SII-3

CLIMATE CHANGE AND CHALLENGES IN THE DRY AREAS

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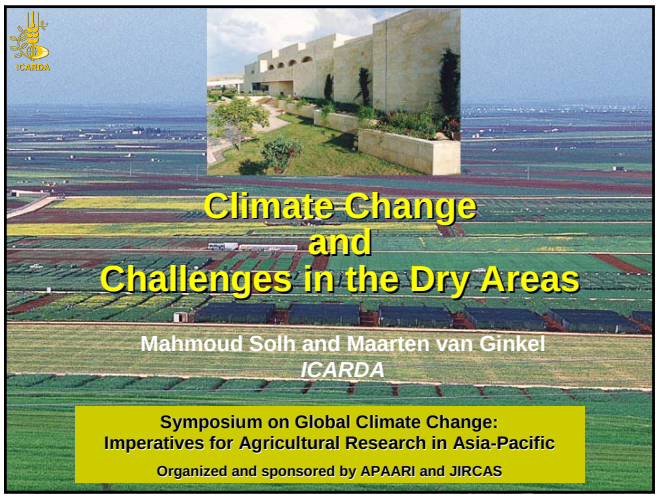
ABSTRACT

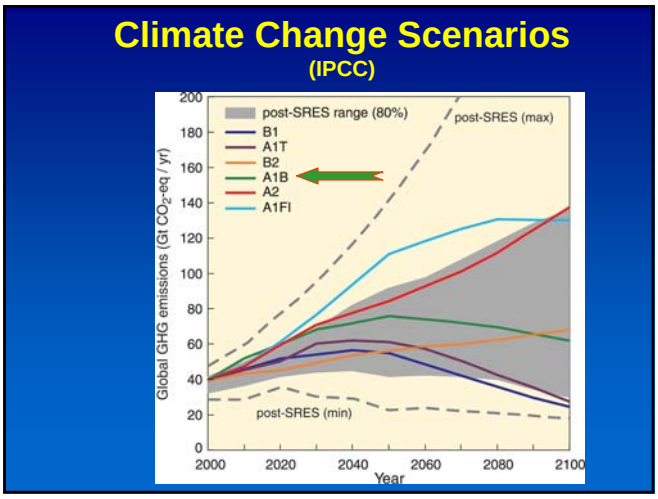
Dry areas cover 41% of the earth's surface, and are home to over 2 billion people – and the majority of the world's poor. Over 80% of the population in these regions lives on less than $2/day, most of which is spent on food. Correspondingly, food insecurity – exacerbated by the current food crisis – is perhaps the key challenge facing communities as well as governments in dry areas. Several factors, some long-standing, others fairly recent, have contributed to the food crisis in dry areas. This situation is further aggravated by the fragile nature of these environments, and the impacts (e.g. extreme weather conditions already being experienced) of climate change.

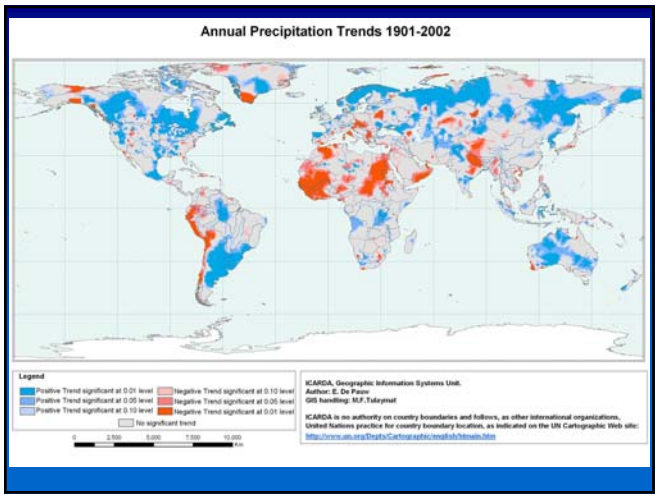
Improving food security and livelihoods of the resource poor in these areas requires an integrated approach based on the three pillars of sustainable agriculture: crop and livestock improvement, natural resource management, and development of policies and institutional capacity. Technology options for crop/livestock improvement and natural resource management are available. But for these technologies to make a positive impact, supportive policies and effective technology transfer are needed, which in turn requires stronger institutions. Policy makers must provide incentives to encourage farmers to invest in new technologies. Simultaneously, they must ensure long-term investment in research to maintain a flow of new technologies.

