المنتدى العربي للبيئة والتنمية
ARAB FORUM FOR ENVIRONMENT AND DEVELOPMENT

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ARAB ENVIRONMENT 2014

ARAB ENVIRONMENT·7
FOOD SECURITY
CHALLENGES AND PROSPECTS

Potential of Rainfed Agriculture and Smallholder Farmers in Food Self-Sufficiency

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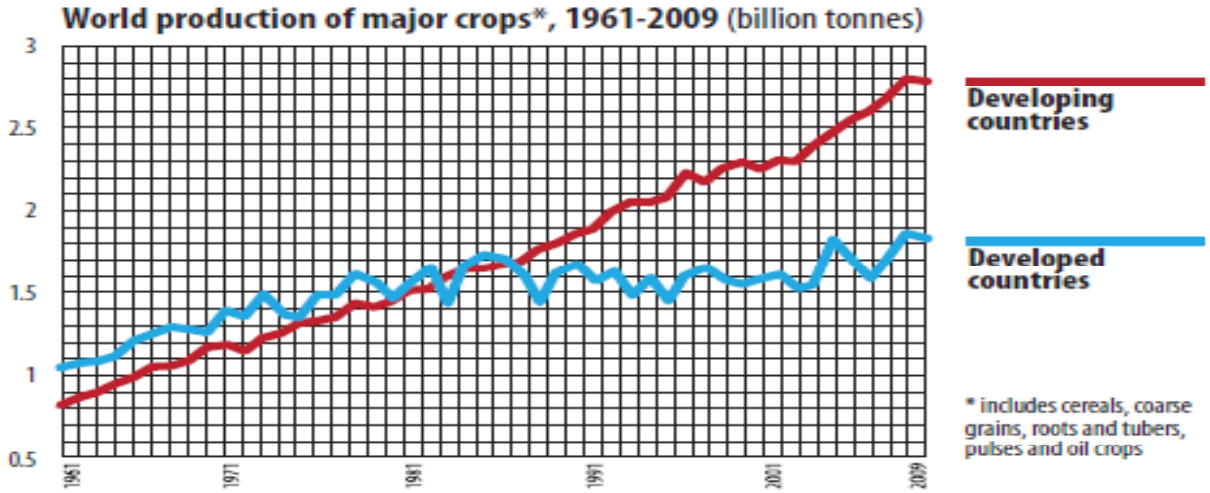
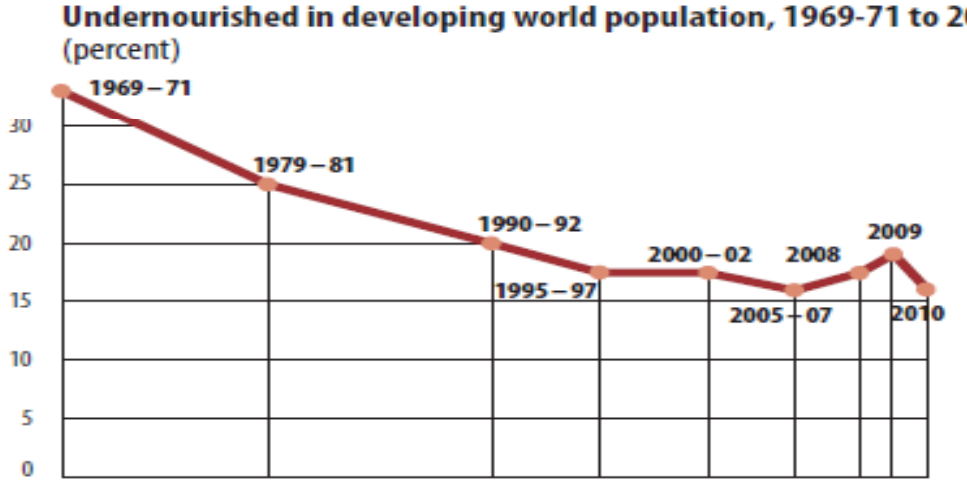
ICARDA
Science for Better Livelihoods in Dry Areas

Relationship between Food Production and Poverty

- Growth in cereal yields and lower cereal prices significantly reduced food insecurity
- Proportion of undernourished population declined from 26% to 14% between 1967-71 and 2000-2002





Source: FAO. 2011. Save and Grow. FAO, Rome

The Context- Increased Demand for Food

- World demand for staple crop products is expected to **increase by 60%** from 2010 to 2050 (with highest increase in the next 20 years), due to:
  - **Population growth**
  - **Per capita income growth**
  - **Usage in (demand for) biofuel**

- Crop area is likely to **grow by 10%** through net increase in arable land and increase in cropping intensity

- The deficit in food production to meet the growing demand has to come from yield increase
  - A minimum of **yield growth of staple crops of 1.1-1.3% annually** is needed

Source: Tony Fischer, Derek Byerlee and Greg Edmeades. 2014. Crop Yields and Global Food Security: Will Yield Increase Continue to Feed the World? ACIAR and GRDC

The Context- Rinfed is a Major Source of Food and Water

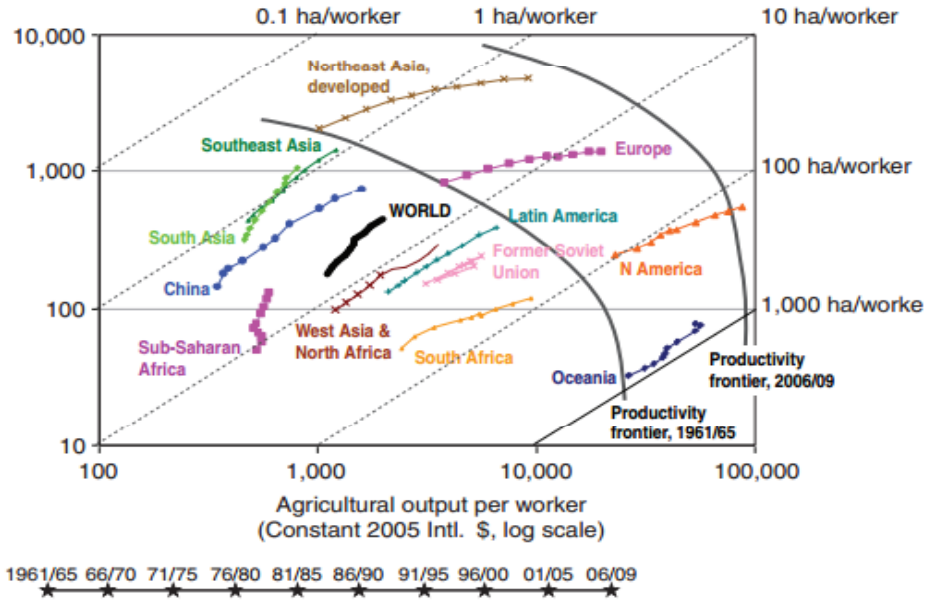
- 500M small farmers in the world, supporting around 2B people
- A recent study on “water footprint of humanity” shows that:
  - **Green water footprint (FP)** is the largest proportion of water used by the agricultural sector, **accounting for 74%**.
  - The green component in the total WF of internationally traded products **is 68%.**
- Most of food production in Arab Countries is in rainfed areas, **accounting for 83%** of seasonal crops’ area.

