CIMMYT-Kazakhstan. High Latitude Wheat Improvement

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Kazakhstan. Country Statistics

<table>
<thead>
<tr>
<th></th>
<th>Rainfed</th>
<th>Irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat area, ha</td>
<td>14.1 mln</td>
<td>0.8 mln</td>
</tr>
<tr>
<td>Yield, t/ha</td>
<td>1.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Kazakhstan. Food security

• About 70% of the potential damage from unfavourable/adverse weather and climatic conditions falls on agricultural production

• Wheat is the main component of food security in Kazakhstan

• Kazakhstan is among the six biggest world exporters of wheat

• North Kazakhstan, the main wheat producing region, is the area of high risk agriculture

• Crop losses from adverse weather conditions in the rainfed areas reach up to 50-70%

• The negative effect of the traditional agrotechnologies (soil degradation, erosion, low crop diversification, salinization, etc.)
CIMMYT-Kazakhstan Program on Wheat Improvement

I. Wheat germplasm enhancement: Spring high latitude wheat and winter wheat breeding

II. Efficient soil and water management: Conservation Agriculture for wheat production and crop diversification

III. Strengthening NARS capacity

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1. Lift productivity and reduce poverty  
2. Contribute to hunger reduction and improved nutrition  
3. Contribute to sustainability and resource efficiency

WHEAT: Strategic Initiatives

SI1: Technology targeting, institutional innovations, and markets for sustainable productivity growth and food security in wheat

SI2: Sustainable wheat systems—improving livelihoods while safeguarding the environment for future generations

SI3: Increasing the use of vital inputs: nitrogen, phosphorus and water

SI4: Sustaining wheat productivity gains by breeding more productive varieties through conventional and molecular approaches

SI5: Durable disease and pest resistance to protect wheat production

SI6: Obtaining wheat yields in the face of climate change-induced heat and drought stress to prevent escalating food prices

SI7: Breaking the wheat yield barrier, by providing genetic potential to increase yields by 50%

SI8: Developing Sustainable Seed Delivery Systems to Enhance Productivity and Ensure Food Security

SI9: Opening the black box of wheat genetic diversity

SI10: Capacity-strengthening of wheat institutions and professionals in the developing world for improved efficiency and impact
CONSORTIUM RESEARCH PROGRAM - CRP "Wheat":
SI 2. Sustainable wheat-based systems
SI 4. Productive wheat varieties
SI 5. Durable resistance and management of diseases and insect pests
SI 6. Enhanced heat and drought tolerance
SI 10. Strengthening capacities

CIMMYT-Kazakhstan Projects:
- CIMMYT-Mexico, Project “Developing Wheat Cultivars Adapted to High Latitudes”, Project period: 2012-14

Kazakhstan-Siberia Network on Wheat Improvement (KASIB)

The KASIB objectives:
- Spring wheat germplasm exchange within 19 Kazakhstani and Russian programs which grow more than 20 mln ha of spring wheat
- Evaluation of the germplasm; promotion of the best varieties into farmers fields; involving the best germplasm in breeding programs
- Communication through annual meetings, traveling seminars, visits and publications

Presently KASIB Network includes all breeding programs of the region – 19 institutions, i.e. 100% coverage!!!
**KASIB Network Activities**

In 2000: KASIB establishing

By 2011: 12th KASIB SBW
          12th KASIB SDW

For the period 2000-2011:
505 varieties studied,
among them:
370 BW varieties
135 DW varieties

The main breeding traits:
- Yield potential
- Drought resistance
- Cold resistance
- Disease resistance
  (LR, SR, Septoriosis etc.)
- Grain quality

Up to 40% of KASIB material are involved in breeding programs

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**Wheat germplasm enhancement**

**SHUTTLE BREEDING**

Mexico - Kazakhstan/Siberia
Number of institutions-participants of the Mexico-Kazakhstan/Siberia Shuttle Breeding program

5085 wheat F4-F5 progenies from Mexico to Kazakhstan & Siberia by 2011

Cereal crops varieties developed on the basis of CIMMYT germplasm, officially tested and released in Kazakhstan as of December 31, 2011

