

## Capacity building and human resources development to foster implementation of scientific innovations in agrarian system of dry lands in Central Asia

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## The Aral Sea Basin



## Principal challenges and potential risks in Central Asia

- Climate change impact: reduced flow, severity of extreme events;
- Demographic pressure – population growth 1.2 – 1.8% year;
- Land degradation;
- Poor water management;
- Competition between power and irrigation;
- Ongoing restructurization of agrarian farming;
- Instability of market and prices.

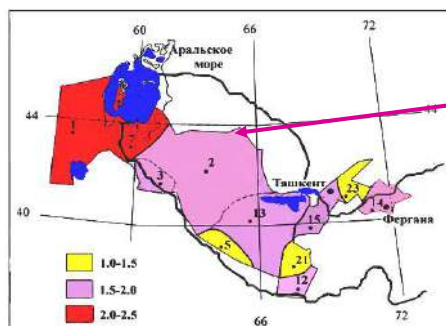


## Transboundary water challenges



## Regional climate scenarios for 2030 year

Received on base of equations of link between global and regional temperature. Model results for assessment of greenhouse gases impact and climate change (MAGICC) for six options of greenhouse gases emission suggested by MGEIK (IS92a-IS92f) are used as global temperature scenario evaluation. Scenarios are twinned in pairs: cd, ab, ef



(Hydromet data)  
For Uzbekistan mean annual air temperature increase by 1,0-2,5°C is expected in case of emission scenario IS92 a,b realization

## Annual temperatures increased by:

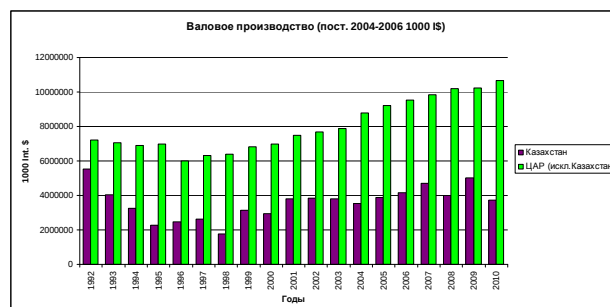
- 0.29 °C every 10 years in Uzbekistan (1950–2005);
- 0.26 °C every 10 years in Kazakhstan (1936–2005);
- 0.18 °C every 10 years in Turkmenistan (1961–1995);
- 0.10 °C every 10 years in Tajikistan (1940–2005);
- 0.08 °C every 10 years in Kyrgyzstan (1883–2005).

## Food security vis-à-vis population growth

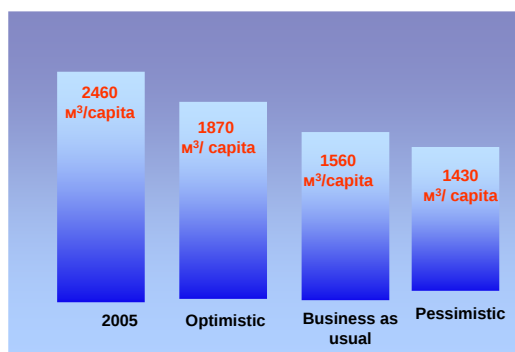
Сопоставление населения и роста производства продуктов питания

| Страна       | Рост населения, млн. чел. |       |       |       | Рост производства продуктов питания |      |      |       | Импорт 2011 |
|--------------|---------------------------|-------|-------|-------|-------------------------------------|------|------|-------|-------------|
|              | 1998                      | 2003  | 2008  | 2013  | 1998                                | 2003 | 2008 | 2013  |             |
| Казахстан    | 14,86                     | 14,75 | 15,57 | 16,44 | 5384                                | 6551 | 8102 | 7810  | 9173        |
| Киргизстан   | 4,82                      | 5,01  | 5,20  | 5,55  | 1348                                | 1647 | 1732 | 1827  | 580,1       |
| Таджикистан  | 6,01                      | 6,53  | 7,28  | 8,21  | 574                                 | 780  | 1090 | 1592  | 496,7       |
| Туркменистан | 4,39                      | 4,65  | 4,92  | 5,24  | 988                                 | 1927 | 2668 | 2446  | 298,9       |
| Узбекистан   | 24,17                     | 25,55 | 27,02 | 28,93 | 5165                                | 5867 | 8119 | 10920 | 1181,7      |