Sources of Food Production Growth

Agricultural Productivity Growth Globally and in Arab Countries

Long Term Trend in Land and labor Productivity

Agricultural land and labor productivity has steadily improved since 1960, but developing countries lag decades behind developed countries



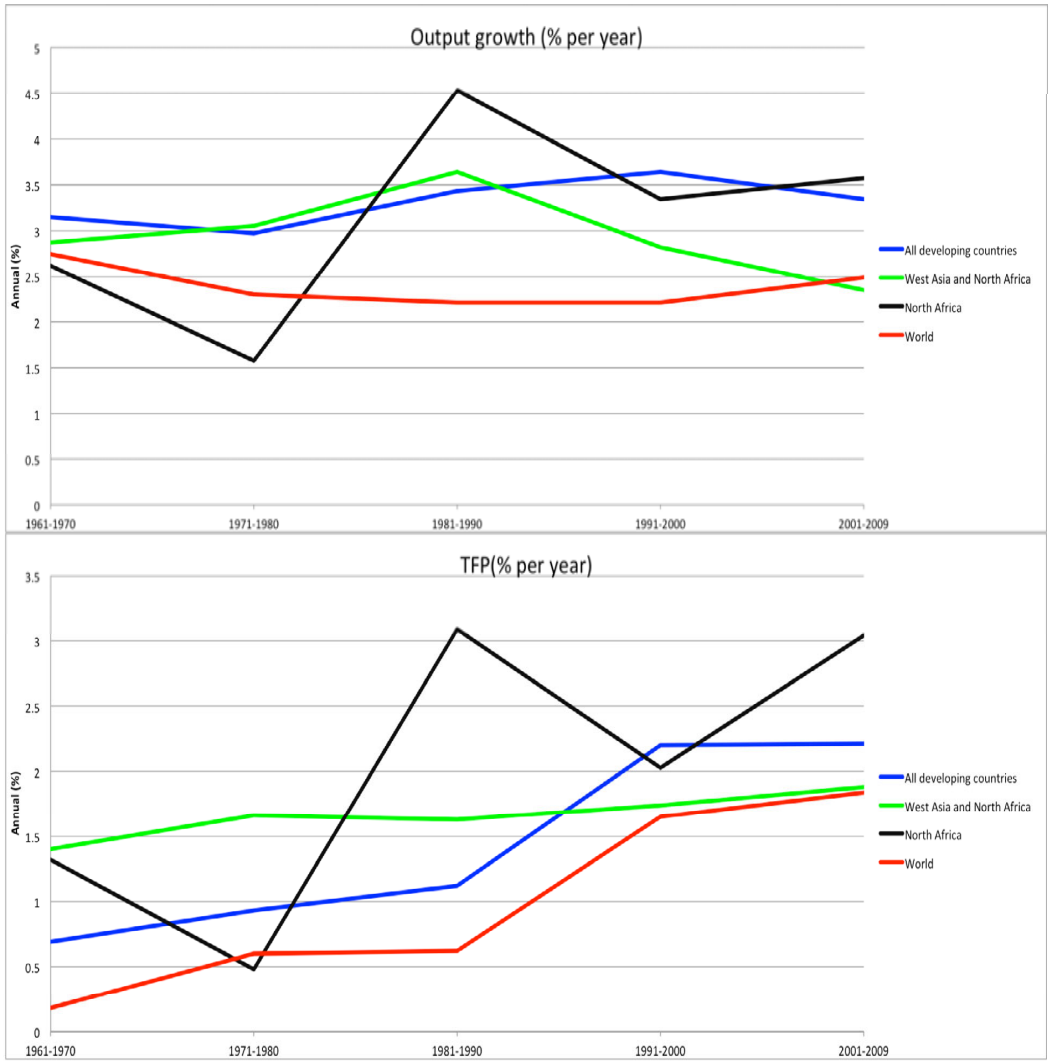
Agricultural output is the composite of 190 crop and animal commodities valued at constant 2005 international prices; agricultural land is total cropland and permanent pasture; agricultural labor is the number of economically active adults employed in agriculture. X and Y axis are in log values.

Source: Fuglie, Wang, and Ball (2012) using data from the Food and Agriculture Organization of the United Nations.

- **Labor productivity grew faster than land productivity in most regions.**
- **Sustainable long-term agricultural productivity growth is explained by:**
  - **National capacity for Ag. R&D**
  - **Enabling environment that encourages uptake and adoption of new technologies**
- **Agricultural productivity growth has led to a reduction in poverty.**