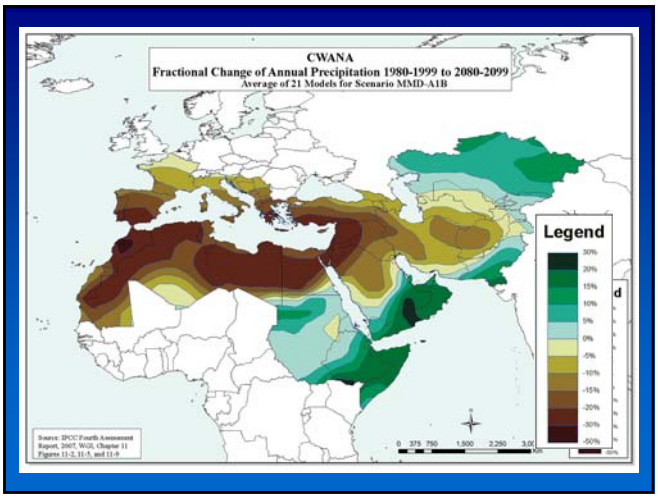
Numerous case studies have illustrated the importance of an integrated approach in improving food security and livelihoods. For the past three decades ICARDA has worked towards sustainable agricultural development in the dry areas, i.e. increasing productivity and production and improved livelihood options for resource-poor farmers. Working in collaboration with the Center, national programs have released nearly 850 improved varieties of wheat, barley, lentil, chickpea and faba bean adapted to the dry areas. Recent successes include 'Alemaya', a rust-resistant lentil variety in Ethiopia, and 'Gokce', a drought tolerant chickpea variety in Turkey, which have had major impacts in these two countries. Integrated fungal and insect pest management techniques have cut production costs and protected the environment. High value crops and protected agriculture are now available to farmers in Afghanistan and Yemen to diversify production systems, and improve nutrition and livelihoods. The Center has introduced improved crop management methods: more efficient water management (e.g. water harvesting, supplemental irrigation), as well as conservation agriculture to increase rainwater infiltration, raise yields, reduce production costs and protect the soil.

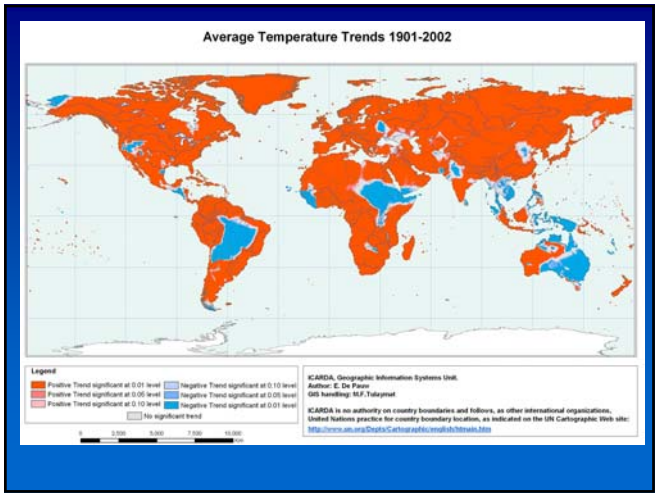
Continued investment in agricultural research will be the key to improving food security, cutting food prices, and developing the capacities of national research centers to help farmers cope with climate change. We believe this investment deserves the full support of the international community.

