Food and Agriculture Organization of the United Nations

Regional Conference on Improving WATER Productivity

TUNIS DECEMBER 2019

ICARDA

Science for resilient livelihoods in dry areas

How water productivity knowledge can inform project design and strategic planning

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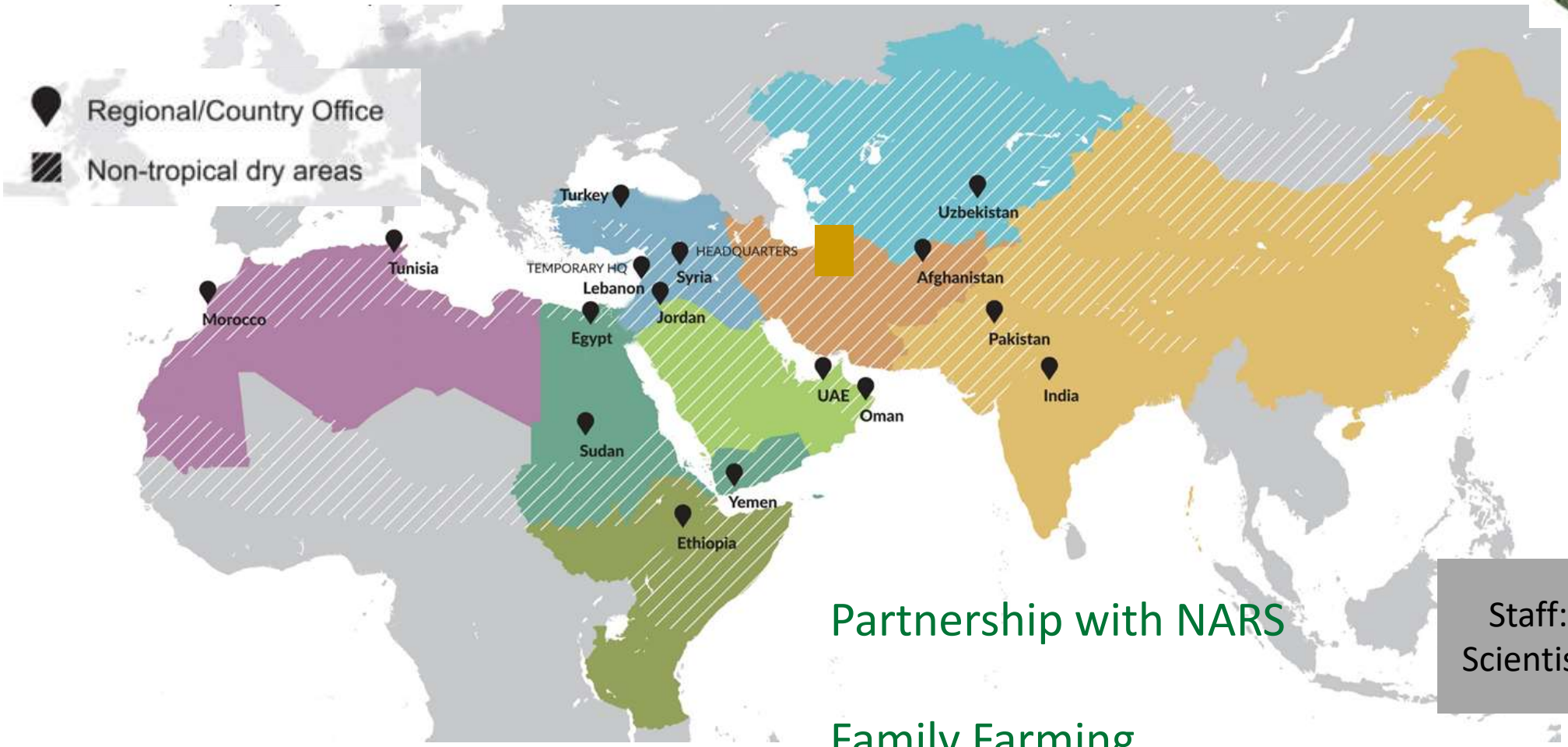
Tunis

ICARDA is a **decentralized R4D** international institute for **agri-food systems** in non tropical **drylands**



Partnership with NARS

Family Farming

Staff: 350
Scientists: 70

1. Water Productivity (WP): a multiscale framework of Indicators

$$WP = \frac{Return}{Unit\ of\ Water\ Consumed}$$

What return?

