Pulses for Food Security, Nutrition and Environment: *the Role of Science & Technology to Enhance Productivity and Production of Pulses*

FAO Launch Ceremony of the International Year of Pulses 2016

FAO, Rome, 10 November, 2015.

Mahmoud Solh
Director General
ICARDA




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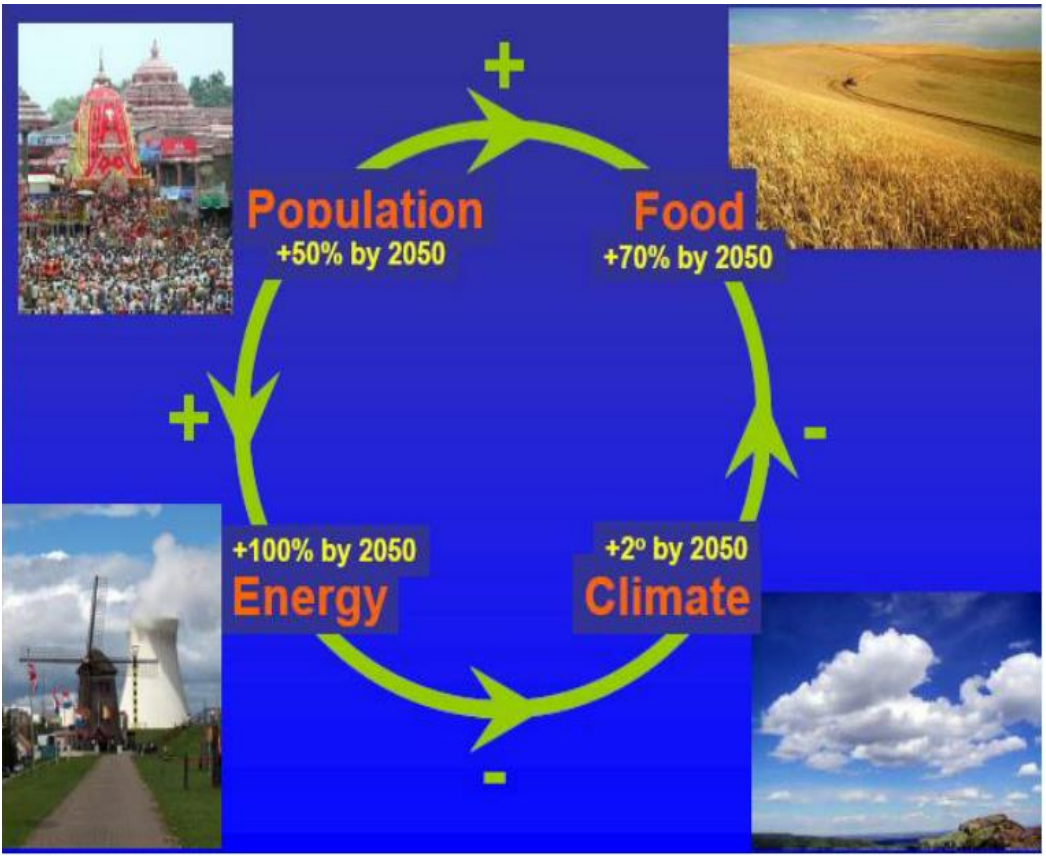
Great Challenges of Agriculture



- Growing world population will cause a “serious storm" of food, energy and water shortages by 2050
- Demand for food and energy will jump 70% and 100% and for fresh water by 30%, as the population tops 9 billion
- In the past, only ~12 crops received the major attention of scientific interventions

The Big Challenge: How to expand agriculture output without further constraining natural resources?

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Why Pulses

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Pulses offer many nutritional benefits

- Pulses are three times richer in low fat protein as compared to cereals including rice and wheat;
- Pulses have complementary Amino acid profile with cereals;
- Micro-nutrient rich grains (Fe, Zn);
- Good carbohydrates make pulses a great functional food;
- High in dietry fibre.

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Pulses - A potential whole food solution

Effect of lentil diet on anemic Sri Lankan Children after 60 Days

Indicator	0 days	60 days	% improvement
Hemoglobin (g/dL)	11.1	11.8	6.3
Serum Fe (µg/dL)	51.5	89.8	74.4
Total Fe binding capacity (µg/dL)	405.3	377.6	-6.8
Trans ferritin saturation (%)	12.8	24.3	89.8
Serum ferritin (ng/mL)	29.5	41.2	39.7

50g of pulses is a good source of Fe, Zn, and Se

Nutrient	Lentil	Field pea	Chickpea	Rice
Protein (%)	20 – 27[a]	20 - 23[d]	19-20	2.9
Se (µg kg^{-1})	425 – 672[a]	373-519[d]	450-850	93
Fe (mg kg^{-1})	73 – 90[b]	44-55	50-55	2.4
Zn (mg kg^{-1})	44 – 54[b]	20-30	20-32	3.7
Phytic acid (mg g^{-1})	1.8 - 4.4[c]	2.2 – 8.2	4.9 – 6.1	7.2-11.9

Source; Pallemulle, Thavarajah, Thavarajah et al. unpublished data, 2013

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The Balanced Diet: Cereals with Pulses

The complementarities of cereals & food legumes

Food Legumes: **High in protein and Lysine, low in sulfur-containing amino acids:**

	Protein percentage
Faba bean	20 – 36 %
Lentil	20 – 27 %
Grass pea	25 – 31 %
Kabuli Chickpea	16 – 24 %
Field Pea	20 - 23 %

Cereals/Wheat: **low in both protein and lysine but high in sulfur-containing amino acids**

Combining food legumes and cereals provides a balanced diet: improving nutrition, especially in low-income communities where other sources of protein like animal protein are limited.

