



Addressing Climate Change Risks on Water and Food Security in the Arab Region

Vinay Nangia, Ph.D.
Research Director



مؤتمر الخليج الخامس عشر للمياه
The 15th Gulf Water Conference



nature

Climate change is hitting the planet faster than scientists originally thought

ENVIRONMENT



A Major Report Warns Climate Change Is Accelerating And Humans Must Cut Emissions Now

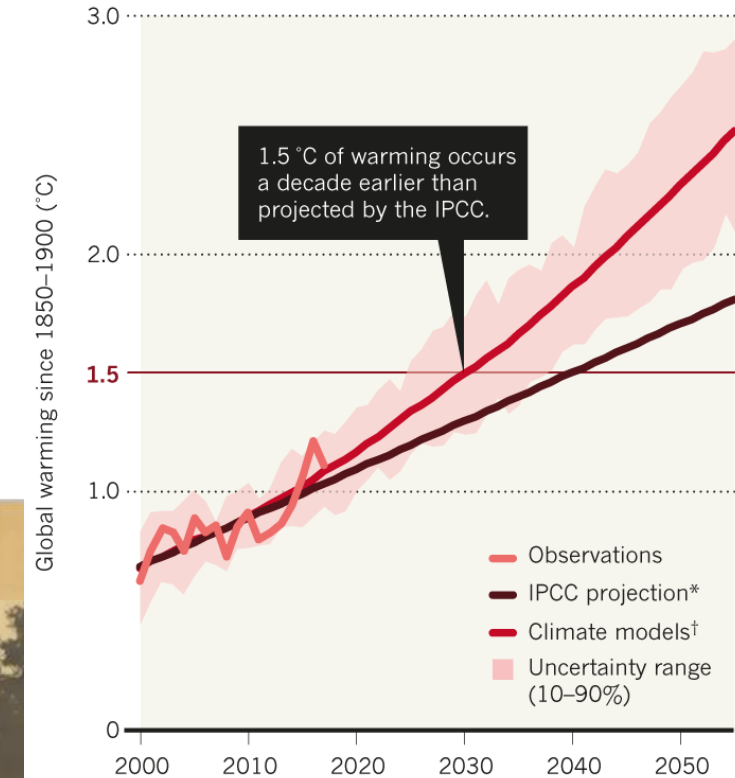
August 9, 2021 · 4:00 AM ET

Climate change widespread, rapid, and intensifying - IPCC



ACCELERATED WARMING

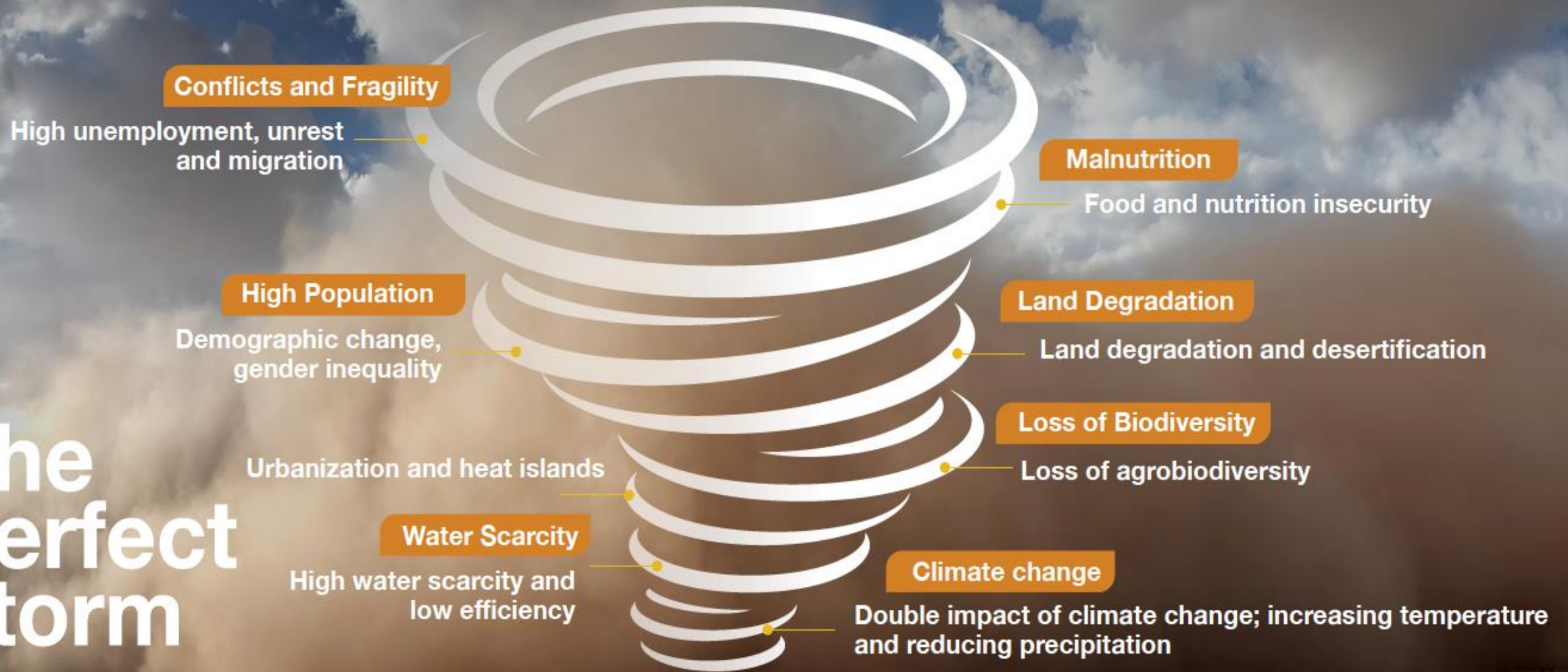
Climate simulations predict that global warming will rise exponentially if emissions go unchecked.



