

Water Sector Reform challenge in Pyanj River Basin with comprehensive approach & innovative technology



Daler Abdurazoqzoda
Ministry of Energy and Water Resources (MEWR) of the
Republic of Tajikistan
Nekruz Mamadjonov

Agency for Land Reclamation and Irrigation (ALRI) under the
Government of the Republic of Tajikistan

October 2-4, 2018

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Water Sector Reform Program

The main goals:

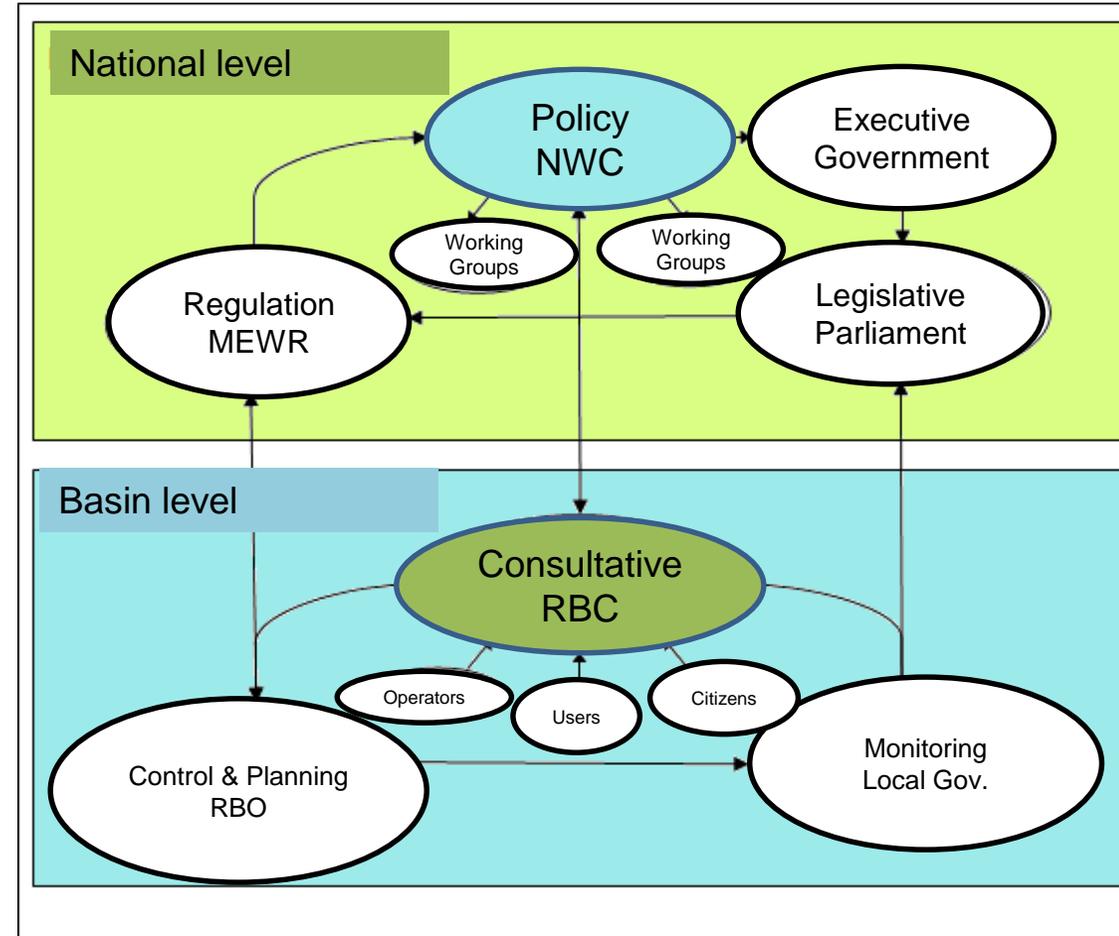
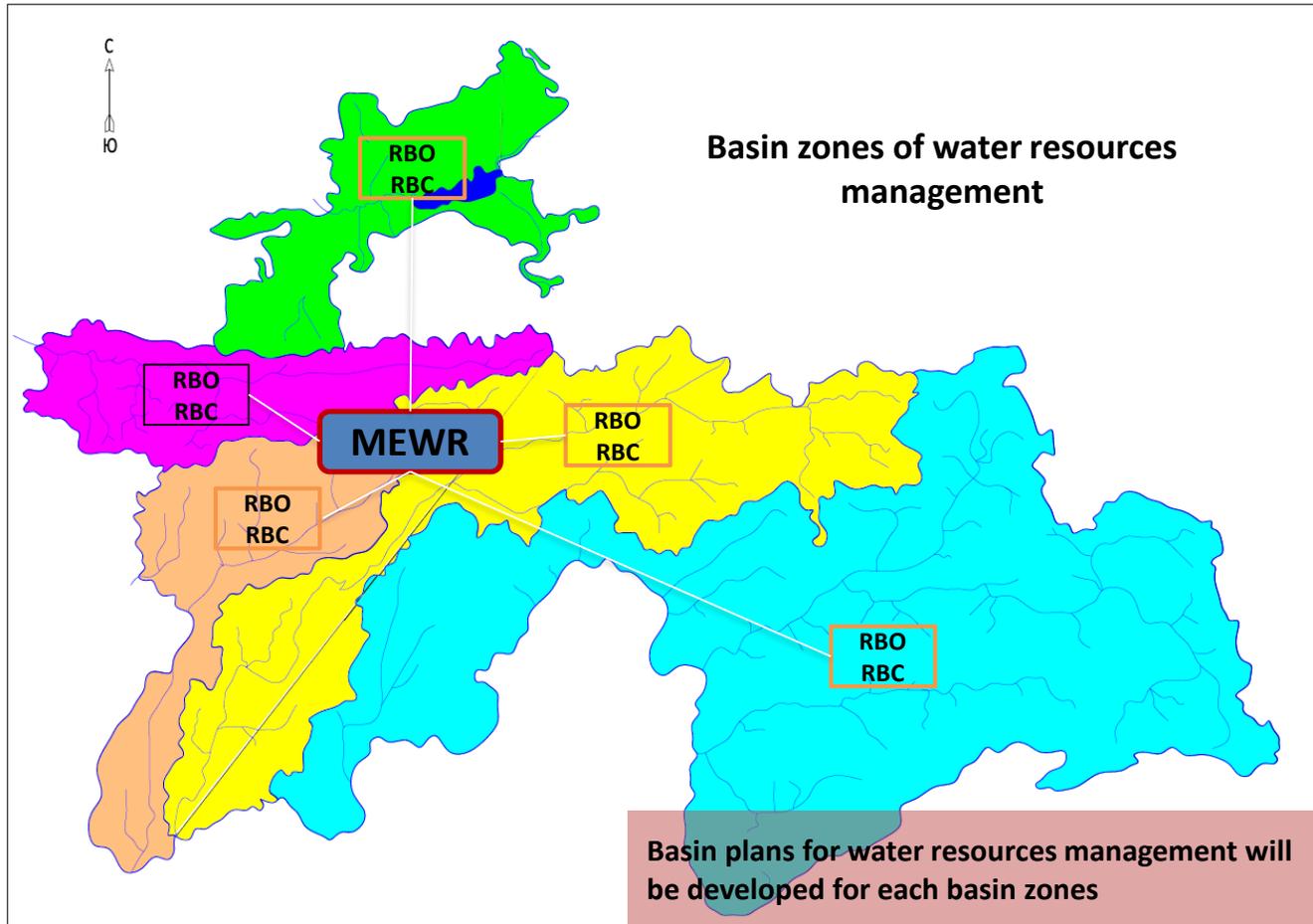
- Guaranteed water supply to all water users, including drinking water, irrigation, industry and hydropower;
- Achievement of economically efficient and environmentally sustainable management of water resources;
- Improving water resources management through the full implementation of basin and integrated water resources management (IWRM).

