المنتدى العربي للبيئة والتنمية
ARAB FORUM FOR ENVIRONMENT AND DEVELOPMENT
AFED

البيئة 2014
ARAB ENVIRONMENT 2014

ARAB ENVIRONMENT • 7
FOOD SECURITY
CHALLENGES AND PROSPECTS

The Role of Science and Technology in Enhancing Food Security

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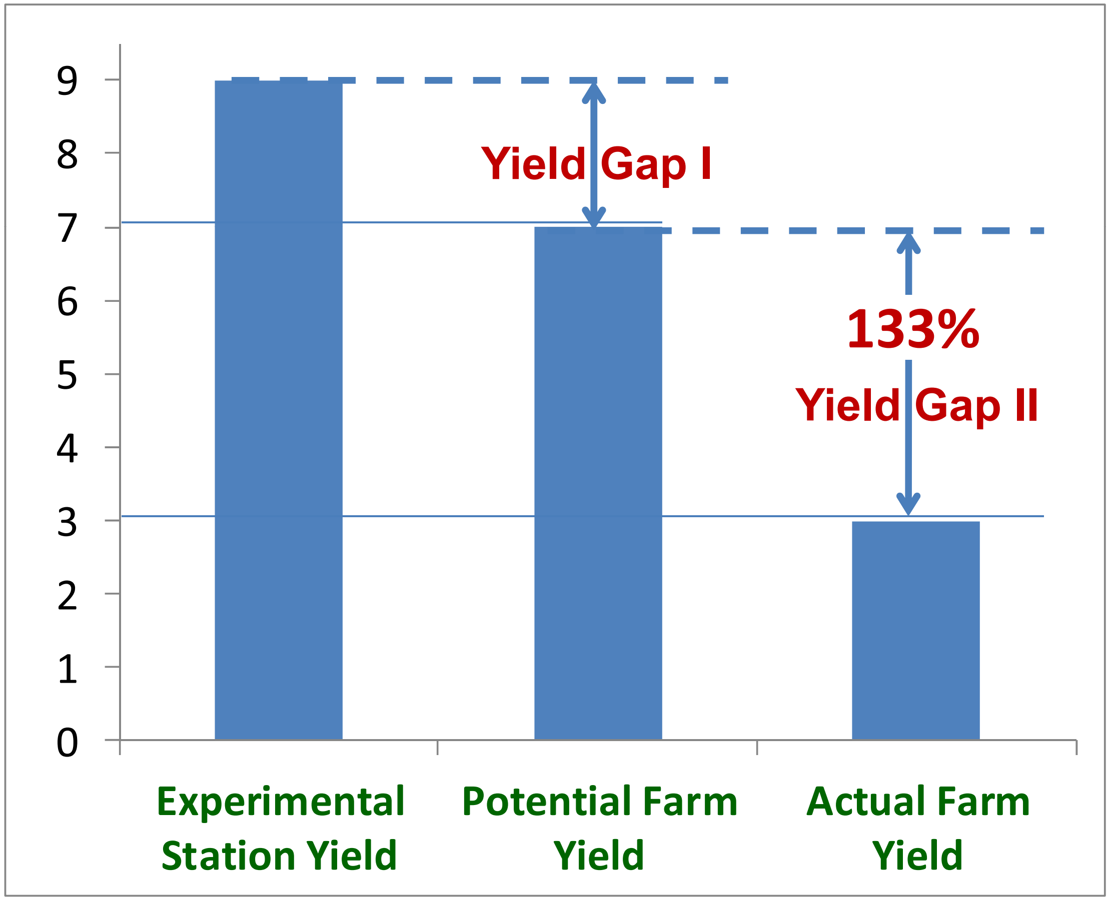
ICARDA
Science for Better Livelihoods in Dry Areas

Challenges in the Arab World in a Changing World

- The largest food deficit region in the world;
- Limited natural resources base;
- Degradation of natural resources, particularly water;
- Serious implications of climate change;
- High food prices in the world market;
- High rate of population growth;
- Very low agricultural productivity.

The Wide Yield Gaps in Arab Countries

Wheat Yield Gap Analysis in Tunisia



Biological constraints
- Variety
- Water
- Weeds
- Diseases and insect pests
- Soil Fertility
- Soil Problems e.g. salinity

Socioeconomic constraints
- Input availability
- Costs and returns
- Credit
- Prices
- Tradition and attitudes
- Knowledge
- Institutions and policies

Major Yield Gap Issues

- **Efficiency of Technology Transfer**
  - **Use of recommended: Sowing date, seed rate, fertilizer amount, rotation, use of proper farm machinery, disease and pest management practices**
- **Proper targeting of Varieties / Production zones**
- **Timely Availability of Inputs**
  - **Quality Seed**
  - **Irrigation Water**
  - **Fertilizers**
  - **Pesticides**
  - **Machinery**
- **Government intervention and Policies: *(Inputs availability & access, and Marketing issues)***

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Research Strategies and Approaches to Bridge Yield Gaps
&
Enhance Agricultural Productivity in Arab Countries

Research for Development
to Enhance Food Security in Arab Countries

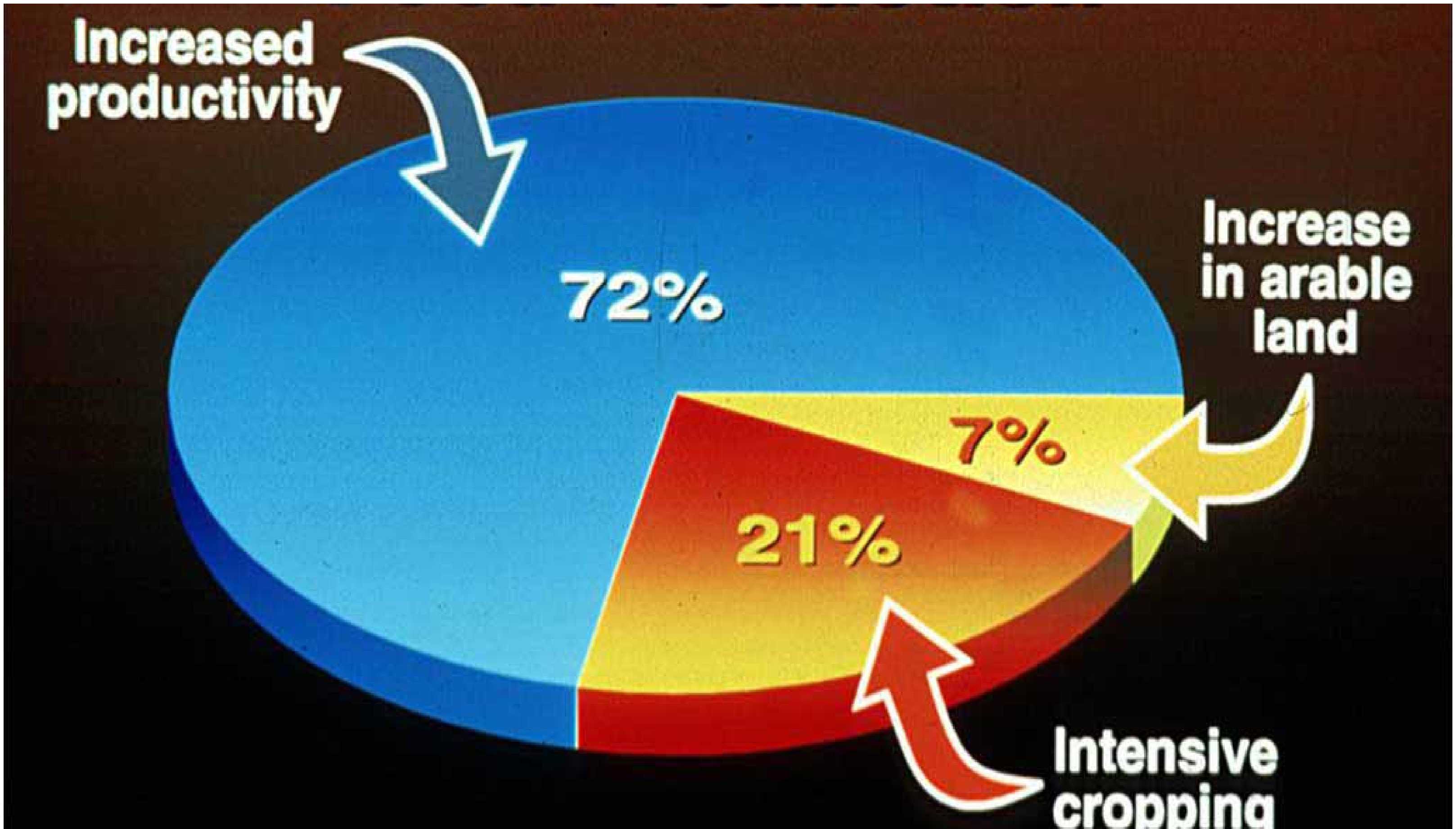
Research targets two major agro-ecosystems in drylands of Arab countries:

A. High potential areas:
relatively high rainfall areas & irrigated agriculture

B. Low potential areas:
marginal lands

A. High Potential Areas

Sources of increase in food production



Potential Availability of Land for Rainfed Cultivation

(1000 ha)

	Total area	Area < 6 hours	Area > 6 hours
Sub-Saharan Africa	201,761	94,919	106,844
Latin America and Caribbean	123,342	93,957	29,387
Eastern Europe and Central Asia	51,136	43,734	7,400
East and South Asia	14,769	3,320	11,450
Middle East and North Africa	2,716	2,647	71
Rest of world	52,134	24,554	27,575
Total	**445,858**	**263,131**	**182,727**

Note: Data reflects potential supply of land in areas with a population density less than 25/km^2.

