   

Increasing the Value of Water in Agriculture in marginal environments

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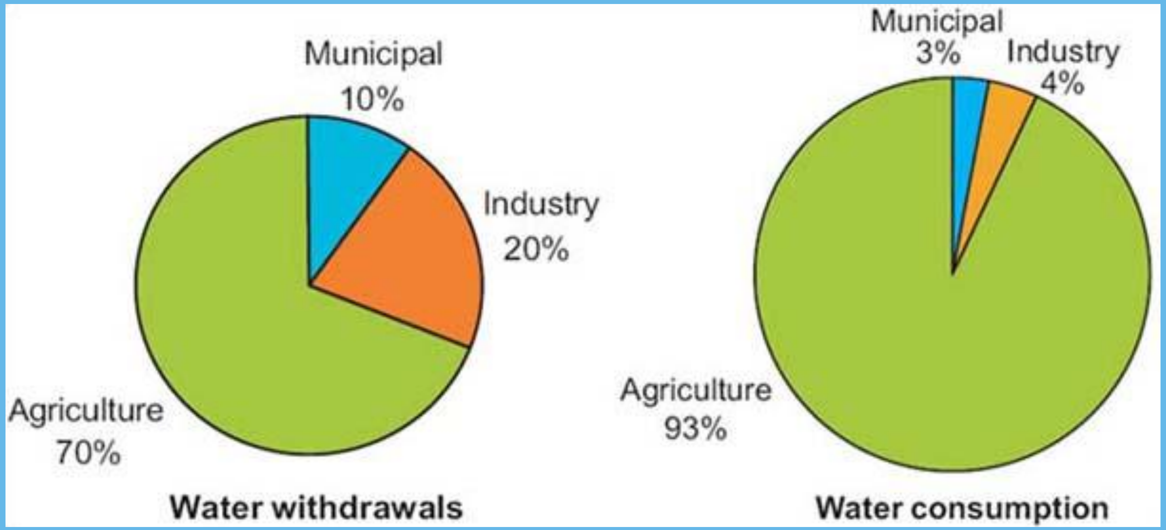
AGRICULTURE FOR TOMORROW

What is value of water in agriculture?

- Value of water is defined by its price, serve as a guide to allocate resources into uses in which they yield the greatest total economic return.
- The marginal value of irrigation water is the increase in crop yield in irrigated agriculture compared to rainfed agriculture.

Challenges in measuring value of water in agriculture

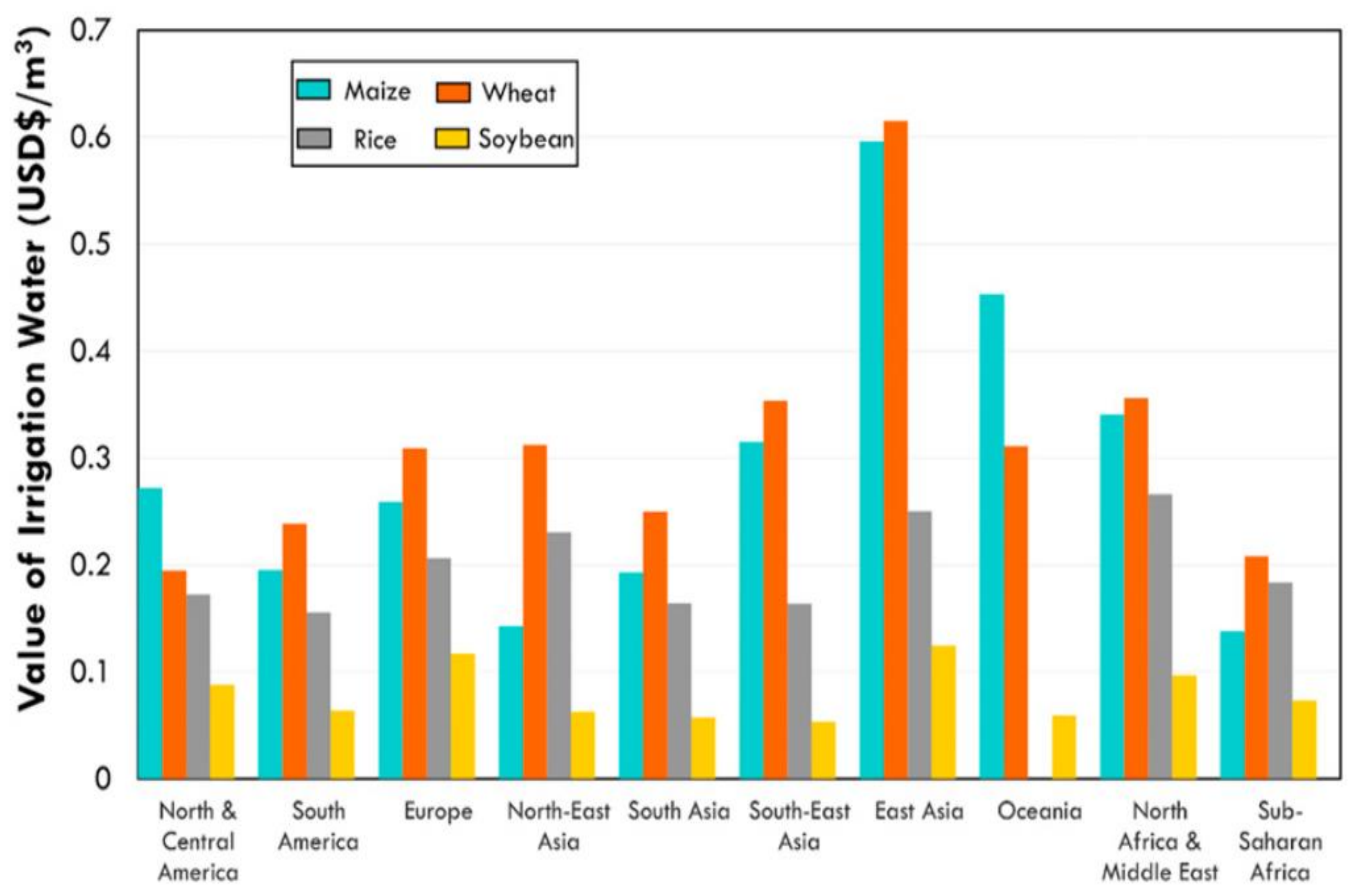
- The valuation of water in agriculture remains a challenge because it is rarely traded like other uses (Municipal and industry)
- In water-scarce regions, agricultural commodities are but the value of the associated "virtual" water is seldom accounted for.
- While there are well-established methods to calculate the virtual water, its economic value remains difficult to assess.
- Information on the value of water in agriculture is important for investing in irrigation development by governments and individual farmers.