## Productivity of rainfed and irrigated lands in Central Asia



## What can be expected in 2030?



## Evaluation of water resources available for use in the Aral Sea Basin, km³

|                                        | Normal year | The 2008 driest year | Scenario B2     |            | Scenario A2     |            |
|----------------------------------------|-------------|----------------------|-----------------|------------|-----------------|------------|
|                                        |             |                      | An average year | A dry year | An average year | A dry year |
| 1. Surface runoff, incl.:              | 116,5       | 86,7                 | 110,9           | 82,6       | 106,6           | 80,0       |
| the Amu Darya River                    | 79,3        | 59,4                 | 75,7            | 55,2       | 71,3            | 53,5       |
| the Syr Darya River                    | 37,2        | 27,3                 | 37,2            | 27,3       | 35,3            | 26,5       |
| 2. Groundwater:                        | 16,9        | 13,5                 | 16,4            | 13,1       | 15,7            | 12,5       |
| the Amu Darya River                    | 5,9         | 4,7                  | 5,5             | 4,4        | 5,3             | 4,3        |
| the Syr Darya River                    | 10,9        | 8,7                  | 10,9            | 8,7        | 10,3            | 8,2        |
| 3. Return water:                       | 32,4/21,6   | 12,9                 | 20,8            | 12,5       | 20,1            | 12,0       |
| the Amu Darya River                    | 19,06/9,7   | 5,8                  | 9,0             | 5,4        | 8,7             | 5,2        |
| the Syr Darya River                    | 13,4/11,8   | 7,1                  | 11,8            | 7,1        | 11,2            | 6,7        |
| 4. Water losses in open channels:      | 13,9        | 13,9                 | 13,9            | 13,9       | 13,9            | 13,9       |
| the Amu Darya River                    | 8,9         | 8,9                  | 8,9             | 8,9        | 8,9             | 8,9        |
| the Syr Darya River                    | 5,0         | 5,0                  | 5,0             | 5,0        | 5,0             | 5,0        |
| 5. Environmental requirements:         | 8,0         | 5,2                  | 8,0             | 5,7        | 8,0             | 5,7        |
| the Amu Darya River                    | 4,8         | 3,2                  | 4,8             | 3,2        | 4,8             | 3,2        |
| the Syr Darya River                    | 3,2         | 2,0                  | 3,2             | 2,5        | 3,2             | 2,5        |
| Total water resources that can be used | 133,05      | 94,1                 | 126,4           | 88,7       | 120,6           | 85,0       |
| the Amu Darya River                    | 81,3        | 57,9                 | 74,6            | 53,0       | 71,7            | 50,9       |
| the Syr Darya River                    | 51,7        | 36,1                 | 51,7            | 35,6       | 48,7            | 34,0       |

## Combination of climatic and water management scenarios

| Water management scenario              | Climatic scenarios   |            |                 |            |                 |            |
|----------------------------------------|----------------------|------------|-----------------|------------|-----------------|------------|
|                                        | Usual natural runoff |            | Scenario B2     |            | Scenario A2     |            |
|                                        | An average year      | A dry year | An average year | A dry year | An average year | A dry year |
| Total                                  | 133                  | 94         | 126,4           | 88,7       | 120,5           | 85         |
| the Amu Darya River                    | 81,3                 | 57         | 74,6            | 53         | 71,7            | 50,9       |
| the Syr Darya River                    | 51,7                 | 36,1       | 51,7            | 35,6       | 48,7            | 34         |
| Hydropower (the irrigation regime W1): |                      |            | 126,4           | 95,8       | 120,5           | 89,9       |
| the Amu Darya River                    |                      |            | 74,6            | 53,6       | 71,7            | 53,8       |
| the Syr Darya River                    |                      |            | 51,7            | 42,2       | 48,7            | 36,6       |
| Hydropower (the hydropower regime W2): |                      |            | 119,2           | 81,2       | 113,9           | 76,3       |
| the Amu Darya River                    |                      |            | 69,7            | 45,8       | 67,4            | 43,5       |
| the Syr Darya River                    |                      |            | 49,5            | 35,4       | 46,5            | 32,8       |

## What we have now?

### On the side of science:

- Huge scope of solutions, knowledge, recommendations;
- Huge data base on different directions and specifics;
- Forecasts and optimizations;
- Human potential.