- Biomass, grain, fruit, meat, milk, fish (kg)
- **Income** ($)
- **Social benefits** (employment)
- **Nutrition** (energy, protein, micro-nutrients, vitamins…)
- **Environmental** benefits (C sequestration C, Land Degradation neutrality…)

What water?

- Quality (salinity, waste water)
- Renewability
- Seasonality

Used (vs. depleted)

- Evapotranspiration
- Percolation
- Quality deterioration

Data Quality?

- Measurement (ET, soil measurement)
- Modeling
- Remote Sensing

Can be used at any scale from field, farm to landscape to country

May be worth to decompose a bit more the equation

$$WP = \frac{Grain\ Production}{Unit\ of\ Water\ Consumed}$$

$$WP = \frac{Grain+Straw}{Unit\ of\ Water\ Consumed}$$

$$WP = \frac{Grain\ Production}{Evaporation+Tranpiration}$$

Bread Wheat

or

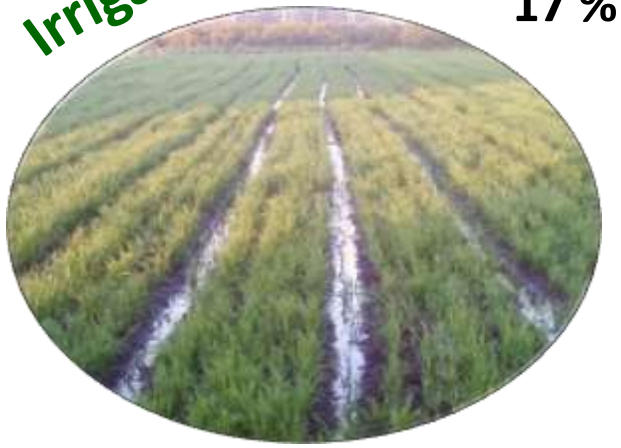
Barley

Winter or Spring Chickpea

The same framework for different agro-ecosystems

Irrigated

17 %



More job per drop

58 %

Agro-pastoral

LDN and Livelihood

ICARDA

Rainfed

22 %

More food per drop

3 %

Desert farming

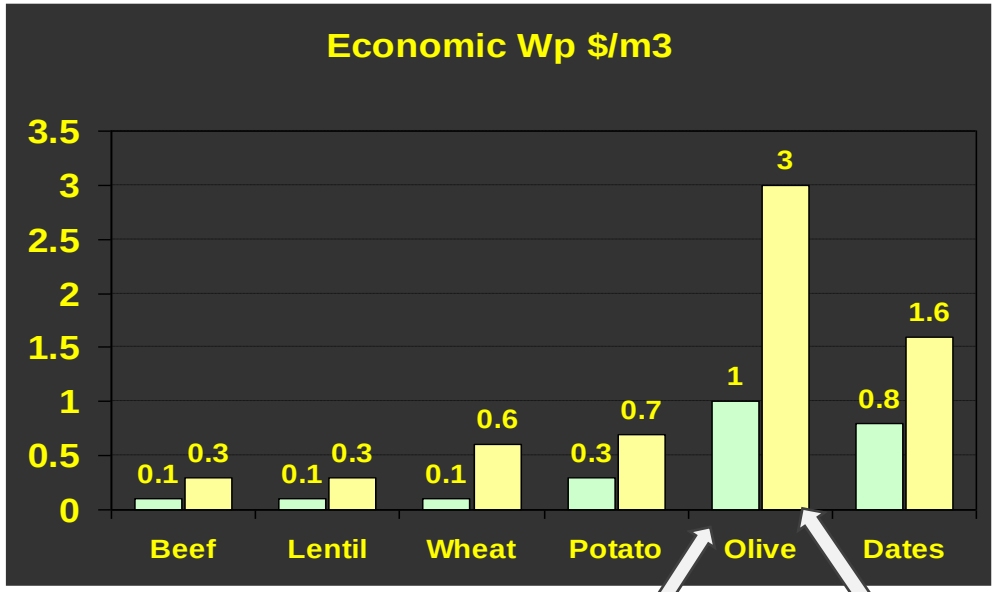
Socio-ecological Resilience

NENA Agricultural Land (2.5 M km2)