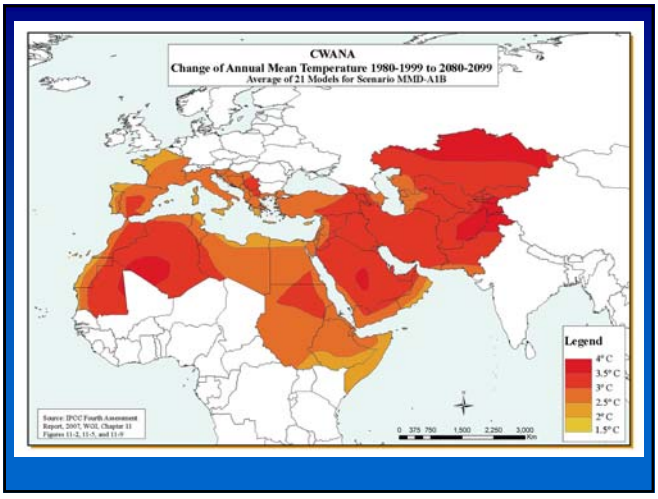

ICARDA
Climate Change
and
Challenges in the Dry Areas
Mahmoud Solh and Maarten van Ginkel
ICARDA
Symposium on Global Climate Change:
Imperatives for Agricultural Research in Asia-Pacific
Organized and sponsored by APAARI and JIRCAS

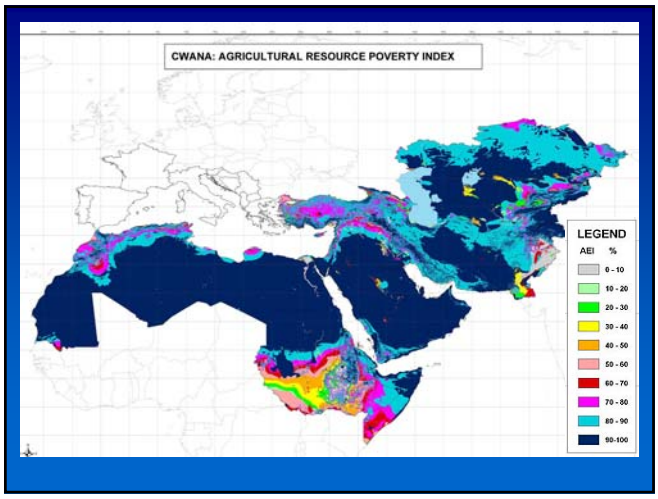

Climate Change Scenarios
(IPCC)
post-SRES range (80%)
post-SRES (max)
post-SRES (min)
B1
A1T
B2
A1B
A2
A1FI
Global GHG emissions (Gt CO2-eq / yr)
Year
0
20
40
60
80
100
120
140
160
180
200
2000
2020
2040
2060
2080
2100


Annual Precipitation Trends 1901-2002
Legend


CWANA
Fractional Change of Annual Precipitation 1980-1999 to 2080-2099
Average of 21 Models for Scenario MMD-A1B
Legend


Average Temperature Trends 1901-2002
Legend

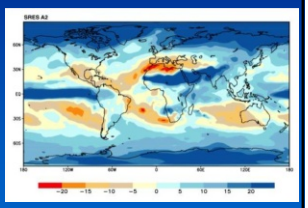

CWANA
Change of Annual Mean Temperature 1980-1999 to 2080-2099
Average of 21 Models for Scenario MMD-A1B
Legend
4° C
3.5° C
3° C
2.5° C
2° C
1.5° C



Climate Change

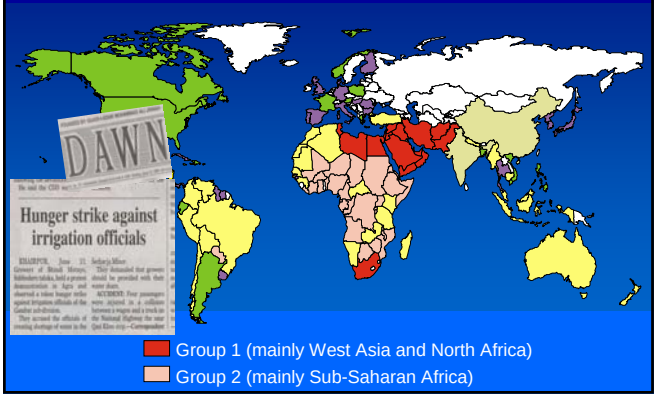
Effects of global warming

- Crops and livestock will face increased heat stress
- Developing countries in the south are likely to be more negatively affected
- 11% decrease in cultivable rainfed land area and possibly more projected by 2080 in developing countries
- Severest impacts expected in Near East, North and Sub-Saharan Africa



