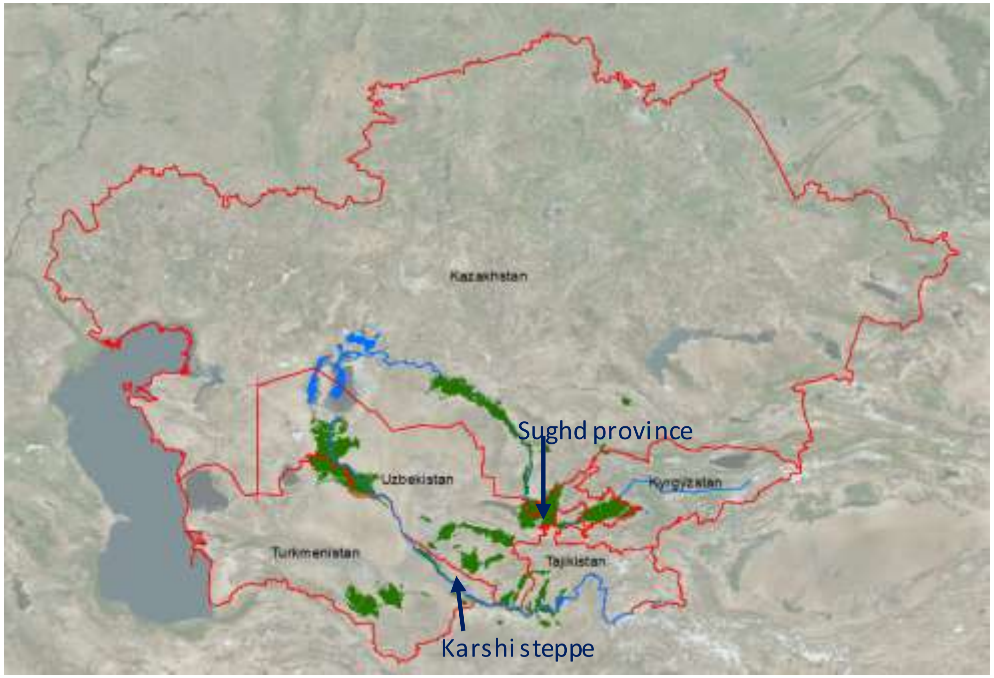
Project title: Mitigating the competition for Water in the Amudarya River Basin by improving water use efficiency

Principal investigator: Kakhramon Djumaboev
Co-Principal Investigator: James Ayars

Duration : 1 November, 2015 – 30 October, 2018

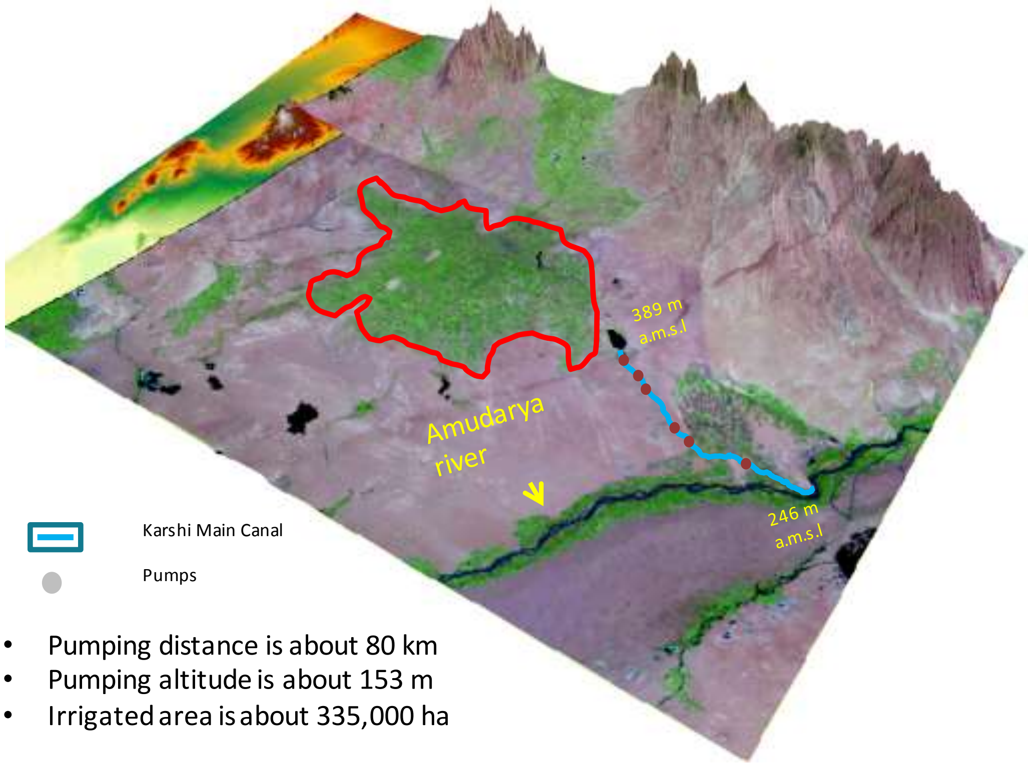
Local and Regional partners: UZGIP and Kashkadarya BISA in Uzbekistan; Sogd WMO in Tajikistan

IRRIGATED AREAS OF ARAL SEA BASIN AND STUDY AREAS



LIFT IRRIGATION SCHEME IN KASHKADARYA (UZBEKISTAN)

- Farmers overuse scarce water as well as mineral fertilizers for irrigation purposes, leading to excess polluted drainage runoff
- Lift irrigated agriculture provides more than 50% of the total water available at the farm gate in Kashkadarya province of Uzbekistan for summer crops
- About 70 percent of MAWR Uzbekistan budget is allocated to electricity used by pump stations (Khamraev 2011)
- In Karshi, the extraction of 1,953 MCM of pumped water for main crops such as cotton and wheat consumes 880 GWh of energy. Carbon emissions attributed to this energy use are 420 kton of CO_2 equivalent emissions yr^{-1}



- Pumping distance is about 80 km
- Pumping altitude is about 153 m
- Irrigated area is about 335,000 ha

STUDY OBJECTIVES

- To estimate water and energy ‘gains’ through improving water and energy use practices in agriculture;
- To assess the costs and benefits of employing water- and energy-saving technologies for farmers, policymakers, and society in general;
- Promote widespread adoption and use of evidence-based management practices that improve water- and energy-use efficiency at sub-basin scale in selected areas of Syrdarya and Amudarya River Basins.