Untapped potential of Water Productivity Gains in farmers fields

Raised Bed + Improved Wheat

WPFood gain = 1,3/0.75 = 1.7



Crop	Farmer N	Farmer Irrigation	Farmer Yield	Farmer WP	Recommended N	Recommended Irrigation	WP	% WP increase
Cluster bean	20	200	1700	0.47	60	100	1.27	290
Mustard	60	350	1800	0.51	100	250	1.03	102
Wheat	100	550	1600	0.29	160	400	0.58	100
Groundnut	40	550	400	0.07	60	400	0.15	114

Poor management

Improved management

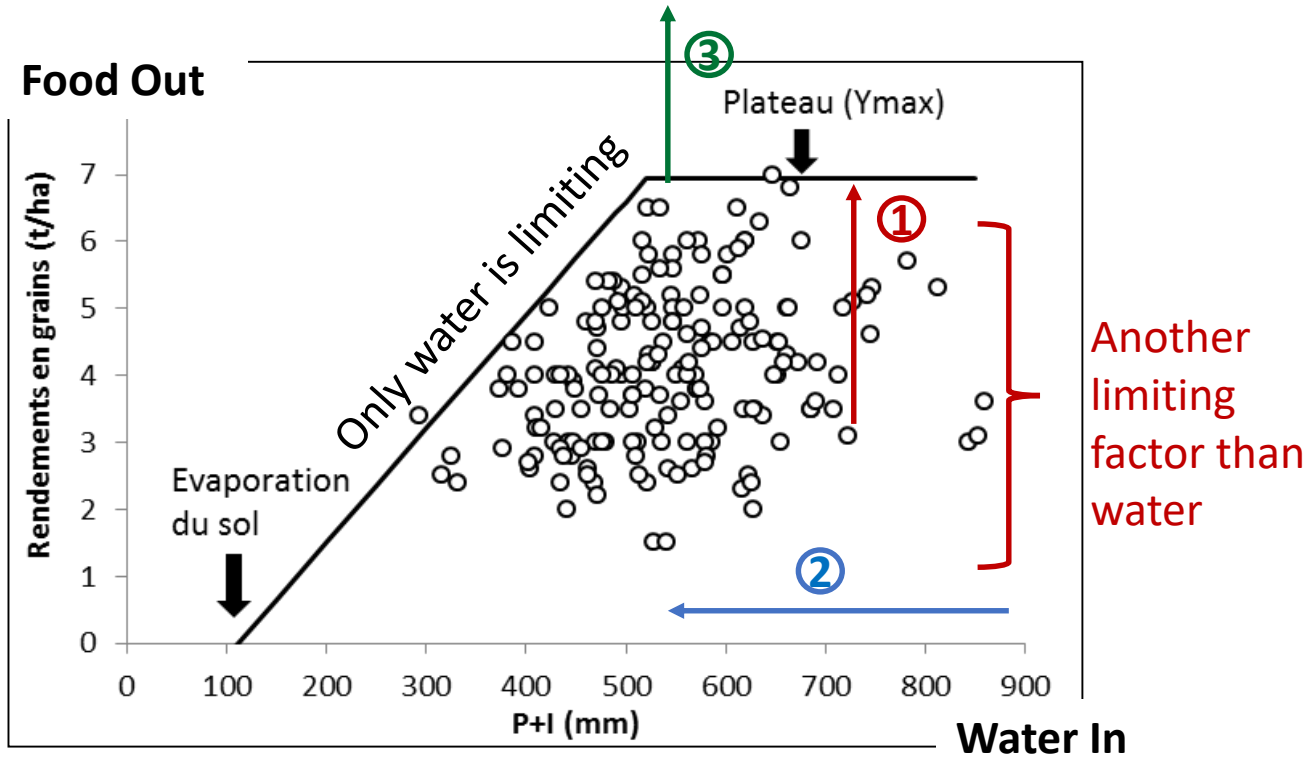
A question to ask systematically

Is water the major limiting factor of land productivity?

① Eg. Mineral Nutrition, pests and diseases, weeds.