*Trend for 2001-15 extended with a constant rate of 0.2 °C per decade, as per IPCC special report. †Ten-year average, 37 climate models for the RCP8.5 scenario (IPCC Fifth Assessment, 2014).

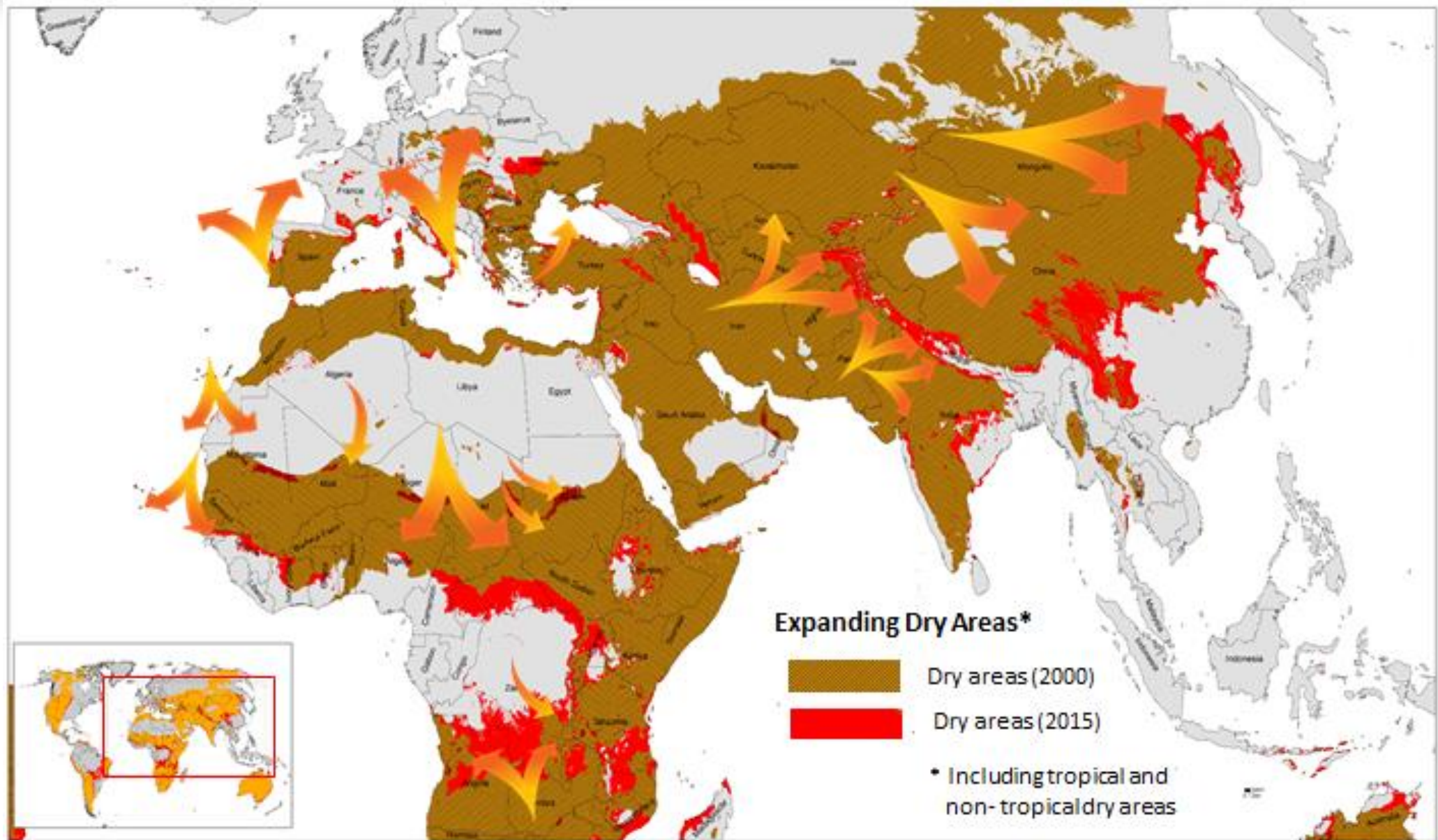
©nature

The perfect storm



With only seven harvests left to achieve the 2030 sustainable development goals, we need to move fast to accomplish our vision of thriving and resilient dryland livelihoods.