Source: Fischer and Shah 2010

Bridging the Yield Gap in High Potential Areas: Sustainable Agricultural Intensification

Agricultural intensification would bridge the yield gap and is very important in Arab countries to enhance food security.

However, it is a serious threat to the environment and natural resources (biodiversity, water, land, and soil) unless it is practiced in a sustainable manner particularly in dry areas……..

Thus, to bridge the yield gap the trend should and will be towards …..

Sustainable Agricultural Intensification of Production Systems in favorable conditions of dry areas …….. and consequently towards

Agricultural Modernization & Sustainable Agricultural Development

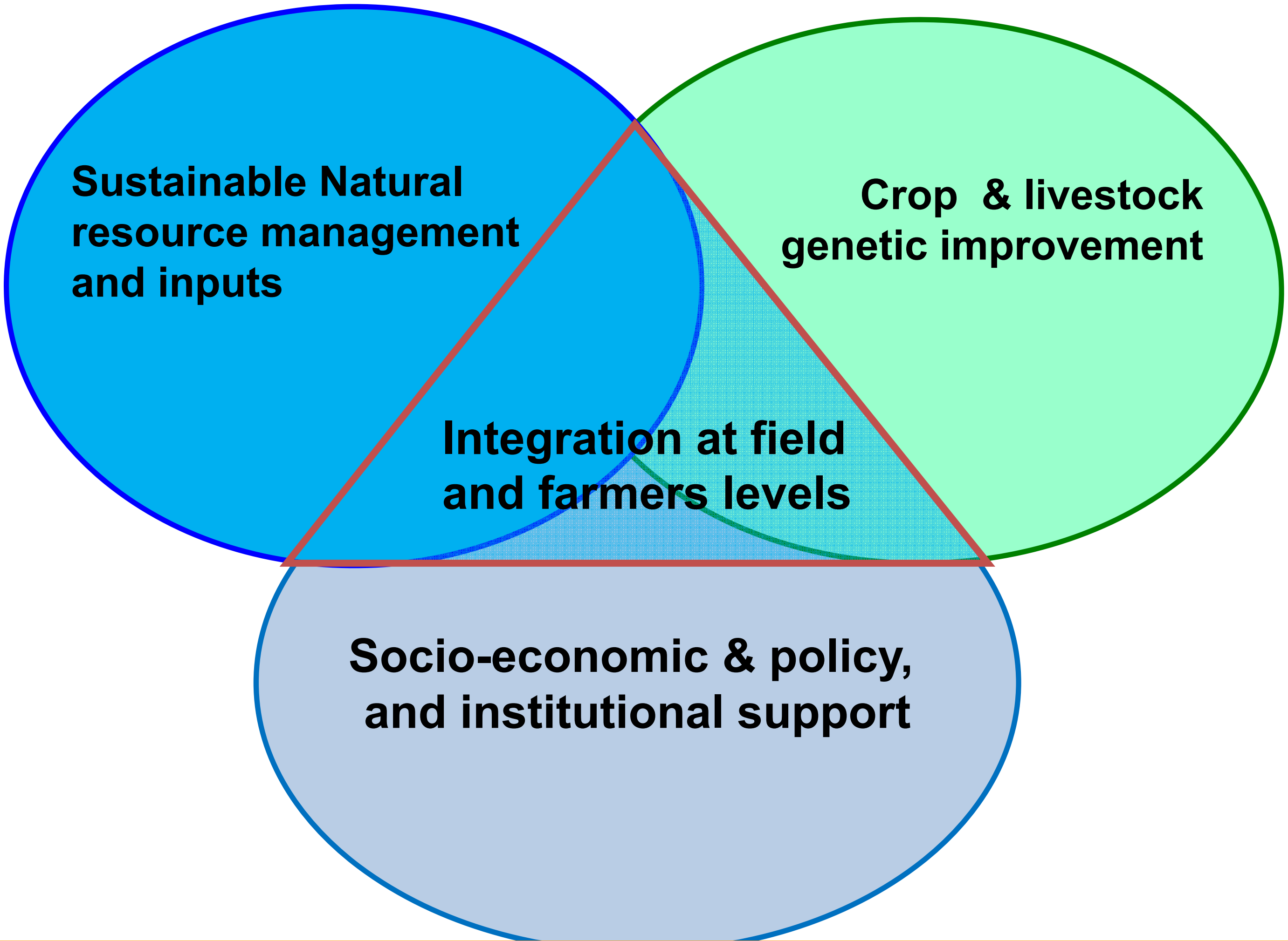
Bridging the Yield Gap in Arab Countries:
S & T and Sustainable Agricultural Development

Science-based technological change developed through agricultural research and technology transfer is the key force for enhancing food security in Arab countries.

The challenge in the Arab countries is how to produce more with less.

How science and technology can do that?

The Integrated Approach for Sustainable Agricultural Development



The Power of Science and Technology
to Enhance Food Security
Examples Thematic Research

Water Management Research:

Enhancing water productivity & water use efficiency

At the basin level:

- Competition among uses (environmental, agriculture, domestic)
- Conflicts between countries
- Equity issues

At the national level:

- Enhancing food security
- Reducing food imports
- Socio-political implications

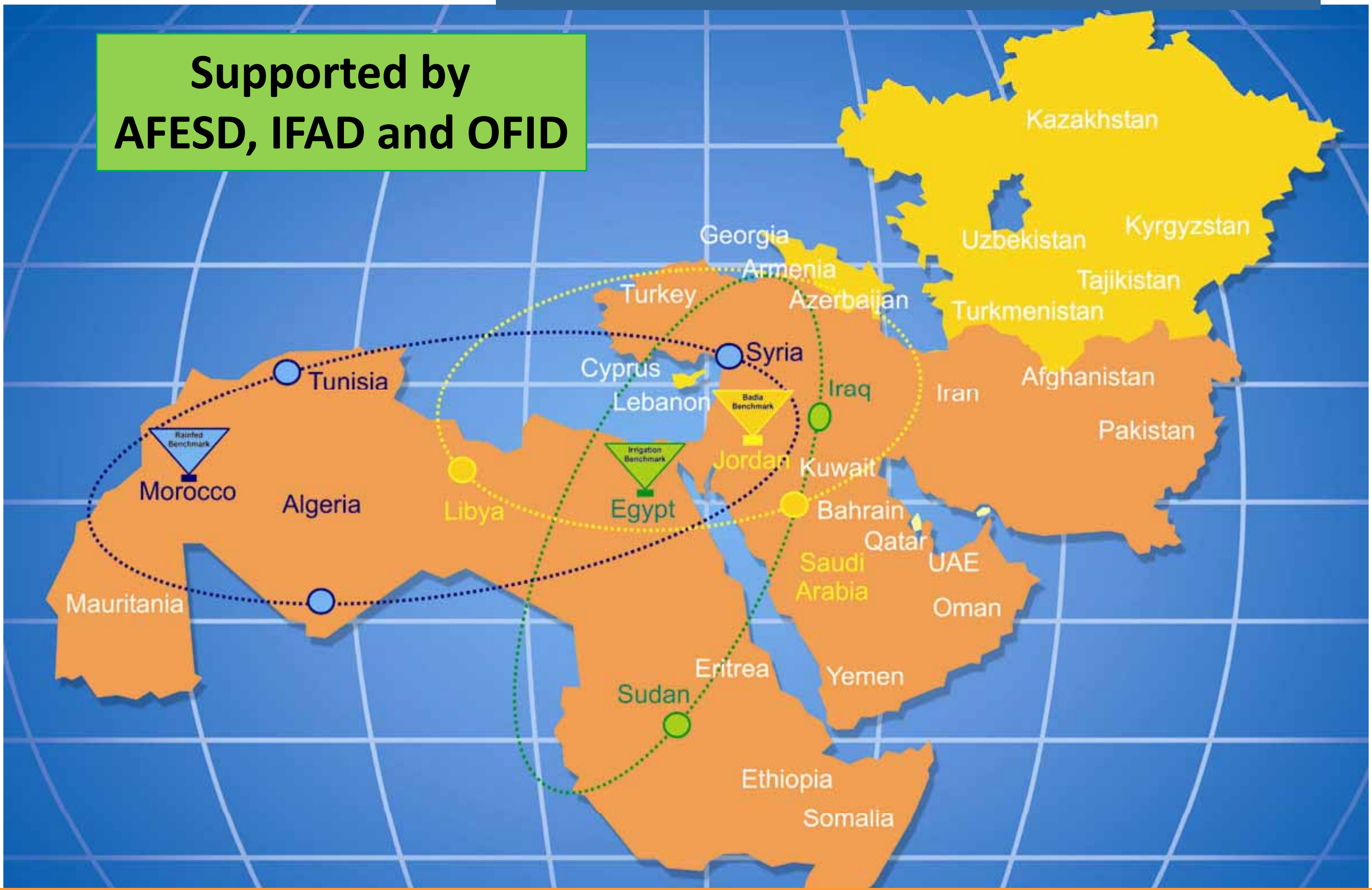
At the farm level:

- Maximizing economic return from water use
- Transitioning subsistence farming to market oriented economy

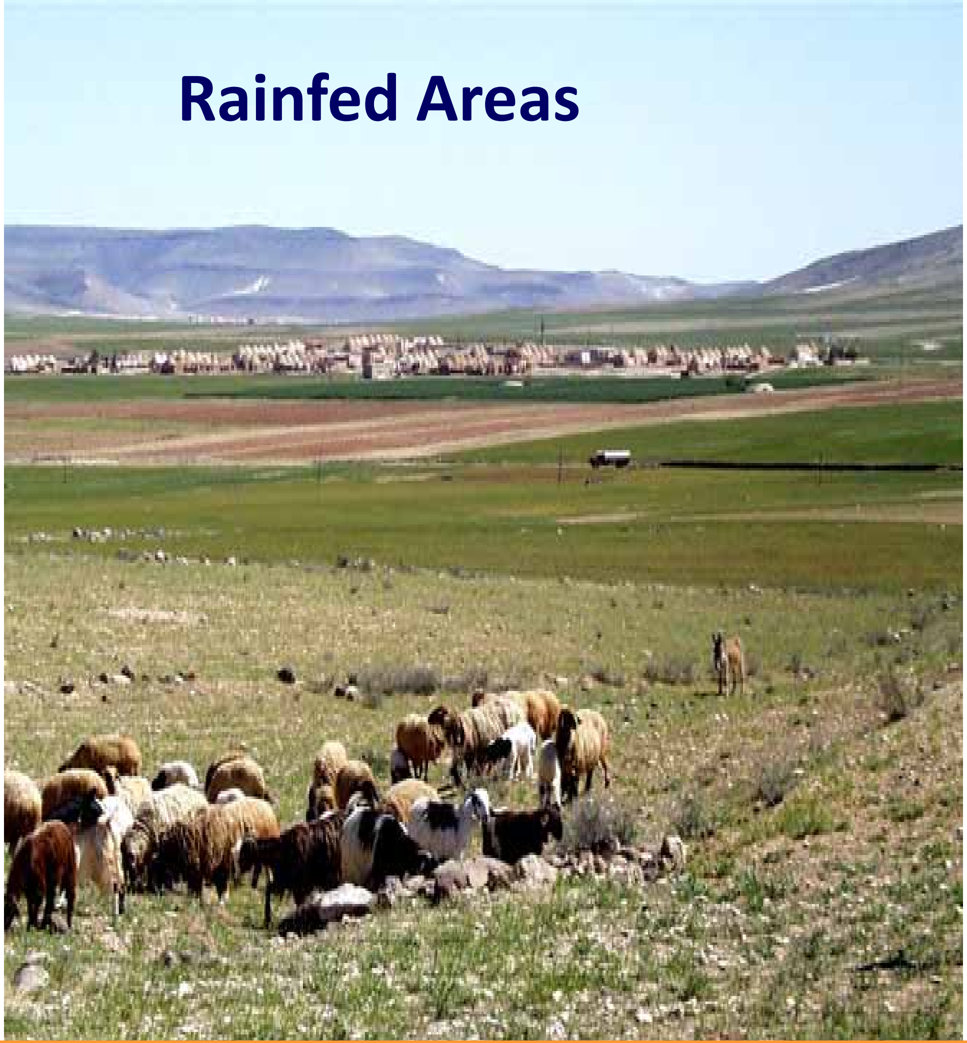
At the field level:

- Maximizing WUE, productivity & income

Research Benchmark Sites for Integrated Water & Land Management



Implementation in Three Agro-Ecologies



Research outputs & technologies for sustainable water management & water productivity

Enhancing water productivity through:

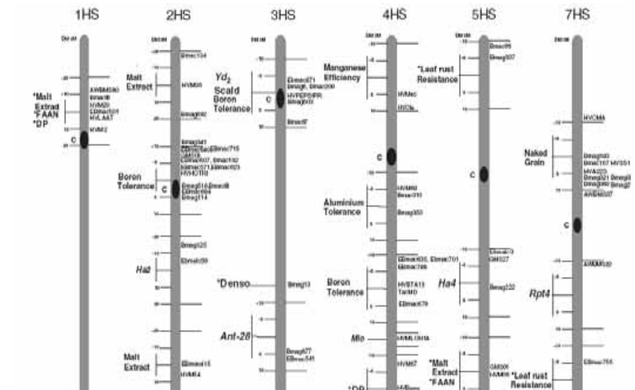
- Modernization of irrigation systems and improving the efficiency of surface irrigation
- Modifying cropping patterns to enhance water productivity and income
- Supplemental irrigation (systems and management)
- Macro- and micro-water catchments (Vallerani and other types)
- Deficit Irrigation as a water management strategy for the water scarce areas
- Watershed management

Crop Genetic Improvement:

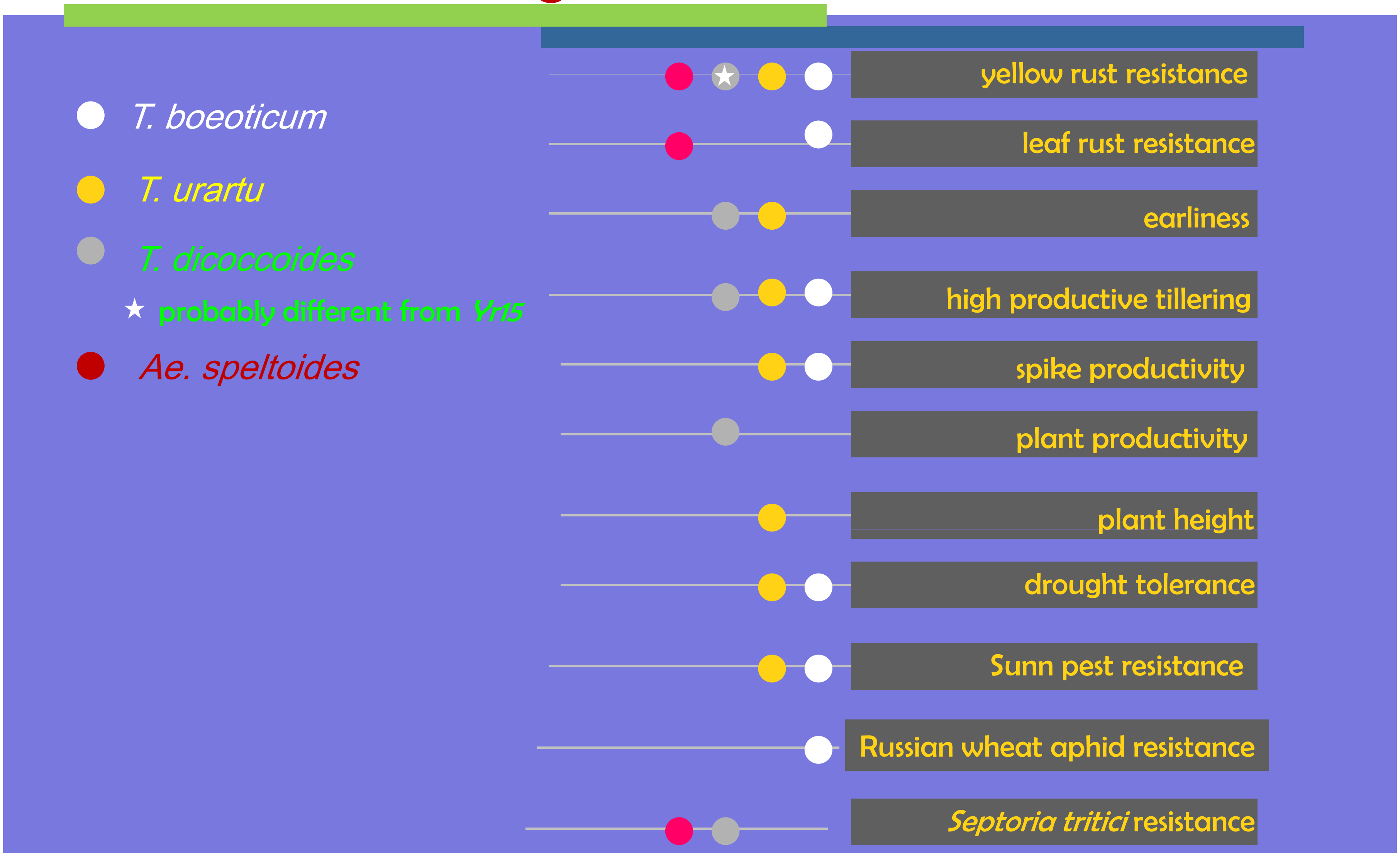
Conventional Plant Breeding

Biotechnology Tools

- Genomics
- Marker Assisted Selection
- Double Haploids
- Embryo Rescue
- Tissue Culture
- DNA Fingerprinting
- Genetic Engineering