Value of water in different regions

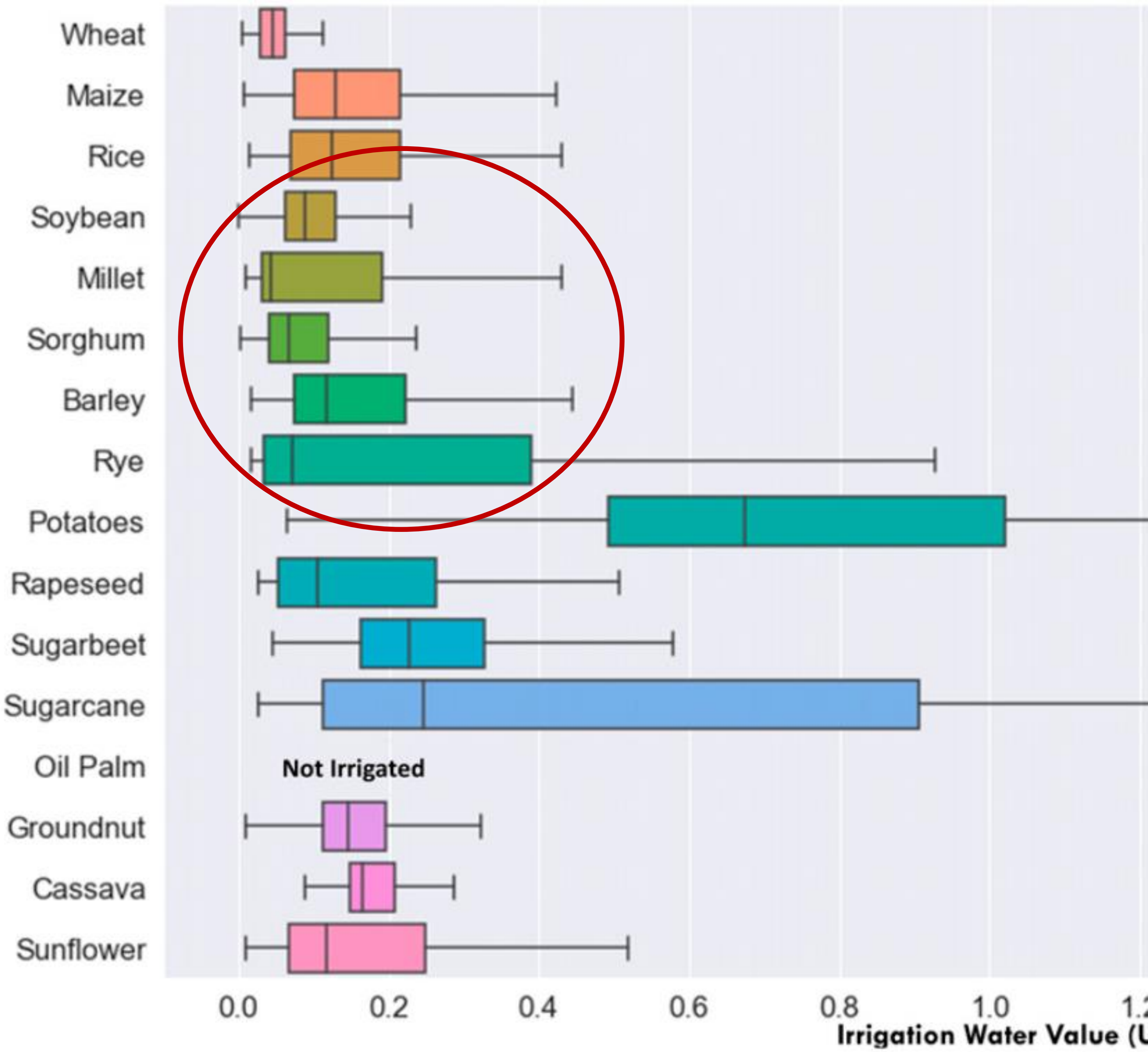
- Four major staple crops (≈60% of global food production), the global mean water values are \$0.05, \$0.16, \$0.16, and \$0.10/m3 for wheat, maize, rice, and soybean, respectively

(for industry and domestic uses (0.30-2.25 US\$/m^3))



Crop specific value of irrigation water (US$/m^3)

- Availability of water
- Crop yields
- Market price of the produce



Value of water in marginal environments

- Water is more valuable when its supply is limited relative to demand both in quality and quantity.
- Value of water in agriculture is directly linked to water use efficiency. Selecting innovative irrigation technologies can help save water and increase WUE.
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- **In marginal environments, an important agricultural policy objective is to grow salt and drought tolerant crops using alternate water resources.**