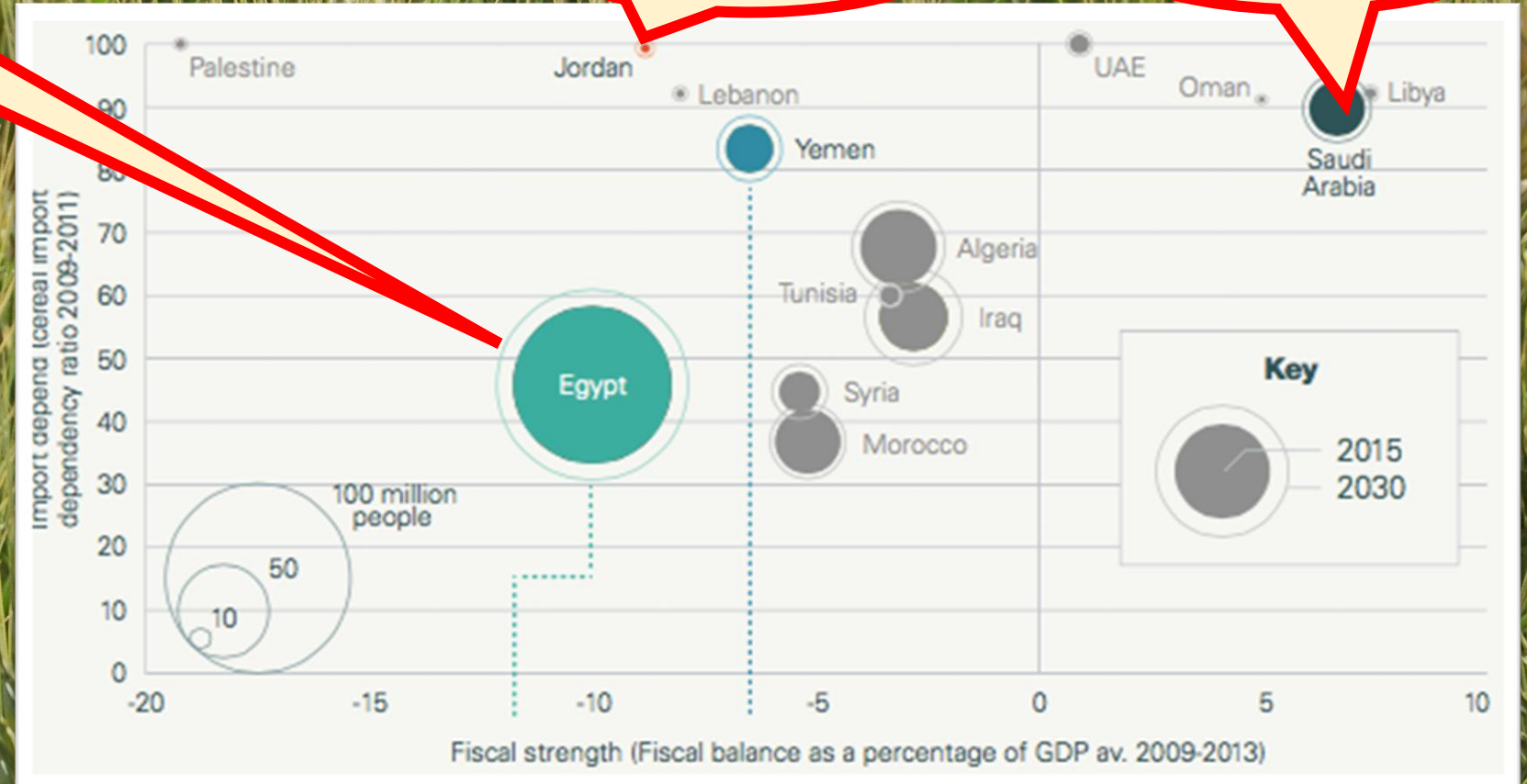
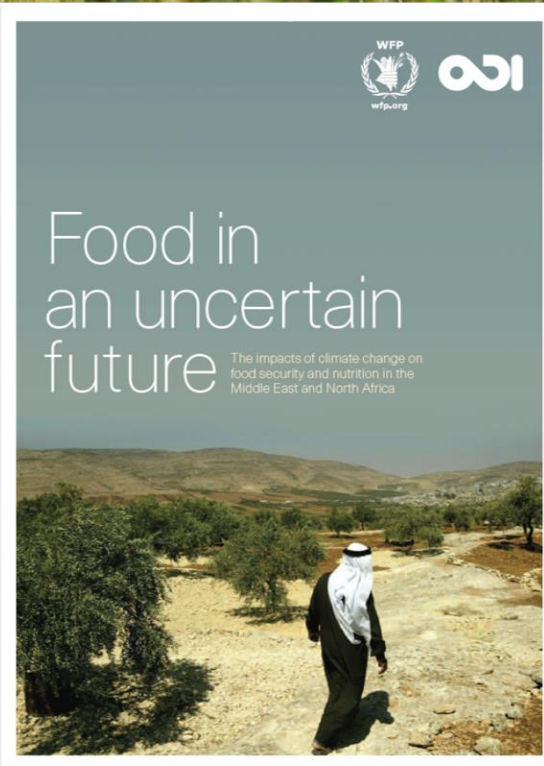
Dry areas expanding