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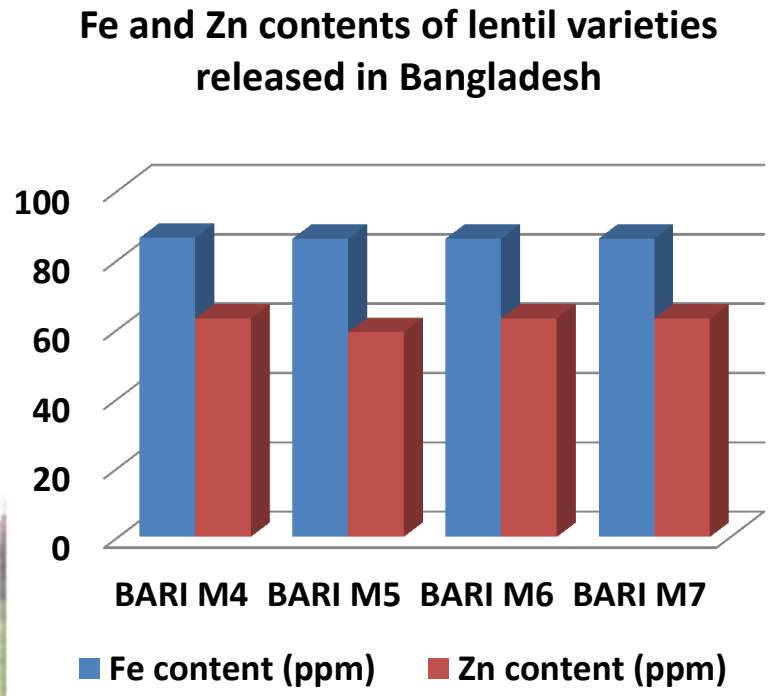
Bio-fortified pulses – a panacea for hidden hunger

In Bangladesh, biofortified lentils developed by NARS and ICARDA are now grown in 145,600 ha, producing 186,000 tons for domestic consumption



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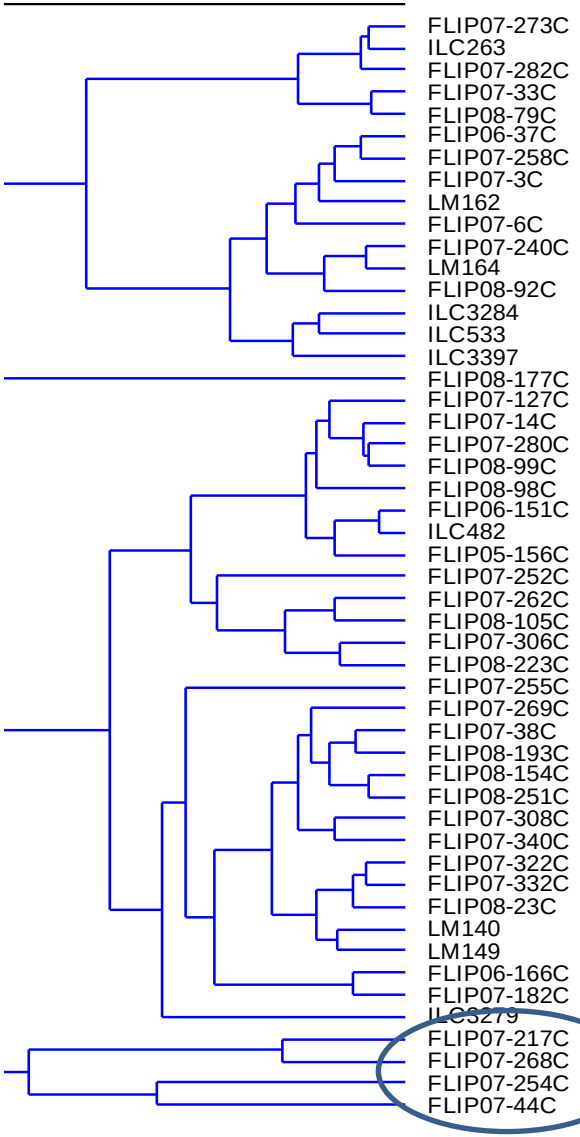
Enhancing Soil Productivity & Health through Biological Nitrogen Fixation

- Chickpea and Faba bean genotypes screened
- Super nodulating lines identified (Egypt)
- TILLING population of FB developed
- Stress tolerant Rhizobium strains identified
- Host-Rhizobium-Environments interaction studied
- Enhancement of soil productivity and soil health.



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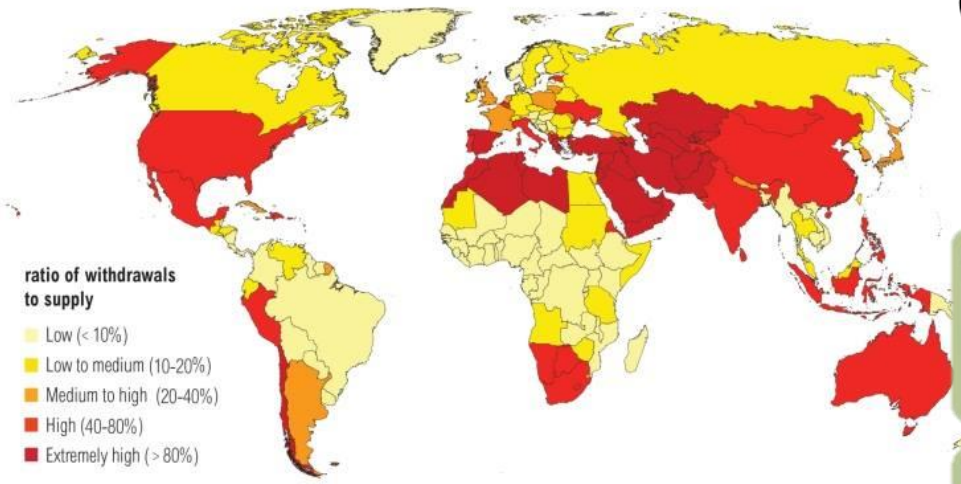
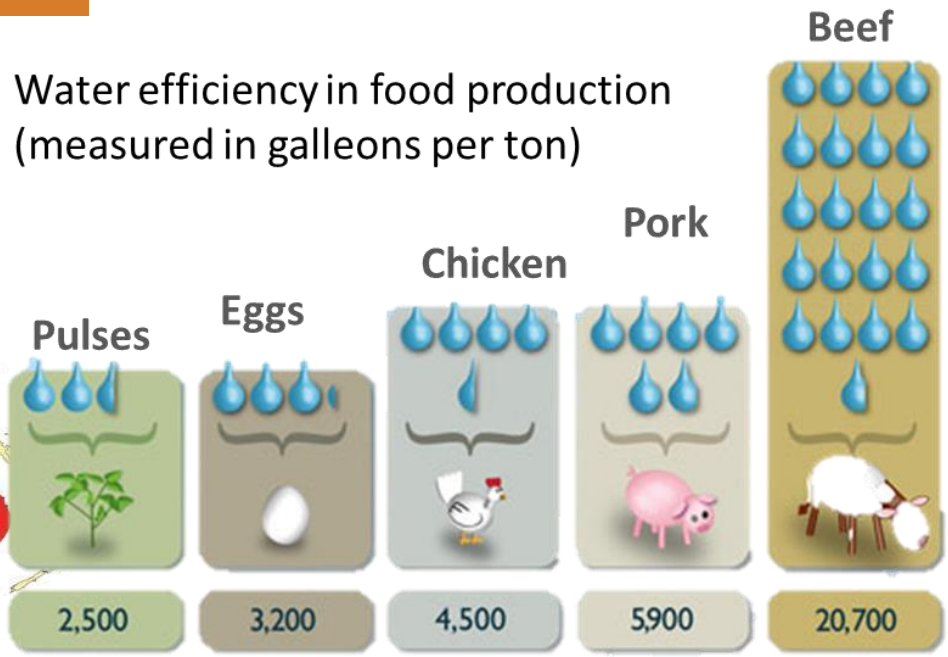
Pulses are climate smart crops with less water requirement