Sustainable agricultural development – challenges in UAE

Decreasing water quantity and quality

Changing rainfall patterns, excessive GW pumping

Poor soil health

Low organic matter, low fertility & poor soil structure

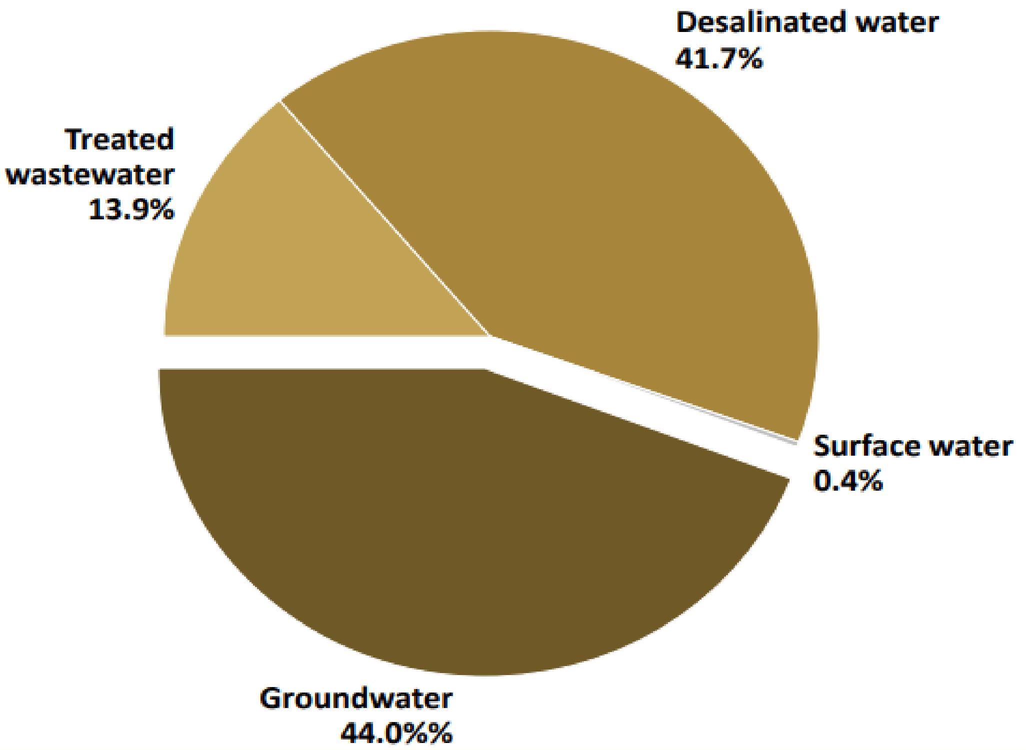

Soil health in UAE

- 75% are sandy soils - limited capacity to support biological activity.
- Low water and nutrient holding capacity - nutrient loss and pollution
- Soil degradation in UAE require special management practices to improve soil health

Decreasing water quantity and quality in UAE)

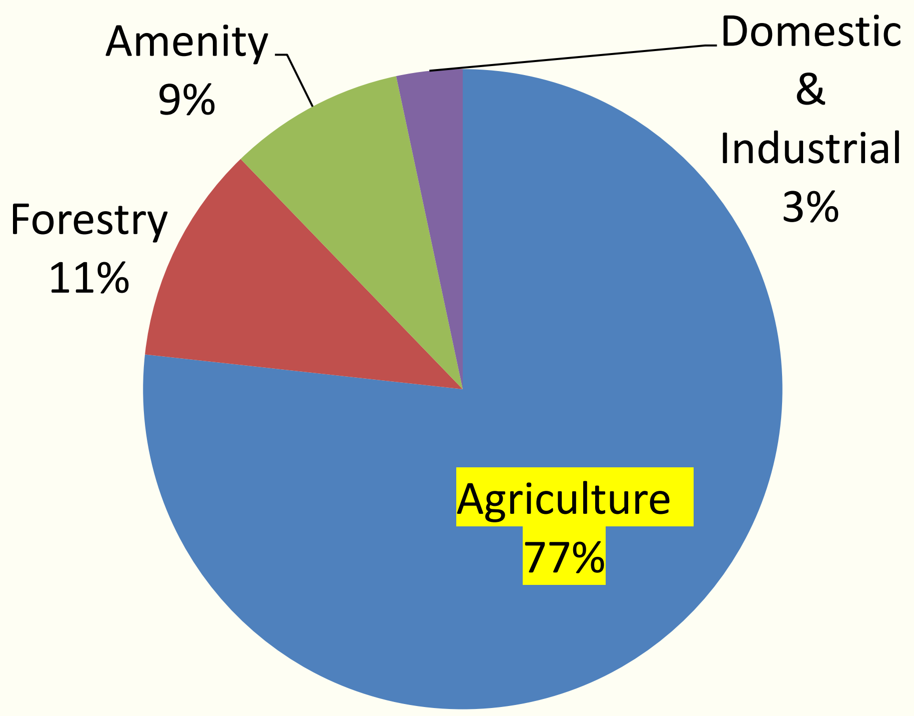
More than 85% of UAE water supply is from ground water and desalinated water