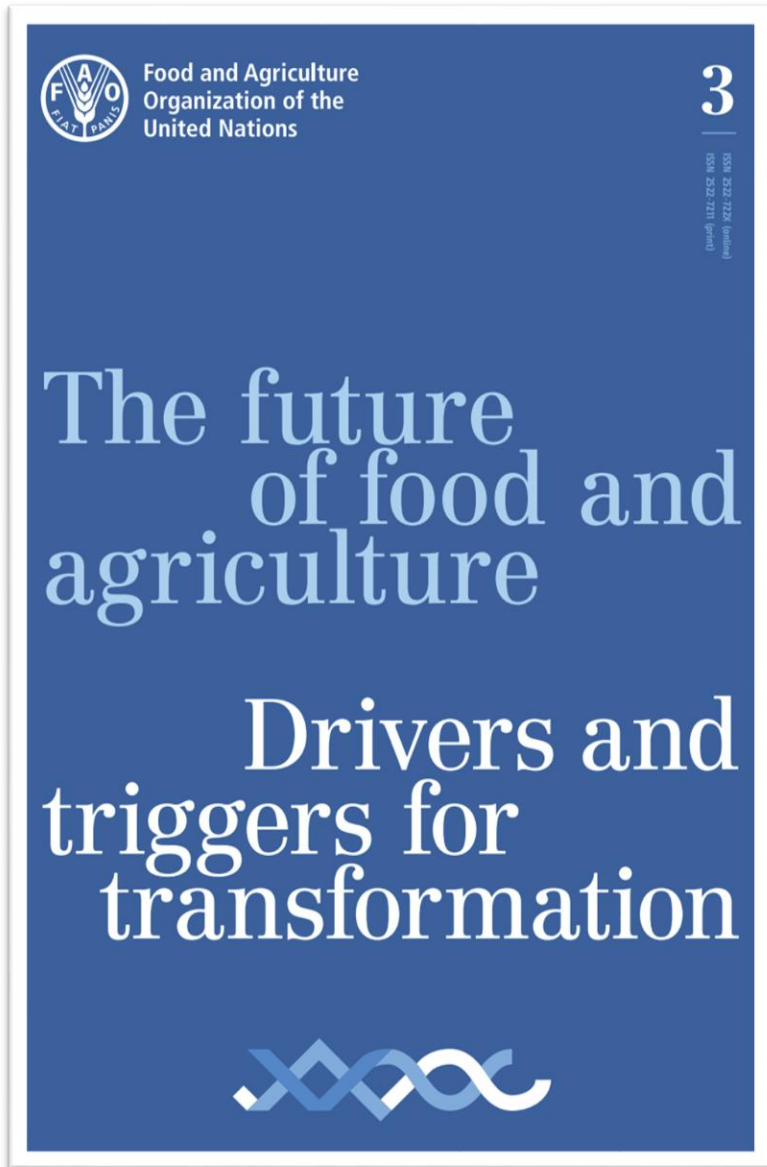
Egypt imports just under 50% of its needs.

Jordan is wholly dependent on imports.

KSA imports 90% of grains it needs.



Countries are most vulnerable to food price shocks when neither citizens nor governments can defray the higher costs



Overarching Concerns

- **Will global agrifood systems sustainably nourish** humanity in the future, while also meeting the non-food demand for agricultural products and the demand for required environmental services?
- Will socioeconomic systems evolve in such a way that income-earning opportunities will be assured to everyone, and that enough income will be universally assured to **afford healthy diets that comprise food produced in a sustainable way?**
- Will the emergence of a critical and informed civil society, and active citizenships, be able to determine governmental action to set off effective **triggers leading to transformative processes of agrifood systems?**