Daal (1kg)
1250 liters

Chicken (1kg)
4325 liters

Mutton (1kg)
5520 liters

Beef (1kg)
13000 liters

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Grass Pea: Tolerance to Excessive Drought and Water Logging

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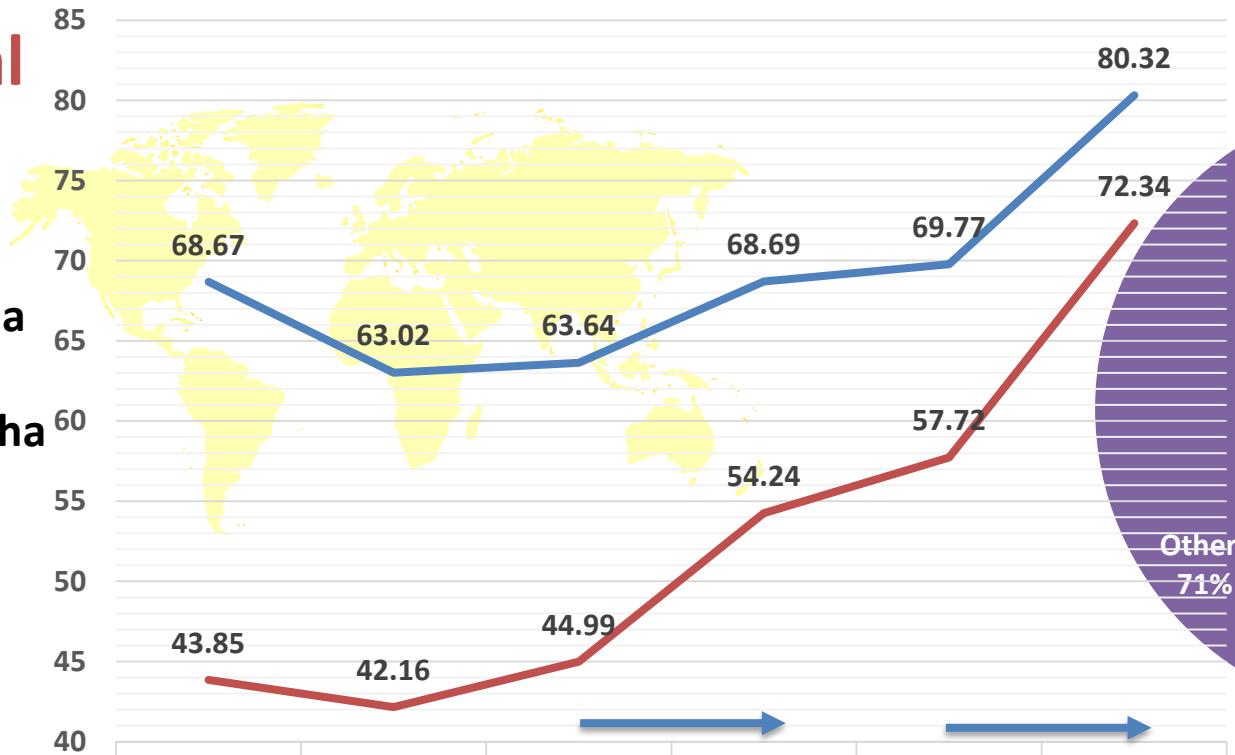
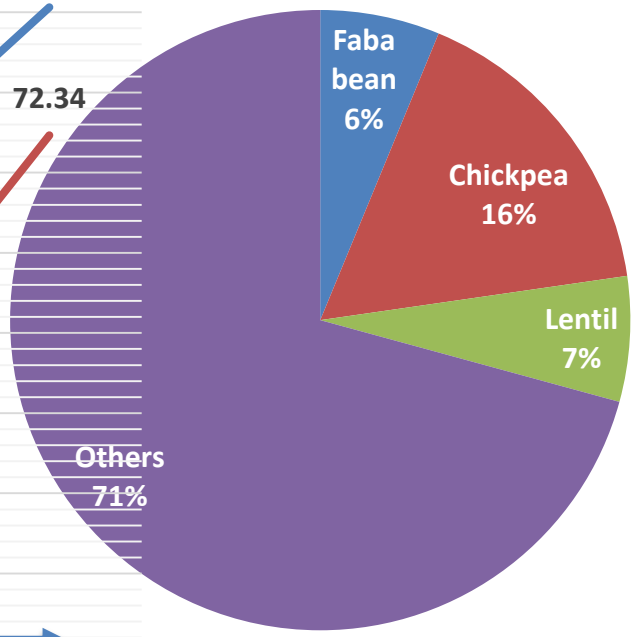
Pulses Production Scenario

Global

Area **m ha**
Prod **m t**
Yield **kg/ha**

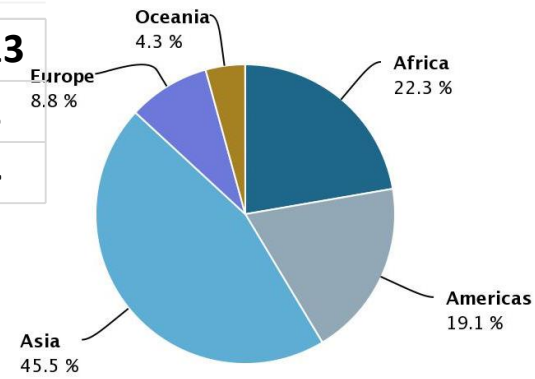


	1961-63	1971-73	1981-83	1991-93	2001-03	2011-13
Area	68.67	63.02	63.64	68.69	69.77	80.32
Production	43.85	42.16	44.99	54.24	57.72	72.34