### On the side of water & land users:

- Lack of knowledge;
- Lack of experience;
- Weakness of governance;
- Difficulty in access to data and forecast;
- Absence of recommendations.

## What we need?

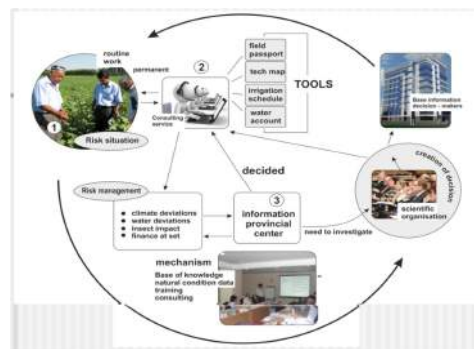
We propose to build:

### The System of Knowledge Transfer and Risk Management in Irrigated Agriculture

built on:

- Partnership chain
- Content of the system: local farming mapping
- Permanent monitoring of changes and risks;
- Providing marketing information and recommended crop pattern.

## Interrelations between key partners of the system



## Content of system

Local farming mapping on the basis of remote sensing to clarify features of local conditions and find reserves to improve farming conditions with orientation at potential productivity, technological cart, drought and salt resistant crops

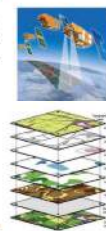
## Permanent monitoring of changes and risks

Example from Italy:

**Operational warning through dispatch service and transfer information by mobile connection to farmers; situation**

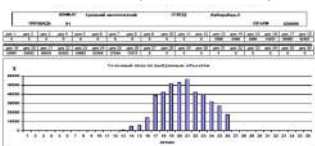
### Which technology ?

- Maps of canopy development (Leaf Area Index, LAI, albedo, "effective" crop coefficient and soil cover) are derived from high-resolution (20 m), multispectral radiometric images of DEIMOS-1 satellite, delivered in near real time (36 hours) and processed
- FAO-56 one-step approach is applied by using in-situ agro-meteorological variables
- Correction factor  $\eta$  for irrigation efficiency (if available)



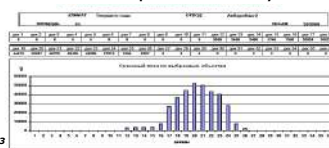
## Example from WUA Akbarabad, Uzbekistan

Cumulative seasonal plan of water delivery to farms



430 th m³

Cumulative seasonal plan of water delivery to farms



353 th m³

Calculation of water use by long-term climatic data and adjustment to climate of a particular year with follow up strong monitoring water delivery

Potential for water saving: 77 th m³

## Another reserve: use of margin waters

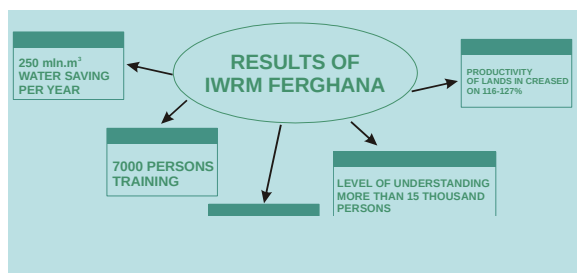
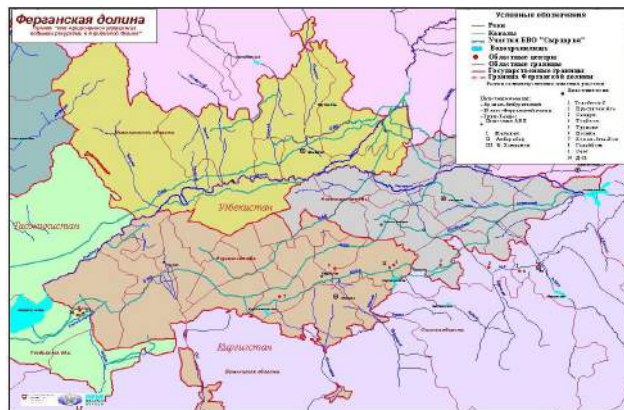
WAY from laboratory to field