② Irrigation Management

③ Improved variety, Rotation, Association



Durum wheat in farmers fields in Tunisia

(adapted from Ben Zekri, 2017 – These SupAgro)

Strong increase of WP can be obtained with Best Agronomic Practices

Rajasthan (India)

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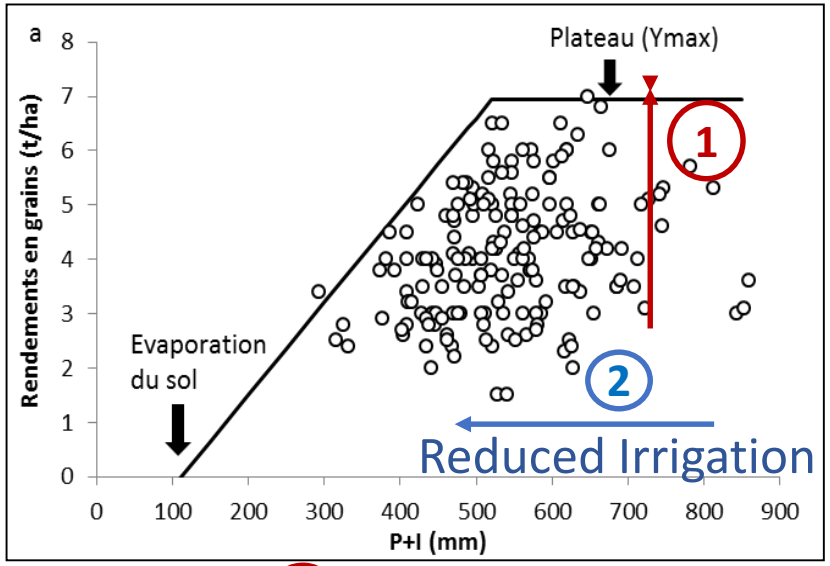

Increased N fertilisation

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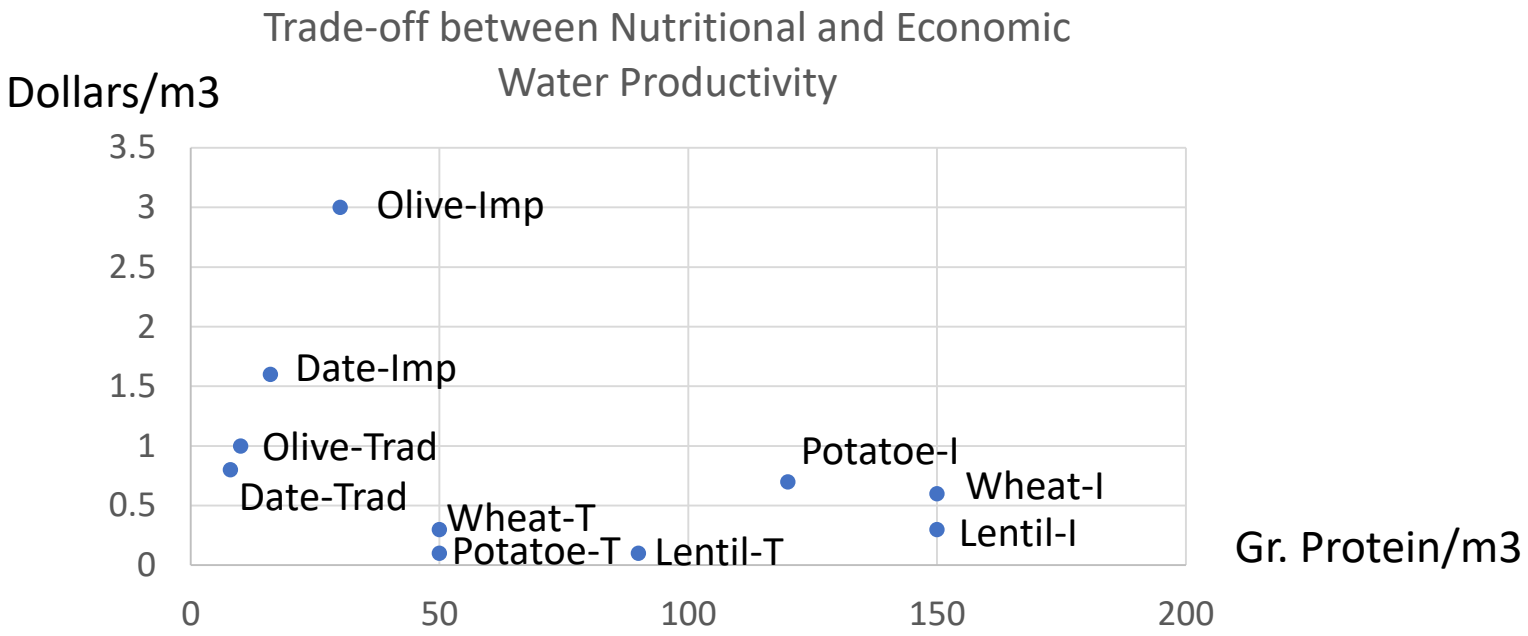
Explore Trade-Offs between the various dimensions of Water Productivity