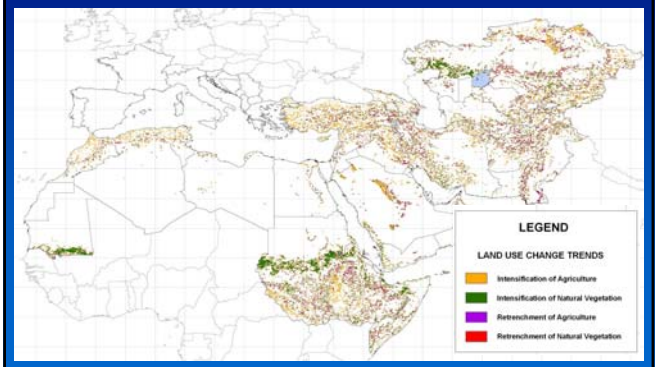
Annual Mean Precipitation
Change: 2071 to 2100
Relative to 1990

Relative Water Poverty Projections 2025

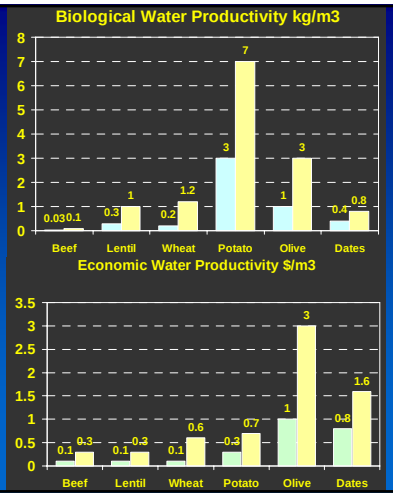


Group 1 (mainly West Asia and North Africa)
Group 2 (mainly Sub-Saharan Africa)

Land Use Change Trends

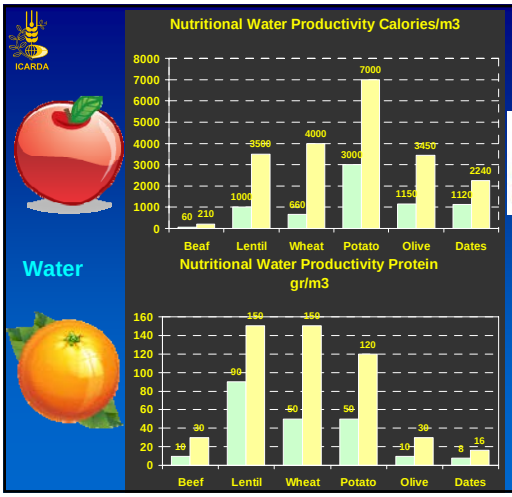


Water



Productivity

Water



Productivity

Environmental Poverty

ICARDA's Global Mandate

ICARDA's Regional Mandate

ICARDA's Geographic Mandate

Implementation

ICARDA's Major Research Programs

Accessions in ICARDA's Germplasm Collection

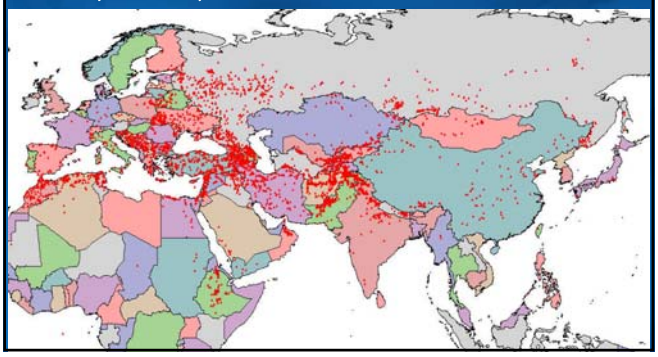
Crop	Accessions
Barley	24,492
Wheat	33,105
Wild cereals	7,266
Forage legumes	28,364
Food legumes	32,342
Wild food legumes	850
Forage and range	5,653
Total	**132,072**