New desirable traits for wheat identified through crosses with wild relatives



Improved Varieties Released by National Partners Using ICARDA Germplasm

Crop	1977 - 2013		Recent 2 years
	Developing Countries	Industrialized Countries	All Countries
Bread Wheat	111	14	9
Durum Wheat	230	6	6
Barley	186	31	11
Chickpea	110	31	2
Faba Bean	54	6	3
Lentil	101	16	5
Forages	31	2	1
Peas	9	0	0
Sub-Total	814	106	37
Total	920		37

Estimated Net Benefit = about US $850 m / year

Crop Varieties Released

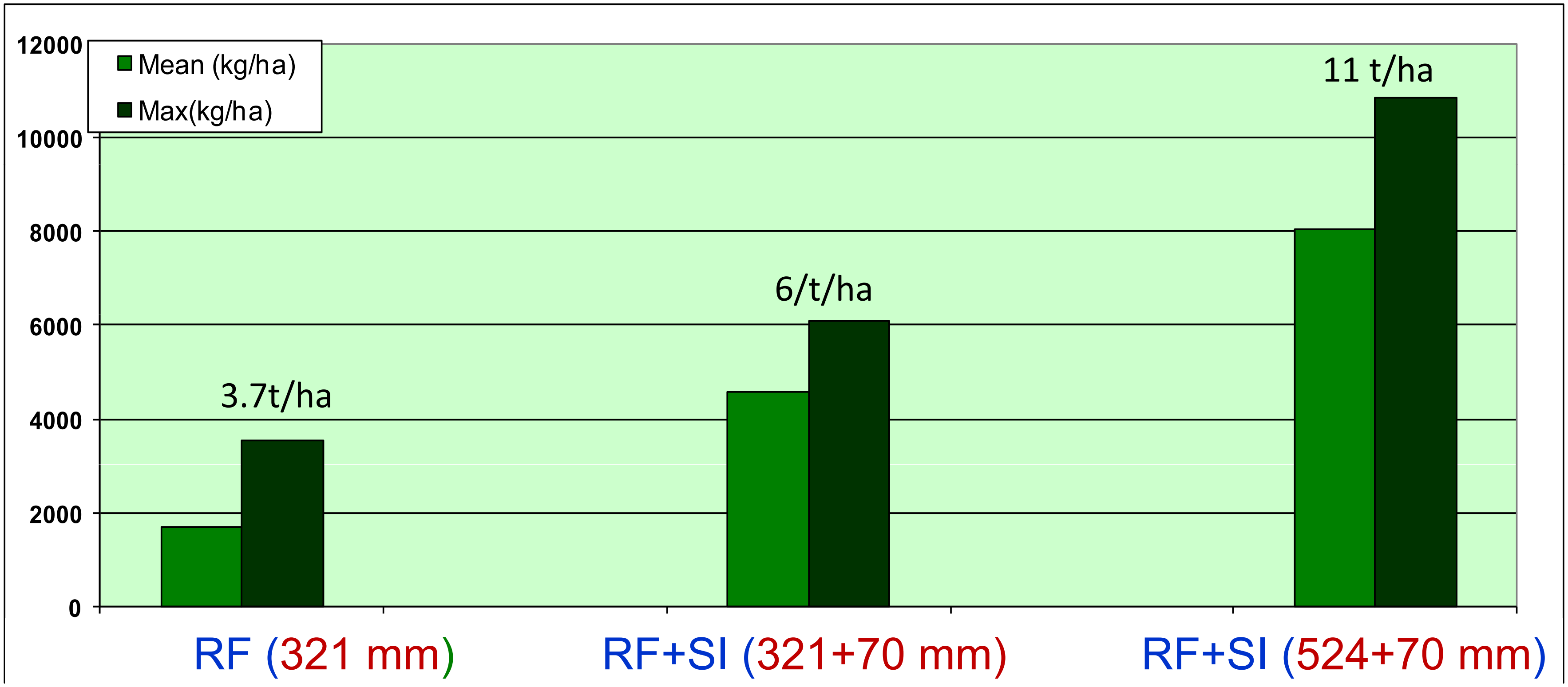
- High yield potential
- Agronomic traits: e.g. earliness, canopy architecture
- Tolerance to abiotic stresses:
  - Drought
  - Heat
  - Cold
  - Salinity
- Resistance/tolerance to biotic stresses
  - Diseases
  - Insect pests
  - Parasitic weeds

Wheat crossed with wild relatives:
Synthetic wheat, tolerance to excessive drought

Parent Variety	Yield t/ha	% recurrent parent
Cham 6*2/SW2	1.6	147
Cham 6*2/SW2	1.5	138
Cham-6	1.10	100
Attila-7	1.3	-

Yield of "synthetic derivatives" compared to parents under drought stress (Tel Hadya 2008 -- 211 mm)

Yields (kg/ha) of promising wheat genotypes under rainfed (RF) and supplemental irrigation (SI)



Irrigated Heat-Tolerant Wheat in Sudan

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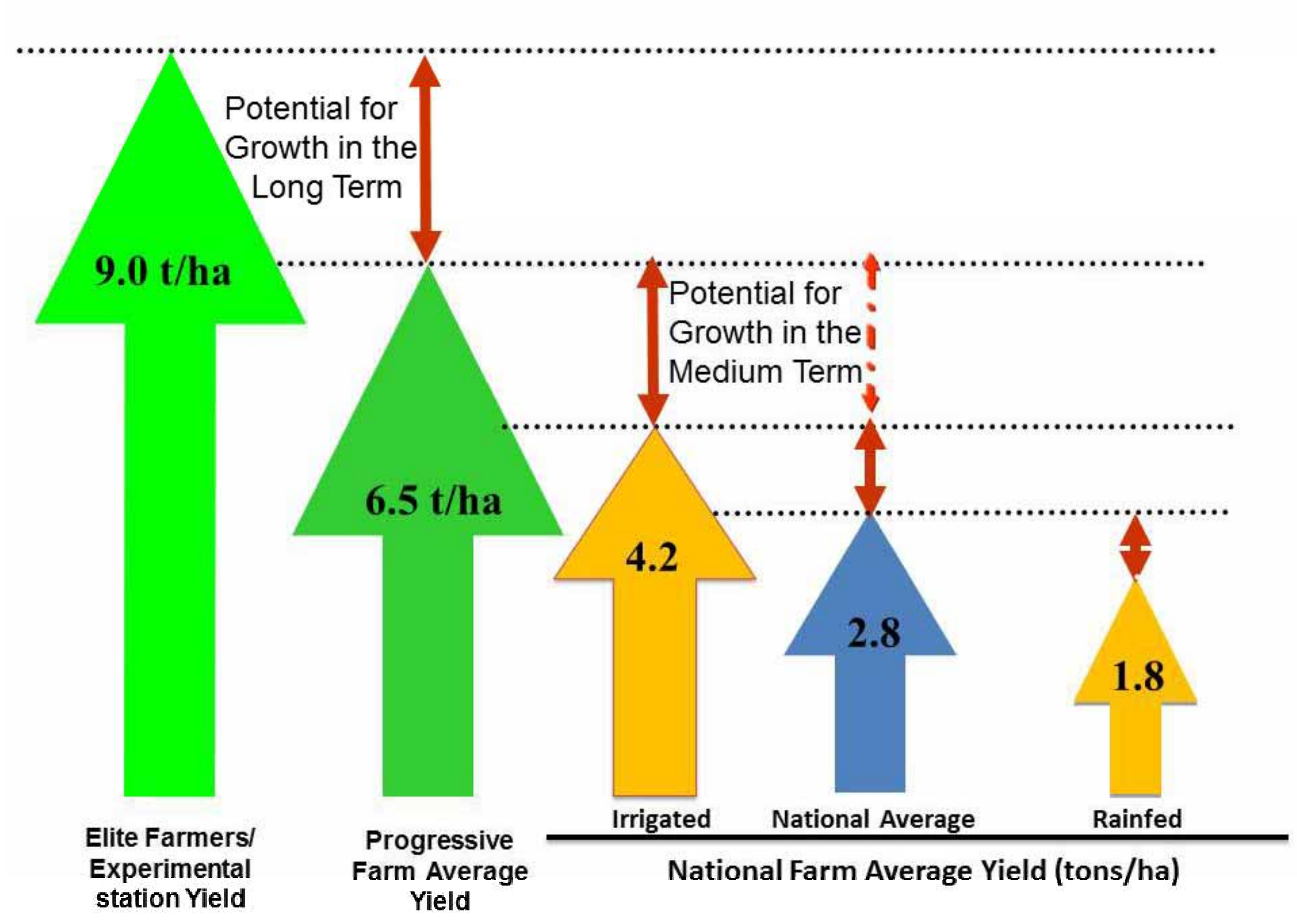
The Power of Science and Technology in Sustainable Intensification of Production Systems to Enhance Food Security in Arab Countries