<table>
<thead>
<tr>
<th>Variety</th>
<th>Crop</th>
<th>Organizations-partners</th>
<th>Year Submitted</th>
<th>Year Released</th>
<th>Area, ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egemen</td>
<td>WBW</td>
<td>Kazakh Research Institute of Farming</td>
<td>2001</td>
<td>2007</td>
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<tr>
<td>Konditerskaya</td>
<td>WBW</td>
<td>Krasnovodopad Experimental Station</td>
<td>2006</td>
<td>2011</td>
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<tr>
<td>Stepnaya 60</td>
<td>SBW</td>
<td>Aktove Experimental Station</td>
<td>2006</td>
<td>2010</td>
<td>200</td>
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<td>Orda</td>
<td>TCL</td>
<td>Krasnovodopad Experimental Station</td>
<td>2004</td>
<td>2009</td>
<td>400</td>
</tr>
<tr>
<td>Kuralay</td>
<td>BRL</td>
<td>Kazakh Research Institute of Farming</td>
<td>2007</td>
<td>2011</td>
<td>100</td>
</tr>
<tr>
<td>CIMKAR 20</td>
<td>SBW</td>
<td>Karabalyk Experimental Station</td>
<td>2011</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alikhan</td>
<td>WBW</td>
<td>Kazakh Research Institute of Farming</td>
<td>2011</td>
<td>-</td>
<td>-</td>
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<td>Azharly</td>
<td>WBW</td>
<td>Kazakh Research Institute of Farming</td>
<td>2011</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vodopad 100</td>
<td>TCL</td>
<td>Krasnovodopad Experimental Station</td>
<td>2011</td>
<td>-</td>
<td>-</td>
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</table>
II. Conservation Agriculture for wheat production and crop diversification

Ploughing up of the virgin lands in the mid of 1950s had led to the dramatic loss of soil fertility in Kazakhstan.

In the beginning of 2000s CIMMYT initiated large-scale Conservation Agriculture activities in North Kazakhstan. Due to these efforts, the area under CA-based practices has been increasing from: 0 ha in 2001 to:

- 500,000 ha in 2007
- 1,200,000 ha in 2008
- 1,600,000 ha in 2011

with continued rapid increases in area according to a recent assessment conducted by CIMMYT. The utilization of CA-based technologies has become an official state policy in agriculture in Kazakhstan. Since 2008, the government of Kazakhstan has been subsidizing farmers who are adopting CA-based technologies.

With this Kazakhstan is now included among the top 10 countries with the largest areas under No-tillage in the world (Source: R.Derpsch & T.Friedrich. Global Overview of Conservation Agriculture Adoption. 2009, FAO)
Adoption of Conservation Agriculture in Northern Kazakhstan

Priorities in Agroindustrial Sector of Kazakhstan:

...Diversified crops production;
Livestock (feed, forage, pastures);
Processing;
Biofuel...

The Challenge

Proclaimed priorities have to be realized in the conditions of:
- Declining water availability for agriculture
- Increasing temperature
- Degraded lands
- New very virulent races&strains of diseases
- Use: Food vs Feed vs Biofuel
**Expected climate change in Kazakhstan: Key Findings**

- Rise in the seasonal and annual surface air temperature
- Almost constant or increase in winter precipitation
- Decline in summer precipitation
- An increase of precipitation will not compensate for increase in air temperature
- Increased irregularity of rainfall in time
- For all scenarios, the change trends towards increased aridity/drought

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**The most important abiotic factors limiting agricultural production in Kazakhstan:**

- drought (lack of precipitation in non-irrigated regions, lack of water in irrigated zone)
- high temperatures
- low temperatures
- salinization
- soil degradation

**The less extended factors with negative impact:**

- microelements deficit (zinc, copper, sulphur, iron, etc.)
- toxicity of microelements (boron)
- lodging
Biotic factors limiting agricultural production in Kazakhstan:

- over 70 species of plant diseases
- about 50 species of polytrophic and over 100 of specialised pests
- about 120 species of weeds

Important Activities in Plant Breeding

- **Breeding for crop yield potential** (efficiency of photosynthesis, reduction of photorespiration, assimilates transport and distribution...)
- **Breeding for resistance to abiotic environmental factors** (drought, high and low temperatures, salinization, toxic elements...)
- **Breeding for resistance to biotic factors** (diseases, pests, weeds)
- **Breeding for quality** (high content of desired substances, biofortification...)

Wide use of glasshouses and phytotrons is extremely important for breeding improvement in Kazakhstan with its short vegetation period.
PARTNERSHIP
Successful implementation of the objectives will be based on a wide range of partnership of gene banks, collections, research institutes, botanical gardens, farms, breeding stations, universities, international centers and organizations (CGIAR centers, FAO, etc.), NGOs, private companies, etc.

Role of CGIAR centers and International organizations:
- Wheat, Maize (CIMMYT, ICARDA)
- Potato (CIP)
- Rice (IRRI)
- Legumes (ICARDA, Bioversity Int.)
- Vegetables (WVC)
- Fruits (Bioversity)
- Barley (ICARDA)
- Salinity, Drought (ICBA, ICARDA)
- ...