ICARDA
Science for resilient livelihoods in dry areas

Collaborative work of ICARDA on climate-resilient technologies for improved land and water productivity in Central Asia

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Scope of presentation – climate-resilient technologies

Crop varieties

Water Management

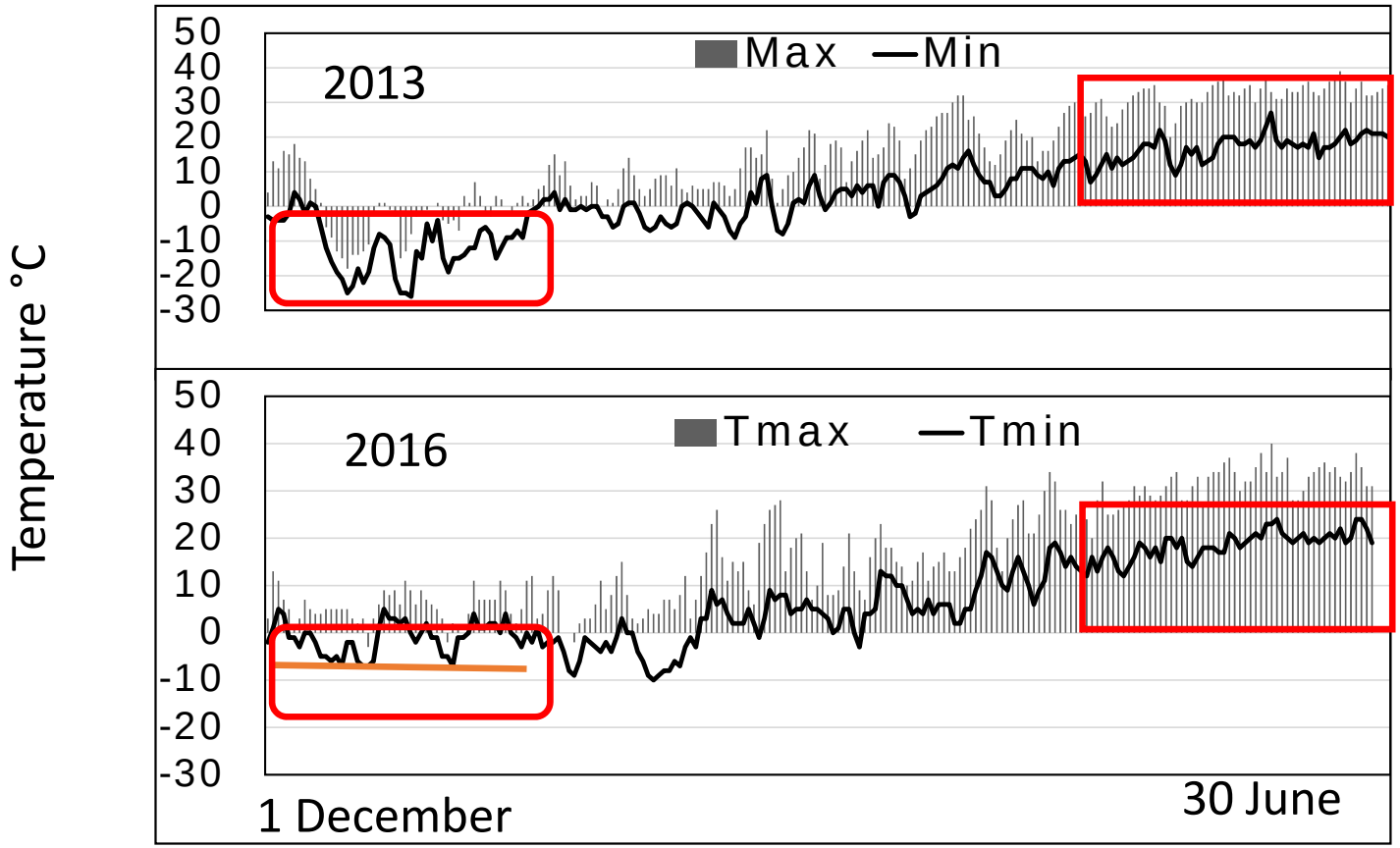
Cropping system diversification

Conservation agriculture

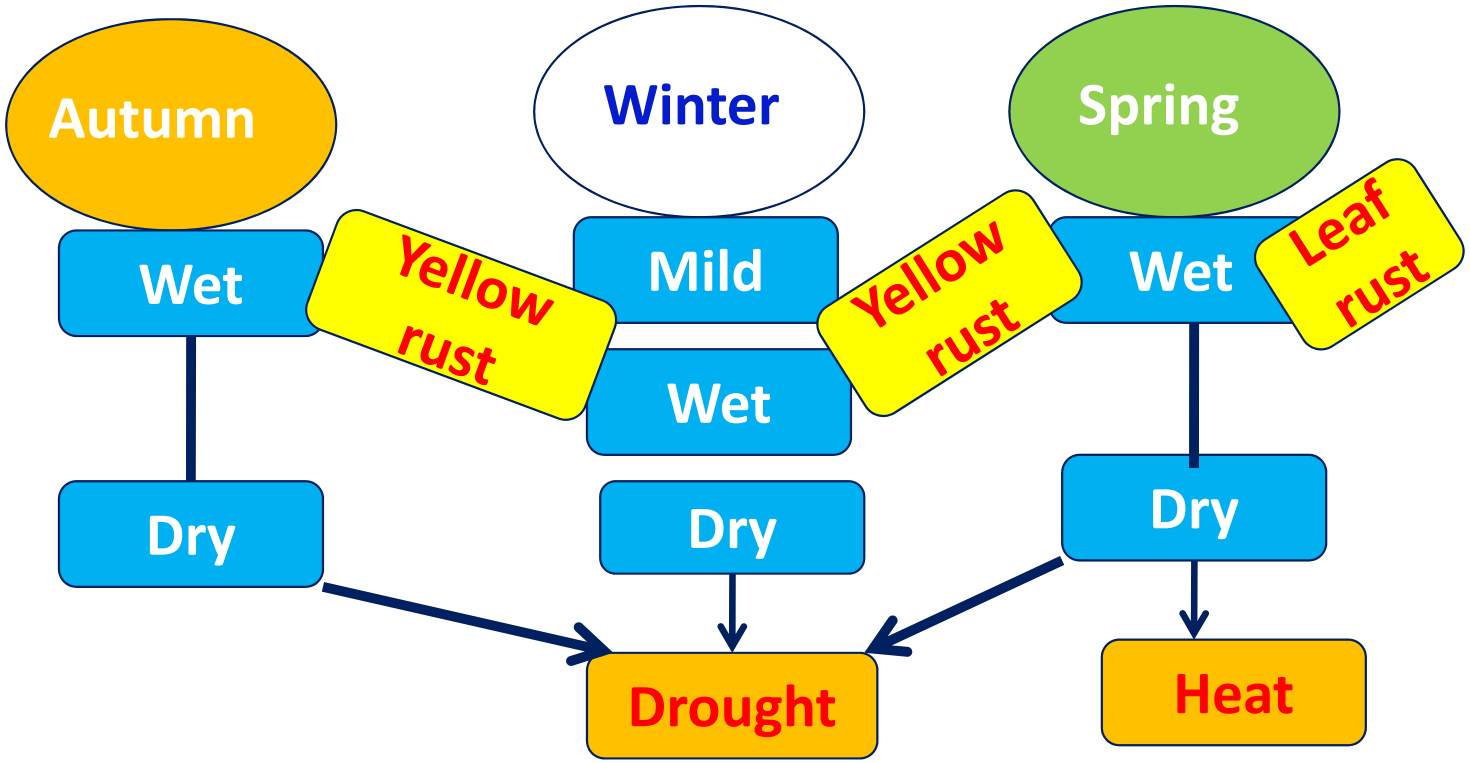
Rangeland improvement

Example of climate change

- Temperature variations in Karkalpakstan 2013 and 2016



Constraints to wheat production under climate change in Central Asia



Wheat stripe rust problem

- Seven stripe rust epidemics since 2009

2009, 2010, 2013, 2014, 2015, 2016, 2017

- 30% yield reduction in Tajikistan and Uzbekistan due to yellow rust

Sharma et al. (2016), J. Phytopathology

Kroshka
2009, Uzbekistan

Krasnodar-99
2013, Uzbekistan

Grom
2016, Uzbekistan

Climate-resilient Winter Wheat – Gozgon

Characters:

1. Highly resistant to yellow rust
2. Heat tolerance
3. Medium maturity
4. Grain yield
   9 t/ha under normal soil, irrigation
5. Quality – satisfactory
6. High straw yield

Has remained yellow rust resistant 2009 - 2018

Climate-resilient Winter Wheat – Buniyodkor

Characters:

1. Highly resistant to yellow rust
2. Heat tolerance
3. Medium maturity
4. Grain yield
   9 t/ha under normal soil, irrigation
   6 t/ha on medium saline soil
5. Quality – satisfactory
6. High straw yield

Has remained yellow rust resistant 2010 - 2018

Climate-resilient Winter Wheat – Chimbay and Amudarya

Dynamic nature of salinity can cause complete loss of winter wheat crop

Characters:

1. Suitable for medium saline soil
2. Suitable for normal soil
3. Tolerant to winter frost and cold temperatures upto -29 C
4. Heat tolerance
5. Moderately leaf rust tolerance
6. Grain yield
   9 t/ha under normal soil, irrigation, fertilizers
   6 t/ha on medium saline soil
7. Quality - satisfactory