Asia

Area	39.32	34.07	35.13	34.86	34.38	40.16
Production	25.18	21.29	23.07	23.14	26.34	32.90
Yield	640	625	657	663	766	819



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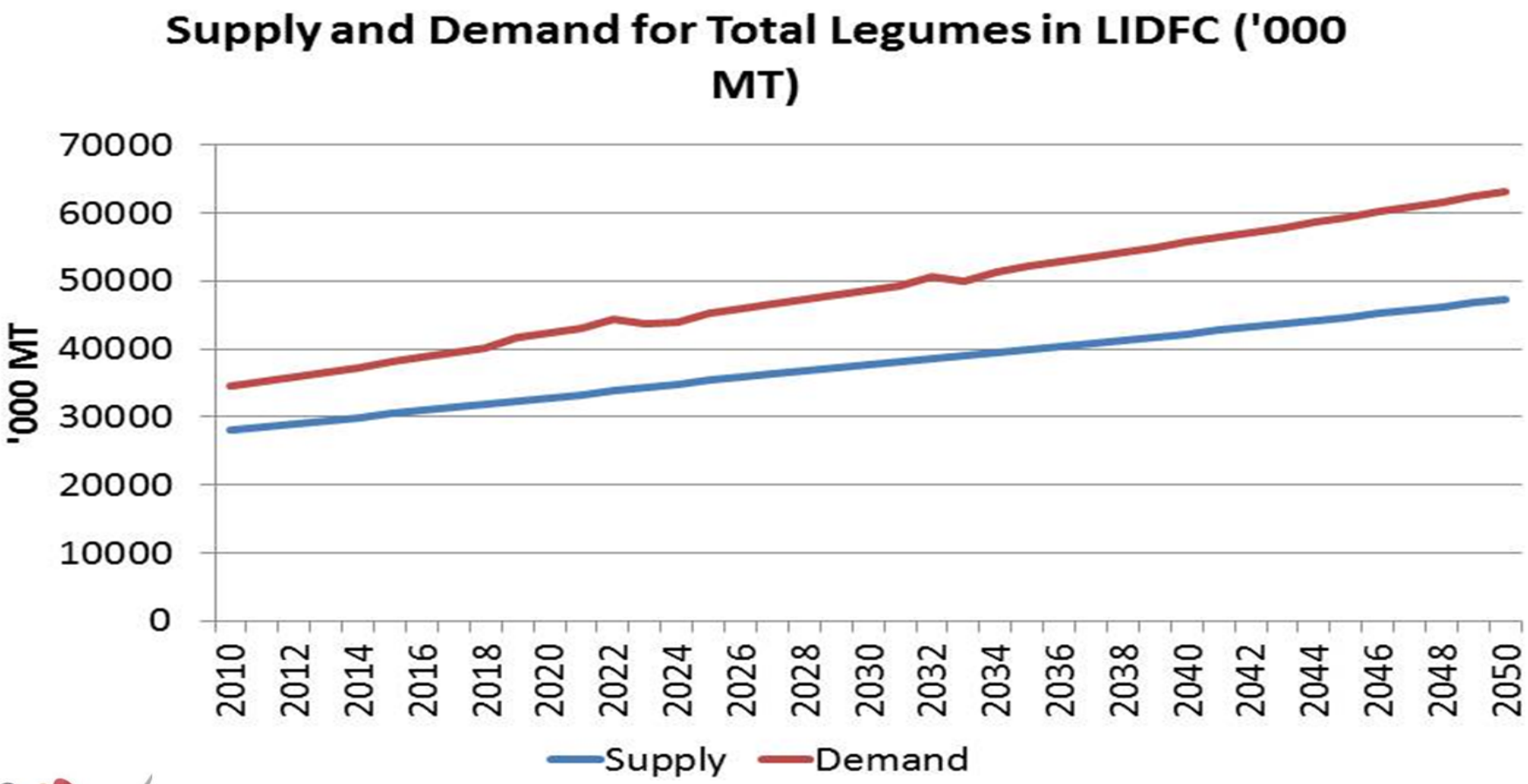
Production sufficiency in pulses is a concern in some regions

- **Asia accounts for 45% of the global pulses production and remains a major producer, importer, and consumer**



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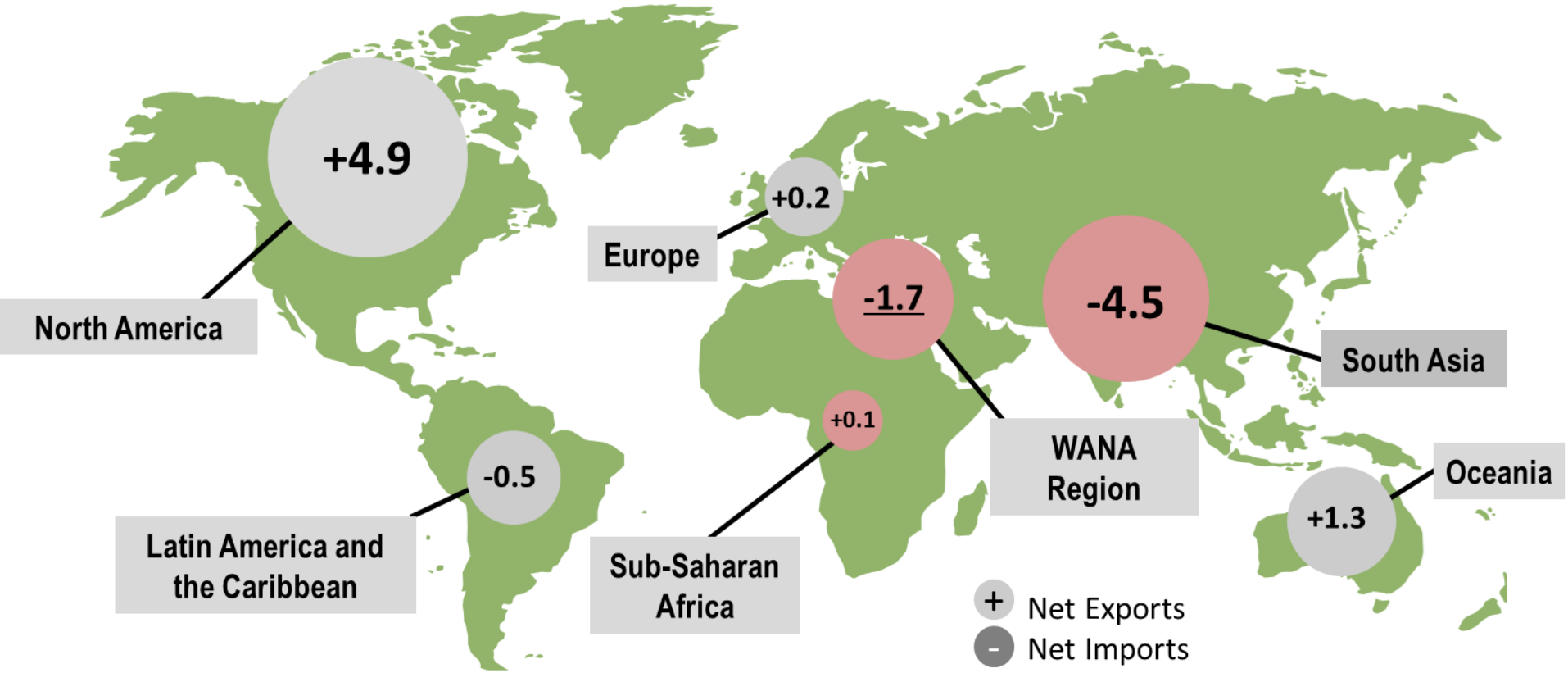
Pulses deficit regions