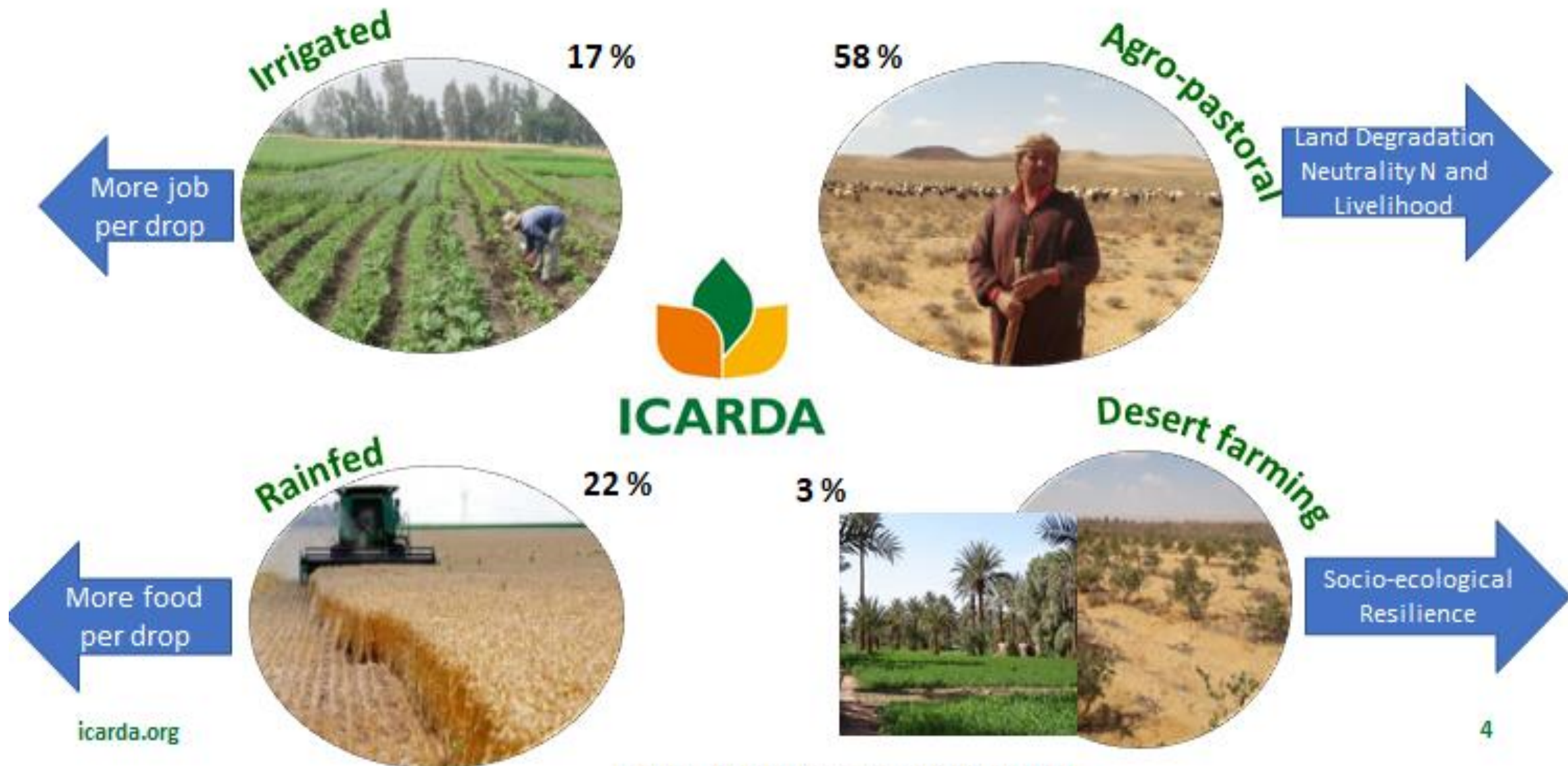


- 1. Sustainable agricultural intensification is key to saving land.** Due to increasing agricultural production and unsustainable practices, the demand for land might exceed the available reserves of very suitable and unprotected land for rainfed crops, as is already the case in specific regions such as the Near East and North Africa, or in selected countries in East Asia and the Pacific. This could entail environmental problems or additional production costs from using lower-quality land and/or building additional infrastructures. As shown by the findings of this report, the sustainable intensification of agricultural sectors can potentially lower the expansion of demand for land while maintaining soil quality.
- 2. Avoiding further land degradation and encouraging land rehabilitation helps tackle land constraints.** Although limited, available information on land degradation suggests that current agricultural practices lead to productivity losses that require an increase in the input intensity. Efforts to rehabilitate degraded land and practices that limit degradation are required to maintain the resource base and reduce the use of inputs.
- 3. Using water more efficiently is increasingly becoming a must.** Many countries already exploit their water resources at unsustainable rates, thereby jeopardizing the potential for future production. Climate change and population growth may exacerbate water scarcity. Under these conditions, increasing the efficiency of water use is becoming increasingly crucial.
- 4. Trading off agricultural yields and sustainability.** The adoption of sustainable agricultural practices might require forgoing certain yield increases, particularly when such increases lead to the overuse of water resources, a reduction in soil fertility, the loss of biodiversity and higher GHG emissions. However, some recovery in yield growth could materialize in the long run, due to a restored natural resource base, or as the result of an improvement in farmers' expertise.
- 5. All the above does not come for free: significant investments are needed.** To ensure that sufficient land and water resources are available to meet total demand from agriculture, significant investments are required in the research and development of sustainable technologies and practices, infrastructure and human capital.

Regional and country offices



- The only CGIAR center headquartered in WANA region
- +40 years dryland agriculture experience
- Long-term partnerships and agreements with countries, government, NARS, private sector and farmers
- Widely-adopted people-centered farming solutions
- A long history of work in fragile states



icarda.org

NENA Agricultural Land (2.5 M km²)

Precision agriculture is a key component of the **third wave of modern agricultural revolutions**

The first agricultural revolution was the increase of mechanized agriculture, from 1900 to 1930 - each farmer produced enough food to **feed about 26 people** during this time

The 1960s prompted the Green Revolution with new methods of genetic modification, which led to **each farmer feeding about 156 people**

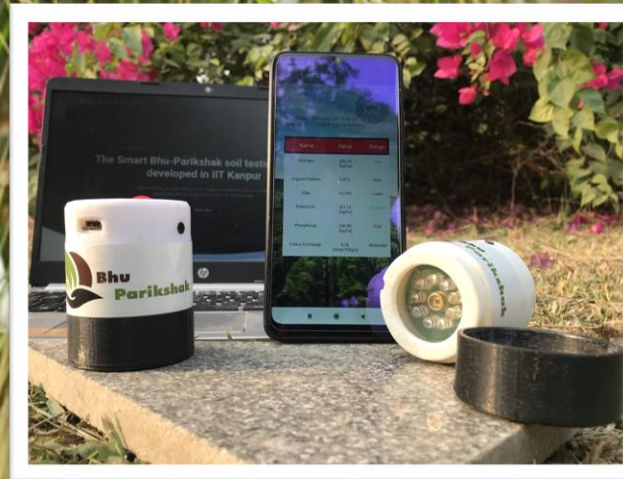
With new technological advancements through the agricultural revolution of precision farming, **each farmer will be able to feed 265 people on the same acreage**

