

# Research challenges for protein crops



*Diego Rubiales*

*“Personal” opinions  
to boost discussion*

Brussels 24 April 2018

# **Legumes** are multifunctional crops with extraordinary importance for the **agriculture, environment** and **culture**

## key role in animal feed

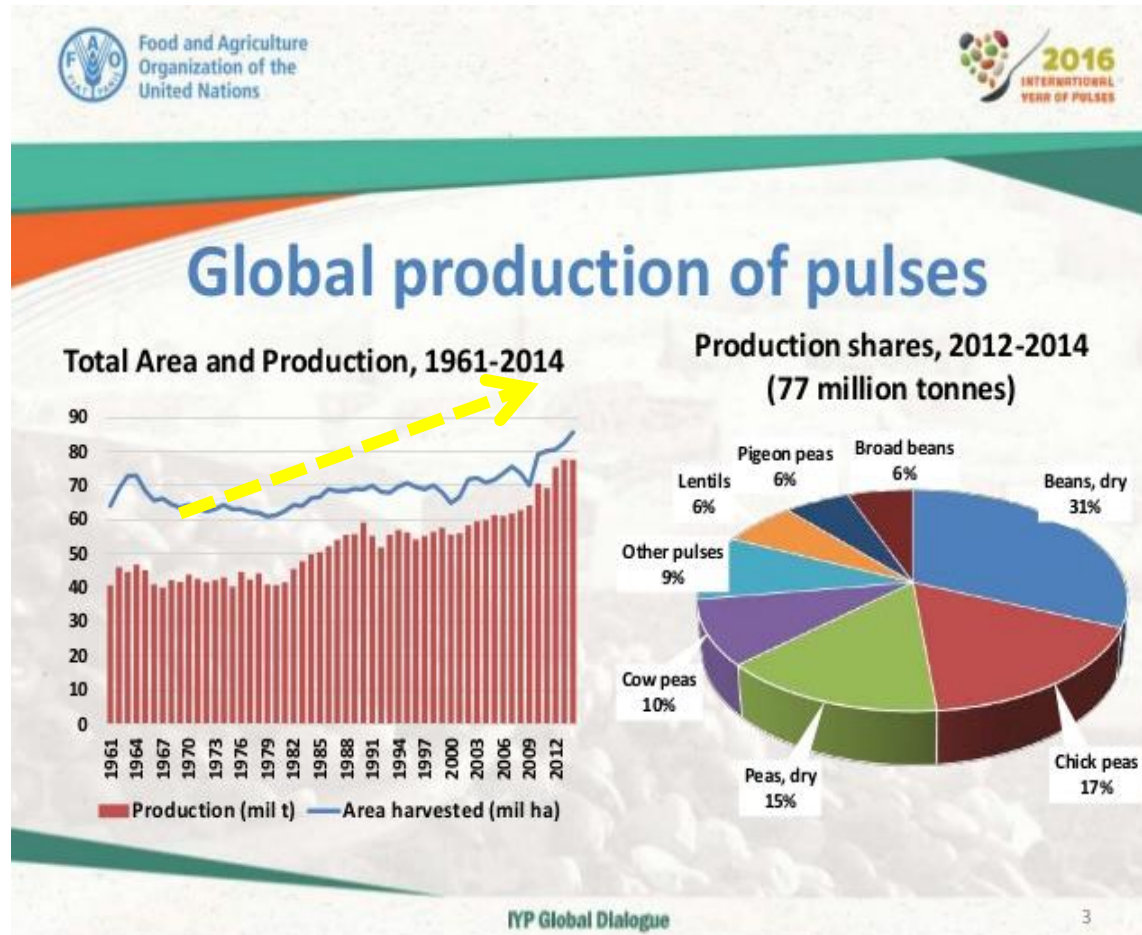


## key role in healthy human diets



**key for sustainable agriculture and environment**

There is an increasing trend at world level



# Perspectives for further growth as word demand will increase

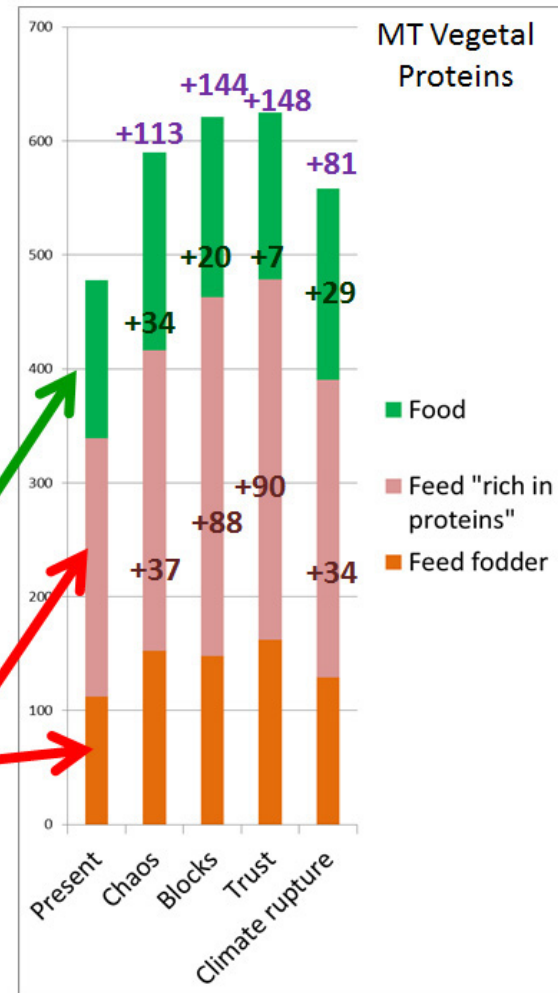
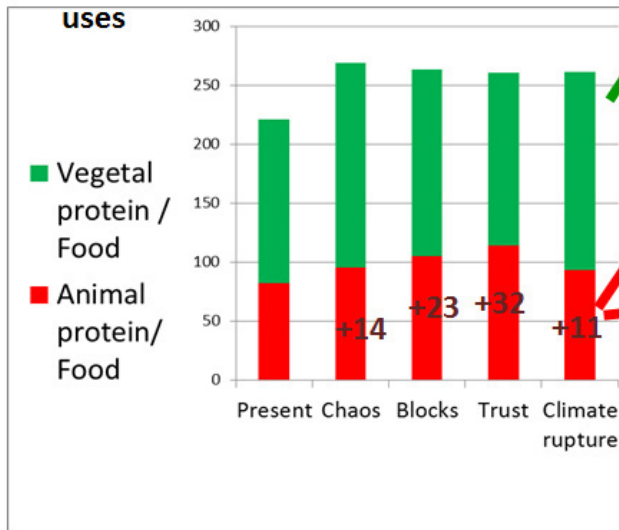
(Pilorge & Muel, 2016)

## World demand for proteins (MT)

Depending on:

- Population growth
- Food habits

### Protein food uses



# Perspectives for further growth:

Models suggest that legumes will be more important by 2030

*(Pilorge & Muel, 2016)*

Expectations for 2030	Escenario Chaos	Escenario Blocs	Escenario Confiance	Escenario Rupture Climatic
Word				
Colza	-	++	+	-
Sunflower	-	+	+	-
Soja	++	+++	++	++
Grain legumes	++	+++	++	+



## Upcoming Publication



# TEN-YEAR PULSE RESEARCH STRATEGY

*The Ten-Year Research Strategy report will be used to set an agenda for global discussion and mobilize champions to advocate for accelerated pulse research investments.*

#### Organizing Author

**Dr. Shoba Sivasankar**, Director, CGIAR  
Research Program on Grain Legumes, ICRISAT