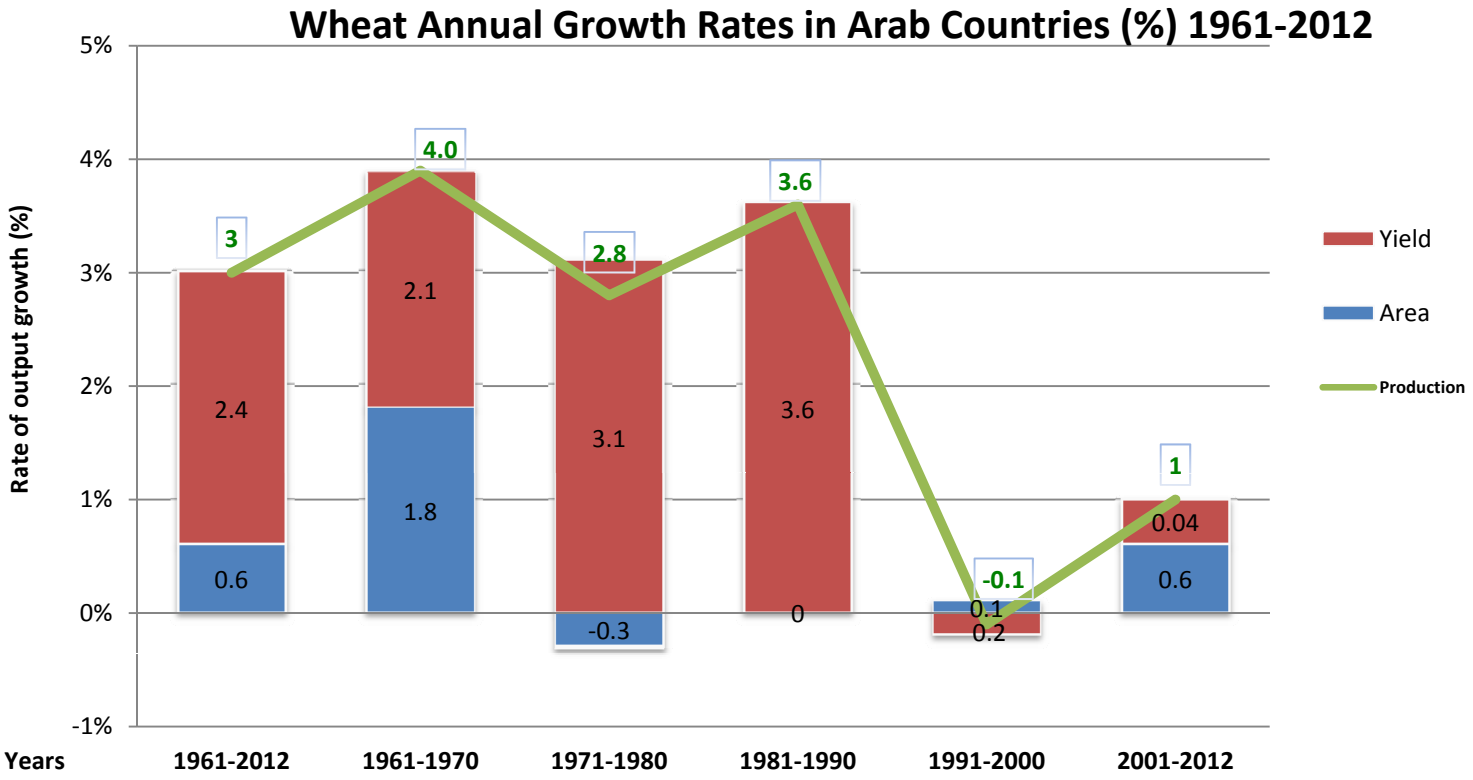
Source: Fuglie, Kheith O.; Wang, Sun Ling; and Ball, V. Eldon. 2012. Introduction to productivity Growth in Agriculture. Chapter 1 in Productivity Growth in Agriculture: An International Perspective (eds. Fuglie et al.), CAB International 2012.

Output and TFP Growth, 1961-1970 to 2001-2009



- Shift in the source of output growth from being primarily input driven to productivity driven.
- TFP accounted for 40% of output growth and inputs represented 60%. In recent decade, TFP has grown faster and accounted for 74% of global agricultural production.
- The association between TFP growth and output growth is more evident in North Africa region.

Sources of Output Growth of Major Commodities in Arab Countries

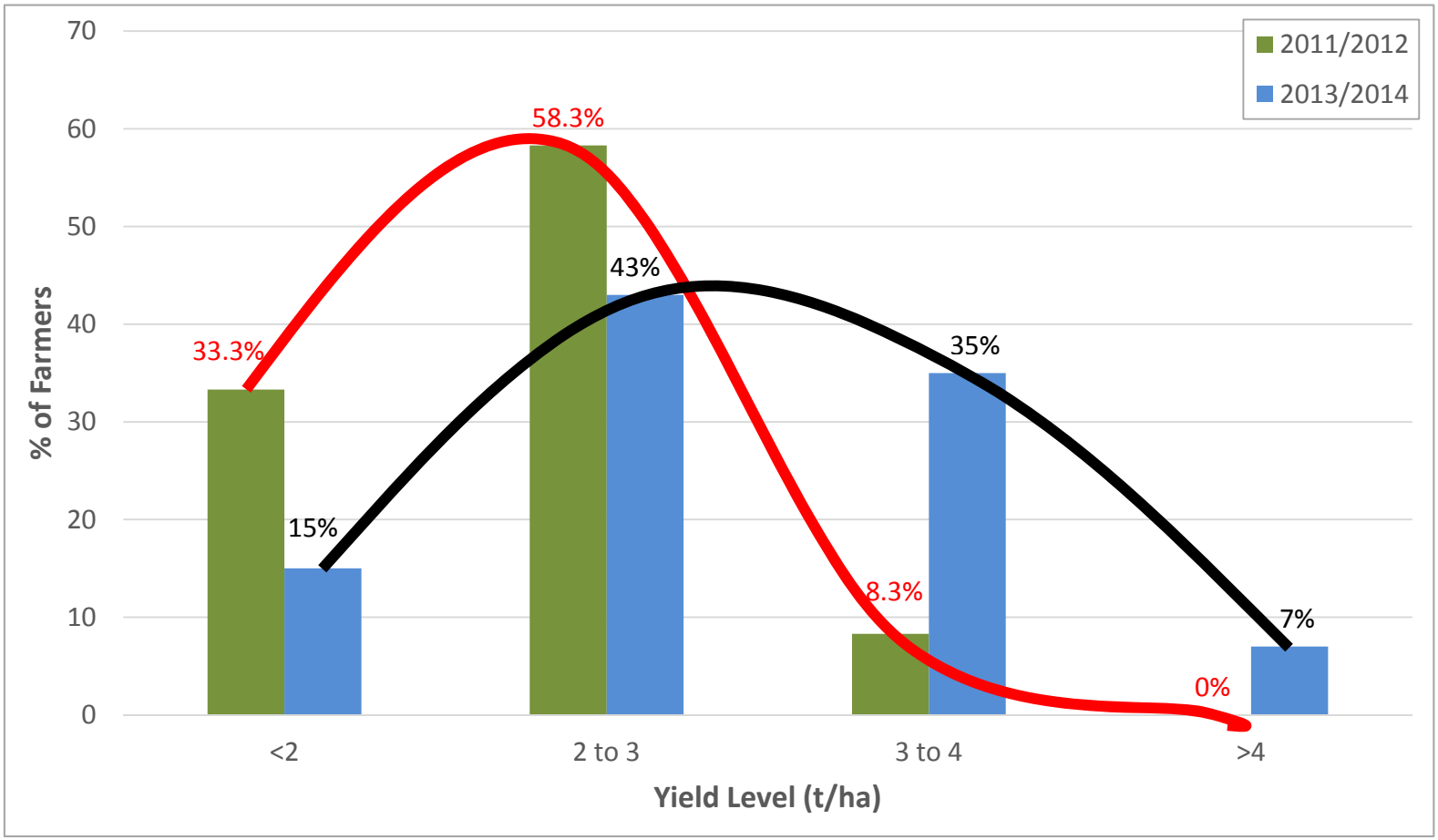


- Wheat production in Arab countries has grown by an annual growth rate of 3% during 1961-2012 period, which is mainly driven by the yield growth achieved before 1990.
- Wheat output growth has drastically slowed down since then due to sharp decline in yield since 1991.
- This is alarming trend given the importance of wheat in Arab food security.