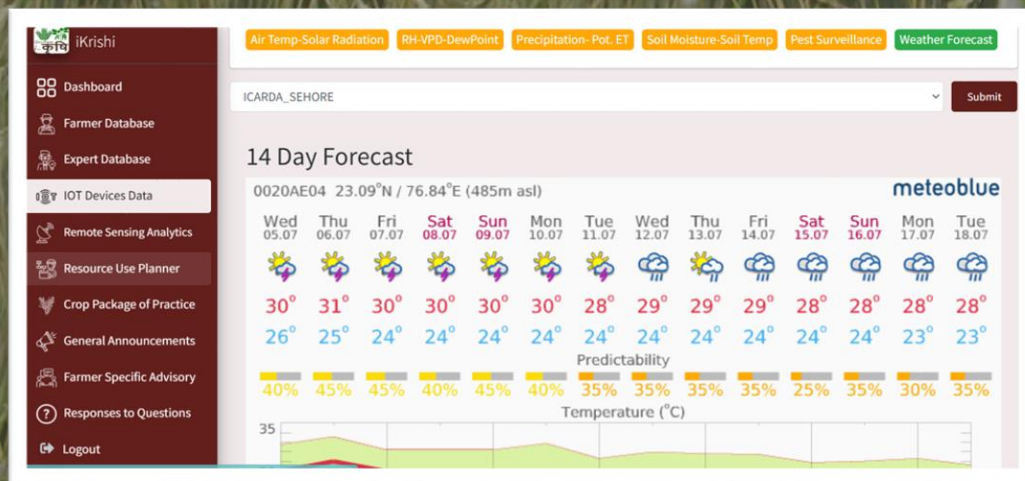
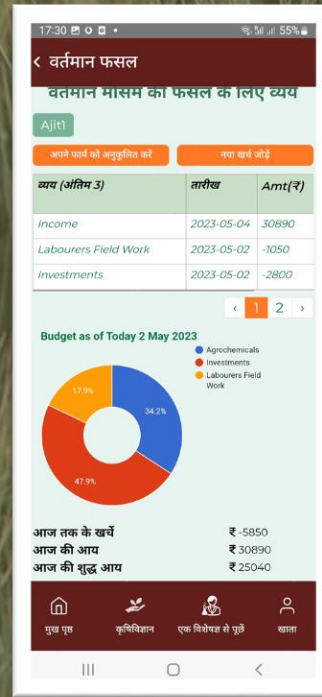
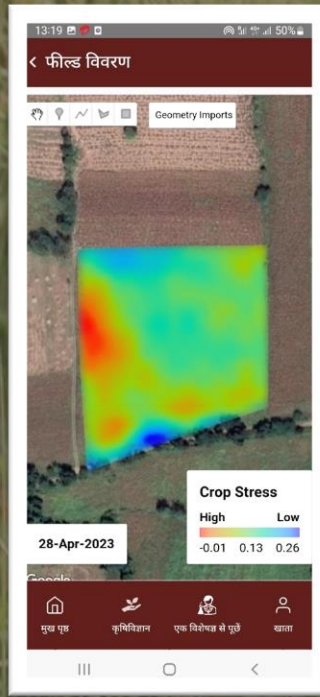
Popular definitions of precision farming describe the concept as 'a **technology-enabled approach to farming management that observes, measures, and analyses the needs of individual fields and crops**'





- ✓ Thermal camera
- ✓ Green Seeker
- ✓ NPK testing kits
- ✓ Geo Agro apps





ICARDA's flagship GeoAgro Platform can:

- Forecast weather
- Do yield gap analysis
- Forecast probability of disease outbreaks
- Improve modeling and climate change patterns

Smart irrigation

Automatically monitor soil conditions, weather changes, evaporative losses, and plant water use to determine and adjust watering schedule

Smart detection

Computer vision-enabled high-resolution cameras recognize insects/pests for detecting and planning for managing pest attacks

Smart advising

Cloud computing-based analytics to generate vernacular advisory for farmers on precision farm management to optimize inputs and enhancing income

Smart fertilization

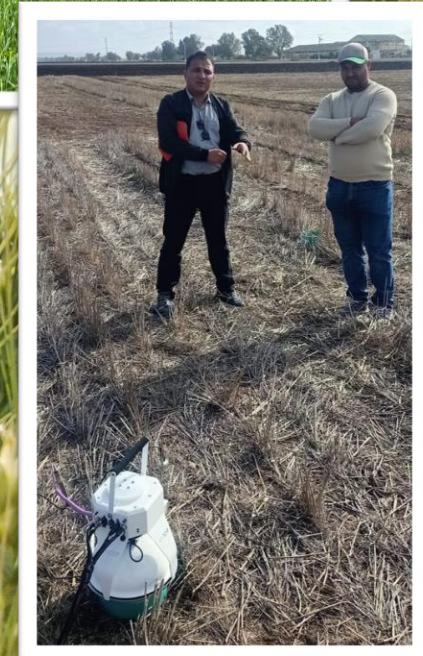
Demand-based application of right inputs at right place at right time for balanced nutrition approach eliminating guess-based fertilizer application by farmers

Smart sensing

Using weather pattern analytics, automatically generate alerts for disease outbreak



- ✓ No or low-till
- ✓ Leaving leftover residue after harvest
- ✓ Using cover crops
- ✓ Cereal-legume rotations
- ✓ Integrated pest management practices
- ✓ Adding organic matter – biochar, compost
- ✓ Using MENA regional network of eddy covariance flux tower to track carbon sequestration



