is a trial version of a no-till drill being manufactured in Nukus, Karakalpakstan.

Installing GPS collar on pastoral animals

The effective and economic locally produced no-till drill solution is a great prospect to speed up conservation agriculture practices in the region, as farmers usually cannot afford imported machinery.

INTEGRATIVE LIVESTOCK MANAGEMENT — TO GENERATE INCOME FOR SMALL LIVESTOCK OWNERS

Meat, milk, fiber and pelts from small ruminants are a key income source for agro-pastoral communities living in the mountains of Tajikistan and on marginal salt-affected lands in Uzbekistan. In early 2015, ICARDA, the Karauzyak district authorities and the livestock cooperative "40 Let Karakalpakstana", which oversees half a million hectares of desert rangelands, collaborated on a breeding program.

An elite flock of sheep was established through mating and as a result, the spring 2016 lambing season produced 164 heads of elite and first class Karakul Sur lambs, which were selected for breeding.

A further key outcome of the project includes the introduction of a manual milk fat separator to improve time efficiency in producing butter. Skimmed milk, a residual product coming from the butter production process, can be used to make fat free cheese. The cheese adds value to the production chains and increases household incomes. A newly developed "Toolkit for rapid assessment of small ruminant value chains in Central Asia" is used to assess livestock value chains in Tajikistan and Uzbekistan.

Training (16 June 2014)

NEW WATER MANAGEMENT TOOLS — TO IMPROVE WATER USE EFFICIENCY

In Central Asia, rising groundwater tables have led to severe problems of water logging, salinization and land degradation. In Uzbekistan, the common over-irrigating of crop fields has an impact on the limited water resources of the region. ICARDA scientists conducted a study on a new irrigation scheduling tool based on evapotranspiration (ET), which enables farmers to manage the right time for irrigation and decide upon the water needs. Results from a study in the Fergana Valley and Khorezm regions show a 35% potential of water savings when irrigation is applied using the ET-based scheduling method. In order to ensure buy-in, all members of water users associations, local water management authorities, national partners, and scientists were consulted and trained, step by step, throughout the research process.

Optimum irrigation via ET scheduling demonstrate an increase in yields of 17% and water productivity by 37%. Optimum irrigation also produces 17% higher economic benefits as compared to traditional ways of irrigation.

Another study investigated soil profiles and how fluctuations in groundwater levels can impact soil moisture, soil salinity, groundwater salinity,crop water uptake, and how much surface water can be saved by controlling the drainage outflows without having adverse impacts on yields. Almost 45% of surface water supplies can be reduced by fluctuating the groundwater levels (between 1 and 2 m below the soil surface). This also shows an impact on salinity, which decreased by 25% as compared to other practices.

Field experiments were conducted exploring canal and drainage waters by using a specific modeling software (HYDRUS) that supports the analysis of water flow, heat and solute transport in variably saturated soils. By simulating scenarios for conjunctive water management in the long term, results showed that conjunctive use of canal and drainage water of salinity 4 ds/m can be used without affecting the crop yields. The project also demonstrated that cropping rotation with no fallow land can reduce salinity levels.

CROP MODELING
— TO ASSESS CLIMATE CHANGE IMPACTS

Crop models are widely used to assess impacts of climate change and to project food security scenarios. By operating with the CropSyst model, researchers simulated the impact of climate change, soil and ecological factors on crops in irrigated systems in Uzbekistan. The model was used to estimate yields for winter wheat and cotton under higher soil fertility conditions as compared to soil with a lower degree of fertility. More fertile soil produce 7.2 tons per hectare of wheat grain and 4.5 tons per hectare of seed-lint cotton. When planted on the soil with lower fertility, crop yields were reduced by 12% and by 31%, respectively.

YEAR-ROUND VEGETABLE
— TO IMPROVE NUTRITION

Vegetables play a vital role in ensuring healthy nutrition. Vegetable storage and conservation during cold winter seasons are important to ensure market supplies throughout the year. The project research team is collecting data at the pilot farm of the Andijan Experimental station affiliated to the Research Institute of Vegetable, Melon Crops and Potato (RIVMCP).

The data collection will be used to conduct a cost-benefit analysis for five crops: vegetable soybean, leaf cabbage, sweet corn, mungbean and yard long bean in order to demonstrate economically sound vegetable production options.

*Representative of **Uzbek Scientific Production Center for Agriculture** explaining vegetable crops to participants*

GEOINFORMATICS
— TO PROVIDE DATA ON CROP PRODUCTION SYSTEMS

Spatial planning via inter and intra annual mapping of crop types, pattern and rotation at the field level trace recent crop production patterns, crop intensity, and indicate spatial temporal variability of production changes and potential land degradation. In the Fergana Valley, the project focusses on cotton and winter wheat. Crop type maps were generated using high resolution satellite images in the years 2014 and 2015. The results identified cotton (39 % – 43 %) and winter wheat (26 % – 36 %) as dominant crops. Outcomes also show that there is a strong indication of heterogeneity in crop yields even within small distances. Assessments of crop area and yields are both in agreement with national statistics, yet provide much finer spatial resolution than the best scale of available statistics. The spatial assessment of cropping diversity revealed, that the highest number of diversified crop types tended to be cultivated in the central and western parts of Fergana Valley and that higher spatial and temporal diversity of the cropping pattern tend to have higher yields.

The research has generated enormous amount of spatial data, maps, web tools which can be accessed via a dedicated WebGIS portal.

BASELINE SURVEYS
— TO UNDERSTAND AGRO-PASTORAL SYSTEMS

The agro-pastoralists from the Aral Sea region are dealing with environmental and market risks. The project engaged a range of stakeholders in collective actions to identify and alleviate the constraints affecting productivity growth, while creating conditions to enable sustainable intensification and diversification.

A baseline survey was conducted in the Karauzyak community from the Aral Sea region and covered 100 households. As a result, a gender-disaggregated database was established for the agro-pastoral system in the region. Another baseline survey was conducted in Kyrgyzstan in the Fergana Valley in 2015, covering 120 households. The survey collected data on demographic characteristics of households such as financial, physical, natural and social capital; agricultural production linked to access, quality, quantity, and management of water resources; livestock production and management, agricultural policy, food security and nutrition, borrowing and access to credit, system vulnerability, and local coping mechanisms used by households.

STRENGTHENING CAPACITY
— TO DEVELOP BETTER SKILLS IN AGRICULTURE

To date, 1565 farmers, researchers, students, and policymakers' skills have been strengthened through capacity building in many different areas of agriculture, including 1,075 men (69%) and 490 women (31%). The key areas of capacity building include land and water management, salinity management, conservation agriculture, cropping system diversification, seed production, crop and livestock improvement/management, rangeland improvement/management, modeling, GIS, and value-chain analysis.

ABOUT THE REGIONAL PROGRAM FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN CENTRAL ASIA AND THE CAUCASUS

The Program, coordinated and led by the International Center for Agricultural Research in the Dry Areas (ICARDA), is a consortium of eight National Agricultural Research Organizations, eight CGIAR Centers and three Advanced Research Institutions. The program, initiated in 1998, is the collective functioning body of these 19 organizations, delivering multidisciplinary research toward better livelihoods and sustainable management of natural resources in the region.

For more information, visit cac-program.org.

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Zero till seed drill