(Adapted from Molden, D., Oweis T., Steduto, P., Bindraban, P., Hanjra, M., Kijne, J. 2010. Improving agricultural water productivity: between optimism and caution. Agricultural Water Management. 97:4, pp528-535.

Solution may be scale-dependent (farm vs landscape vs country)

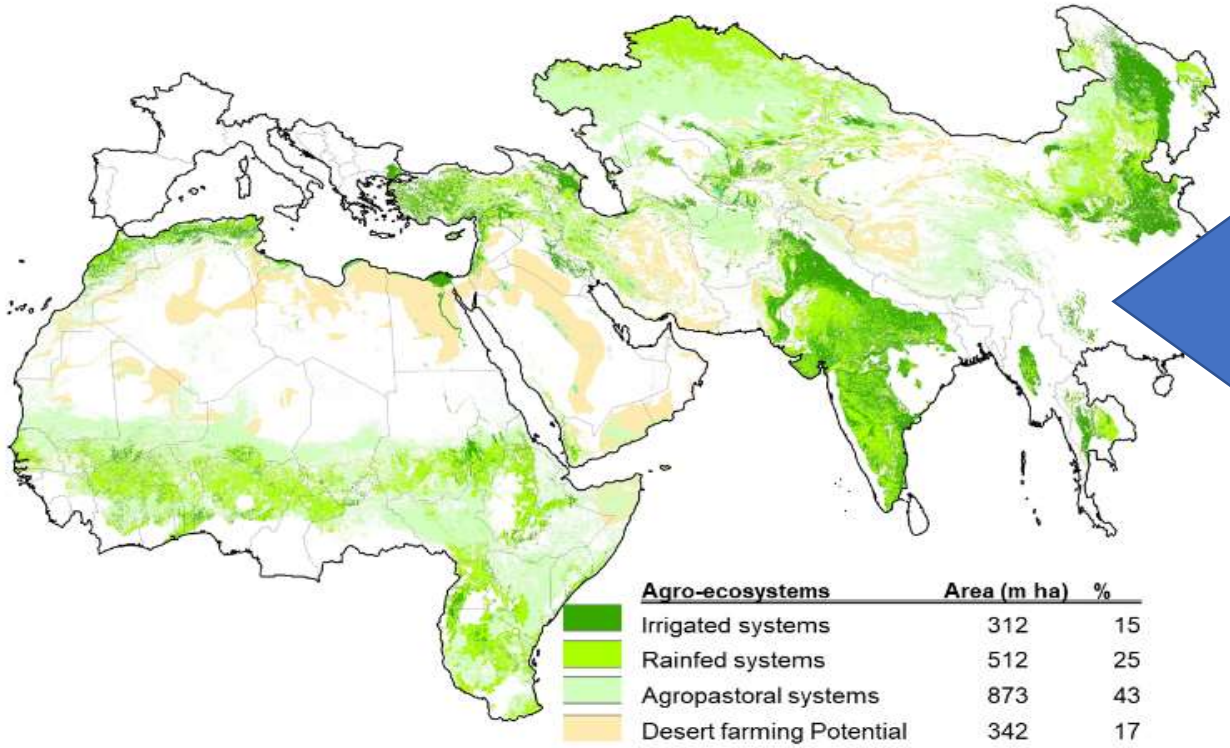
Keep always an eye on the Amount of water used

2. A framework to develop projects based on water productivity

CGIAR

DryArc

Systemic Innovation for Dryland Family Farming



Agro-ecosystems	Area (m ha)	%
Irrigated systems	312	15
Rainfed systems	512	25
Agropastoral systems	873	43
Desert farming Potential	342	17