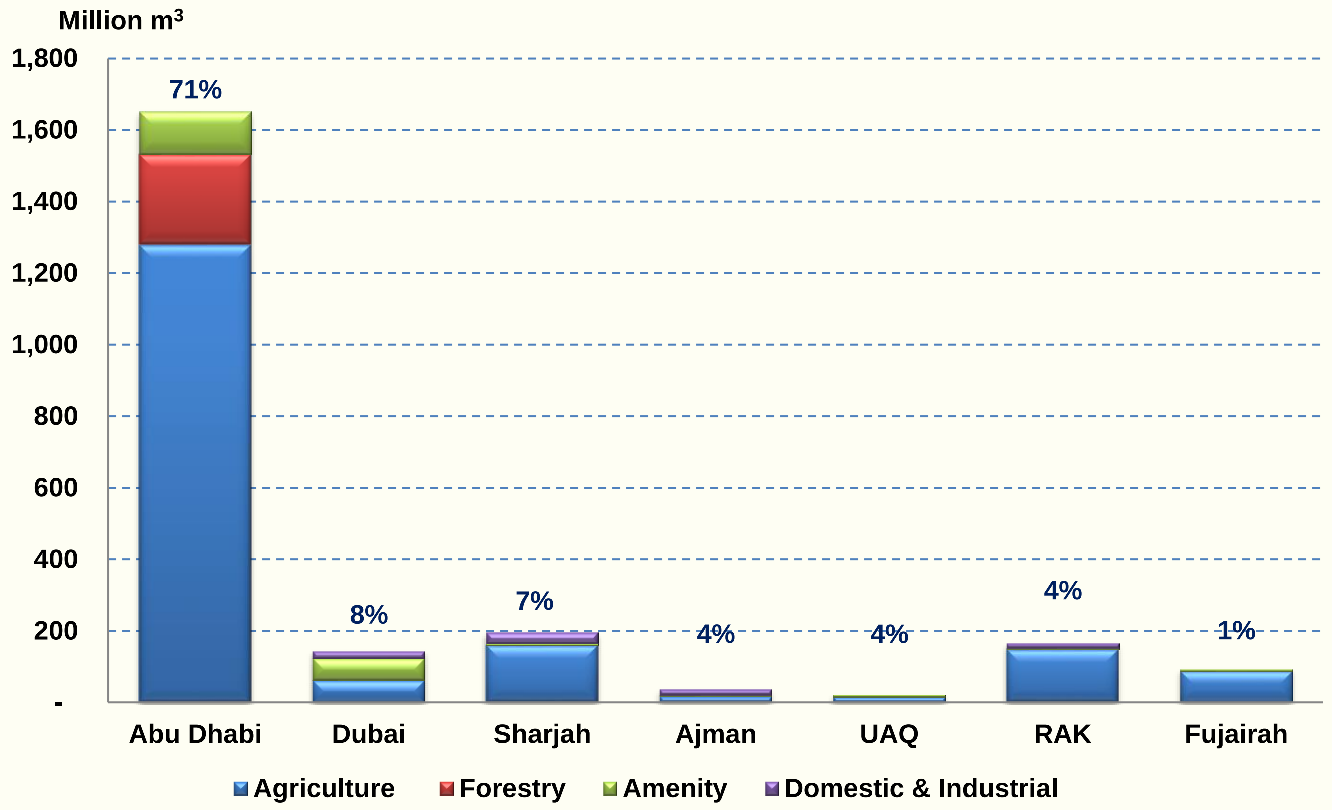
2 Water supply – Key sources[1] for all types of usage
(2013, % of total water supply)



Water sources	Trend	Characteristics
Groundwater (~44%)	↓	• Groundwater is the water locatec surface of the earth and can be e: wells • Groundwater has been depleted i over the last decades
Desalinated water (~41.7%)	↑	• Supplies predominantly the dome drinking) and industrial sectors • Production increased by 3% per y to 2016 to cater for increased de
Treated wastewater (~13.9%)	↑	• 64% used in irrigation of gardens, and reforestation trees • 32% disposed in sea • Remaining 4% is stored • 86 plants in 2016 (39 in Abu Dhab Ras Al Khaimah) • Treated wastewater increased by between 2011 and 2016
Surface water (~0.4%)	↓	• Includes any water that collects c of earth and is maintained throug • UAE has arid climatic conditions; rainfall levels have dropped 80 m to 2013[2]