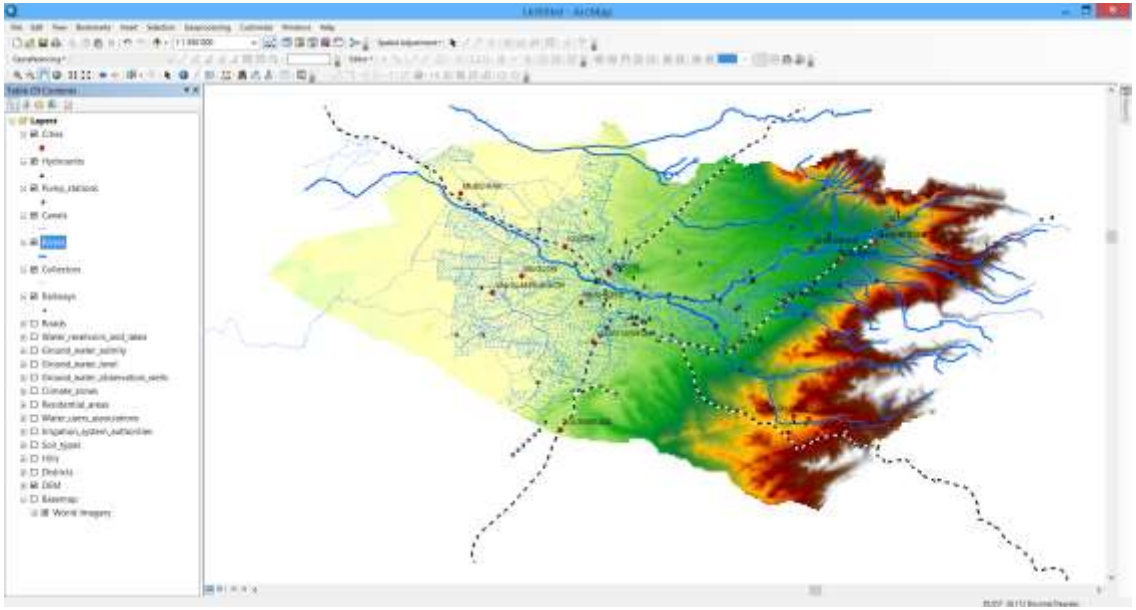
GEODATABASE OF KASHKADARYA PROVINCE AND ZAFARABAD DISTRICT

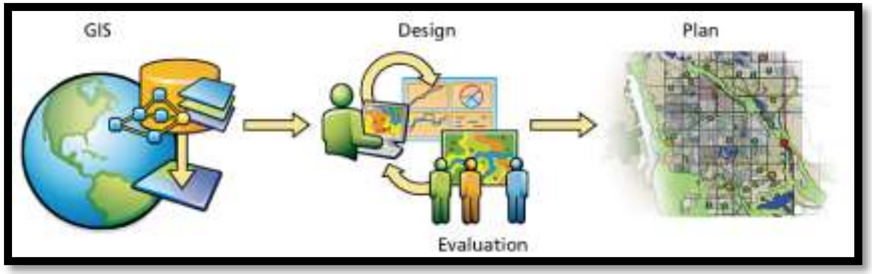
Geodatabase is a collection of geographic datasets of various types held in a common file system.

Content:
- Agricultural administration
- Ground water
- Water resources
- Climate
- Soil
- Land cover/use
- Vegetation
- Crop

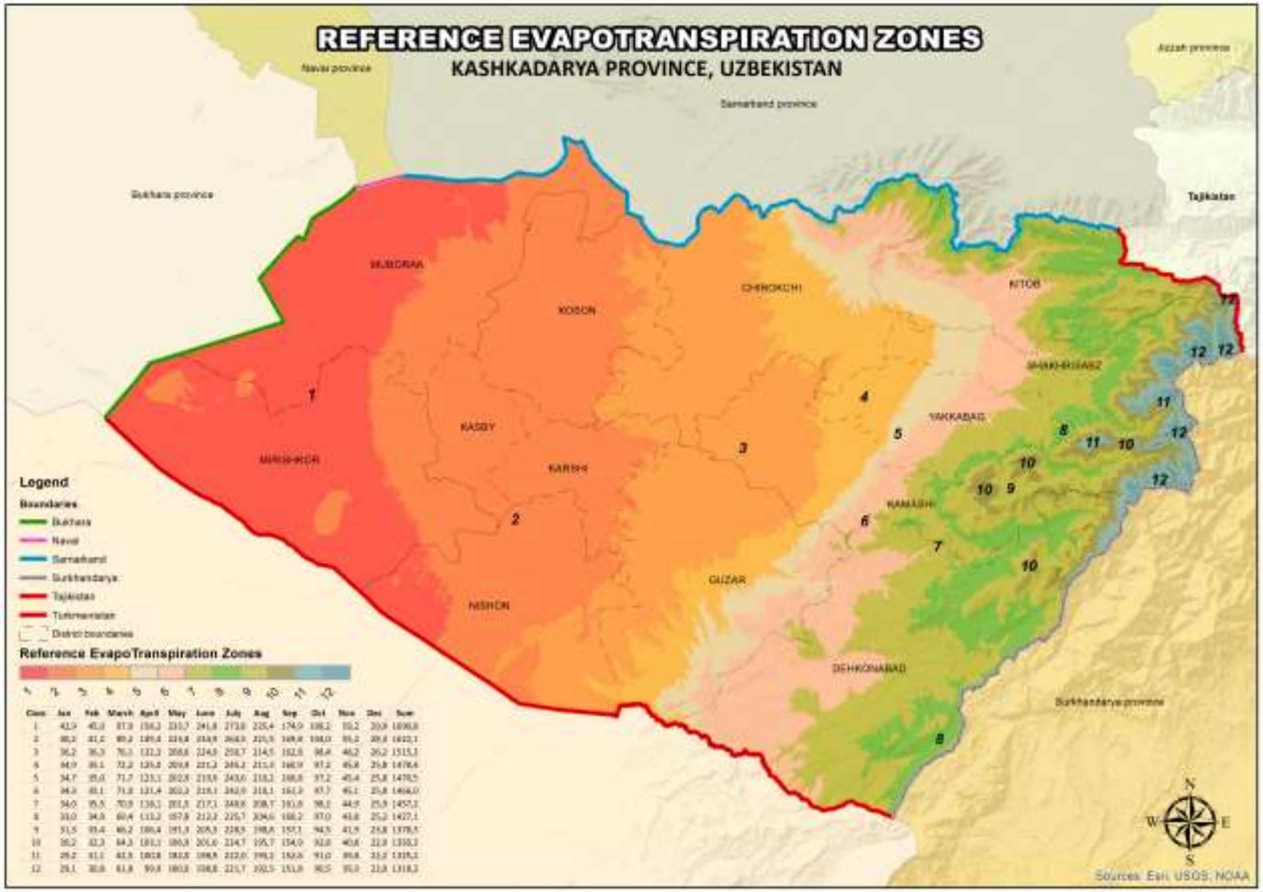
Methods:
- Analogue data
- Satellite image analyses
- Climate model
- Field trips