#### Lead Author – Breeding and genetics for improved productivity and resilience

**Dr. Noel Ellis**, ICRISAT (retired)

#### Lead Author – Pulses in integrated crop systems and agricultural landscapes

**Dr. Robin Buruchara**, Director of the Pan  
Africa Bean Research Alliance, CGIAR-CIAT

#### Lead Author – Integration of pulses into food systems

**Dr. Carol Henry**, Associate Professor of  
Nutrition and Diet, University of  
Saskatchewan

#### Coordinating Author

**Dr. Christine Negra**, Principal, Versant Vision

#### Lead Author – Integration across agricultural, nutritional and social sciences

**Dr. Diego Rubiales**, Professor, Spanish National  
Research Council, Institute for Sustainable Agriculture

#### Lead Author – Spatially-explicit analyses related to local and global challenges

**Dr. Jeet Singh Sandhu**, Deputy Director General,  
Indian Council of Agricultural Research, Division of  
Crop Science

The UN Food and Agriculture Organization has declared 2016 the International Year of Pulses (IYP) to encourage connections throughout the food chain that would better utilize pulse-based proteins, further global production of pulses, increase the efficiency of crop rotations, and address trade challenges. The International Year creates a unique moment to showcase transformative research investments that would allow pulse crops to deliver on their full potential as a critical player in the global food system.