Agrovoltaics

Photovoltaic Electrodialysis (PV-ED) Desalination of brackish water

Solar-powered Ultra-Low Energy Drip Irrigation

Solar-powered hydroponic systems with Rootzone Cooling

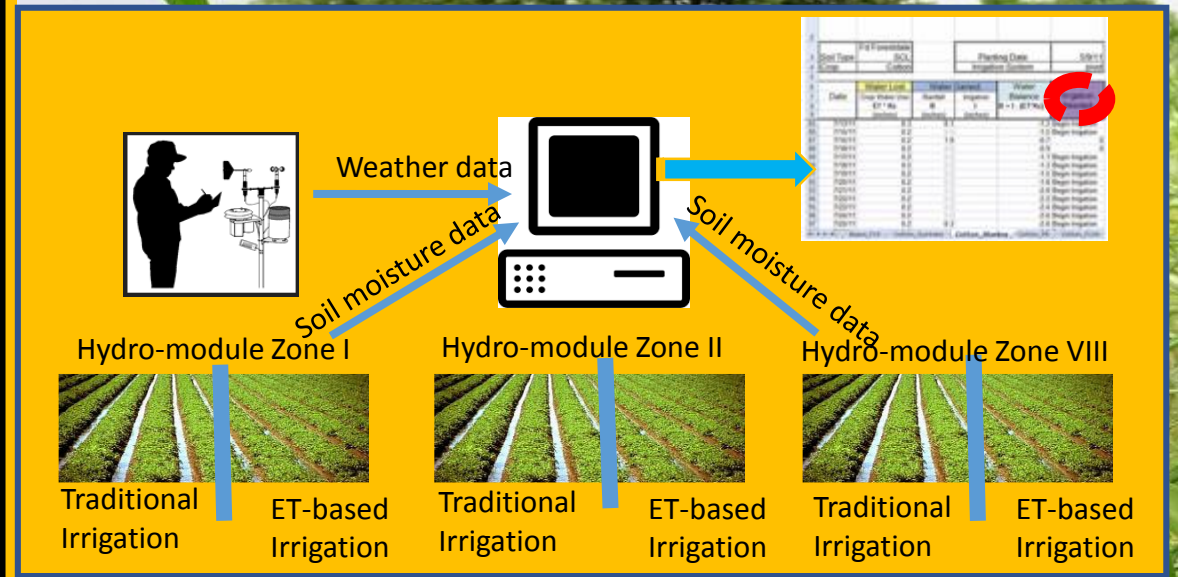


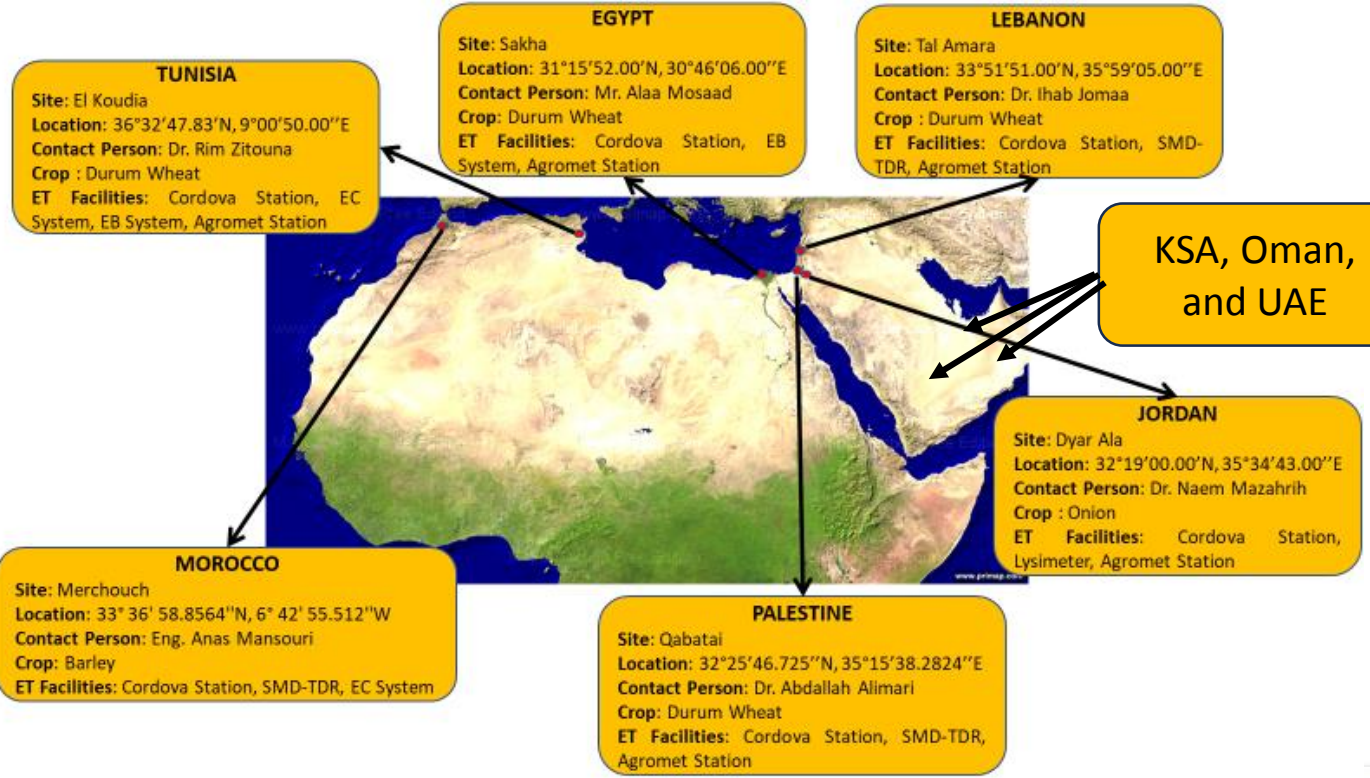
Solar-Powered Ultra-Low Energy Drip Irrigation