Global pulse trade at present: almost 12 million tons



Sources: FAOSTAT (2011)

in Million MT by region (2011)

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What Science Can Do to Enhance Productivity and Production of Pulses

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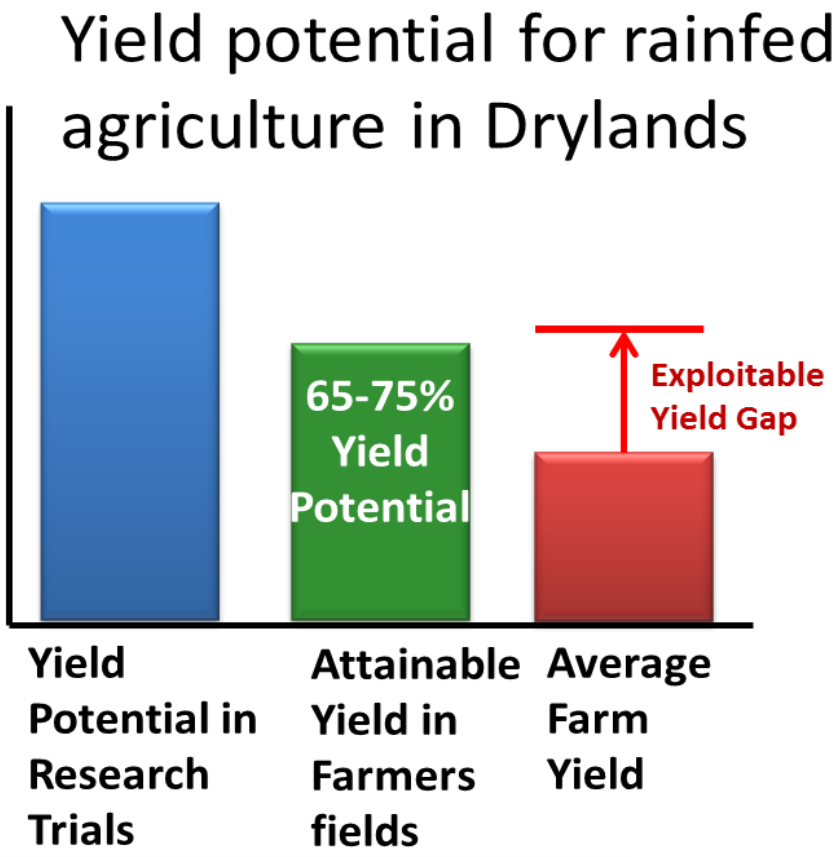
Strategy for Enhancing Pulses Production

- Crop genetic improvement & new genetic gains for improved varieties;
- Vertical increase in productivity through sustainable intensification of production systems;
- Closing the yield gaps
- Horizontal expansion
- Reduced post-harvest losses



- 25-60% yield gaps in pulses
- Reasons are many…….
- Closing the yield gaps can alone supply 60% of pulses deficit
- Farmers participatory research

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Winter vs. spring chickpea in West Asia & North Africa

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Drought Tolerant Chickpea Variety Survived 2007 Excessive Drought in Turkey

Gokce is used on about 85% of the chickpea production areas (over 550,000 ha). With a yield advantage of 300 kg/ha over other varieties, and world prices over USD 1000/t, this represents an additional USD 165 million for Turkish farmers, in 2007 alone.

The Kabuli chickpea, 'Gokce', developed by ICARDA and Turkish national scientists, has withstood severe drought in Turkey and produced when most other crops failed in 2007.

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Food Legumes Production Improvement in Ethiopia

Field visits to pulse farmer involving policy makers

Increase in production 2000/01 - 2009/10:

Lentils: 3 times

Faba Bean: 40%

Chickpea: 60%

Alemaya lentil variety widely adopted in Ethiopia

Increased production and added value products provides employment through food processing in rural areas

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Fast-tracking of Iron & Zinc-rich lentil varieties

India: Pusa Vaibhav (Fe 102 ppm)

Bangladesh: Barimasur-4 (Fe 86 ppm; Zn-59 ppm

Nepal: Shekhar (Fe-78 ppm; Zn-68 ppm)

Ethiopia: Alemaya (Fe-98, Zn-64 ppm)

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Lentil cultivars with high concentration of Fe & Zn are in 'fast-tracking' seed dissemination

- Ethiopia: Alemaya
- Bangladesh: Barimasur-4, Barimasur-5 and Barimasur-6, Barimasur-7, Binamasur-7
- India: Pusa Vaibhav
- Nepal: Sisir, Shital, Shekhar, Khajurah-1, Khajurah-2
- Syria: Idlib-2, Idlib-3 and Idlib-4
- Turkey: Myveci-2001
- Portugal: Beleza