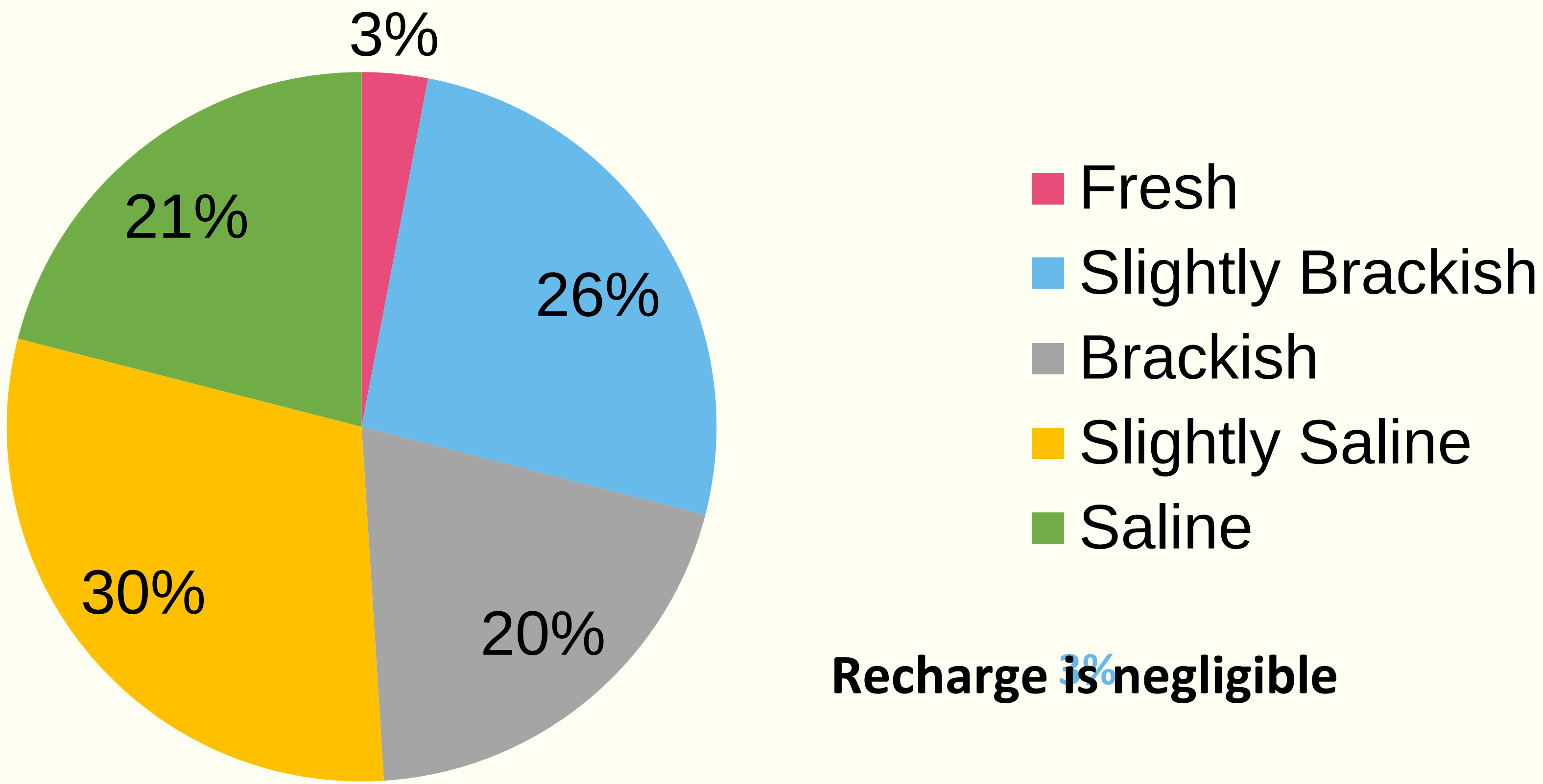
Groundwater Use in UAE





UAE Groundwater reserves by quality

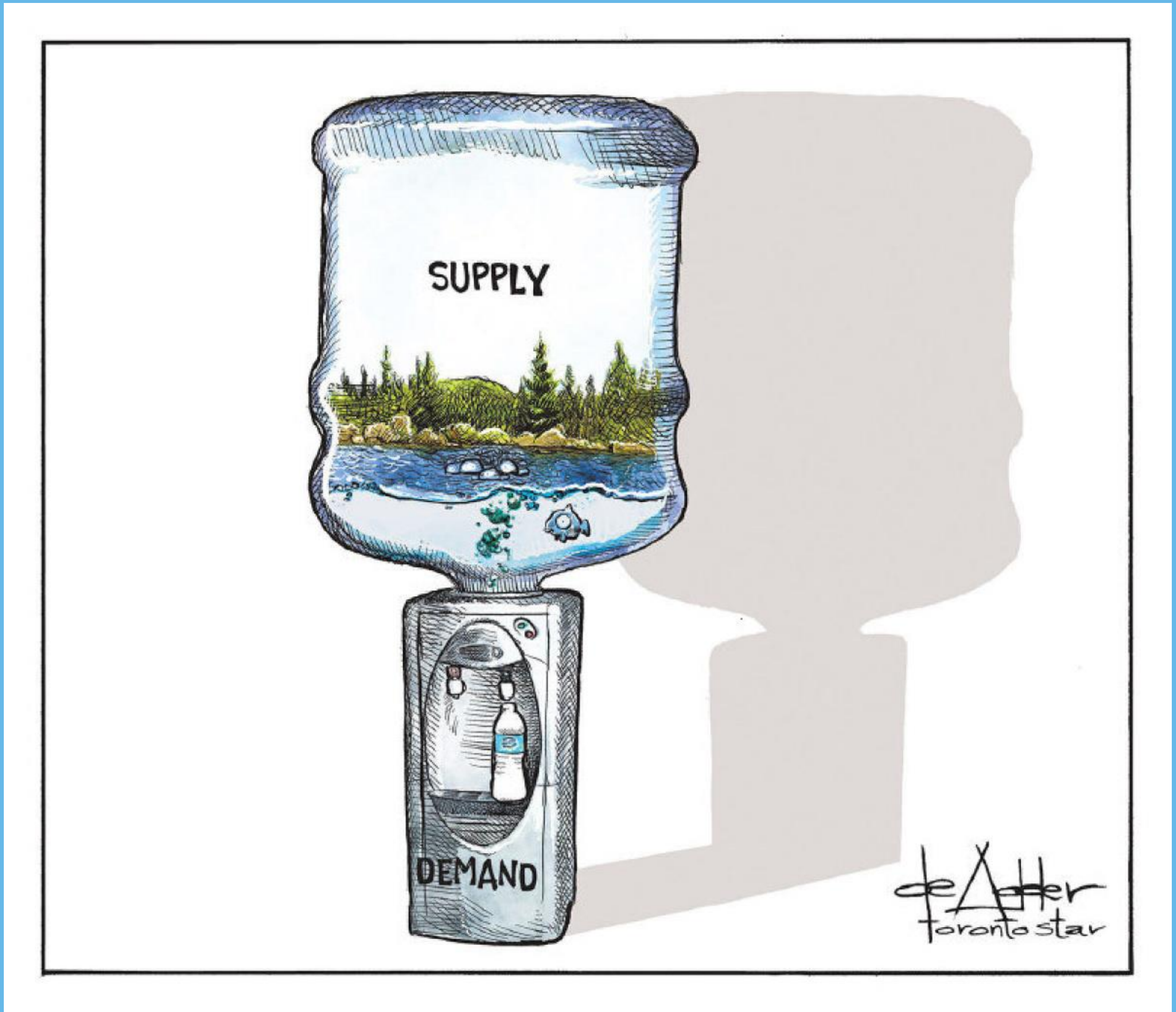
Groundwater resources are of a poor quality