SHARE Knowledge, Technologies and Data

COMBINE Technologies in Systemic Innovation

ACCELERATE co-design with Farmers Communities

ENABLE- Policies and Institutions for Systemic Innovation

INTEGRATE Innovations and Methods

Don’t re-invent the wheel…but check data quality

SHARE Knowledge and Technologies

$$WP = \frac{Return}{Unit\ of\ Water\ Consumed}$$

Net Houses

Has the same net benefit as cooled greenhouse, thanks to savings in water and electricity (for cooling)

Solar Cooling

Enhancing the current cooling system using solar energy saves up to 60% water

Hydroponics

Increases Yield and Water Productivity by 50%

Smallholders in Yemen

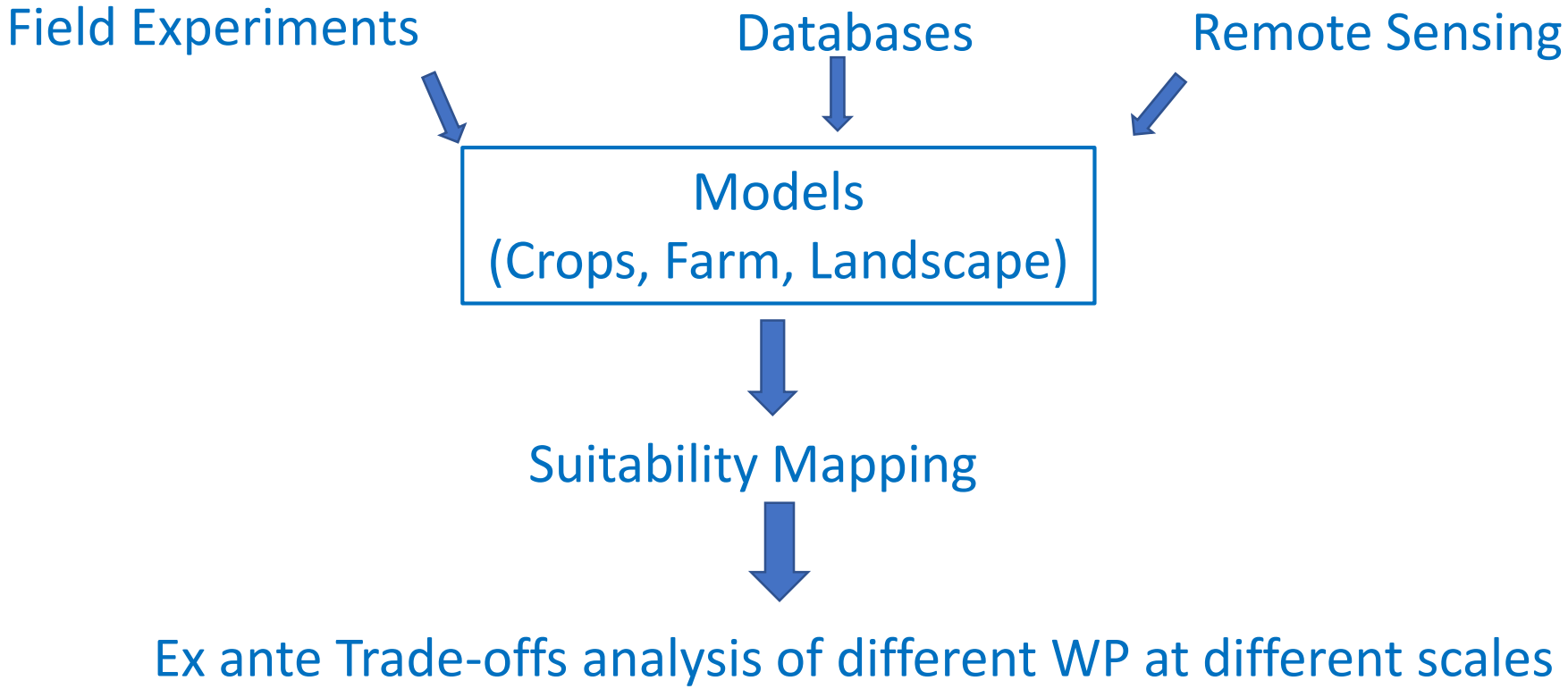
?