Climate-resilient Chickpea – Malhotra, Khalima and Obod, Sino

Characters:

1. Tolerant to cold (-15 C)
2. Suitable for autumn planting
3. Suitable for spring planting
4. Heat tolerance
5. Suitable on medium saline soils
6. Grain yield potential
   - 2.5 t/ha under normal soil and irrigation
   - Upto 50% higher yield for winter crop vs. spring crop

Cropping system diversification for climate-resilience

Many ways of diversification

Cropping system diversification on irrigated land using climate-resilient varieties of wheat

Increasing cropping intensity by incorporating legumes – an example with mungbean

	Crop rotation	1st YEAR (Nov-Jun)	1st YEAR (Jul-Sep)	2nd YEAR (Oct-Feb)	2nd YEAR (Mar-Oct)	*Cropping intensity*
1	Wheat-Cotton	Wheat	Fallow	Fallow	Cotton	*2 crops in 2 years (100%), no legume*
2	Wheat-*Mungbean*-Cotton	Wheat	*Mungbean*	Fallow	Cotton	*3 crops in 2 years (150%), once legume*
3	Wheat-*Mungbean*-Green manure-Cotton	Wheat	*Mungbean*	Green manure	Cotton	*4 crops in two years (200%), twice legumes*
4	Wheat-Mungbean-Wheat-Mungbean	Wheat	*Mungbean*	Wheat	Wheat-Mungbean	*4 crops in two years (200%), twice legumes*

Cropping System diversification on irrigated land

Inclusion of leguminous crops in wheat-wheat rotation

Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Oct	Nov	Dec
winter wheat								Fallow / Mungbean				Winter wheat		






Benefit from mungbean

- Nutrients added in soil
- Additional income from mungbean crop

Cropping system diversification on rainfed land using climate-resilient varieties of chickpea

Wheat planted on 16 November in dry year

Chickpea planted on 28 February in dry year

Chickpea planted in autumn

Conclusion:

- Replace winter cereals with chickpea on rainfed land
- Plant chickpea in autumn and not in spring

- 35-50% higher productivity when planted in autumn
- Higher income from chickpea than growing cereals

Cropping system diversification on rainfed land

Wheat planted on 16 November

Chickpea planted on 28 February

Chickpea planted on 10 October

Conclusion:

- Replace winter cereals with chickpea on rainfed land
- Plant chickpea in autumn and not in spring

- 35% higher productivity when planted in autumn
- Higher income from chickpea than growing cereals

Conservation Agriculture for climate-resilience crop production

Benefits

- Lower inputs cost
- Higher stable yields
- Improved soil nutrient exchange
- Enhanced long-run profitability

Conservation Agriculture

Mungbean after wheat using minimum and zero tillage with retention of crop residues in Karshi, Uzbekistan (2011-2013)

Planting method	Spent fuel for planting, l/ha	Root length, cm	Plant height, cm	Yield, t/ ha
Conventional	**53.6**	**25.4**	**67.2**	**1.85**
One cultivation	**13.6**	**23.5**	**68.8**	**1.97**
No-till	**5.9**	**23.8**	**65.4**	**2.24**

- Fuel saving
- Higher yield
- Improves soil health

Source: A. Nurbekov, ICARDA

Tillage management
NT= No tillage; CT=Conventional tillage

Benefit-cost ratio for double-cropped mungbean under no-till and conventional tillage in Uzbekistan

Cost items	No tillage			Conventional tillage		
	Durdona	Local	Marjon	Durdona	Local	Marjon
Yield kg/ha	**427**	**250**	**407**	**395**	**237**	**427**
Crop price per kg/usd	2.1	2.1	2.1	2.1	2.1	2.1
Yield USD/ha	897	525	855	830	498	897
Total variable costs, USD/ha	570	570	570	668	668	668
Profit, USD/ha	**327**	**-45**	**285**	**162**	**-170**	**229**

Profitability may depend on choice of crop variety

Tillage management as a climate resilient technology

Raised-bed planting: maximizing water use efficiency

- 25% average saving in applied irrigation water
- 30% average increase in grain yield
- 73% average increase in water use efficiency
- 30-50% saving in the quantity of seed used for planting.