With funding support by the International Development Research Council (IDRC) of Canada, this initiative is led by Emerging Ag, Inc. on behalf of the Global Pulse Confederation, which has sponsored a wide array of activities for the International Year of Pulses. It is motivated by the large gap between the potential of pulse crops for meeting global sustainability challenges and the current capacity to seize this potential.

**Pulses receive globally <1% of  
resources for research**

**target: increase this to 10%**

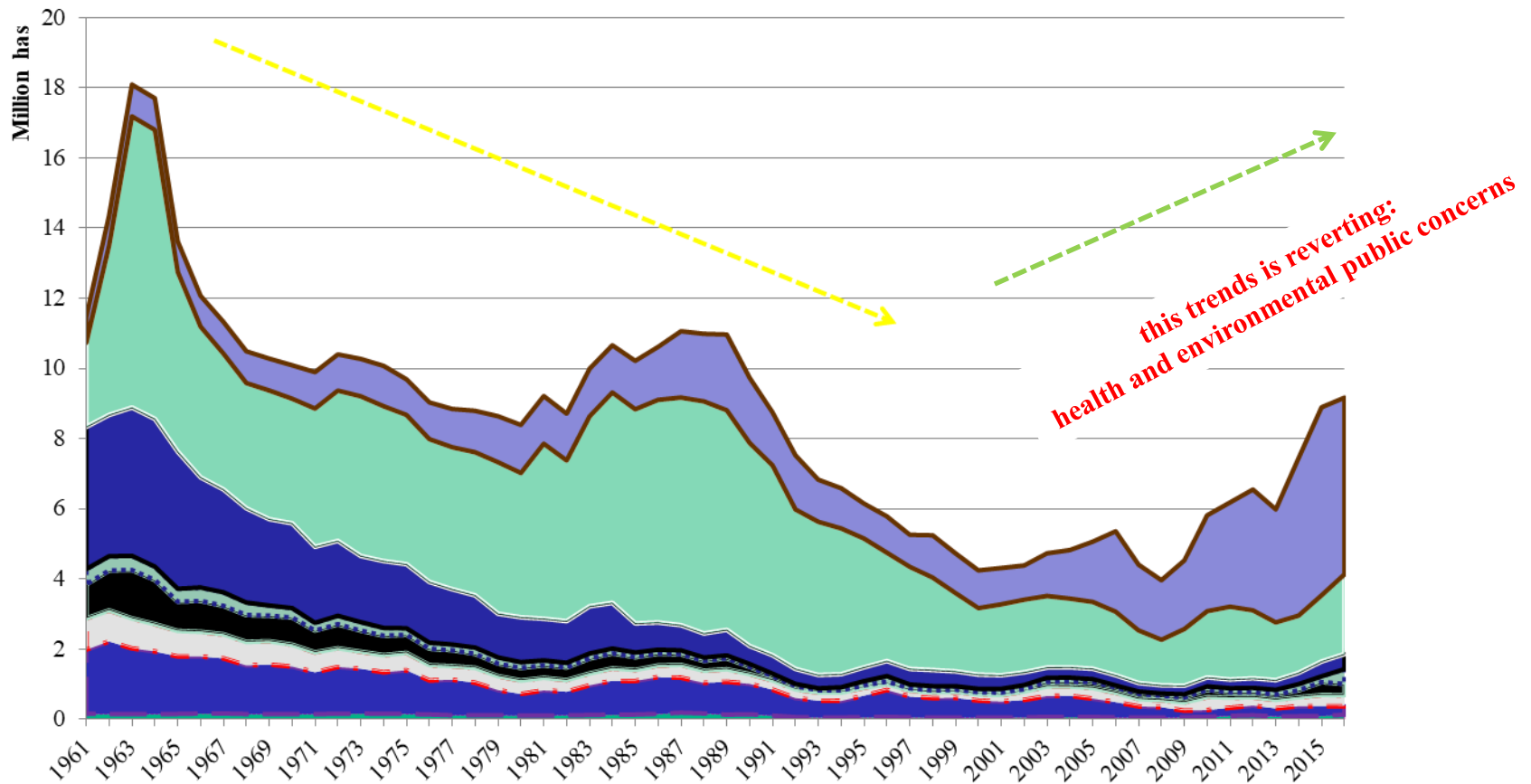


# Even better perspectives for Europe!

(Pilorge & Muel, 2016)