Empowering Smallholder Farmers in Rainfed Areas to Enhance Food Security: Options to Improve Efficiency

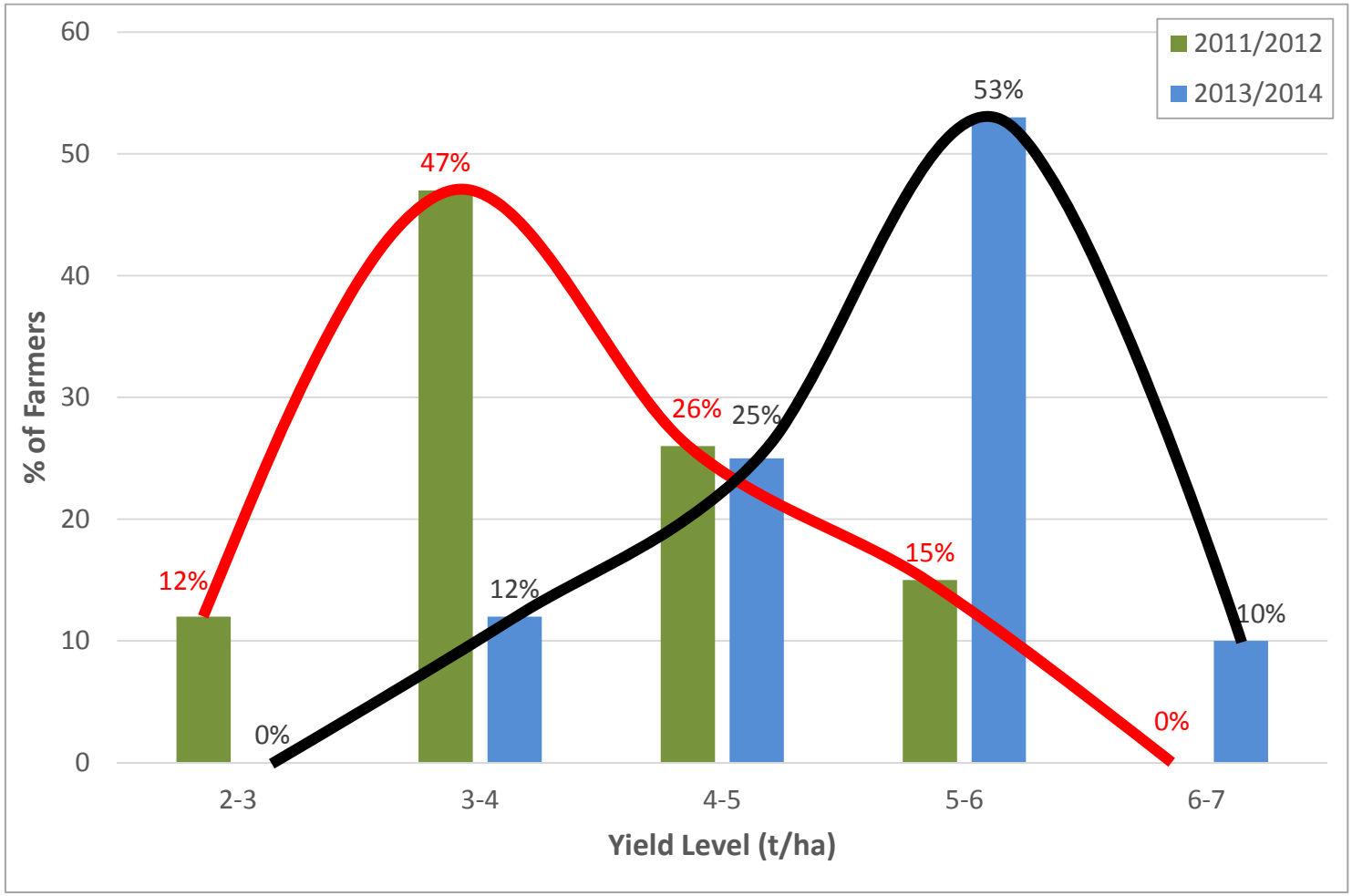
- 6 Options (among others)
  - Closing the yield gap
  - Investing in technology development and dissemination (e.g., CA)
  - Sustainable intensification of production systems
  - Water saving technologies
  - Policy options
  - Capacity Development

1. Closing Wheat Yield Gap in Farmers' Fields in Fernana- Tunisia under Rainfed Conditions



Source: ICARDA's managed project on "Enhancing Food security in Arab Countries", funded by AFESD, KFAED, IsDB, OFID