Recharge is negligible

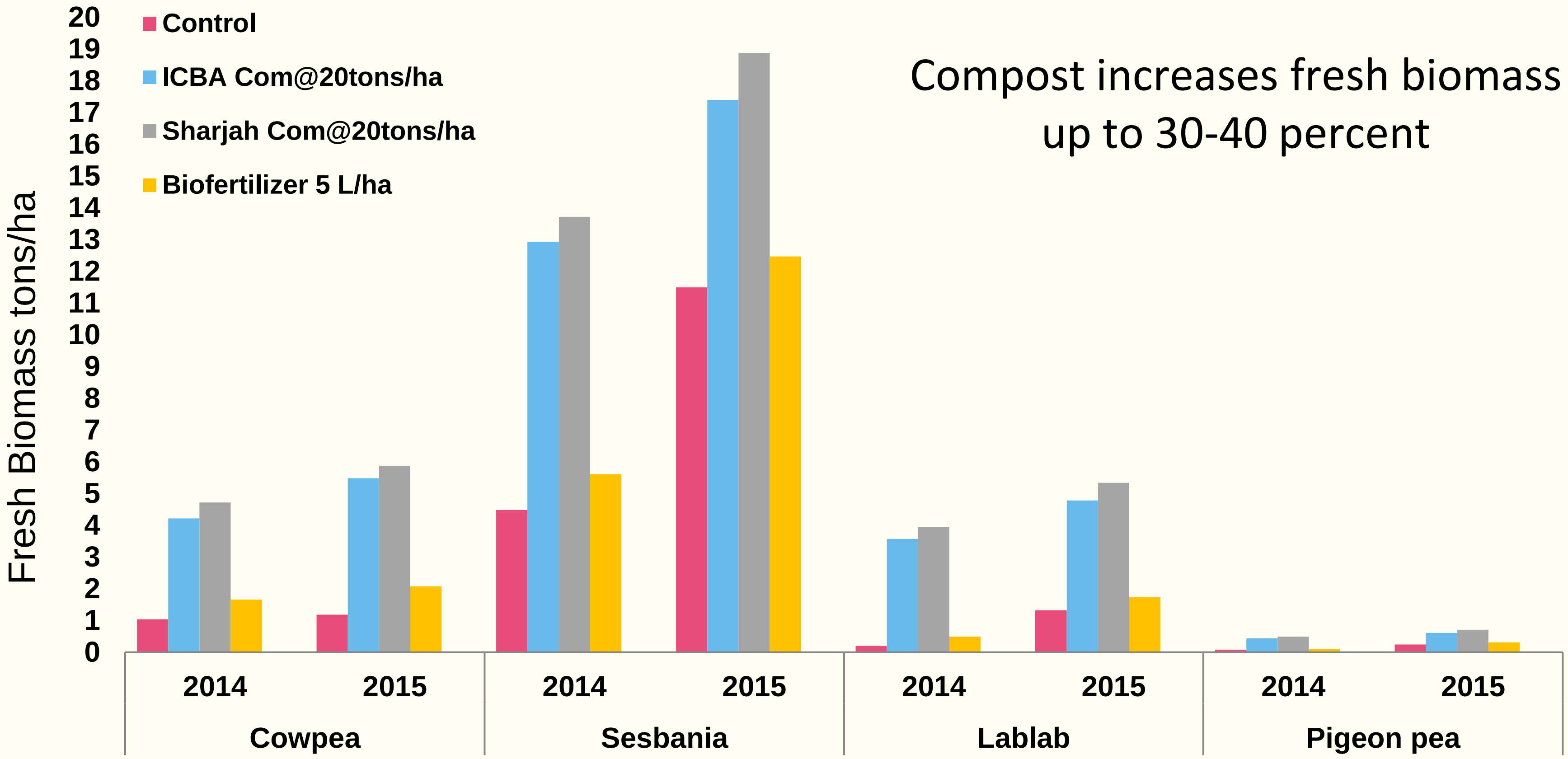
Potential solutions

- Improve soil health (stability, fertility, and salinity, etc.)
- Use alternative resources of water
- Increase WUE in all sectors; using more water-efficient technologies and water-efficient crops
- Manage water demand i.e., reduce per capita water use



ICBA Interventions

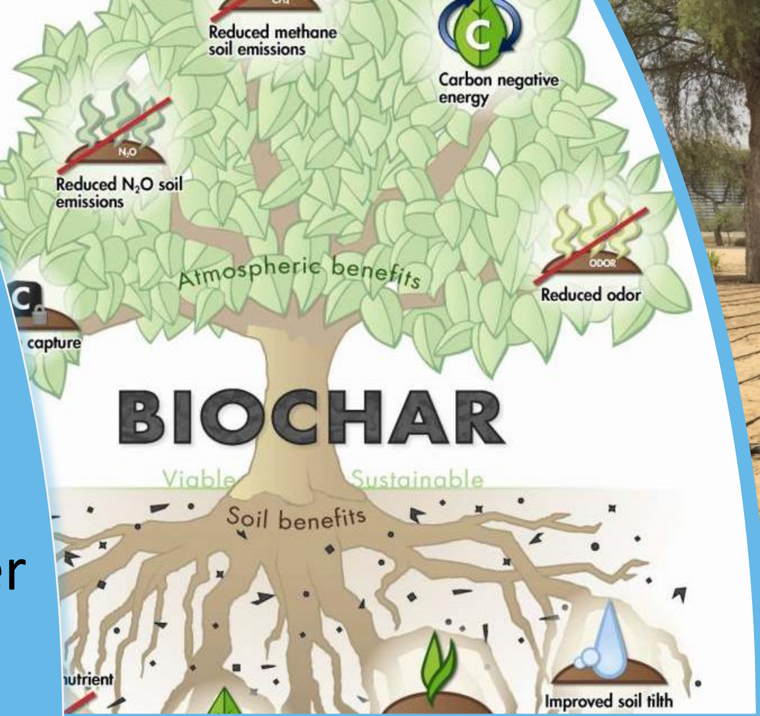
Soil improvement - effect of compost on crops



Compost increases fresh biomass up to 30-40 percent

Biochar to improve soil fertility

- Effective to regain soil fertility, save water and soil nutrients, reduce GHG.
- In greenhouse maize, biochar @ 5 tons/ha increased fresh biomass by 29% and 50% reduction in fertilizer application.
- Field trials on pearl millet increased fresh biomass by 46% and water retention by 40%.