Expectations for 2030	Escenario Chaos	Escenario Blocs	Escenario Confiance	Escenario Rupture Climatic
Word				
Colza	-	++	+	-
Sunflower	-	+	+	-
Soja	++	+++	++	++
Grain legumes	++	+++	++	+
Europe				
Colza	-	-	=	--
Sunflower	-	--	-	--
Soja	+++	+++	++	+++
Grain legumes	+	+++	+++	+++

## EUROPE



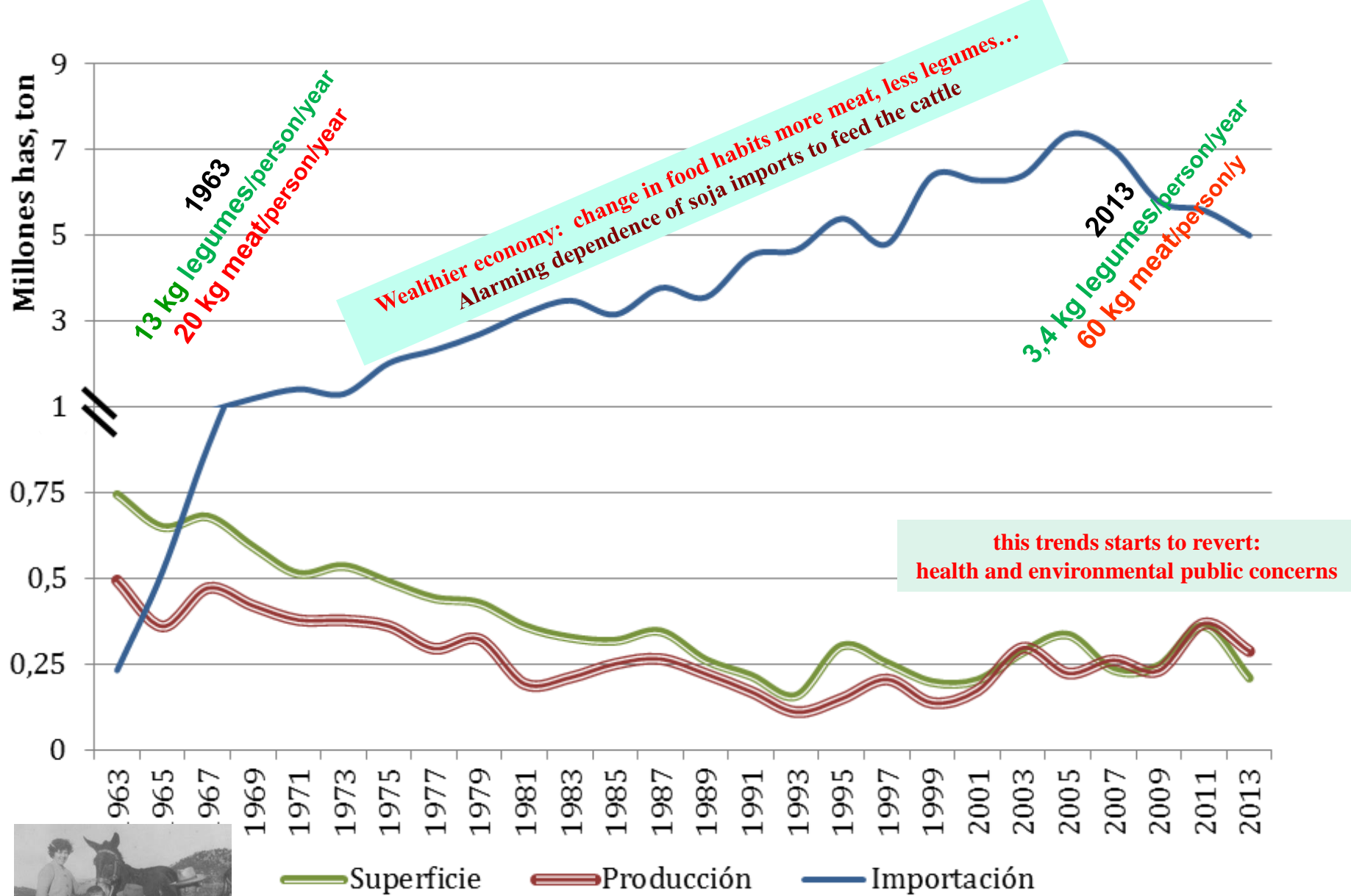
**Historic trend in legume cultivation in Europe**