Source: ICARDA
https://www.icarda.org/update/raised-bed-planting-maximizing-water-use-efficiency

Laser technology improves farm productivity

- saves up to 25% irrigation water
- Lowers soil movement during irrgation
- Enhance the effectiveness of salt leaching

Source: ICARDA
https://www.icarda.org/blog/%5Bnode%3ABlog%20type%5Dlaser-technology-improves-farm-productivity

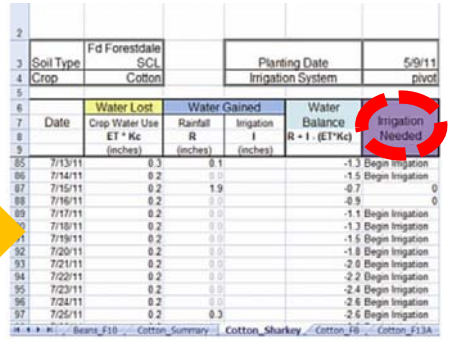
Water management

Evapo-transpiration-based irrigation scheduling

Weather data

Soil moisture data

Soil moisture data



		Fd Forestdale					
Soil Type		SCL			Planting Date		5/9/11
Crop		Cotton			Irrigation System		pivot
		Water Lost	Water Gained		Water		
	Date	Crop Water Use ET * Kc (inches)	Rainfall R (inches)	Irrigation I (inches)	Balance R + I - (ET*Kc)	Irrigation Needed	
85	7/13/11	0.3	0.1		-1.3	Begin Irrigation	
86	7/14/11	0.2	0.0		-1.5	Begin Irrigation	
87	7/15/11	0.2	1.9		-0.7		0
88	7/16/11	0.2	0.0		-0.9		0
89	7/17/11	0.2	0.0		-1.1	Begin Irrigation	
90	7/18/11	0.2	0.0		-1.3	Begin Irrigation	
91	7/19/11	0.2	0.0		-1.5	Begin Irrigation	
92	7/20/11	0.2	0.0		-1.8	Begin Irrigation	
93	7/21/11	0.2	0.0		-2.0	Begin Irrigation	
94	7/22/11	0.2	0.0		-2.2	Begin Irrigation	
95	7/23/11	0.2	0.0		-2.4	Begin Irrigation	
96	7/24/11	0.2	0.0		-2.6	Begin Irrigation	
97	7/25/11	0.2	0.3		-2.6	Begin Irrigation	

Hydro-module Zone I

Hydro-module Zone II

Hydro-module Zone VIII

Traditional Irrigation | ET-based Irrigation

Traditional Irrigation | ET-based Irrigation

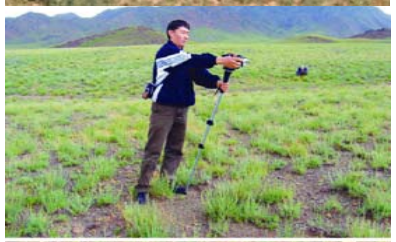
Traditional Irrigation | ET-based Irrigation

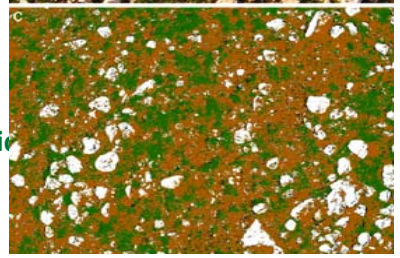
Save approx. 30-35% irrigation water at the field level without adversely affecting yields.

Rangeland improvement and diversifying sources of animal feed

- Controlled grazing
- Utilization of desert land for fodder production
- Alternative sources of animal feed and fodder
- Dual purpose crops
- Multipurpose tree species
- Agro-forestry

Rangeland improvement and diversifying sources of animal feed





- Key to sustainable meet production from small ruminants

Knowledge sharing and capacity building

- Formal and informal training
- print materials
- short videos
- website (cacilm.org)
- On-site demonstrations

Climate resilient technologies through collaboration of ICARDA

Summary

- High yielding crop varieties tolerant to biotic and abiotic stresses
- Cropping system diversification for improved land and water productivity
- Conservation agriculture
- Tillage practices
- Animal and rangeland improvement
- Knowledge sharing / capacity building

SDGs

ICARDA New Strategy 2017 - 2026

CGIAR SLOs

REDUCED POVERTY

FOOD & NUTRITION SECURITY

SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES

Taking Research to Scale – Partnerships for Impact

OUR RESEARCH

5 SRATEGIC RESEARCH OUTCOMES (SRO)

SRP1. Collect, Conserve and use **agricultural biodiversity** in drylands in order to meet future climate and market related challenges.

SRP2. Improved and resilient crops for greater food security in face of climate change and market volatilities.

SRP3. Develop **integrated drylands farming systems** for improved and resilient livelihoods.

SRP4. Support the establishment of **functional value chains** and viable off-farm activities for diversified incomes and improved livelihoods in drylands.

SRP5: Support **sustainable use and management** of water and land resources in drylands.

4 CROSS-CUTTING OUTCOMES (CCO)

- Climate Change Adaptation & Mitigation
- Gender Equity & Youth
- Capacity Development
- Big Data & ICT

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- Donor organizations: WB, ADB, IDB, BMZ/GIZ, EU, FAO, GEF, IFAD, Russian Federation, Turkish Government, UNDP, USAID, and others
- Others