Examples on Integrated Approach

Bridging the wheat yield gap : Syria

Gaps between national average yields and progressive farmers yields



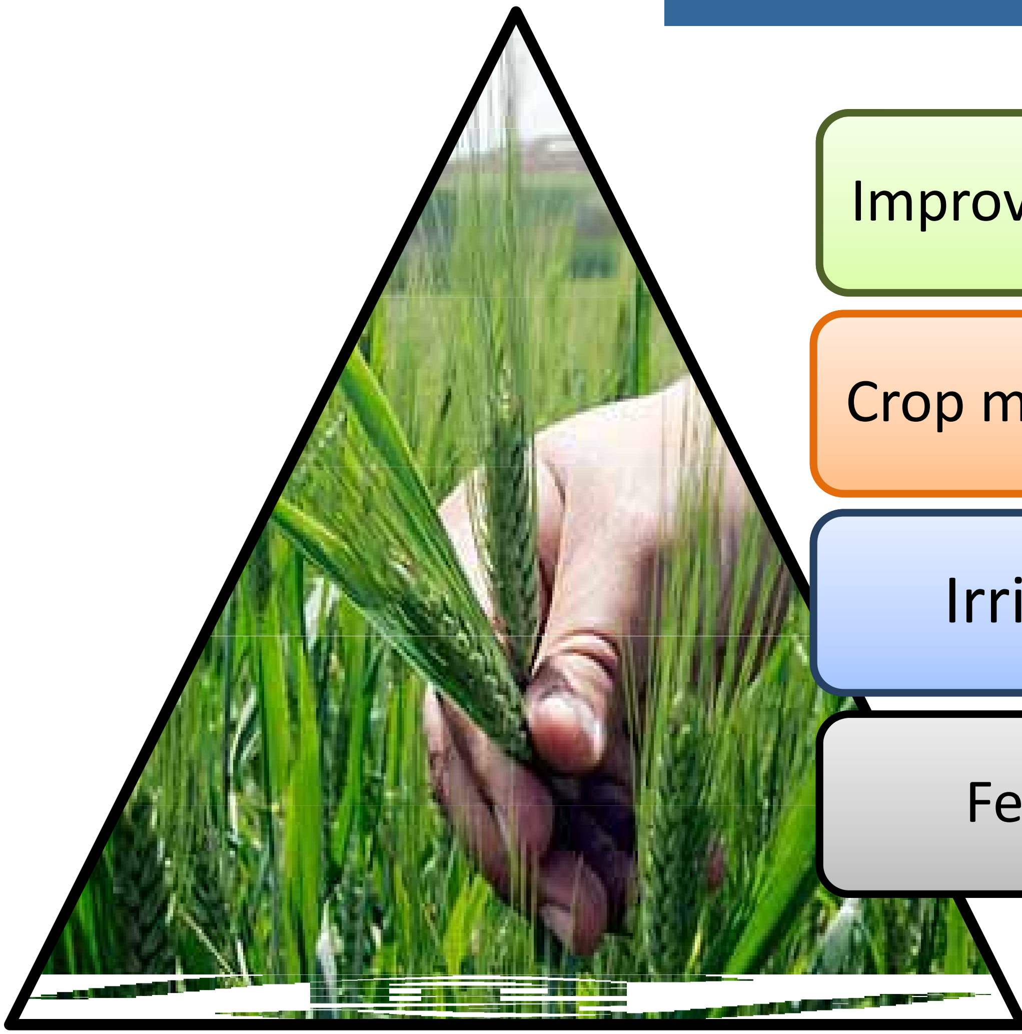
Impact of the integrated approach in wheat production in Syria

- **Formerly a wheat importer, the country became self-sufficient – and an exporter in 2000's in spite of keep the wheat area almost the same.**

- **Between 1991 and 2004 wheat production rose from 2.1 million to 4.5 million tons, with a combination of new high-yielding varieties, supplemental irrigation technology and supportive policies.**

- **In spite of the very serious drought starting 2008, Syria continued to achieve relatively high productivity and high production.**

The impact of agricultural technologies on the increase of wheat productivity in Syria



Improved varieties 32%

Crop management 23%

Irrigation 27%

Fertilizers 18%

Enhancing Food Security in Arab Countries
Focusing on Wheat Production

Partners

Algeria, Egypt, Iraq, Jordan, Morocco, Palestine, Sudan, Syria, Tunisia, Yemen, ICARDA

Highlights on Phase I
2011-2014

Financially supported by
AFESD, KFAED, IDsB and OFID

Grain Wheat Yield (t/ha) in demonstration fields versus farmers’ fields

Average of 4 cropping seasons (2010-2014)

Country	Egypt	Jordan *	Morocco		Palestine***	Sudan	Syria		Tunisia		Yemen **	Overall mean
Production system ****	I	R	R	SI	R	I	R	SI	R	SI	SI	
Improved practices	8.28	2.24	2.85	6.00	2.02	3.62	1.90	5.11	3.20	5.75	4.03	4.09
Framers’ practices	6.65	1.75	2.53	4.83	1.74	2.17	1.63	4.53	2.60	4.46	2.58	3.22
Average increase (%)	25	28	13	24	16	67	17	13	23	29	56	28
Maximum yield	10.35	3.45	4.30	7.50	2.17	5.37	2.96	6.96	4.36	7.90	5.14	5.50
	56	97	70	55	25	147	82	54	68	77	99	75

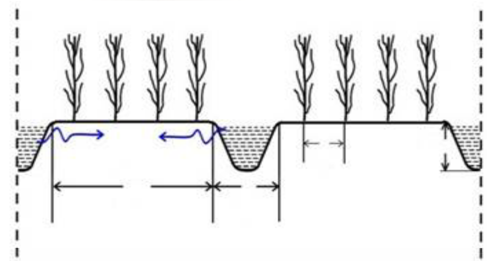
*** R: Rainfed, SI: Supplemental Irrigation, I: Full irrigation

Average Yield Increase = 28%

Maximum Yield Increase = 75%

Enhancing Food Security in Arab Countries

Outcome Raised-Bed Wheat Production Package in 'Sharkia' Province, Egypt



- **Reduce applied water by 30%**
- **Increased yields by 25%**
- **Reduced seed rate by 50%**
- **Increased WUE by 72%**
- **70,000 feddan/acres in Egypt in two**