ICBA Interventions

Improving irrigation water use efficiency (WUE)

WUE of crop species

Cereals = 2.37 kg/m^3

Oilseeds = 0.69 kg/m^3

Fiber crops = 0.45 kg/m^3

Legumes = 0.42 kg/ m^3

Water-Intensive Crops

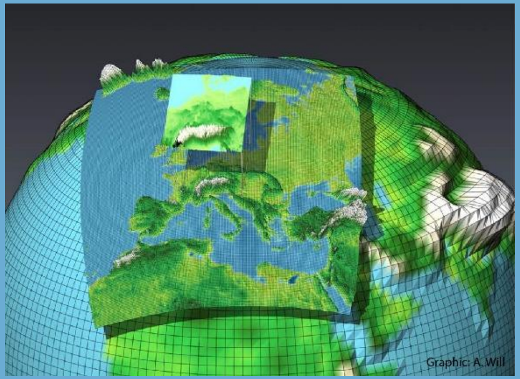
Some of the most popular crops are highly water-intensive. These crops include:

- Rice
- Soybeans
- Wheat
- Sugarcane
- Cotton
- Alfalfa
- Pasture

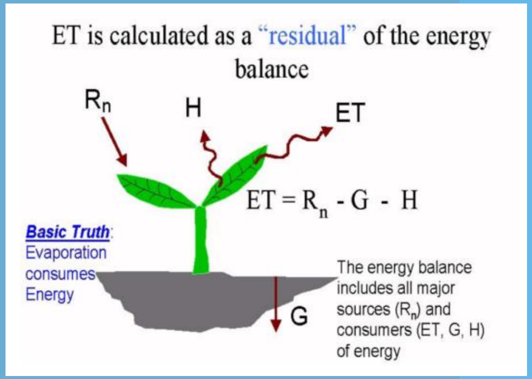
ICBA Interventions

Improving irrigation water use efficiency (WUE)

Satellite Imagery



Weather Modelling



Energy Balance Modelling

- Produce daily land surface temperature and climate data
- Calculate crop water requirements
- Calculate actual crop water use
- Produce Agricultural Water Productivity maps
- Estimate irrigation water use and groundwater abstraction

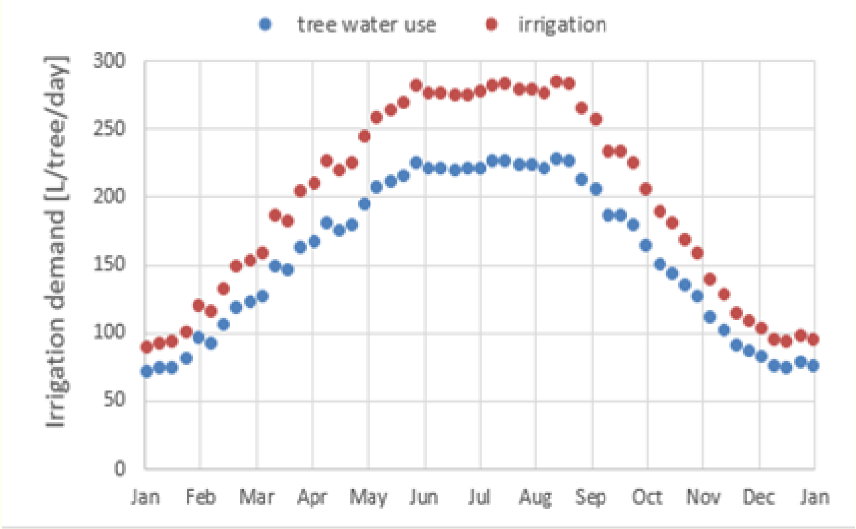
Growth of water-intensive crops

Crop	WR (m^3/ha)		Crop	WR (m^3/ha)
Alfalfa	15,700		Watermelon	5,500
Rhodes	15,000		Sunflower	4,830
Date Palm	14,800		Tomato (GH)	4,050
Lemon/Citrus	10,200		Sweet melon	3,100
Tomato (field)	6,500		Onion	2,500
Okra	6,400		Potato	2,500

Improving irrigation water use efficiency

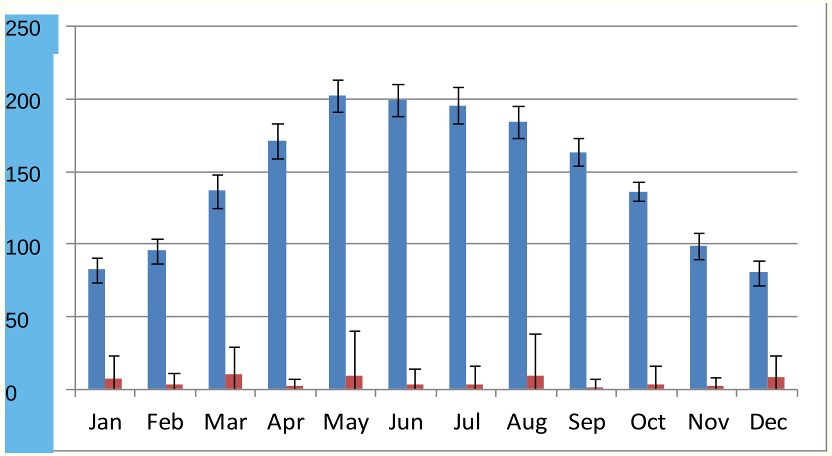
Water saving for date palm

- Present water application is 280 l/tree/day
- Trees are using 50 -75 l/day (winter) and 200-250 L/day (summer)
- New technologies have saved about 35% of water



Testing of water-efficient technologies

- Sub-surface drip irrigation systems
- Deficit irrigation
- HydroRock irrigation system
- Use of poor-quality irrigation water



- Annual ET > 1900 mm/yr
- Annual rainfall < 60 mm/yr

Treated wastewater use for vegetables in UAE

- Most TWW in UAE is used for landscape and not for food crops.
- To evaluate uptake of heavy metals (i.e., ***Cu, Fe, Zn and Cr***) and microbial loading by 6 vegetables grown with TWW.
- To quantify the associated health risks for humans.