The main principles:

- Transition to basin water resources management based on the hydrological boundaries of river basins with establishment of basin and sub-basin organizations;
- Equitable accounting of the needs of all water users in the management and distribution of water resources, i.e. implementation of integrated water resources management with special emphasis on socio-economic development and improvement of people's well-being, as well as proper coordination between all sectors of water users;
- Separation of functions on water policy and regulation from operational and maintenance.



New Institutional Mechanisms of Integrated and Basin Water Resources Management



RBO – River Basin Organizations
RBC – River Basin Councils

NWC – National Water Council
MEWR – Ministry of Energy and Water Resources of Tajikistan



Water Resources Management in Pyanj River Basin Project

- Output 1: Water Resources in PRB better managed
 - Establishment of Joint Afghanistan-Tajikistan Pyanj River Basin Commission
 - Establishment of RBOs, development of basin plan and data base
- Output 2: Modernized and climate proofed Chubek irrigation system WRM infrastructure fully operational
 - Sediment Excluding Basin is constructed
 - 8 Pumping Units modernized and rehabilitated etc.
- Output 3: Farm management capacity and water use skill improved
 - Establishment of WUAs and its capacity development
 - **Monitoring and evaluation system using satellite remote sensing technology for efficient water use**



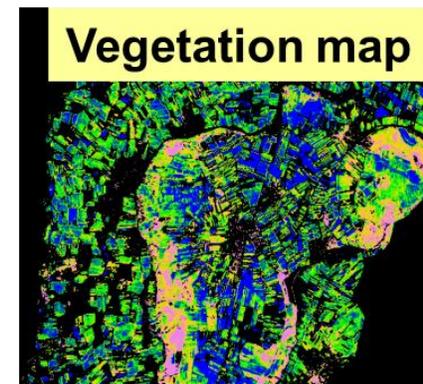
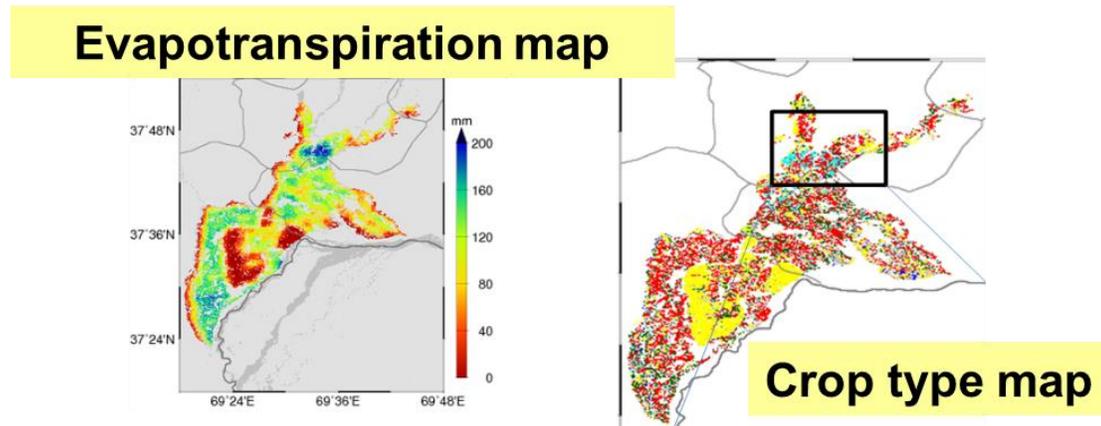
Irrigation System Performance Assessment using Satellite Remote Sensing Data

- An M&E monitoring system using satellite remote sensing technology to assess water use efficiency and water conveyance efficiency was developed under the project preparation technical assistance.

Satellite image is “**observation data**” from space

Satellite can provide:

- **Evapotranspiration (ET) maps = Crop Water Consumption**
- **Vegetation (NDVI) maps**
- **Crop type maps**



Irrigation Consumptive Use Coefficient (ICUC)

- ICUC = How many portion of water was consumptively used at the irrigation system level

$$\text{ICUC (\%)} = \frac{\text{Water consumptively used as ET}}{\text{Water applied as Irrigation}} \times 100$$

→ Satellite-based ET data

→ Pump data and Rainfall data

- By comparing ICUC before and after irrigation projects, it's possible to evaluate the improvement.



Water Use Ratio (WUR)

- WUR indicates how much actual field is close to the optimum in terms of water consumption

$$\text{Actual ET (mm)} = \text{Reference ET (mm)} \times \text{ET Index (-)}$$

Standard ET based on weather condition
(solar radiation, air temperature and humidity, wind speed)
Ground data (weather station)

Ratio (0 – 1.23) indicating degree of evaporation
Satellite data

$$\text{WUR} = \frac{\text{Actual ET (mm)}}{\text{Optimum ET (mm)}}$$

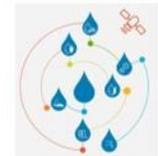
$$\text{Optimum ET (mm)} = \text{Reference ET (mm)} \times \text{Optimum ET Index (-)}$$

FAO provides ET Index for each crop growth stage

“Optimum ET for each crop”