1. Closing Wheat Yield Gap in Farmers' Fields in Tadla- Morocco under SI

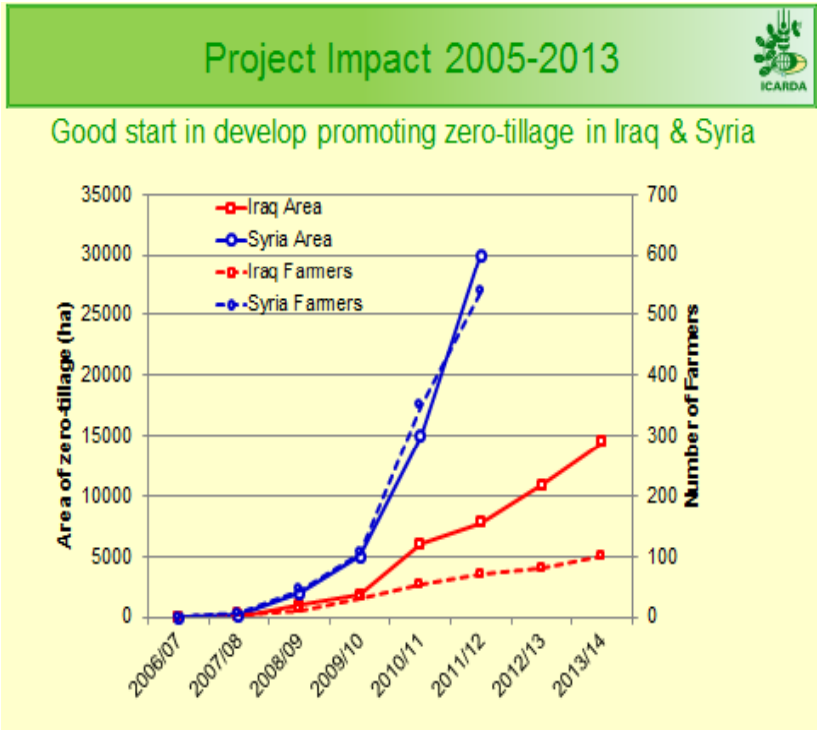


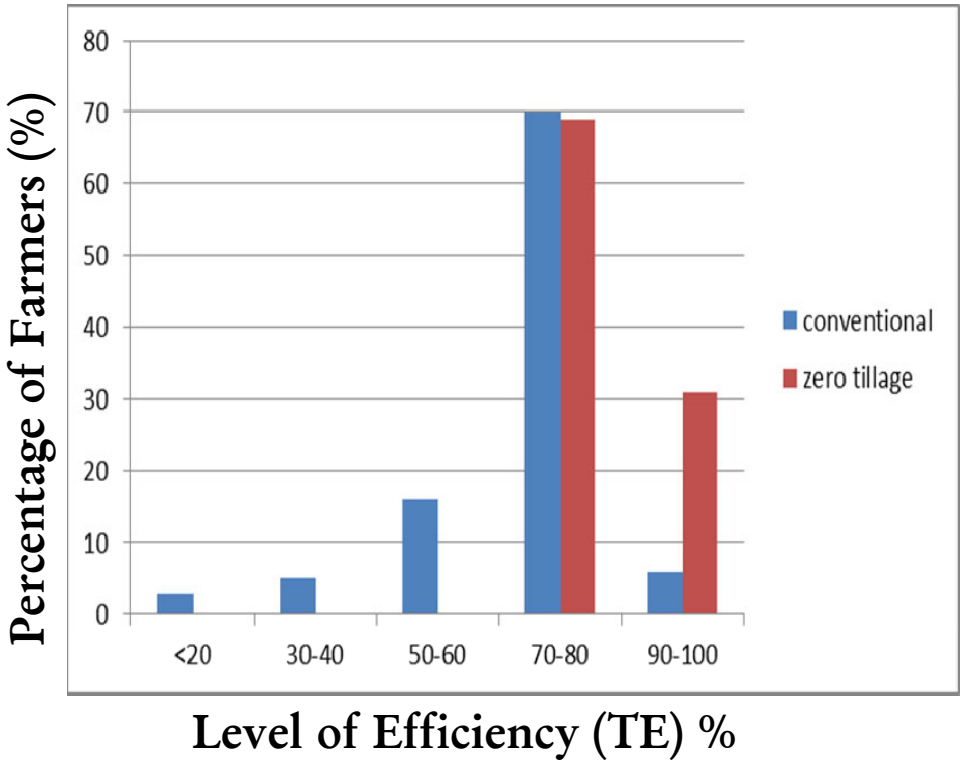
Source: ICARDA's managed project on "Enhancing Food security in Arab Countries", funded by AFESD, KFAED, IsDB, OFID

Options to Improve Efficiency in Dry Areas:

2. Conservation Agriculture

Efficiency Gains Associated with Conservation Agriculture in Wheat Production, Iraq





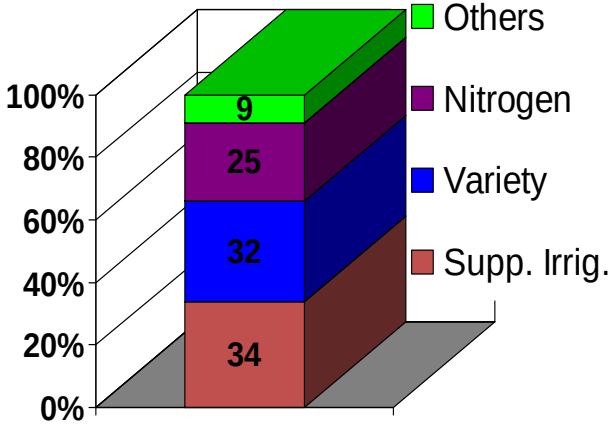
Funded by ACIAR/AusAID

13% Efficiency gains associated with the use of ZT

Unlocking the Potential of Rainfed Agriculture in Dry Environments

- Increasing the effectiveness of rainfall and improving water management to overcome drought spells:
  - **Supplemental Irrigation**
  - **Deficit Irrigation/ Deficit SI**: highest WP was obtained at rates of 1/3rd and 2/3rd of full SI requirements (in addition to rainfall)
  - **Early planting** is another SI strategy
  - **Improved Cultivars**

Integration is the key to maximize productivity & profitability

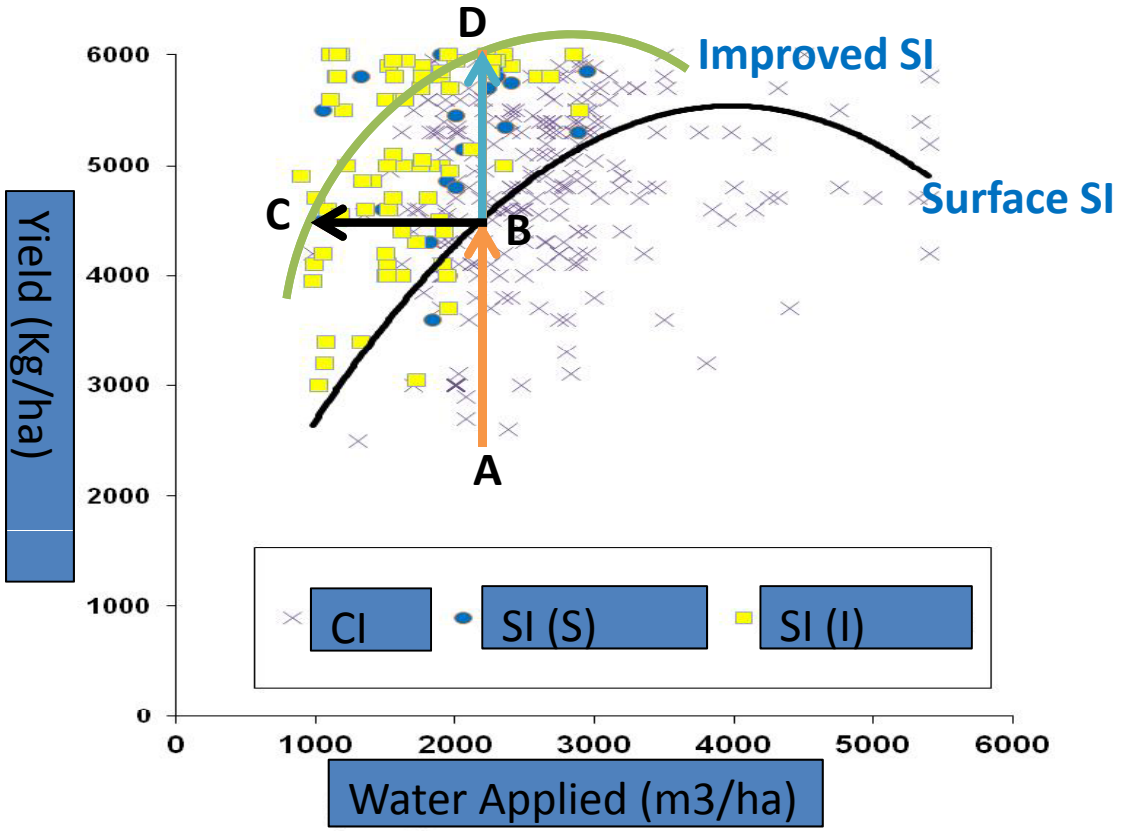


Options to Improve Efficiency in Dry Areas:

4. Water Saving Technologies (SI)

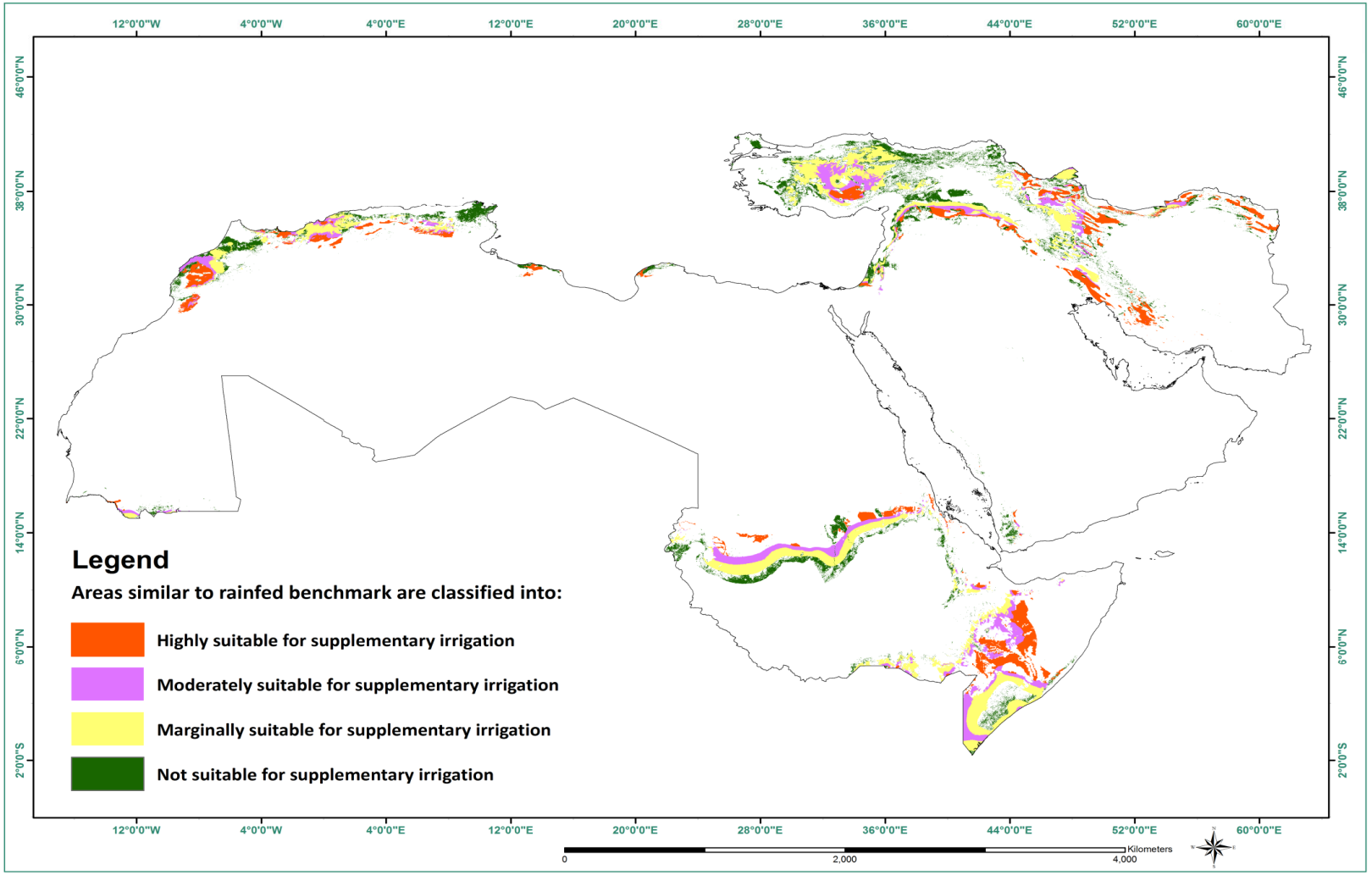
With Improved SI Technology:

- Remove system inefficiencies (A to B)
- Produce same food level with less water (B to C)
- Produce more food with the same level of water (B to D)
- Prevent the excessive use of water