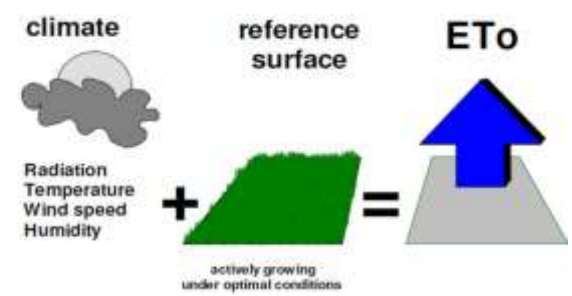
Aim: to provide key stakeholders an evidence-base tool and guide to inform water and land management practices and to support decision-making that will lead to more productive and efficient use of resources.





Reference Evapotranspiration values for Kashkadarya region





Monthly Average Reference Evapotranspiration by ETo Zone (mm/month)

Classes	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Sum
1	42,9	45,0	97,9	158,2	233,7	241,8	273,8	225,4	174,9	108,2	59,2	20,9	1650,8
2	40,2	41,2	89,2	149,4	223,8	234,9	264,1	221,5	169,8	104,0	55,2	28,3	1622,1
3	36,2	36,3	76,1	132,3	208,8	224,9	250,7	214,5	162,8	98,4	48,2	26,2	1515,7
4	34,9	35,1	72,2	125,0	203,9	221,2	245,2	211,3	160,9	97,1	45,8	25,8	1478,4
5	34,7	35,0	71,7	123,1	202,8	219,9	243,6	210,2	160,8	97,2	45,4	25,8	1470,5
6	34,3	35,1	71,0	121,4	202,2	219,1	242,9	210,1	161,3	97,7	45,1	25,8	1466,0
7	34,0	35,5	70,9	118,1	201,5	217,1	240,8	208,7	161,8	98,2	44,9	25,9	1457,2
8	33,0	34,9	69,4	113,2	197,8	212,3	235,7	204,6	160,2	97,0	43,8	25,2	1427,1
9	31,5	33,4	66,2	106,4	191,3	205,3	228,3	198,8	157,1	94,5	41,9	23,8	1378,5
10	30,2	32,3	64,3	103,1	186,9	201,6	224,7	195,7	154,9	92,6	40,8	22,9	1350,2
11	29,2	31,1	62,5	100,8	182,0	198,9	222,0	193,2	152,6	91,0	39,8	22,2	1325,2
12	28,1	30,8	61,8	99,0	180,0	198,8	221,7	192,5	151,8	90,5	35,0	22,0	1318,2

Reference evapotranspiration was calculated based on Hargreaves – Samani equation. This methodology requires minimum input data which is quite acceptable for data limited regions.

DOCUMENTING WATER- AND ENERGY-SAVING TECHNOLOGIES IN THE FIELD

International Water Management Institute

Water for a food-secure world

www.iwmi.org

LEARNING ABOUT THE EXPERIENCES OF "BRIGHT" FARMERS IN KASHKADARYA

- Farmers who achieve high levels of agricultural performance using innovative methods such as water- and energy-saving technologies
- Identified through quantitative and qualitative assessments, including collection and analysis of data from local irrigation system administrations and diagnostic surveys that included detailed interviews with the local farmers
- Finally, a structured questionnaire survey was used to document the experiences of "bright" farmers who employed innovative methods of irrigation, which included collection of data on crop yields, water, minerals, fuel, and seed use, and ripening time