# **What is wrong with legumes in EU ???**

**in spite of the good performance at global level**

**legume cultivation is decreasing at EU level**



**Historic trend: change in economy and agriculture**

# “wrong assumptions” hampering legumes image

Eating legumes is not ”cool”: **“the food of the poor”**

Shouldn't we say **“the food of the smart”**?



interesting.. Pulses is the future of food.. @CICILSIPTIC

World Economic Forum @wef

A new report says we should tax meat-eaters like smokers [wef.ch/2Gs0fyC](https://wef.ch/2Gs0fyC)  
#health

Ruminant livestock (beef and lamb) is the most emissions-intensive food we consume due to the methane gas produced by the animals.

5.77 kg



Pork\*

3.65 kg



Chicken\*

3.49 kg



Fish\*

3.46 kg



Eggs

(all species combined)

2.55 kg



2.13 kg



1.29 kg

To produce **1 kg of raw meat**:

- Emission of 27 Kg CO<sub>2</sub>
- 15.400 liters of water
- 1 kg of protein requires 600 m<sup>2</sup>

To produce **1 kg of lentils**:

- < 1kg CO<sub>2</sub>,
- 5.854 l of water
- 1 kg protein 250 m<sup>2</sup>

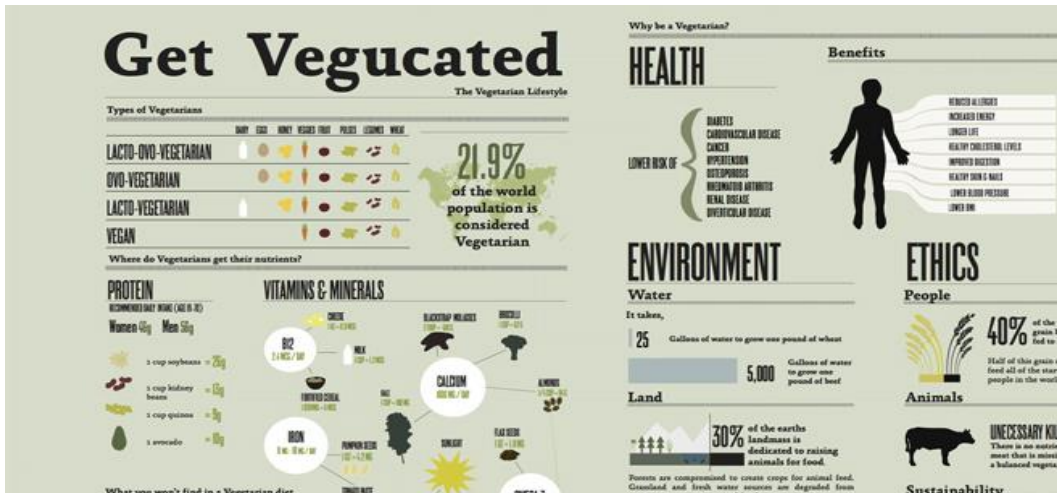
# Legumes are cool!

“The Future of Food Is Plant-Based”

<https://t.co/v72w31jQrd>



“We're addicted to meat. And it's destroying the planet”



# Pulses are the Future of Food.

*Pulses are the future of sustainable food.*

Pulses have a low carbon footprint.

Pulses are a water and fertilizer efficient crops.

Pulses enrich the soil where they grow.



**Growing Pulses is good for  
our planet**

- **Decreased Greenhouse gas emissions**
- **Improved soil health**
- **Increased water efficiency**



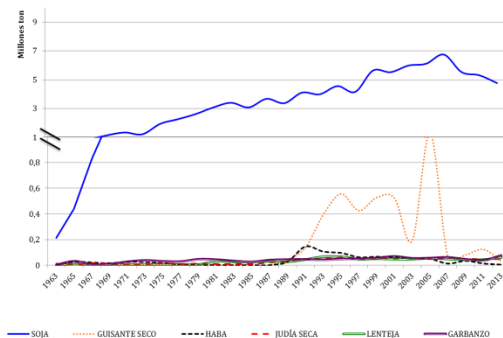


# Increasing consumption will solve the problem?

Consumption is today much lower than before,  
STILL, we import about el 60 -85% of the food legumes that we eat in Spain!!!