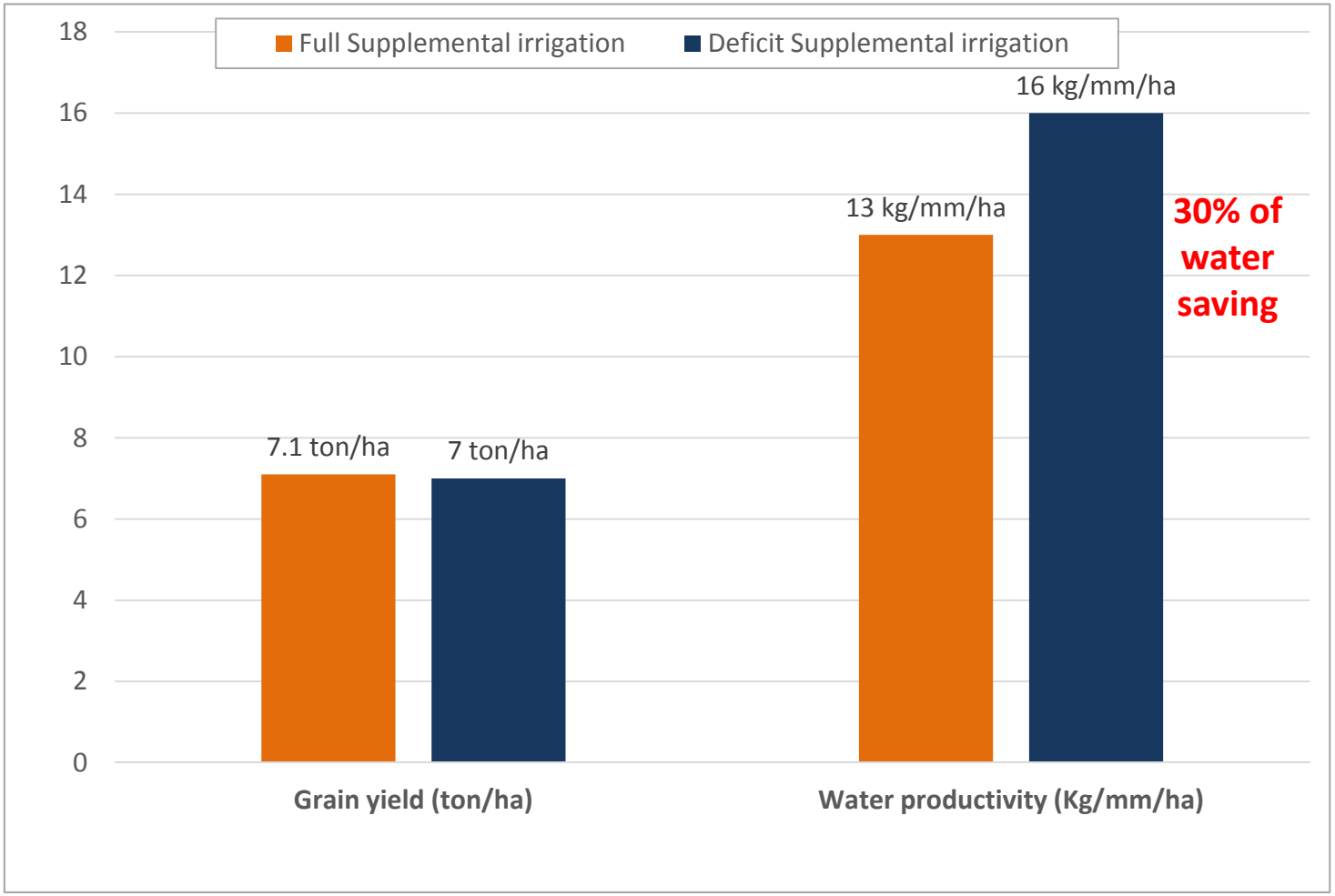


CI= Conventional SI; SI (S)= Surface SI;
SI (I)= Improved SI (Sprinkler)

Areas Suitable for Supplementary Irrigation



4. Water Saving Technologies: Water Productivity under Deficit irrigation in Tadla- Morocco, 2012-2014



Source: ICARDA's managed project on "Enhancing Food security in Arab Countries", funded by AFESD, KFAED, IsDB, OFID

Options to Improve Efficiency in Dry Areas:

5. Policies to Encourage Adoption: Water User Charges

- Despite the benefits of ISI, the TSI is still practiced by 78% of wheat farmers with an average water application rate of 2600 m^3/ha.

- What can the government do to encourage adoption? One option is to introduce “Water User Charges”

Impact of Water User Charge on Water Use and the Adoption of ISI (wheat in Syria)

- Promotes the conservation of scarce groundwater
- Substantial increases in water charges to make farmers apply the recommended level (water demand is highly inelastic)
- Importance of extension to reduce the actual water use to its profit maximizing level

User Charge ($/m^3)*	Profit Maximizing Application Rate (m^3/ha)	Actual Use by Farmers (m^3/ha)
0	2375	2686
0.11	2075 (sprinklers)	Water demand elasticity = - 0.16
0.20 (82% increase)	1800 (13% decrease)	

* User charge is charging a specific level of "water user charge" for every cubic meter applied in excess of the recommended application level of 1800 m^3/ha

Concluding Remarks

- The problem in dry areas (and Arab countries) is not only resources scarcity. It is the combination of **resources limitations, degradations and low resource use efficiency**
- Future growth in food production must **come mainly from productivity growth** and intensification, rather than expansion of cultivated areas
- **Removing Inefficiencies** in food production and resource us is the key
- **Promotion of integrated systems approach**. This is particularly needed to achieve **the eco-efficiency criteria** of the sustainable food production systems**.**
- Dryland agriculture holds the key to future food security **(and possible new green revolution).**
- **More policy attention and clear priority in investment should be given to rainfed areas**
- **Regional approach to food security**

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THANK YOU for YOUR ATTENTION

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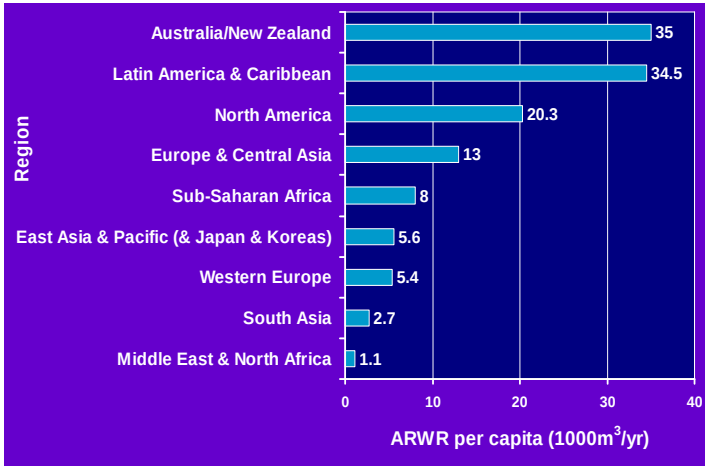
The Context- Importance of Agriculture

- 500M small farmers in the world, supporting around 2B people
- Nearly 70% of the world hungry people live in rural areas and depend predominantly on agriculture for their livelihoods.
- In Arab countries,
  - about 25% of population is poor and 76% of the poor live in rural areas.
  - Agriculture employs nearly one-third of total labor force.

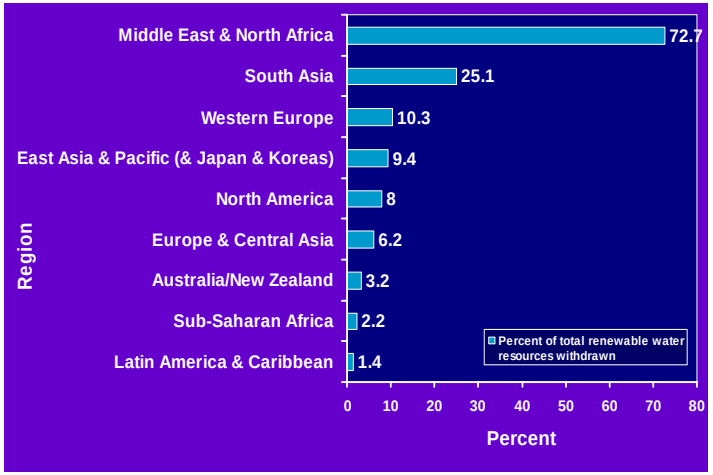
Natural Scarcity of Water in Arab Countries

- MENA is the world's most water-scarce region
- Highest water withdrawal in MENA
- On-farm WUE in wheat production, for example, is as low as 40%, suggesting huge over-irrigation of scarce water

Actual Renewable Water Resources (ARWR) per capita



Total renewable water resources withdrawn (%)