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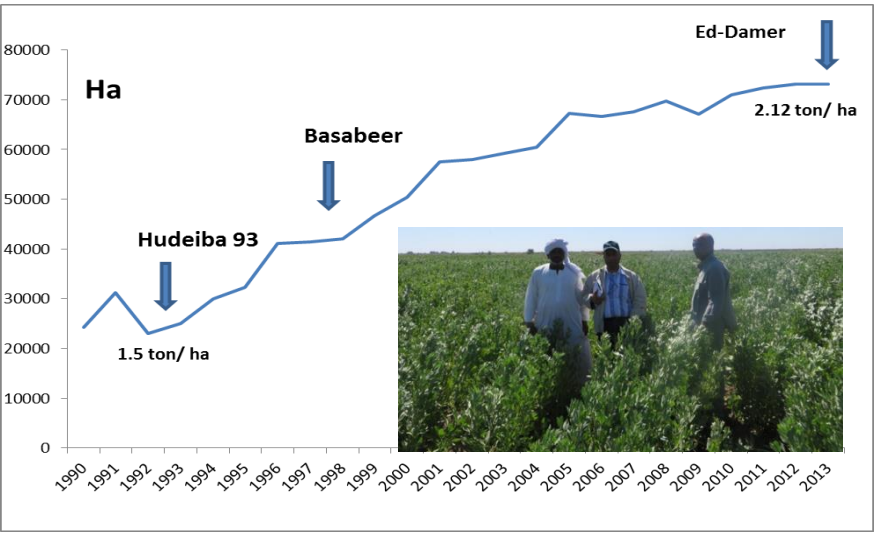
Climate resilient varieties of faba bean



- Heat tolerant faba bean varieties in Sudan
- Production increased from ~40,000 t in 1995 to 150,000 t at present.
  - Area increased by 50,000 ha
  - Productivity increased by 600 kg/ha

- Misr3 - orobanche tolerant and Nubaria2 and Nubaria3 - drought tolerant varieties helped improved the self sufficiency level of faba bean in Egypt

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Insect Resistant Chickpea

Leaf miner

- 6 segregating population and FIGS set evaluated at Kemis Zemamra station in Morocco
- 200 single plants with good resistance and pods/plant.

Pod borer

- FIGS (375) evaluated in Annaceur (off season)
- 34 lines with 1-5% damage

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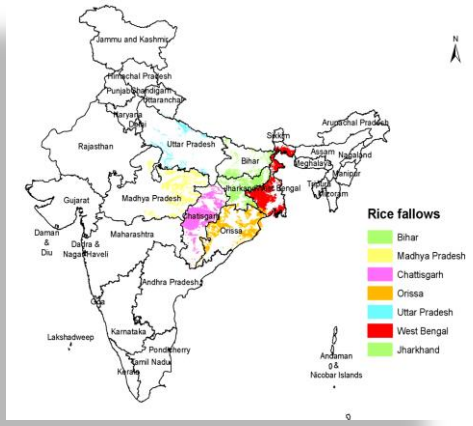
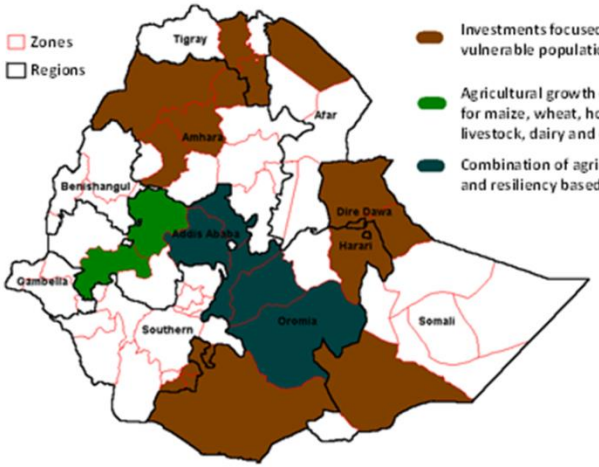
Extra Early Varieties



Replacing fallow in rice fallow in South Asia



Lowland Areas in Ethiopia

Monsoon Rice (July-Oct)	Super-early legumes Nov-Jan (<90 days window)	Boro Rice (Feb-June)

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Pulses offer scope for diversification of cereal based systems

- Intensification of cereal based CS by inclusion of pulses as catch crop
- Diversification of cereal based CS by replacement
- Introduction in Rice-fallows in South Asia
- New niches such as winter planting
- Market opportunities for rural income

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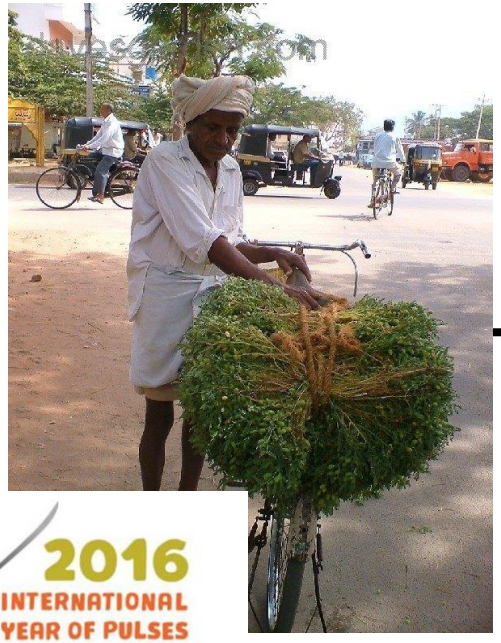
Enhancing profitability of pulses production

- **Reducing cost of cultivation**

- **Value addition and linking farmers to market**



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Early Lentil Demonstration Replacing Fallow in Fallow Rice Rotation in Bangladesh & India