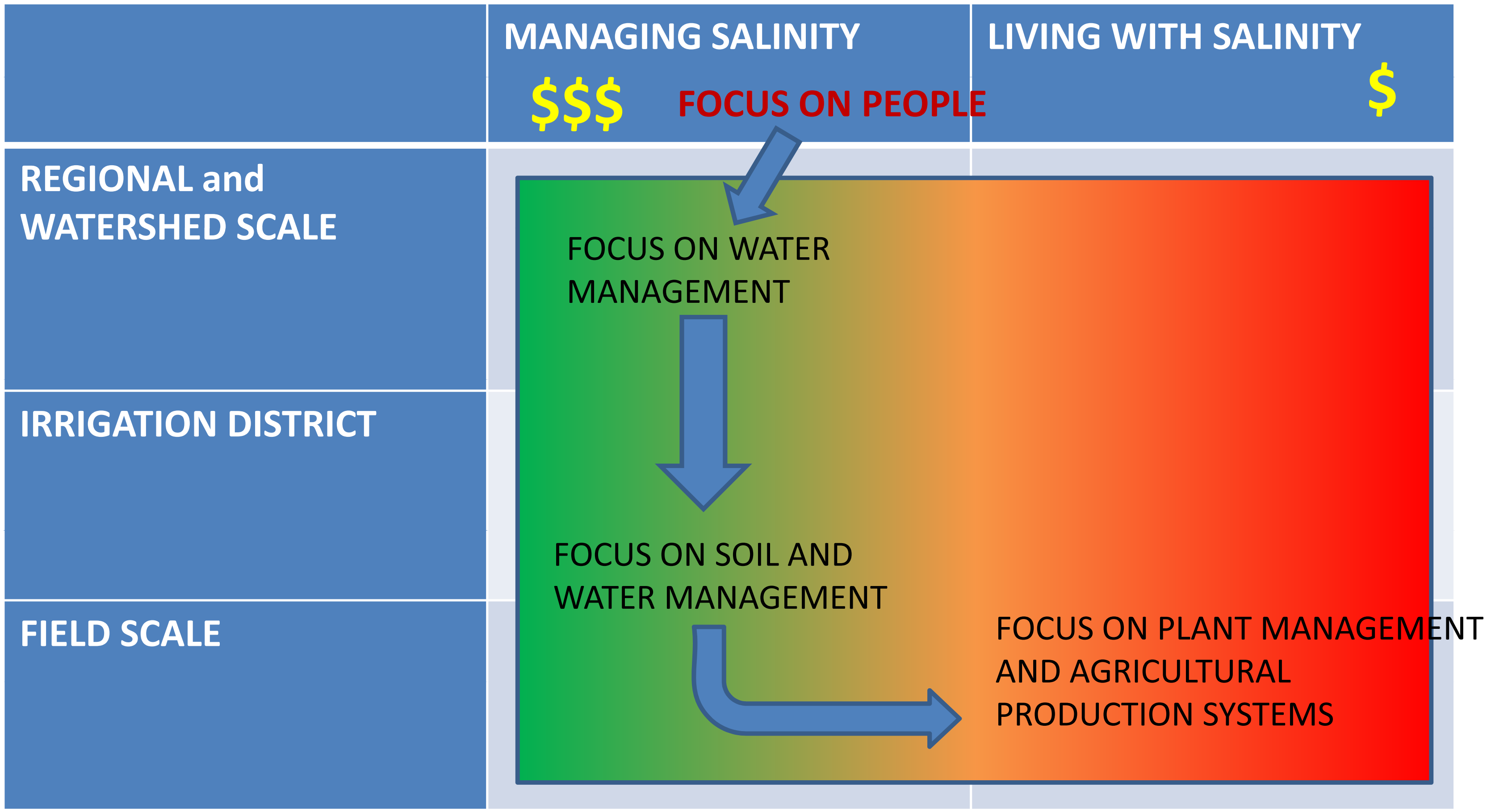
FP: furrows irrigation

FlP: flat bed irrigation

RBP: raised bed irrigation

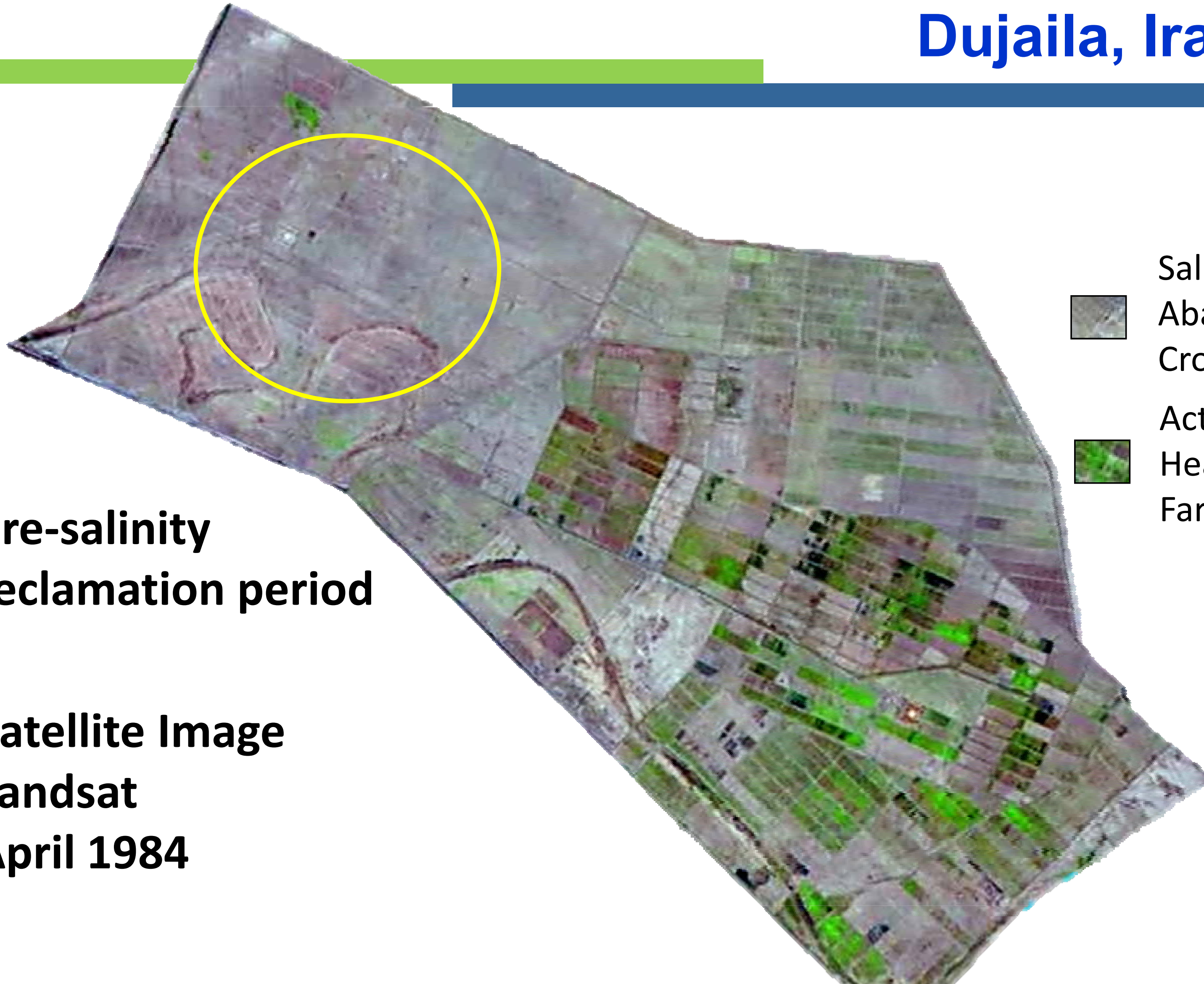
Salinity Management in Iraq:
The Integrated Approaches
(supported by ACIAR & Italy)