Managing high to extreme water and land salinity

Conserve fresh water for domestic, industrial and agriculture purposes (for crop cultivation)

Use marginal saline land and water for growing:

- Salt tolerant crops
- Forage/Fodder crops
- Timber value trees

Use highly saline/sea water for growing halophytes for:

Forage/Fodder species

- Timber value trees
- Oil producing species
- Landscaping

Crop management for salt-affected soils

Salinity Type	Salinity Levels	Production system
Slightly saline	<5 dS/m (<3500 ppm)	Salt tolerant crops
Moderately saline	5-15 dS/m (3500-10,500 ppm)	Salt tolerant crops
Highly saline	15-25 dS/m (10,500 – 17,500 ppm)	Salt-tolerant and halophyte crops
Very highly saline	>25 dS/m (> 17,500 ppm)	Salt-tolerant and halophyte crops
Seawater	40-60 dS/m (28,000-42,000 ppm)	Halophyte crops

Developing water and salinity tolerant crops

Date Palm

Forages

Salicornia

Sporobolus

Moringa

Sunflower

Safflower

Mustard

Lablab

Cowpea

Quinoa

Amaranth

Barley

Sorghum

Pearl millet

Biosaline Agriculture

ICBA has introduced drought and salinity tolerant crops

Date Palm:

- Up to 15 dS/m (some varieties) but 10 is max for better growth and fruiting.

Forages:

- 15 dS/m (Buffle grass, Blue Panicum, Guinea grass);
- 15-30 ds/m (Distchilis, Sporobolus, Paspalum etc.
- 30 ds/m to seawater salinity (Salicornia)

Other crops

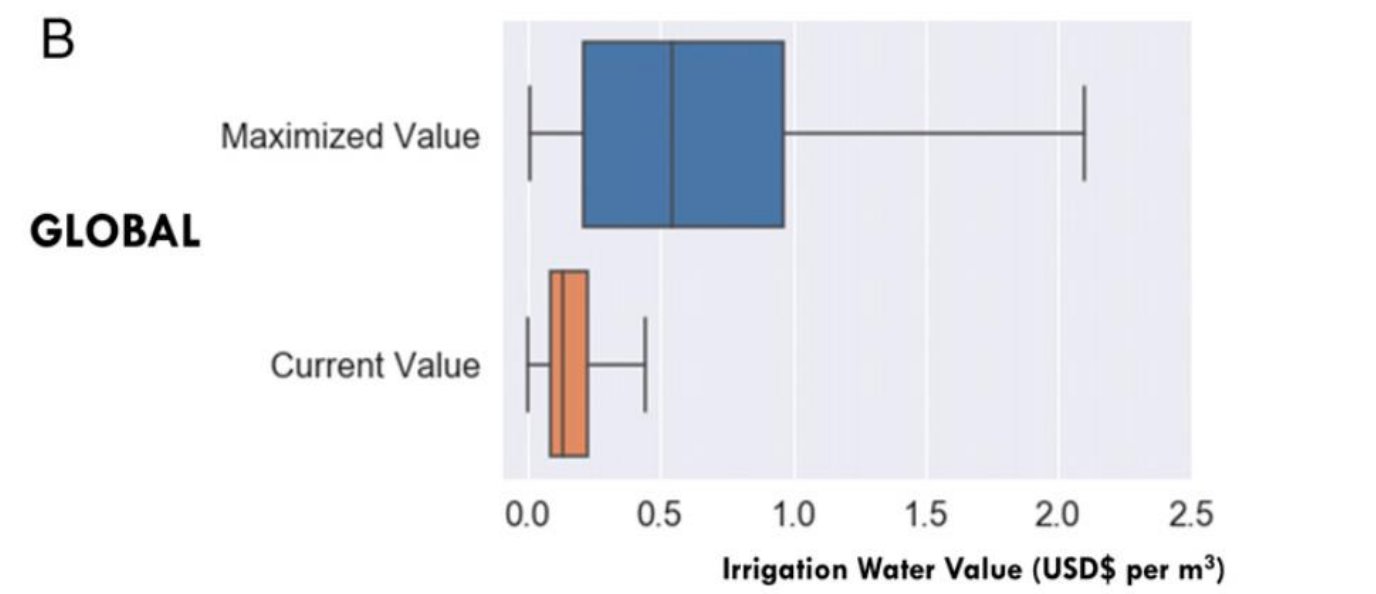
Sporobolus:	15-30 ds/m
Moringa:	10 dS/m (max)
Sunflower:	5-8 dS/m (Max)
Safflower:	5-10 dS/m (Max)
Mustard:	(5-8 dS/m)
Lablab:	5-8 dS/m
Cowpea:	6-10 dS/m
Quinoa:	10-15 dS/m
Barley (fodder)	6-10 dS/m (grain); 8 – 12
Sorghum:	5- 8 dS/m
Pearl Millet:	5 -8 dS/m

Where Biosaline agriculture can be practiced?

- Salt-affected irrigated agricultural lands
- Only marginal quality irrigation water is available.
- Marginal lands (abundant saline soils in dry regions).
- Sub-coastal saline lands (20,000 – 25,000 ppm).
- Coastal lands with salinity up to sea levels.

Conclusions

- Agriculture plays an important role in the global economy; therefore its sustainability needs priority.
- There is a large scope for increasing value of water in agriculture.
- This can be achieved by improving WUE and introducing drought and salt-tolerant crops.
- Precision farming using data driven agricultural approaches can help increase water and land productivity.



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