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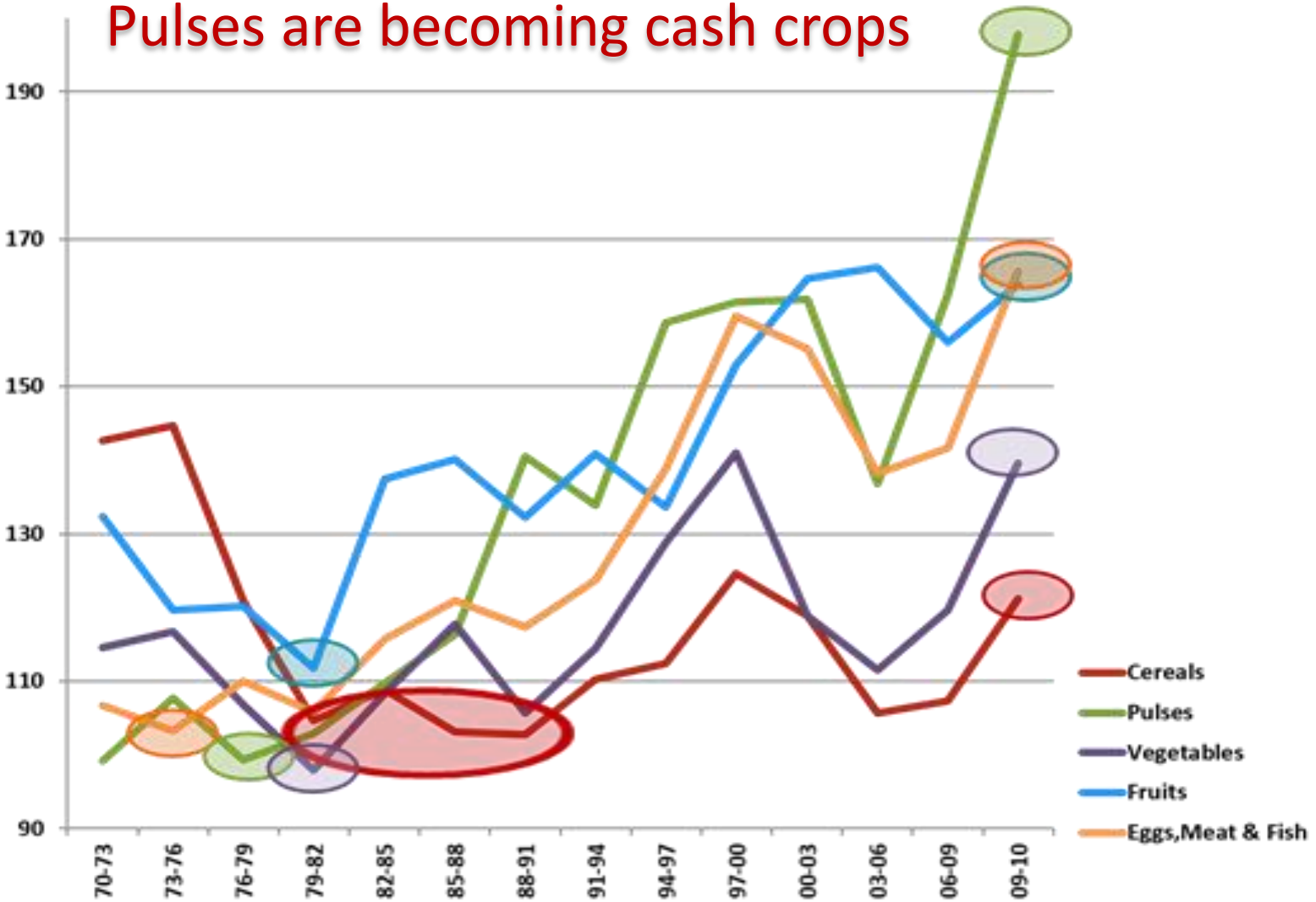
Steep rise in food prices in India over 30 years

Pulses are becoming cash crops



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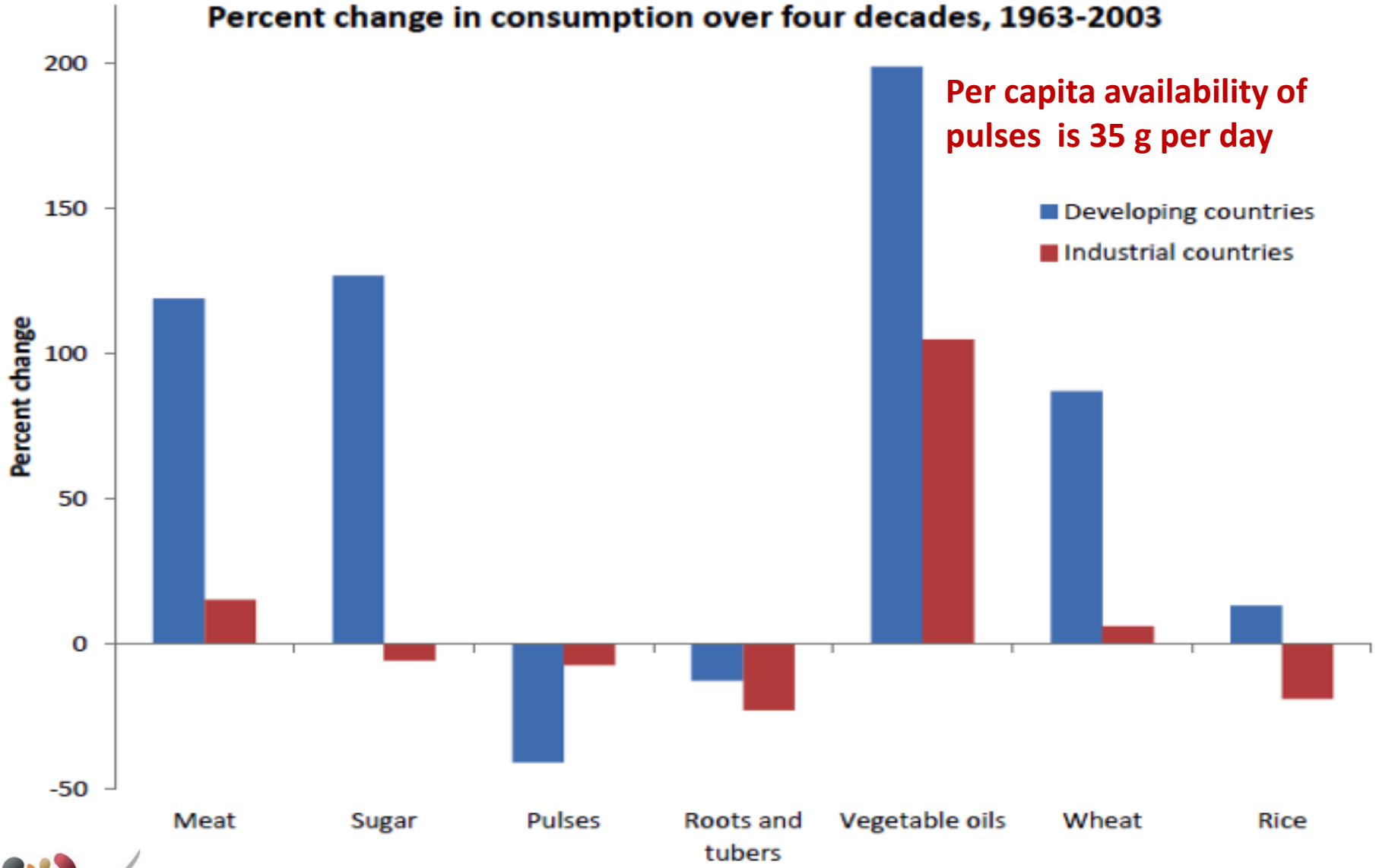
Consumption of pulses has gone down over the years



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How to raise awareness about pulse benefit?