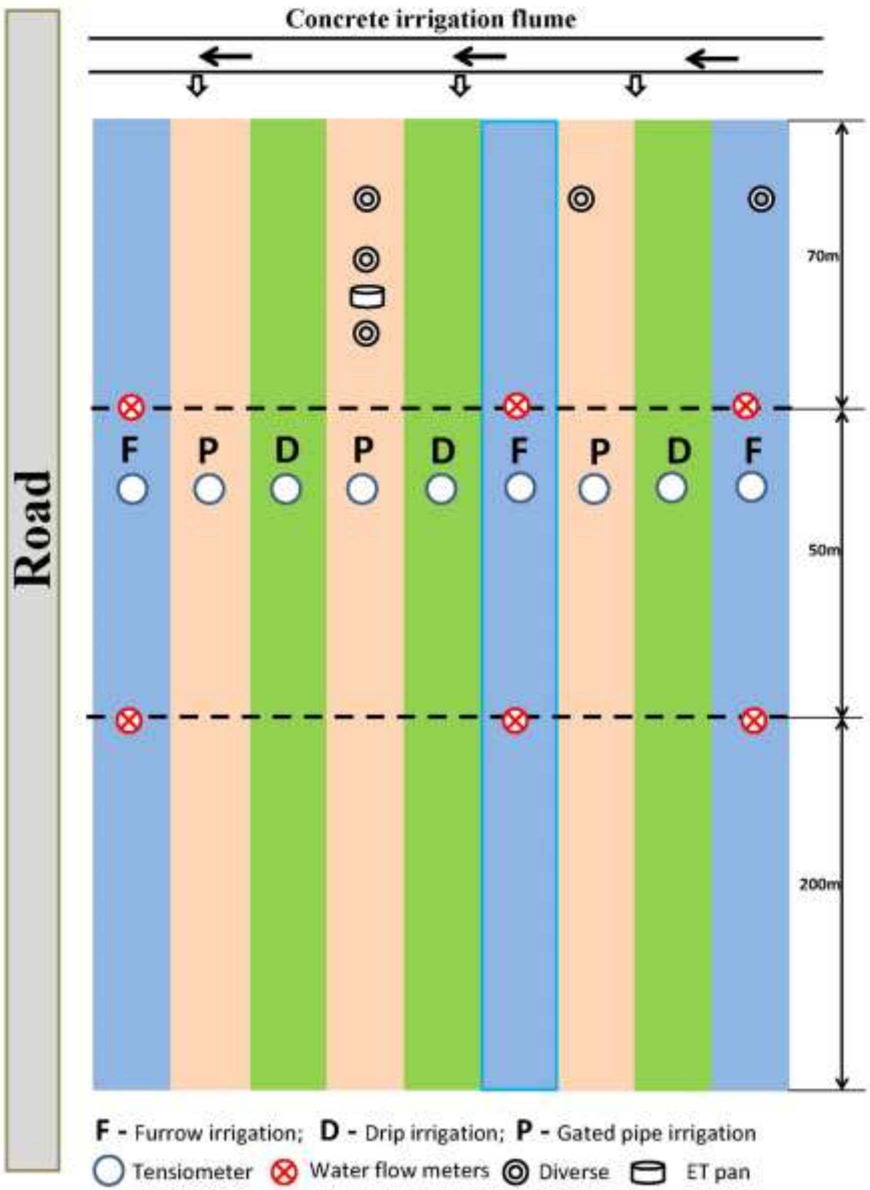
WATER SAVING TECHNOLOGIES IN THE FARMERS' FIELDS IN KASHKADARYA PROVINCE

Comparison of traditional and drip irrigation methods in the “Najotkor” farm, Karshi steppe

Parameters	Unit	Results		Economic efficiency % (+/-)
		Traditional method	Drip irrigation	
Crop yield	c/ha	26.0	37.0	+42%
Water use	m^3/ha	6600	3300	-50%
Fertilizer use	kg/ha	750	450	-40%
Fuel use	l/ha	300	85	-72%
Seed use	kg/ha	55	27	-51%
Ripening time	Day	132	110	-17%

Improved crop yields, water use efficiency, mineral fertilizers efficiency, fuel use efficiency, seed use efficiency, and reduction of ripening time

METHODOLOGY



TREATMENTS:

1. Normal irrigation scheduling (NIS),
2. Gated pipe irrigation (GPI)
3. Drip irrigation (DrI)

Cotton variety: Porlok-4

Design: Randomized Complete Block design

Replications : 3

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DATA COLLECTION





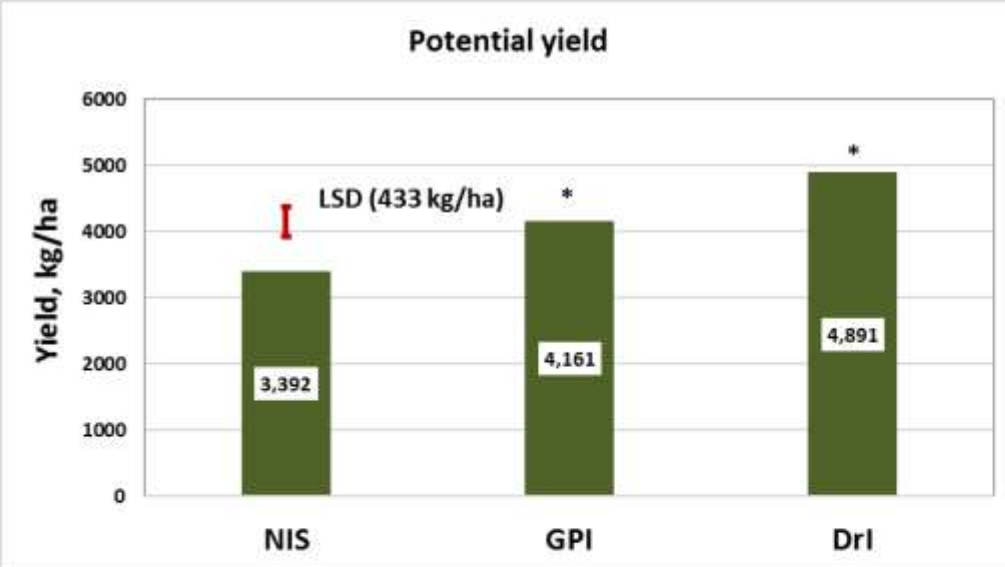


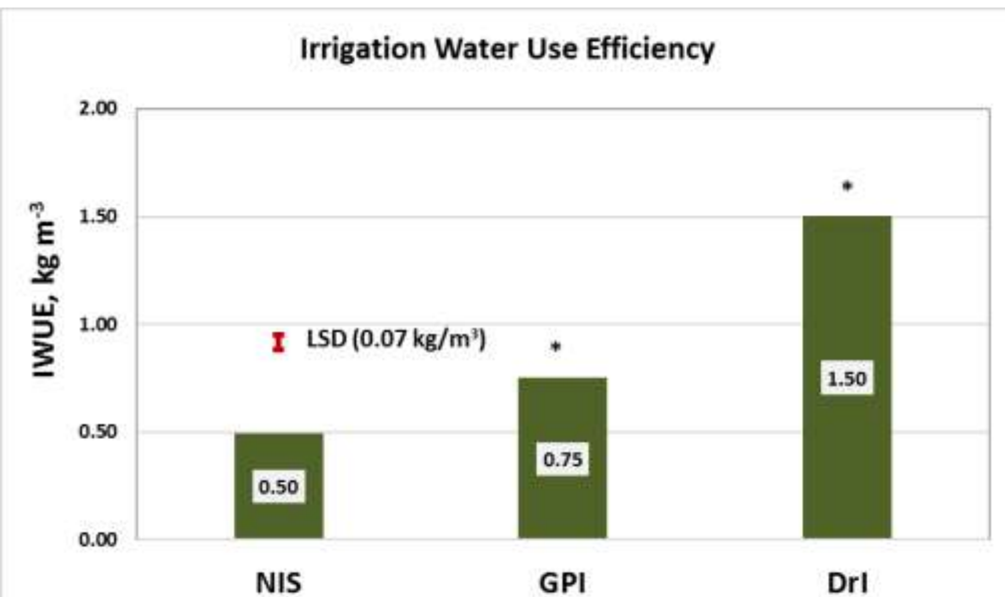
DATA COLLECTION





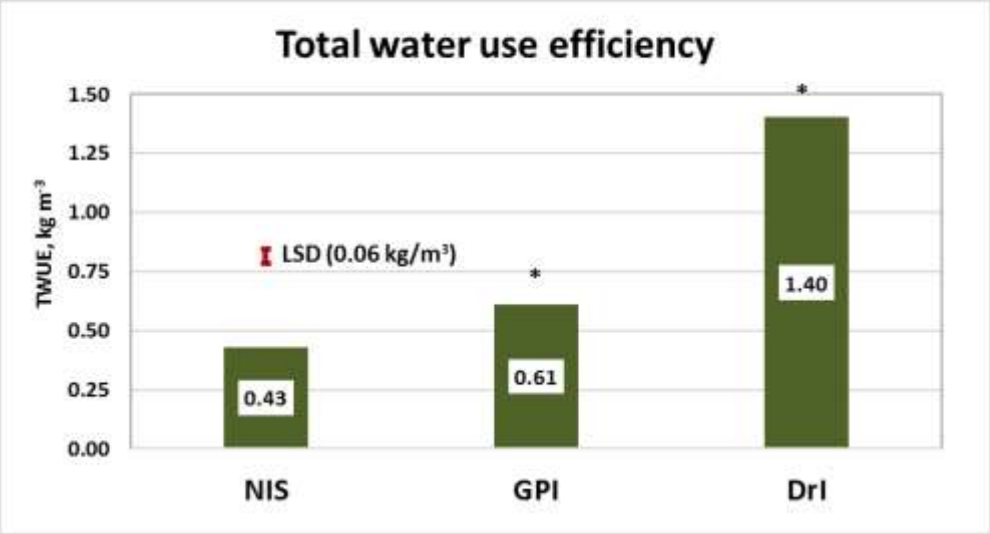

Results and discussion

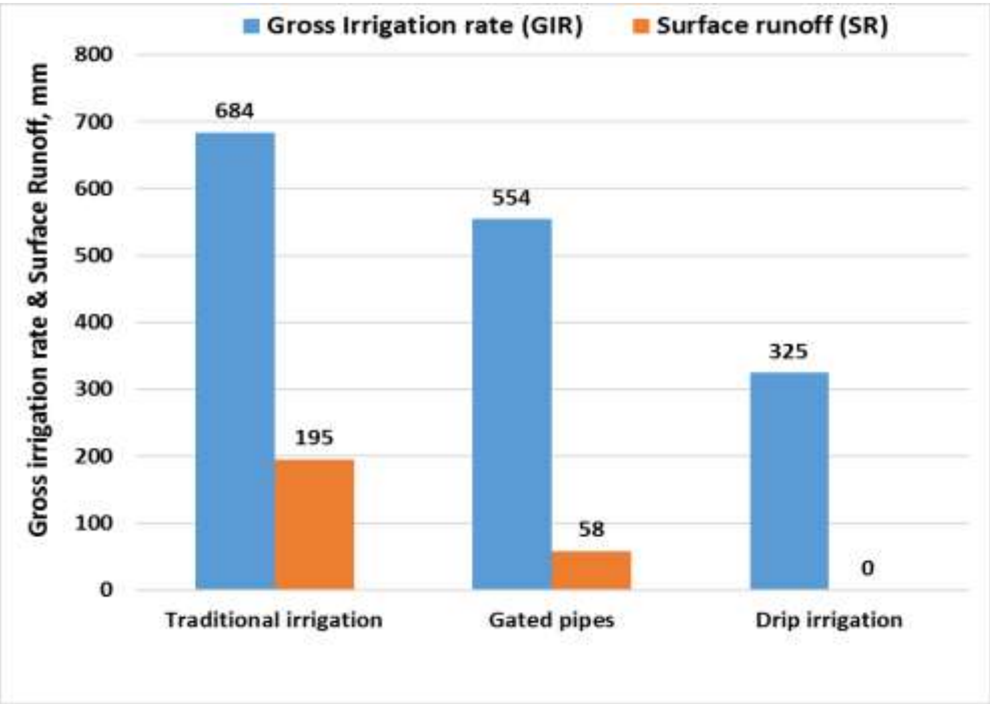




- The highest yield of 4.8 t/ha was obtained under the DrI treatment, whereas the lowest yield of 3.4 t/ha was obtained under the NIS treatment. In general, the NIS and GPI irrigation treatments produced slightly lower yields than the DrI treatment, which used the least amount of irrigation water.
- Total gross irrigation rates were 325, 554 and 684 mm for Drip, Gated pipe and traditional irrigation, respectively.
- The mean values of irrigation water use efficiency estimated as (IWUE = Yield/ Water Use) for NIS, PGI and DrI were, respectively, 0.30, 0,75 and 1.50 kg/m3, and IWUE of DrI treatment was significantly higher than that of NIS.