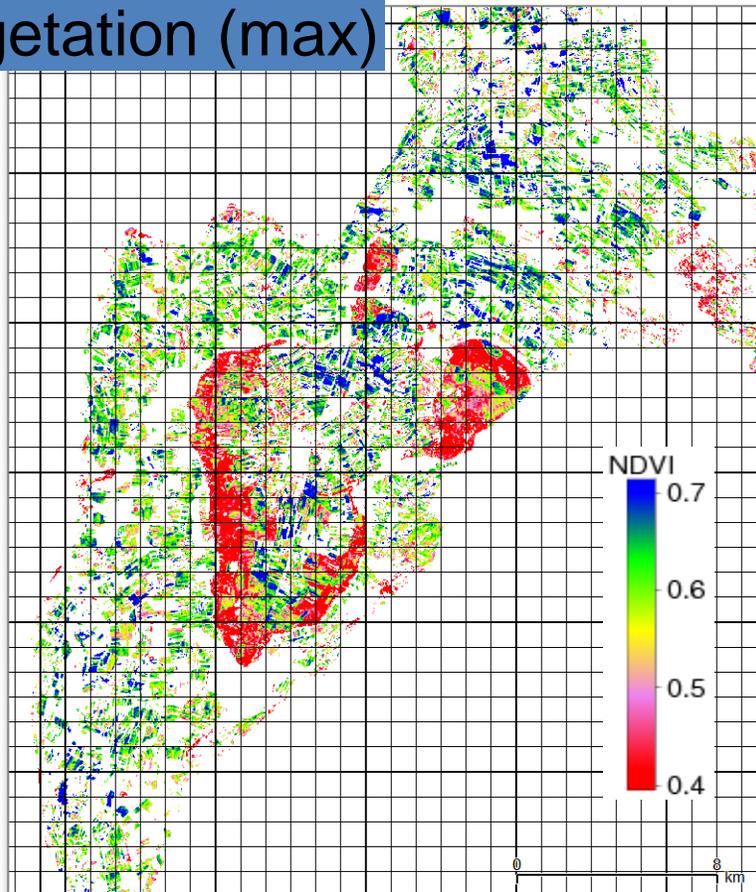
Crop coverage map is needed



An example of satellite-based assessment using WUR

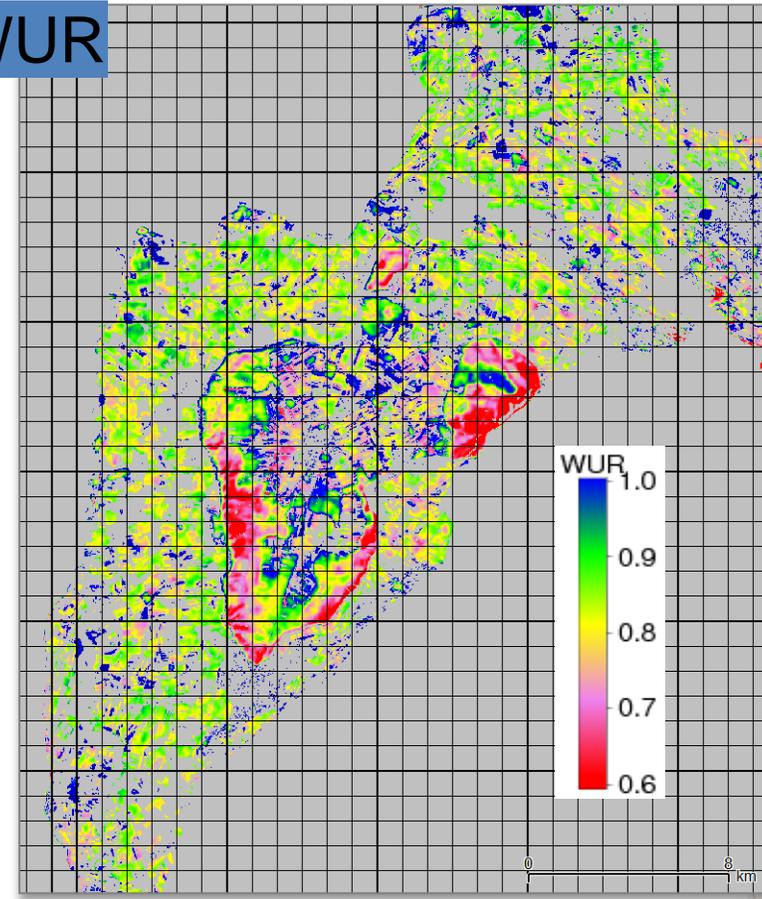
- Conduct the analysis before and after irrigation projects, it's possible to evaluate the improvement.

Vegetation (max)



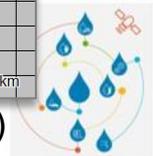
Made with Landasat data (30m grid)
Period: April – October, 2014

WUR



Made with Landasat data grid (100m grid)

Field : Cotton + Wheat Source: RESTEC 2016, final feasibility report



What is the benefits using the system?

- Assessment of (i) actual ET maps (current crop water consumption) and (ii) optimum ET (crop water requirement) enables us to understand irrigation performance and to identify area requiring modernization.
- A WUR map will be helpful to understand irrigation status easily.
- By updating cropping cover map every year, changing process of crop pattern in the irrigation system can be monitored.



What is the enable conditions?

- Quality ground observation data will be needed to enable better estimation.
- The M&E system requires powerful and stable computer resources and stable internet connection for satellite data processing and evapotranspiration (and several index) model processing.
- Experienced engineers with high expertise will be needed for periodical calibration.

It is difficult to maintain the system only by the government



For further upscaling

- External resources such as a regional platform for managing the satellite monitoring data can enable the sustainable O&M of the system.
- We are welcome if international organizations can establish such a kind of platform to utilize the remote sensing technology for future development of the regions.



Thank you very much for your attention !!!