Mostly landraces and unique set of wild relatives

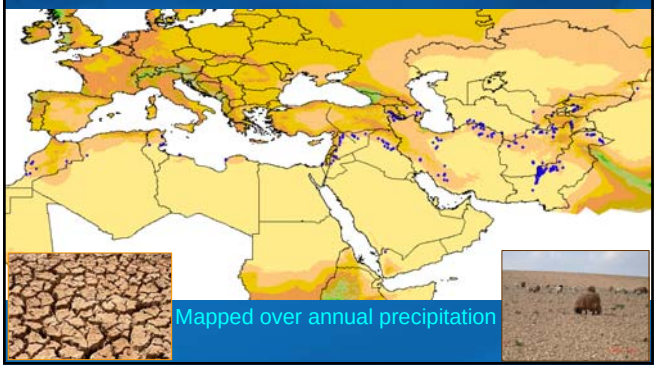
Distribution of 17,000 bread wheat landraces

A virtual collection from these gene banks:

- ✓ ICARDA, Aleppo, Syria
- ✓ VIR, St Petersburg, Russia
- ✓ AWCC, Tamworth, Australia

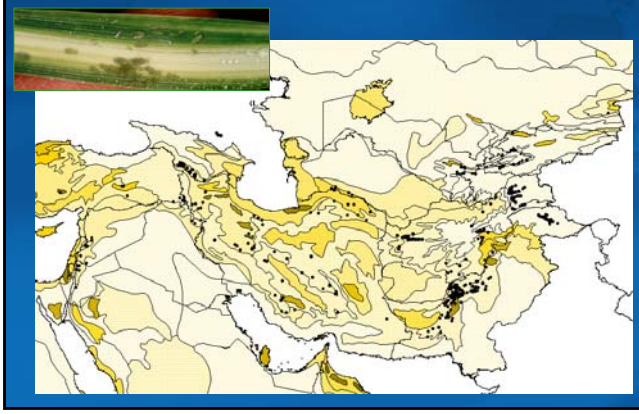


Focused Identification of Germplasm Strategy (FIGS) Drought Tolerance Best-Bet Set