- Inclusion pulses benefits in school curriculum among children;
- Innovations in pulse products and ready to eat products;
- Messages by celebrities and eminent personalities about the benefits of pulses in electronic media and print;
- National, regional and global events involving participation of general public and celebrities;
- Short documentary films on benefits on pulses.

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Global Pulses Federation
2016 International Year of Pulses Signature Events

Follow us on Twitter or visit our website for more information on events celebrating the International Year of Pulses!
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PULSES
THE FUTURE OF FOOD

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Conclusions & Recommendation

- **Pulses for Food Security**

- Pulses contribute to global food and nutritional security both directly & indirectly through high protein content.
- Major source of micro nutrients
- Important source of dietary fibre;.
- The protein content of legumes is not as affected by e[CO_2] as cereals & grasses –

- **Pulses for Environmental Benefits and Mitigation of Climate Change**

- Pulse production enhance soil N content and soil productivity and health;
- Production of pulses has lower greenhouse gas emissions than crops that require N-fertilization;.
- Lower fossil energy costs than crops that needs N-fertilization;

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Conclusions & Recommendations (cont'd)

- **Pulses for Environmental Benefits and Mitigation of Climate Change** (cont'd)
  - **The inclusion of legumes in farming systems appears to accelerate soil C sequestration promote soil health since it breaks the disease and insect cycles in soil created by the prevailed cereal mono-culture .**
- **Considering the nutritional and environmental benefits of pulses, it is essential that pulses consumption is well encouraged;**
- **It is important to bridge the gap between production and consumption at both national and global levels;**
- **There is an urgent need to invest more in science and technology to enhancing pulses productivity, production and reduce production cost.**

The IYP is an excellent opportunity to promote the consumption of pulses & investment in Science & Technology to increase pulses productivity and production.

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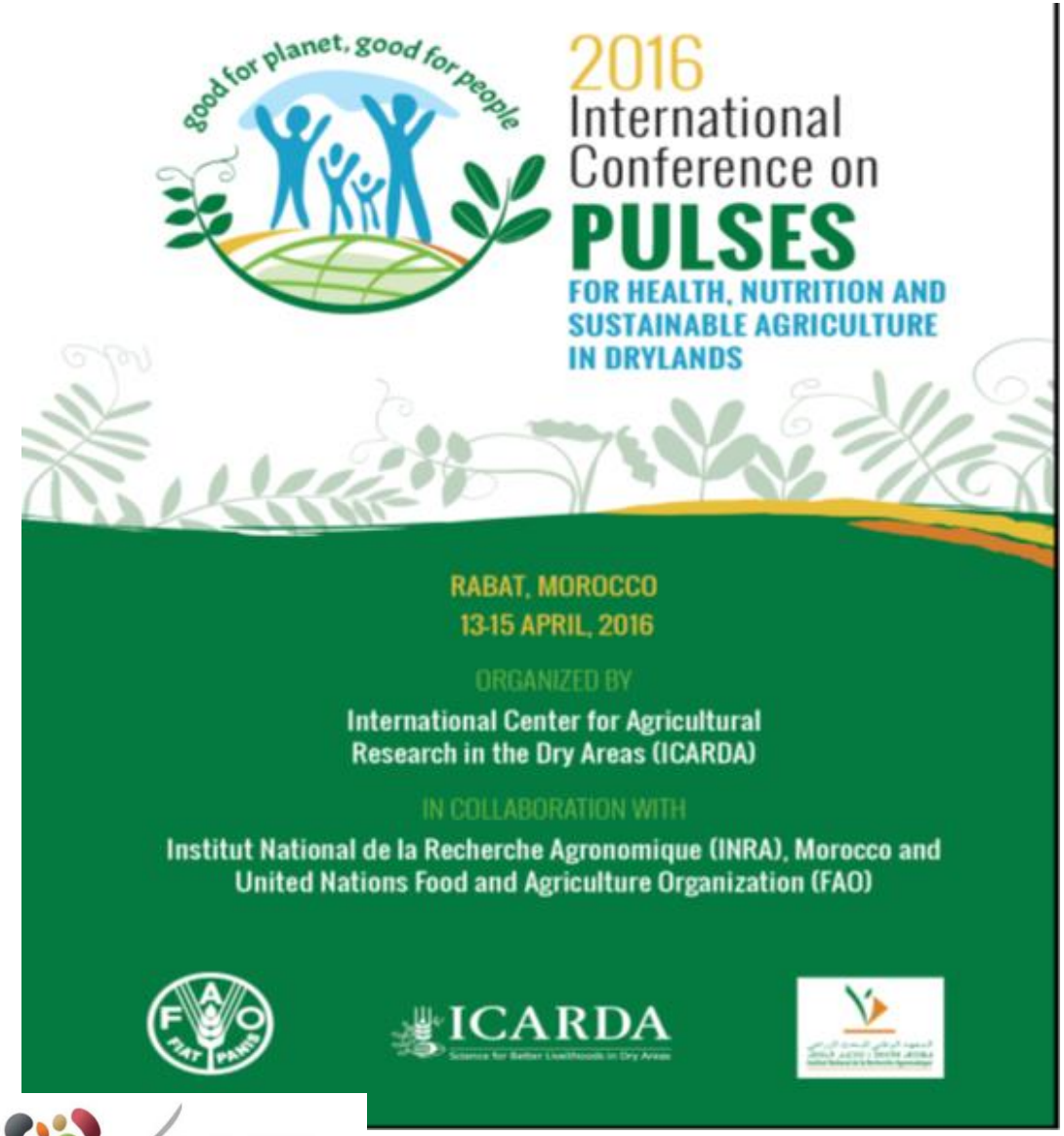
Celebrating the 2016 - International year of Pulses



International Conference on Pulses for Health, Nutrition and Sustainable Agriculture in Drylands (13-15 April 2016, Rabat, Morocco).

Thank you

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