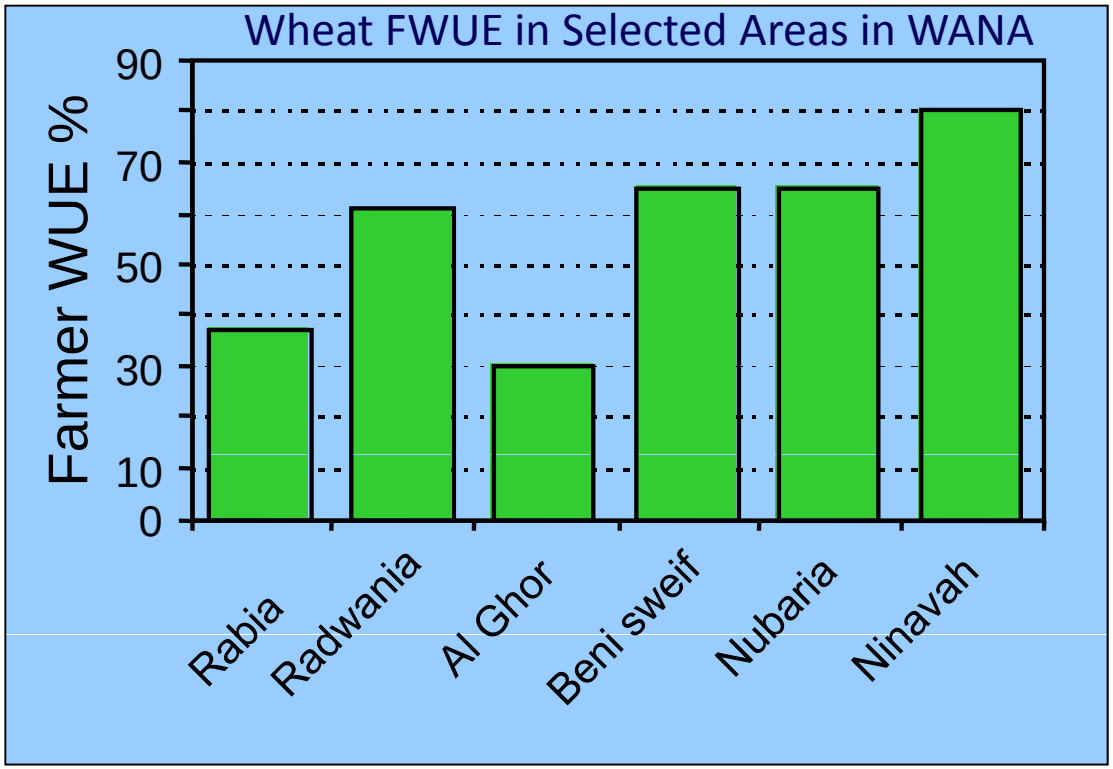
Not only Water Scarcity, Low On-farm WUE in in Arab Countries

FWUE = the ratio of the required amount of water for a target production level to the actual amount of water used.

FWUE = 1 perfect efficiency

> under -irrigation

< over -irrigation



On-farm WUE is as low as 40%, suggesting huge over-irrigation of scarce water

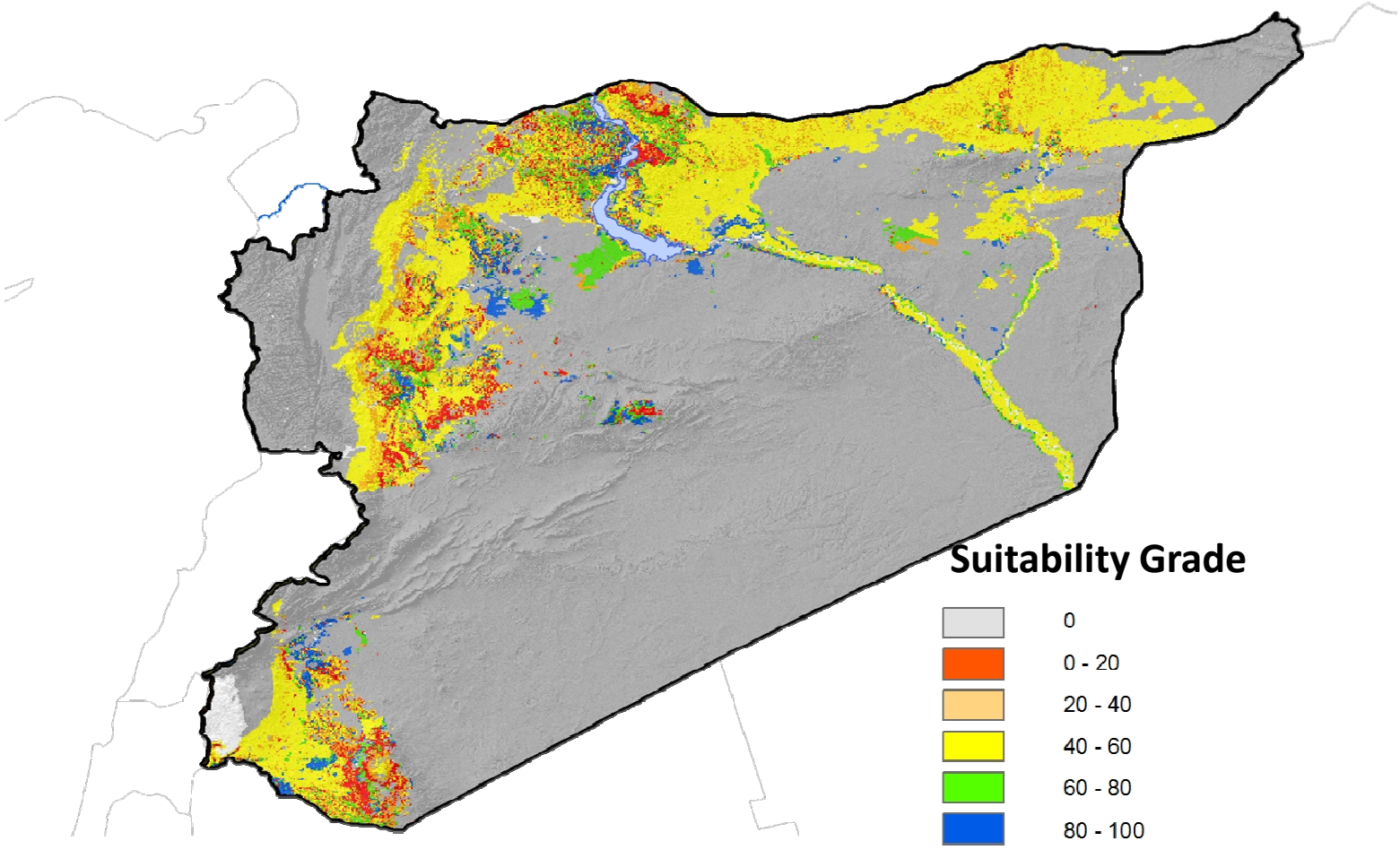
The Context- Problem Redefined

- To sum, the problem in Arab Countries is not only one of resource scarcity.
  - It is the combination of resource limitations, degradation, and **low efficiency of resource use.**

- Under such conditions, future increases in productivity and production for improving food security and ensuring environmental quality, need to come from enhancing the efficiency of resource-use – rather than using more inputs or increasing the food production area.

- A wide range of technology solutions is available to bridge the efficiency gap.

Potential in Existing Farming Systems for increasing production with supplemental Irrigation



Source: ICARDA Geoinfromatics Unit, Dr. Chandra Biradar, 2014