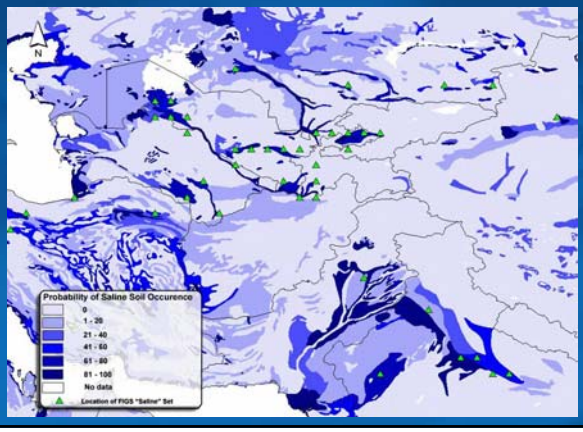


Mapped over annual precipitation

Russian Wheat Aphid Tolerance FIGS Best-Bet Set Mapped over Agro-Climatic Zones



Salinity Tolerance FIGS Best-Bet Set Mapped over Probability of Soil Salinity

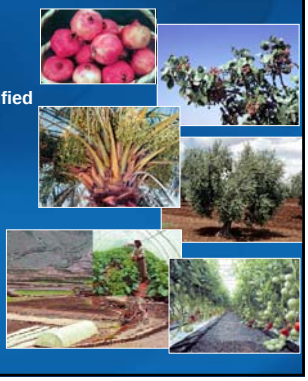


Heat Tolerant Spring Bread Wheat Yield Trial 2008- 2009

NAME/PEDIGREE	CROSS/PEDIGREE
CHAM-8 (CHECK)	JUP/BJY//URES
NEJMAH-12	SKAUZ/BAV92/3/CROC-1/AE.SQUARROSA (224)//OPATA
JAWAHIR-12	SHUHA-4//NS732/HER
ADEL-2	SAMAR-13/PASTOR-1
ADEL-4	SAMAR-13/PASTOR-1
ADEL-5	SAMAR-13/PASTOR-1
ZAKIA-8	CHAM-6//KAUZ'S'/3/FOW'S'//NS732/HER
ATTILA-7 (CHECK)	ND/VG9144//KAL/BB/3/YACO/4/VEE#5
ZAKIA-10	CHAM-6//KAUZ'S'/3/FOW'S'//NS732/HER
ZAKIA-11	CHAM-6//KAUZ'S'/3/FOW'S'//NS732/HER
ZAKIA-15	CHAM-6//KAUZ'S'/3/FOW'S'//NS732/HER
N-AZRAQ-1	CHAM-6/GHURAB'S'//REGRAG-1
FARIS-16	CHAM-6/GHURAB'S'//JADIDA-2
RABIH-5	CHAM-6/GHURAB'S'//MELLAL-1
KHIDER-1	DYBR1982-83/842ABVD C-50//KAUZ/3/PLK70/LIRA/4/KAPSW
DEBEIRA (Check)	HD 160/5/TOBARI/CIANO/23854/3/NAINARI 60//TITMOUSE/SONORA 64/4/LERMA ROJO/SONORA 64
KHIDER-3	DYBR1982-83/842ABVD C-50//KAUZ/3/PLK70/LIRA/4/KAPSW
KHIDER-4	DYBR1982-83/842ABVD C-50//KAUZ/3/PLK70/LIRA/4/KAPSW
BASHAIR-4	GHURAB-2/DORG-1
AGEEB-1	ATTILA-1/KAR-2
AGEEB-2	ATTILA-1/KAR-2
KEMBAL-1	ATTILA-1/3/MON'S'/ALD'S'//ALDAN'S'/IAS58
DAHAB-4	KAUZ/LUCO-M//PVN/STAR/3/FOW-1
NATIONAL CHECK	.....

Diversification and Sustainable Intensification of Production Systems

- Promotion of improved technologies for producing value-added products, to achieve higher income for rural communities in the intensified/diversified integrated crop/rangeland/livestock production systems
- Methodologies that focus on farming communities with participatory and gender-sensitive approaches

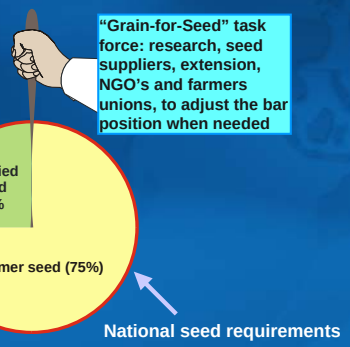


In 2003, the ICARDA Board approved a more vigorous effort on horticulture (including as protected agriculture), specifically on vegetables, fruits, nuts and medicinal and aromatic plants.

"Grain-for-Seed" Concept to Cope with Climate Change
Good season with no seed shortage

"Grain-for-Seed" Concept to Cope with Climate Change
Good season with no seed shortage

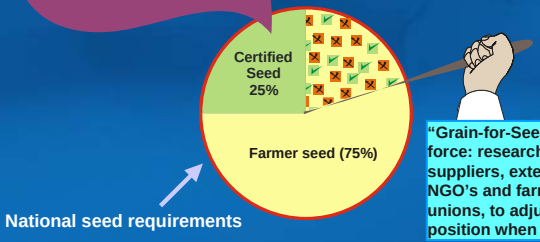
- Improved practices
- Crop inspection and roguing
- Seed testing
- Known varietal identity, seed quality (purity, germination health)



"Grain-for-Seed" task force: research, seed suppliers, extension, NGO's and farmers unions, to adjust the bar position when needed

"Grain-for-Seed" Concept to Cope with Climate Change
Bad season with severe seed shortage

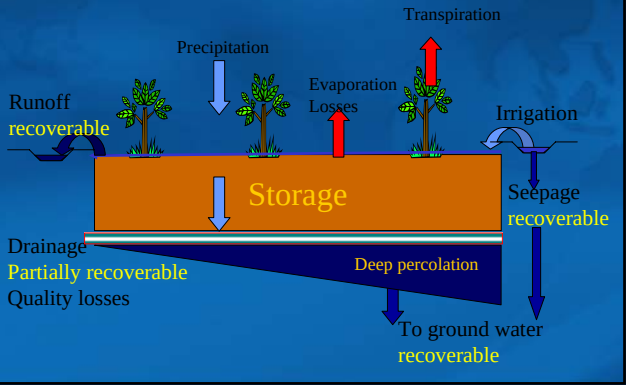
- Improved practices
- Crop inspection and roguing
- Seed testing
- Known varietal identity, seed quality (purity, germination health)