Results and discussion

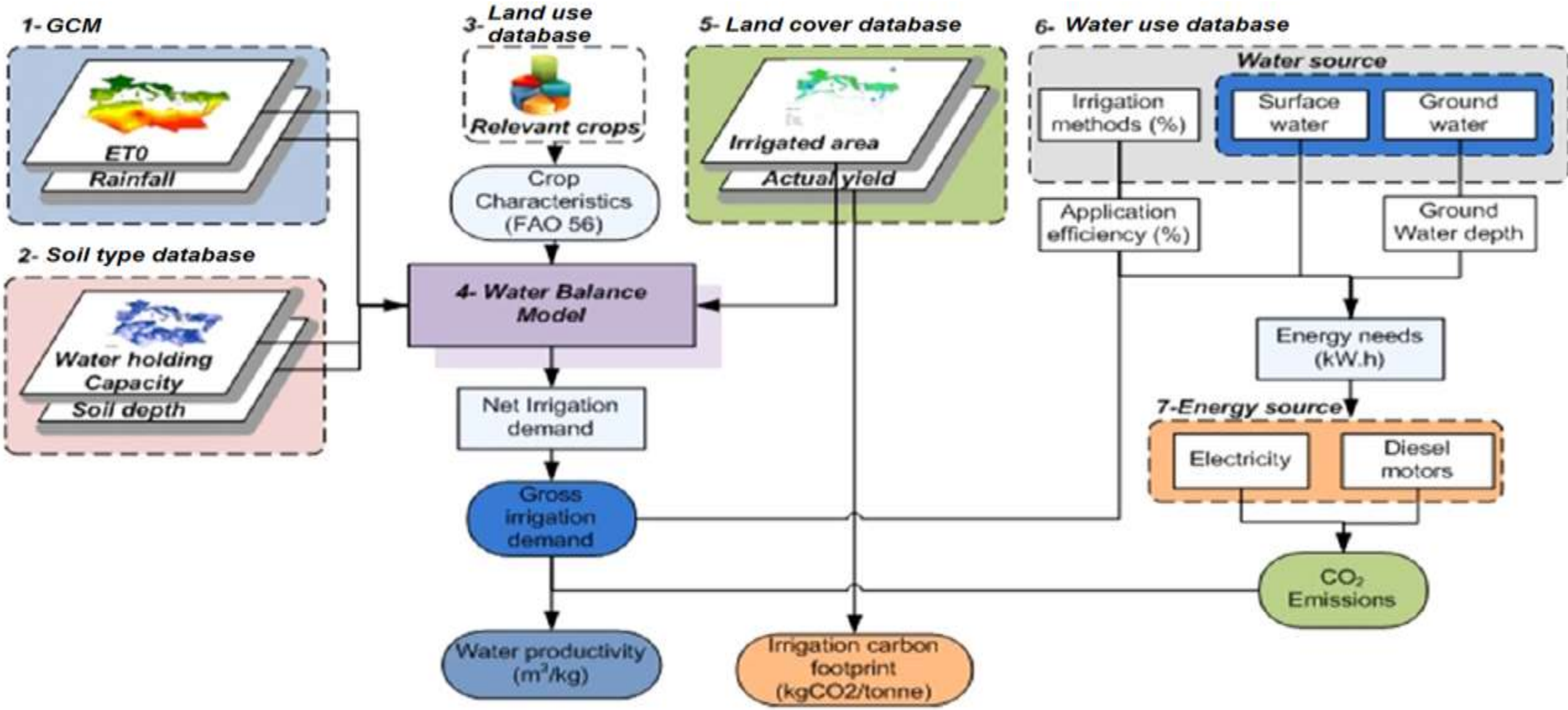




- The maximum total water use efficiency (TWUE) was observed for DrI, while minimum was for NIS .
- IWUE of DrI and PGI treatments were significantly higher than that of NIS.

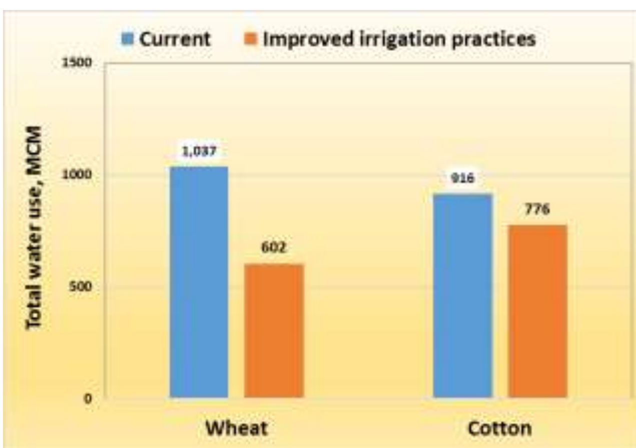
- According to the data maximum runoff (around 28%) was observed for control- traditional irrigation , while that was only 10% for gated pipe irrigation, treatment due to higher water losses via runoff and deep percolation under control .
- There were no runoff for drip irrigation treatment

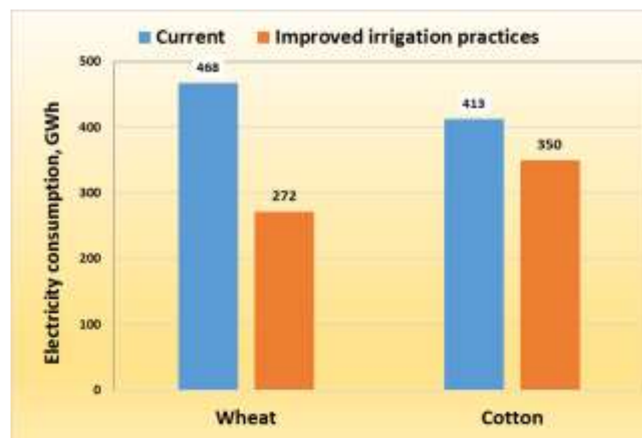
METHODOLOGY TO ASSESS WATER AND ENERGY NEEDS OF LIFT IRRIGATION AREAS
(ADAPTED FROM DACCACHE ET AL., 2014)