The Integrated Approaches to Cope with Salinity



Impact of Investment in Salinity Reclamation

Dujaila, Iraq



Saline or Abandoned Croplands

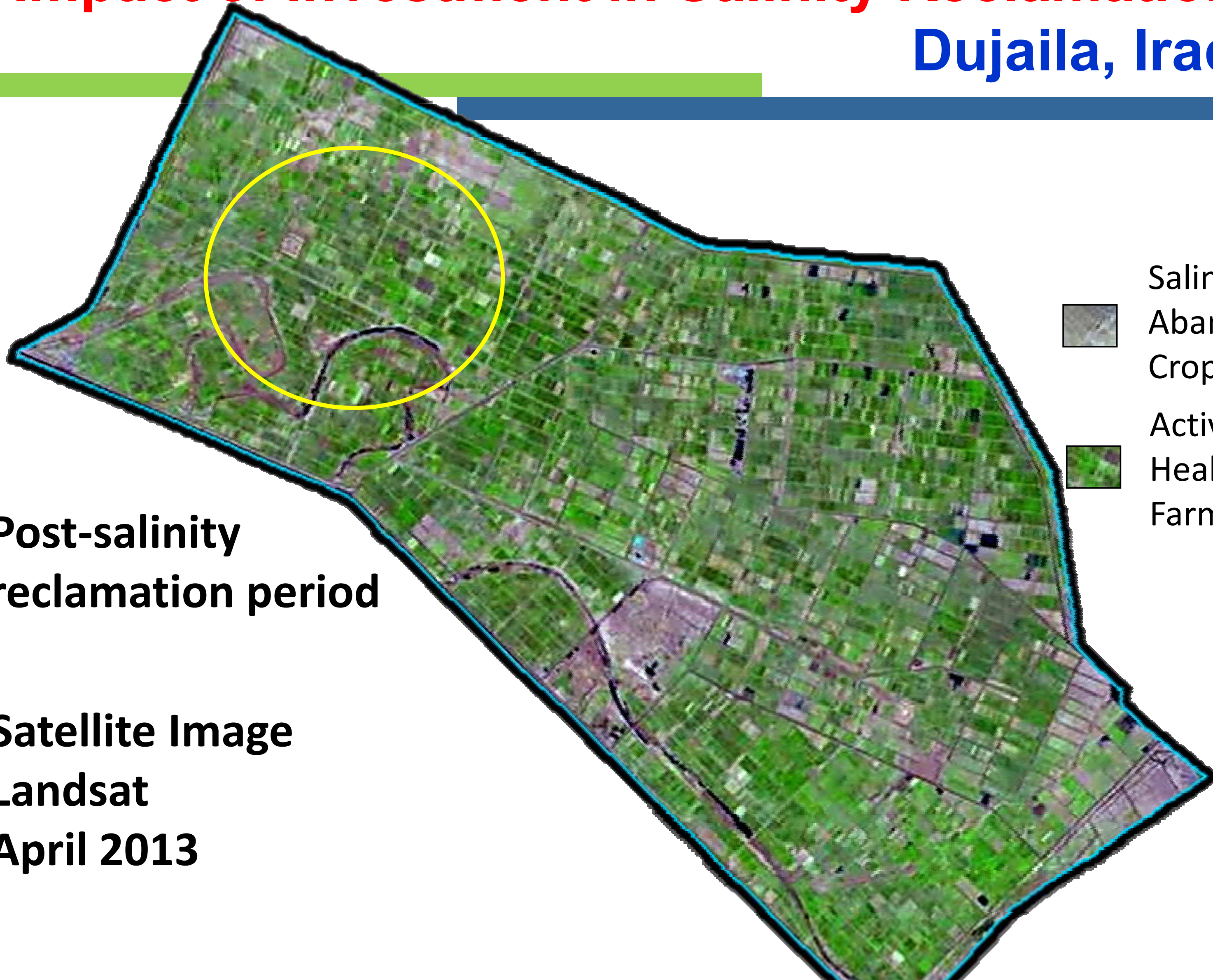
Active or Healthy Farmlands

Pre-salinity reclamation period

Satellite Image
Landsat
April 1984

Impact of Investment in Salinity Reclamation

Dujaila, Iraq



Saline or Abandoned Croplands

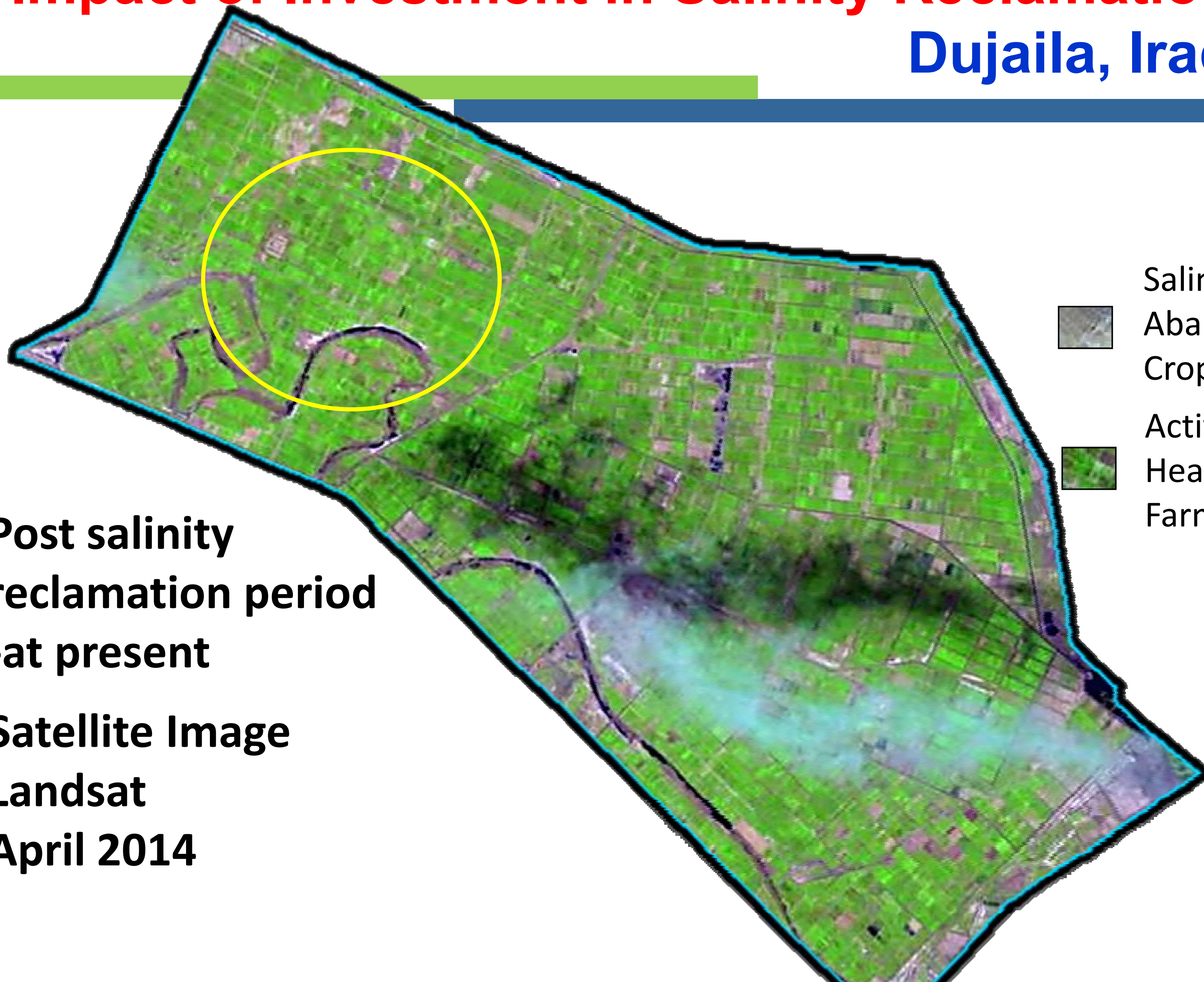
Active or Healthy Farmlands

Post-salinity reclamation period

Satellite Image
Landsat
April 2013

Impact of Investment in Salinity Reclamation

Dujaila, Iraq



Saline or Abandoned Croplands

Active or Healthy Farmlands

Post salinity reclamation period -at present

Satellite Image
Landsat
April 2014

Socio-Economic and Policy Research to Enhance Food Security

Key part of any agricultural research portfolio

- Integrated approach, working closely with all research partners
- Analysis – poverty, livelihood strategies, gender
- Impact assessments
- Study of markets, policies, institutions
- Natural resource economics