"Grain-for-Seed" task force: research, seed suppliers, extension, NGO's and farmers unions, to adjust the bar position when needed

Fields selected for grain for seed to cope with seed shortage
Substandard grain fields

Field Water Balance



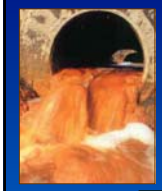
Scales and Drivers to Increase Water Productivity

- At the basin level:
  - ✓ Competition among uses (Environm., Agric., Domestic.)
  - ✓ Conflicts between countries
  - ✓ Equity issues
- At the national level:
  - ✓ Food security
  - ✓ Hard currency
  - ✓ Socio-politics
- At the farm level:
  - ✓ Maximizing economic return
  - ✓ Nutrition in subsistence farming
- At the field level:
  - ✓ Maximizing biological output

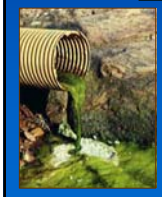
Strategies for Improving Low Water Productivity with Livestock

- Enhancing feed water productivity
  - ✓ Feed selection
  - ✓ Use of residues
  - ✓ Feed water management
  - ✓ Multiple use of water
- Increase animal productivity
  - ✓ Animal health and nutrition,
  - ✓ Genetic resources, wild breeds
  - ✓ Access to markets & byproducts
- Improve rangelands
  - ✓ Rehabilitate degraded rangelands
  - ✓ Improve grazing management

Drainage and Wastewater Re-Use in AAA



- Agriculture
- Agroforestry
- Aquaculture



Benchmark Sites for Integrated Research on Water

Social, Economic and Policy Research

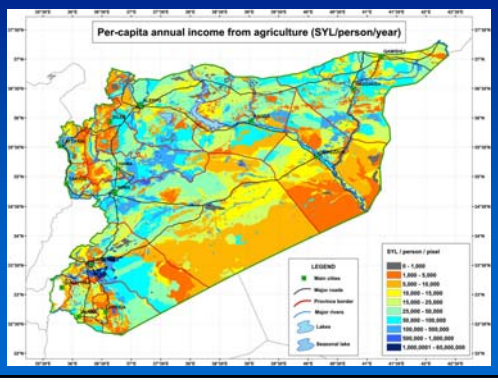
ICARDA

Key part of any agricultural research portfolio

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

Poverty Mapping

ICARDA



Crop/Livestock/Rangeland Integration

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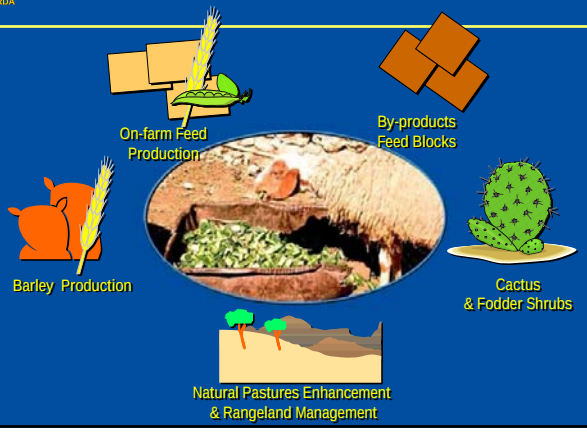

Capacity Building

1977 to 2007

Persons trained: 15,000
MSc and PhD: 550

Countries: 100

CC and the Way Ahead

- **Water productivity** should be the measure when we use water
- **Conservation agriculture** as a strategic platform using integrative approaches at the system level
- Use an **integrated crop/livestock/rangeland** approach
- **Add-value** by expanding high value and protected agriculture options
- **Prioritization of research locations (benchmark)**, so solutions found in some locations have a large chance of working elsewhere
- Increased efforts on **inspiring and training young scientists**
- Opening our minds to new ideas and **original research**
- Policy makers providing an **enabling environment** for success research on difficult questions (e.g. facilities, salaries)
- Underpin research technology transfer with supportive **policies and institutions**
- **In many ways dry land research will lead CC research**