Drip irrigation, compared to flood irrigation, has been shown to increase crop yields by 8–29% while reducing water consumption by 9–70%
 ULE drippers have an activation pressure of 0.15 bar, which require **50% less overall system pumping power** than existing products and lowers the **capital cost of a solar-powered drip irrigation system by 42%**

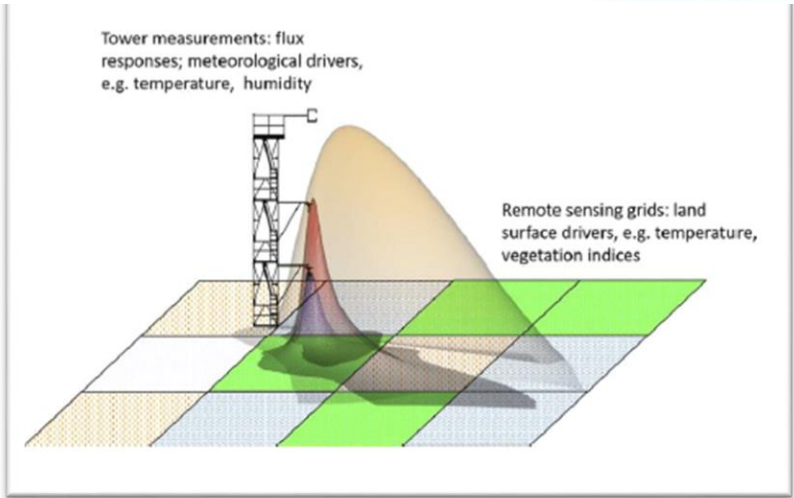
Smart Sensor-based Irrigation Scheduling

In Uzbekistan, switching from traditional flood irrigation scheduling method to ICARDA's smart system, there was on average **32% saving of irrigation water** and **50% increase in water productivity**





- **FAO and ICARDA** established and maintain a regional network of ET measurement instrumentation for **informed decision making on agriculture water management**.
- Data used for **simulation model** calibration and validation.
- For **water accounting** calculations.
- For validation of **remote sensing algorithms**.

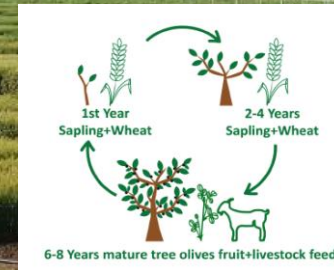
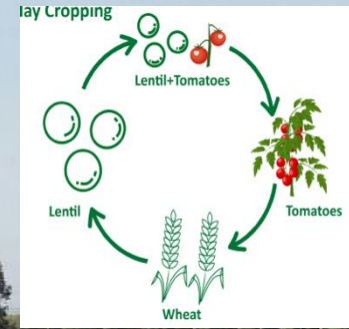
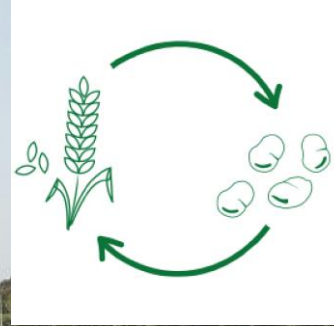


Profitable Diversified Cropping Systems



Diversified cropping systems provide nutritious diets through climate-smart and sustainable production systems.

Crop Rotation: Different crops types crops are rotated in a set seasonal order



Intercropping: Two or more crops or trees are grown simultaneously with or without a row arrangement.

Crop diversification for improve farm income, food security and resilience

Relay-cropping: a second crop is planted before the first crop is harvested



In **Morocco**, system level gross margin was greatest under:

- Lentil+onion system: \$ 11,104/ha
- Lentil+quinoa: \$ 10,726/ha
- Lentil+chickpea: \$ 1391/ha
- Lentil+bean: \$ 1219/ha
- Wheat: \$ 809/ha
- Lentil: \$ 633/ha

Key Take-home Messages

- There is unequivocal evidence that there is **no going back from some climate-induced changes in the system**
- The **dryland region is naturally water scarce** and there is limit to which technologies and management options can overcome this
- With a young aspirational population, advent of new materials and business models, significant ownership of smartphones and reduction in cost of IoT sensors, drones, remote sensing imageries etc., there is hope that **digital technologies can bring transformative changes** in the livelihoods and food security in the Arab Region
- Under the umbrella topic of climate-smart agriculture, **CGIAR and ICARDA are developing scalable solutions** that are embedded in local context, existing enabling environment, adoption barriers and impact-at-scale



Frequent Collaborators and Donors



ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT



THE WORLD BANK



Food and Agriculture Organization of the United Nations



Massachusetts Institute of Technology



鳥取大学
Tottori University



भारत
ICAR



BILL & MELINDA GATES foundation



CGIAR



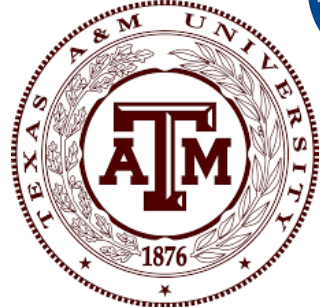
Sida



المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique



IFAD
INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT



UNIVERSITY OF MINNESOTA



United States Department of Agriculture



THANK YOU!