Arabian Penninsula Program (Donors: AFESD, IFAD, OFID)

Assess Combinations of Technologies in a nexus

COMBINE
Technologies

Eg. Intercropping drip irrigation fruit trees with rainfed cereal-legume rotations and with real-time ET estimate



Increase System's Water Productivity in a socio-economic context

ACCELERATE
co-design
with Farmers
Communities

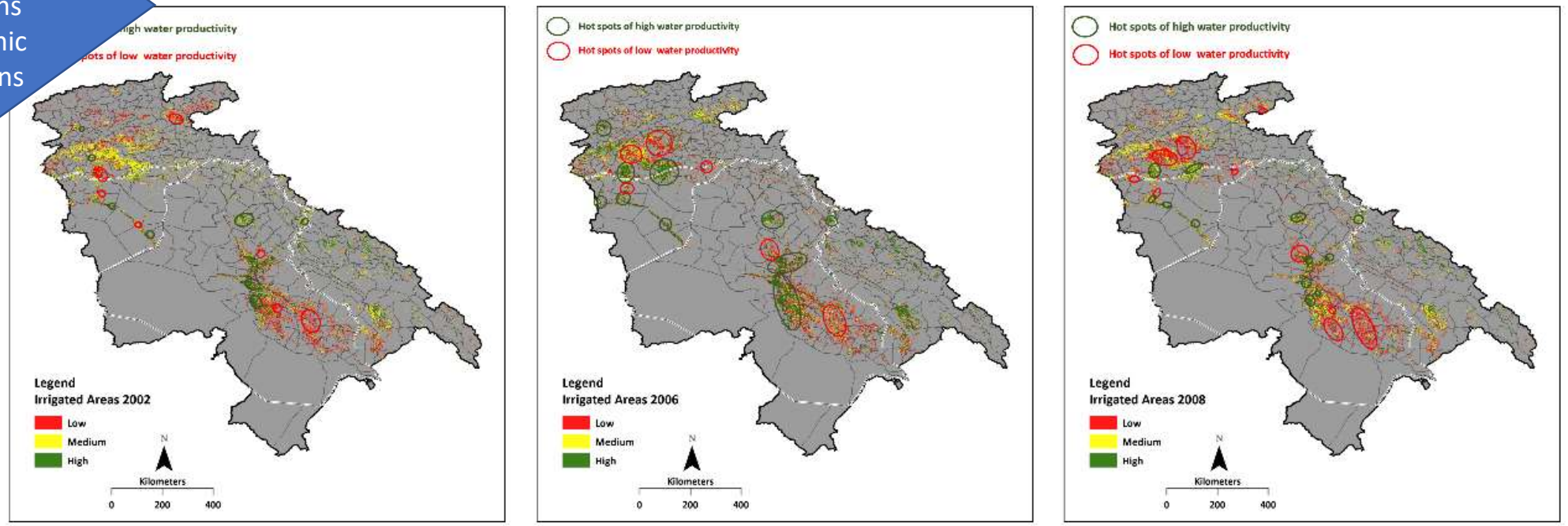
Co-design systemic solutions with local communities

- Select the most suitable combinations of technologies for soil and climate
- Adapt to the local community aspirations
- Adapt to farm and watershed context
- Adapt to the project duration and funding
- Re-assess the systemic innovation in the Water Productivity Framework (ex ante)
- On-farm and On-landscape experiments (co-design)
- Lessons learnt go back to the SHARE module (co-learn)

Informing policies on trends, options and trade-offs

ENABLE- Policies and Institutions for Systemic Innovations

Euphrates- Tigress basin (project funded by SIDA)



Hot spots of high and low water productivity in the irrigated areas for year 2002, 2006 and 2008

"The analysis shows that achieving high AWP in all the region would either increase crop production by 8 million tons or save 8.1 BCM of water annually maintaining current production levels"

Untapped potential of water savings and food security in the Euphrates-Tigress river basin through improved agricultural water productivity (Oweis et al., submitted)

Conclusion

- **The multidimensional** nature of Water Productivity
- **Quality of data** → more measurements of WP across the range of drylands agro-ecosystems
- **Explore trade-offs and synergies** (among WPs and with Water Use)
- **At different** scales (field, farm, watershed, country)
- **An Integrated Framework** to support water productivity based transformation of Agriculture (DryArc)

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