Total water use, water and energy consumption saving under current and improved irrigation practices (Karshi)

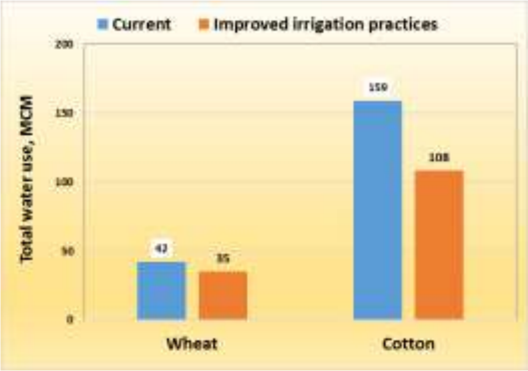
Crop	Total pumped area, ha	Irrigation application, mm		Total water use, MCM		**Total water saving, MCM**	Electricity consumption, GWh		**Total energy saving, GWh**	GHG emissions, Kton		**CO_2 reduction, Kton of GHGs**
		Current	Improved irrigation practices	Current	Improved irrigation practices		Current	Improved irrigation practices		Current	Improved irrigation practices	
Wheat	102600	1011	587	1037	602	**435**	468	272	**196**	219	127	**92**
Cotton	119681	765	648	916	776	**140**	413	350	**63**	194	164	**30**
Total	222281	N/A	N/A	1953	1378	**575**	880	621	**259**	413	291	**122**

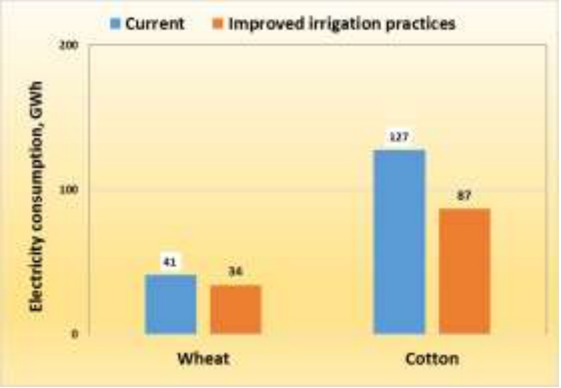




Total water use, water and energy consumption saving under current and improved irrigation practices (Zafarabad)

Crop	Total pumped area, ha	Irrigation application, mm		Total water use, MCM		Total water saving, MCM	Electricity consumption, GWh		Total energy saving, GWh	Pumping cost, USD		Pumping cost, USD
		Current	Improved irrigation practices	Current	Improved irrigation practices		Current	Improved irrigation practices		Current	Improved irrigation practices	
Wheat	6388	662	546.8	42	35	**7**	41	34	**7**	237864	196471	**41393**
Cotton	12220	1302	885.2	159	108	**51**	127	87	**41**	737078	501123	**235956**
Alfalfa	5975	1367	1320.8	82	79	**3**	71	68	**2**	409272	395440	**13832**
Maize	1047	1040	850.7	11	9	**2**	12	9	**2**	67067	54860	**12208**
Vegetable	932	1289	619.1	12	6	**6**	10	5	**5**	59417	28538	**30880**
Melon	1172	1289	767.9	15	9	**6**	13	8	**5**	74903	44622	**30281**
Trees	1849	730	535.1	13	10	**4**	12	8	**3**	66831	48988	**17843**
Rice	200	3600	2491.9	7	5	**2**	4	2	**1**	20623	14275	**6348**
Total	29783	N/A	N/A	341.8	260.6	**81**	289	222	**67**	1673055	1284316	**388739**





PEER REVIEWED PUBLICATION

- Djumaboev K, Hamidov A, Anarbekov O, Gafurov Z and Tussupova K. (2017). Impact of Institutional Change on Irrigation Management: A Case Study from Southern Uzbekistan. Water 2017, 9(6), 419, doi: 10.3390/w9060419 http://www.mdpi.com/2073-4441/9/6/419

- Kakhramon Djumaboev, Ahmad Hamidov and Oyture Anarbekov 2017.Collective Action in the Irrigation Sector of Uzbekistan: A case Study of Water Consumers Associations (WCAs) in the Karshi Steppe of Uzbekistan. http://centralasia.iwmi.cgiar.org/regional-content/central_asia/pdf/collective_action_in_the_irrigation_sector_of_uzbekistan.pdf

- Kakhramon Djumaboev, Tulkun Yuldashev, Bunyod Holmatov and Zafar Gafurov (2018). Assessing Water Use, Energy Use, and Carbon Emissions in Lift Irrigated Areas: A case Study from Karshi Steppe in Uzbekistan. Paper accepted for publication. Irrigation and drainage journal of International Commission on Irrigation and Drainage. https://onlinelibrary.wiley.com/journal/15310361

- Gafurov, Z., Eltazarov, S., Akramov, B., Djumaboev, K., and Anarbekov, O. 2018. *Geodatabase and Diagnostic Atlas: Kashkadarya Province, Uzbekistan*. Colombo, Sri Lanka: International Water Management Institute (IWMI). http://centralasia.iwmi.cgiar.org/regional-content/central_asia/pdf/geodatabase_and_diagnostic_atlas-kashkadarya_province-uzbekistan.pdf

- Gafurov, Z., Eltazarov, S., Akramov, B., Djumaboev, K., and Anarbekov, O. 2018. *Information tool for Zafarabad district, Sogd province (Tajikistan)*. Colombo, Sri Lanka: International Water Management Institute (IWMI). http://centralasia.iwmi.cgiar.org/regional-content/central_asia/pdf/information_tool_for_zafarabad_district_sogd_province_tajikistan.pdf