## Marketing information



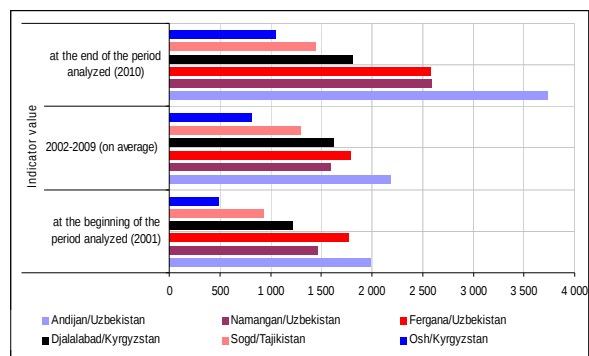
## Pilot interventions in the Fergana Valley



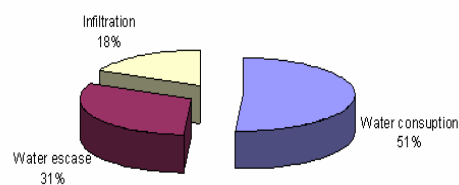
## Dynamics of water supply to pilot channels

| Pilot canal           | Specific water supply in this m <sup>3</sup> /ha |      |
|-----------------------|--------------------------------------------------|------|
|                       | 2004                                             | 2010 |
| Aravan Akbura Canal   | 8.11                                             | 7.88 |
| Khodja-Bakirgan Canal | 14.04                                            | 7.15 |
| South Fergana Canal   | 11.35                                            | 8.45 |

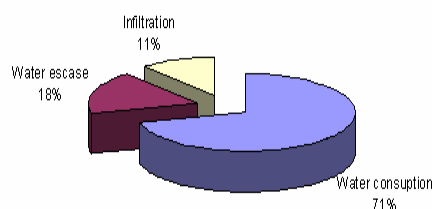
## Comparison of crop yield dynamics in the Fergana Valley



## Water supplied for irrigation is lost through surface outflow from irrigated fields and deep infiltration



**Water supply reduced by 22-30%,  
water losses reduced from 49% to 20%  
regarding water supply**



## Four pillars of knowledge transfer

1. Knowledge base;
2. Data base;
3. Training of users;
4. Adopting best practices.

## Knowledge Base Rubricator: 15 sections



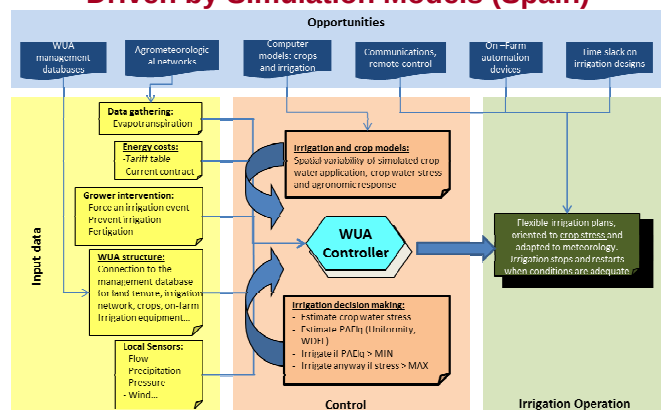
## Training of land and water users on the fields

Example:

Addressing  
Water Scarcity  
and Drought in  
Central Asia Due  
to Climate Change



## A WUA Solid-set Irrigation Controller Driven by Simulation Models (Spain)



Thank you for your attention!

We will be glad to collaborate with you all!!!

[www.cawater-info.net](http://www.cawater-info.net)

[www.sic.icwc-aral.uz](http://www.sic.icwc-aral.uz)

[www.eecca-water.net](http://www.eecca-water.net)