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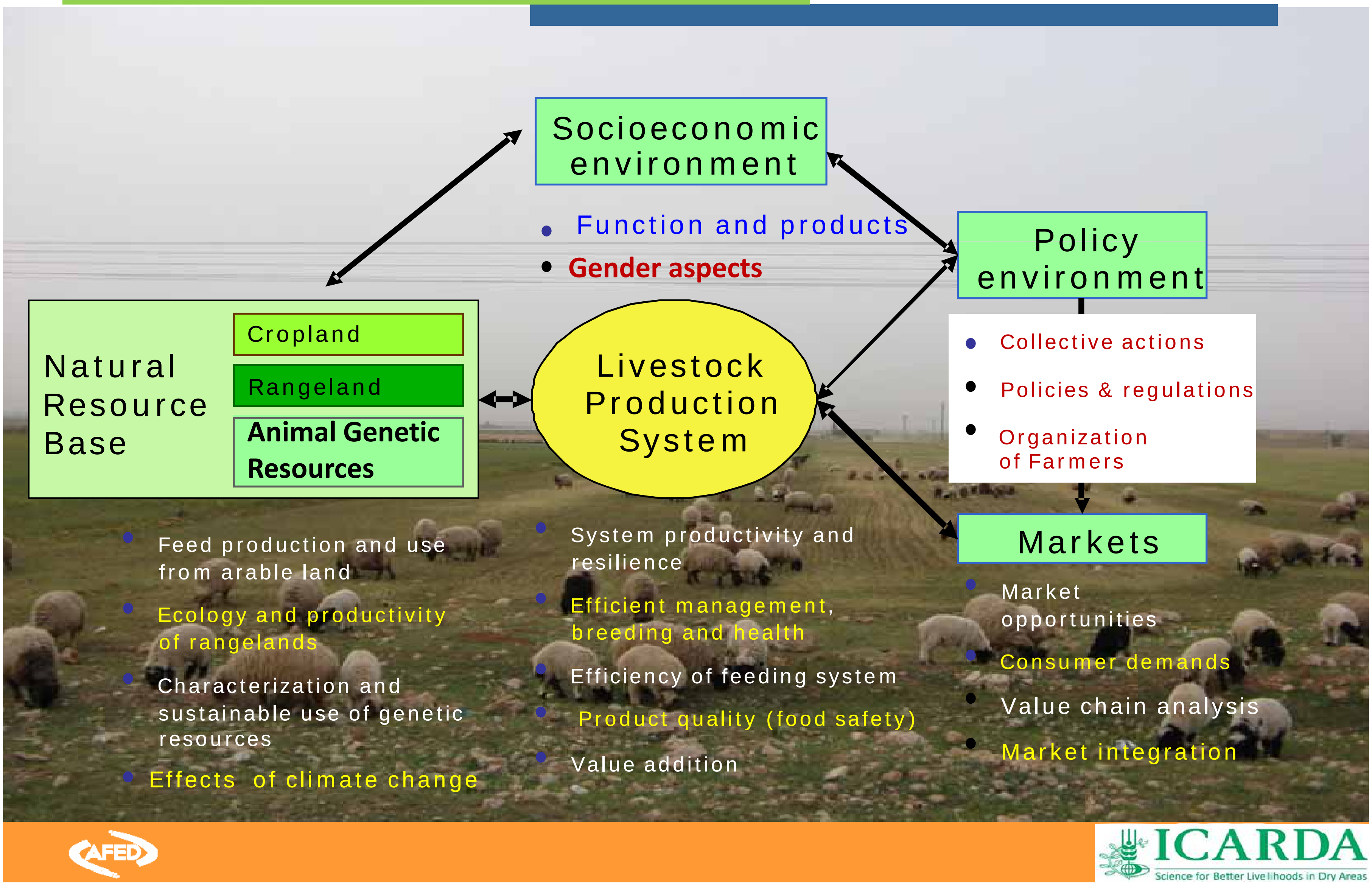
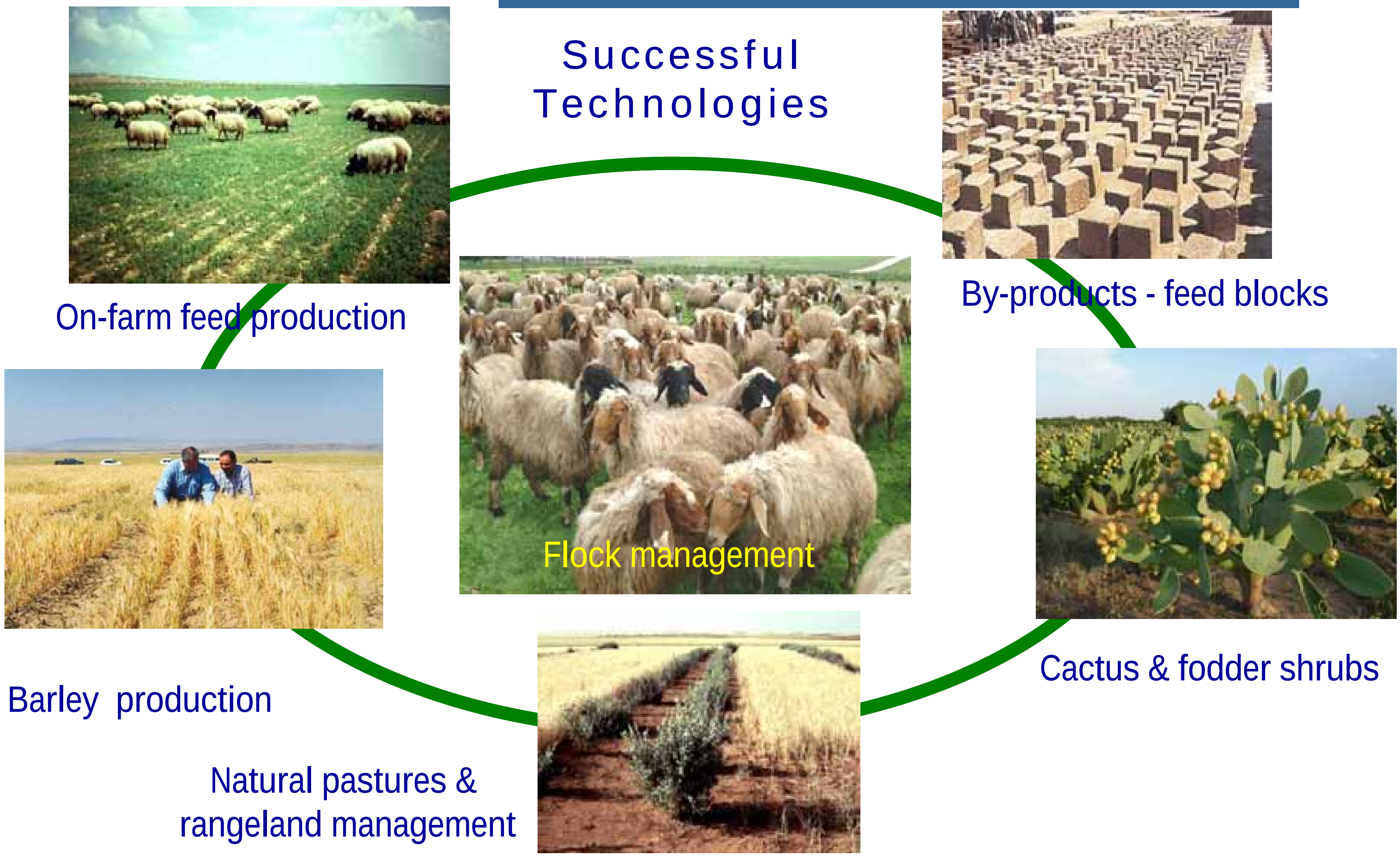
B. Production System Resilience in Marginal Lands

Development of Livestock/Rangelands/Crops Production Systems

Integrated Research Approach for Livestock/Rangelands/Crops Production Systems



Integration of Crop, Rangeland and Livestock Production Systems





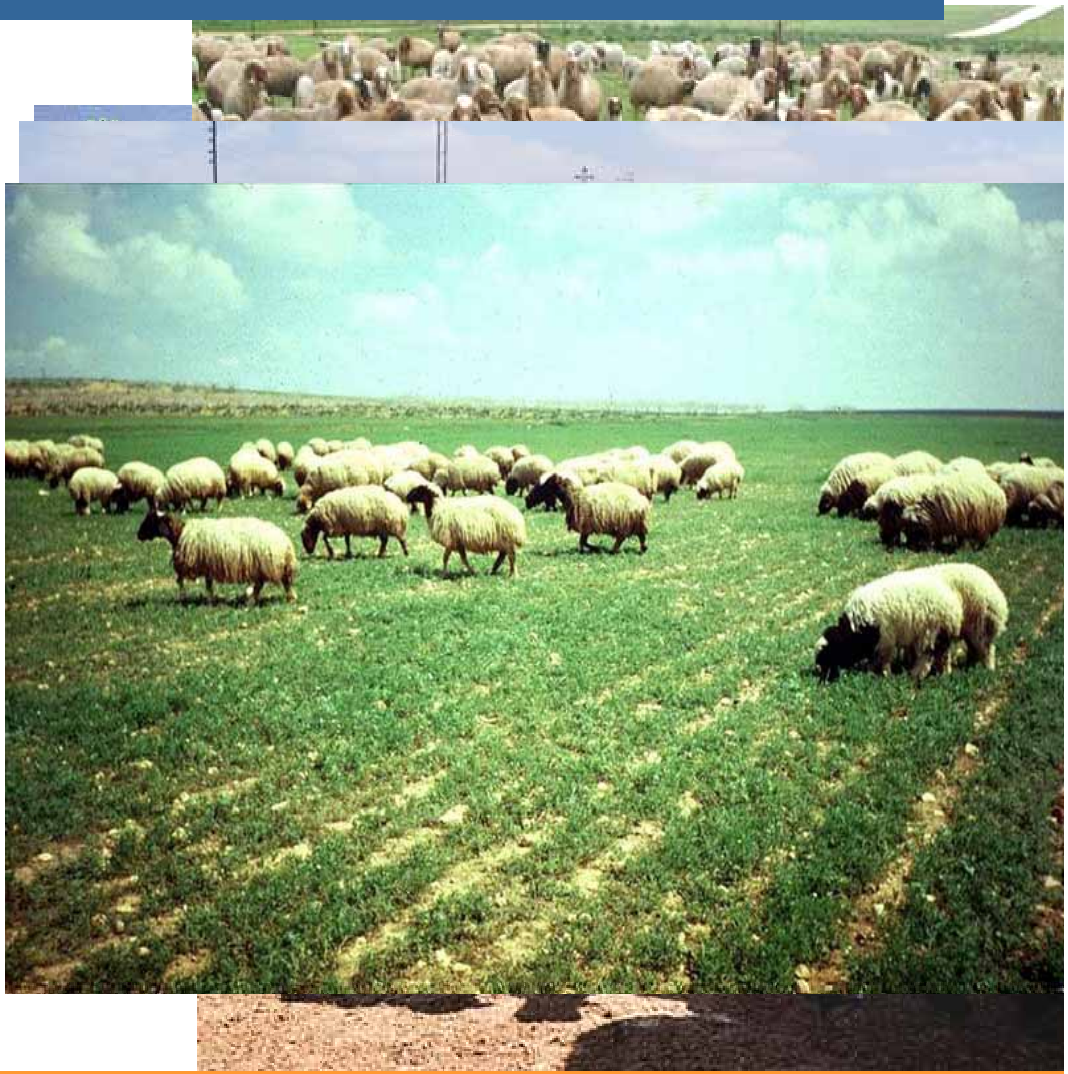


- Characterization of indigenous breeds of small ruminants and some are highly adaptable to changes in the climate/environment;
- Community livestock breeding.




Successful Technologies in Farmers' Fields

- Feed blocks using crop residues and agro-industrial by-products
- Improved rams
- Early weaning
- Improved barley cultivars
- Rotations of barley with forage legumes



Conclusion: What can make the difference?

- Enabling policy environment and strong political will to put agriculture as a national priority;
- More investment in science & technology and agricultural research;
- More investment in agricultural development;
- Greater priority to enhance sustainable water productivity;
- Sustainable intensification of production systems in high potential areas;
- Enhancing resilience of production systems in marginal lands or low potential areas; Modernization of extension and effective technology transfer mechanisms;
- Special attention to capacity development institutional support;
- Innovative partnership & networking.

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