PUBLICATIONS UNDER INTERNAL REVIEW

- ✓ Report on experiences of “bright” farmers and the use of water- and energy-saving technologies documented, including a preliminary cost-benefit analysis framework;
- ✓ Research report on Ecosystem Service Assessment prepared for Kashkadarya watershed;
- ✓ Research report on Water and energy saving technologies demonstrated for farmers in the study areas;
- ✓ Report on water and Energy footprint of lift irrigated area: A case study Zafarabad district of Tajikistan
- ✓ Policy brief on Importance of GIS geodatabases for improving water and energy use efficiency in Uzbekistan and Tajikistan
- ✓ Policy brief on Nexus Approach in Improving Water and Energy Use and Reducing Carbon Emissions in Lift Irrigated Areas of Uzbekistan

Capacity building activities under USAID PEER Cycle 4

Meeting with FAO-Turkey Project representatives
26 August, 2017

Number of participants was 25. Workshop has brought together representatives of FAO-Turkey, Amu-Kashkadarya Irrigation System Authorities, Water Consumer Association






Students supported under USAID PEER Cycle 4

- ✓ **Gulchehra Eshmuratova**, a bachelor's student at TIIAME defended her BSc Thesis. Her thesis title is: Water balance and irrigation regime scheduling for cotton using advanced technologies (GIS and RS) under Karshi steppe conditions
- ✓ **Malika Mahmudova** from Tashkent Institute of Irrigation and Melioration conducted her Master's Thesis on water and energy use efficiency and USAID PEER project team supported her in completing her thesis.
- ✓ **Shovkat Khodjaev**, 2014-2016 Master student at German Kazakh University, Almaty, Kazakhstan, Thesis title: Implementation of Smart Water Technology in river basin scale.
- ✓ **Uktam Adkhamov**, Bachelor Student, 2012 – 2016, Bachelor Student at Tashkent Institute of Irrigation and Melioration, Thesis title: Modelling of soil moisture and cotton crop yields in the condition of drip and furrow irrigation in Karshi Steppe.
- ✓ **Zafar Gafurov**, PhD student, 2015-2018, Research Institute of Uzhydromet: Study of changing Eto values for Kashkadarya region under climate change using GIS & RS.
- ✓ **Rustam Karshiev** started his PhD thesis under PEER project in Karshi Steppe and he is affiliated with TIIAME. His research is focused on Impact of water conservation technologies on energy use in Lift Irrigated area.

Policy Dialogue workshop

Dissemination of project results in international and national conferences

MAIN POLICY RECOMMENDATIONS

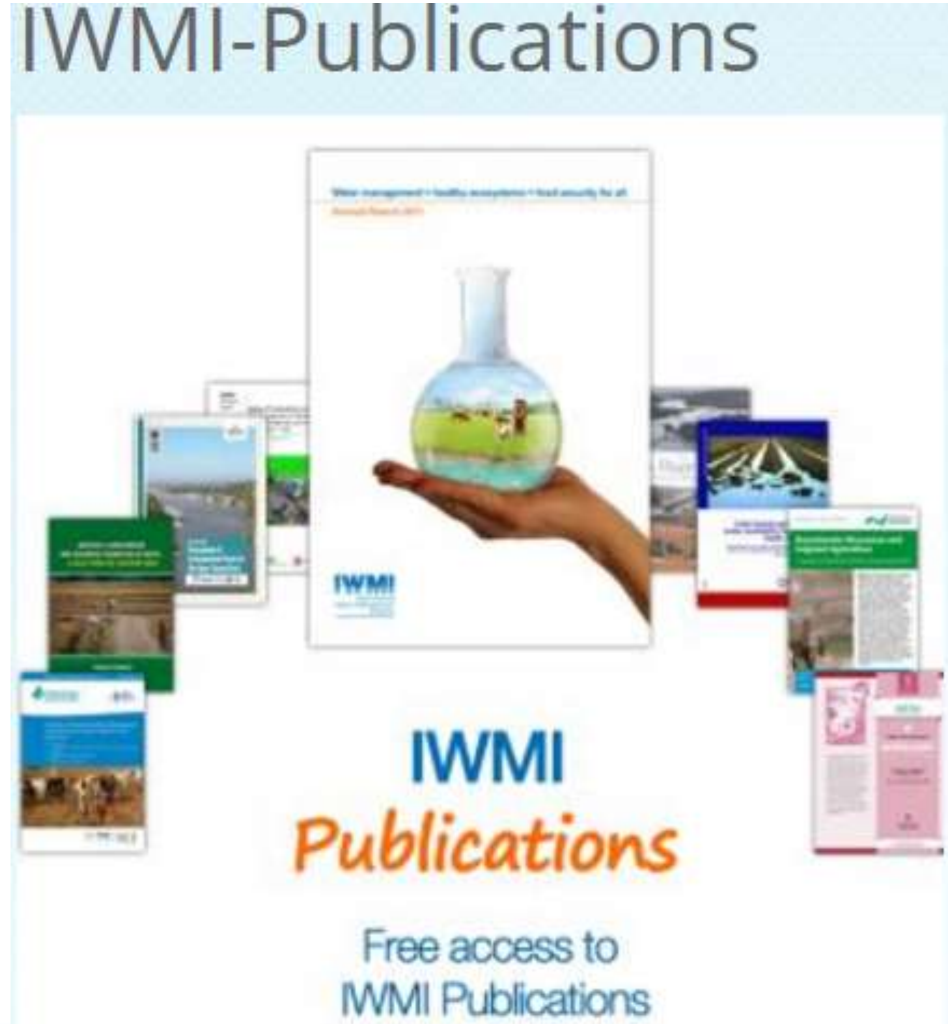
- Promote the use of GIS and RS/EO based maps by decision makers as an evidence-based tool to identify need areas and to devise targeted interventions;

- Quantify the costs and benefits of using water- and energy-efficient technologies to the government, farmers and society as a whole and strengthen the evidence-base to promote their widespread adoption and use;

- Educate farmers and relevant stakeholders by sharing project findings and demonstrating the benefits of employing water- and energy-efficient methods and technologies;

IWMI PUBLICATIONS

- http://www.iwmi.cgiar.org/resources/apps/



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