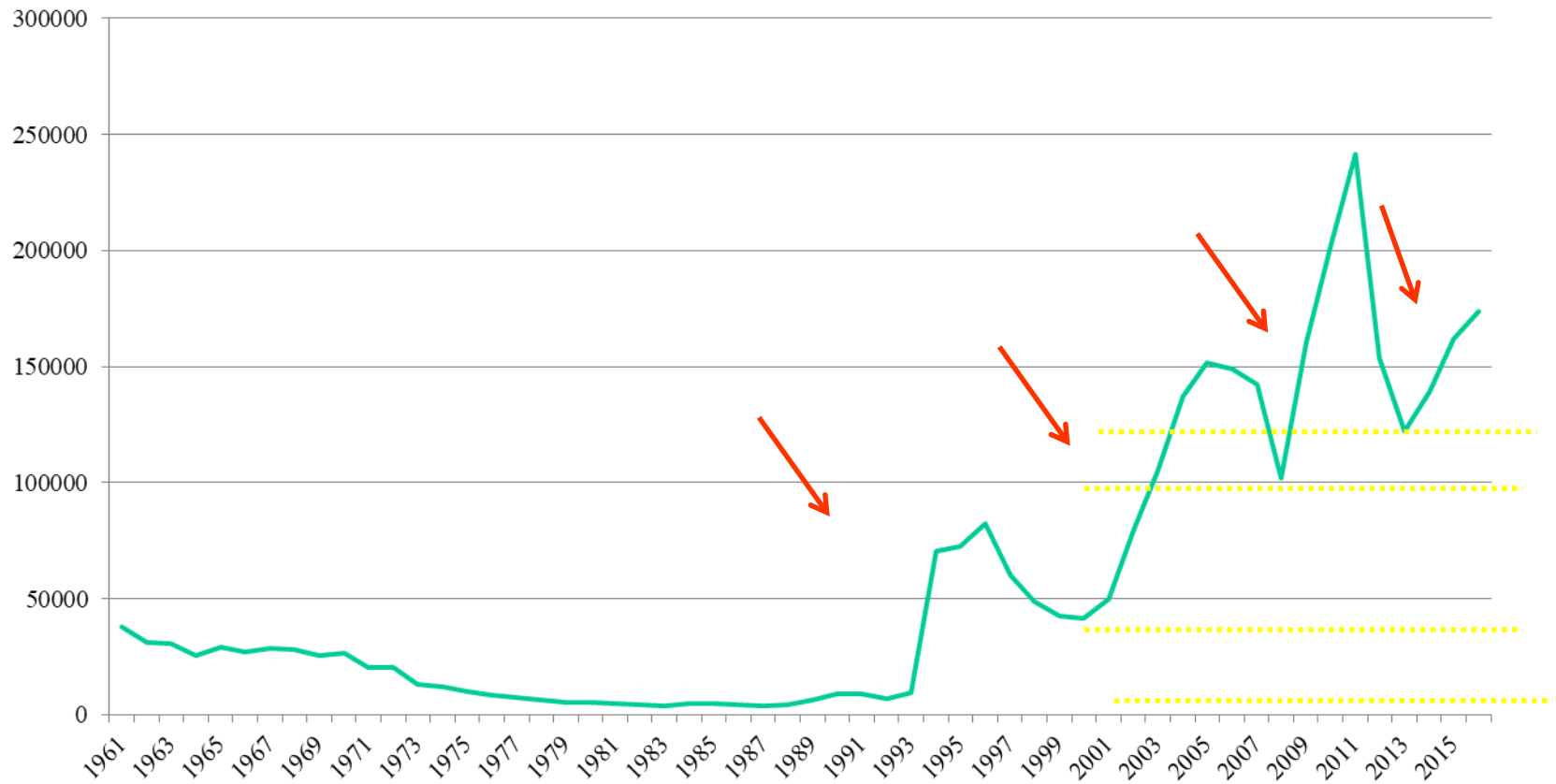
By promoting consumption but not acting at the production level,  
we would be just promoting imports!!!  
What about ecological services? What about rural economies?

**Soya case study: the continuous increase in use for feed concentrates did not results in increase cultivation but on dramatic dependence on imports**

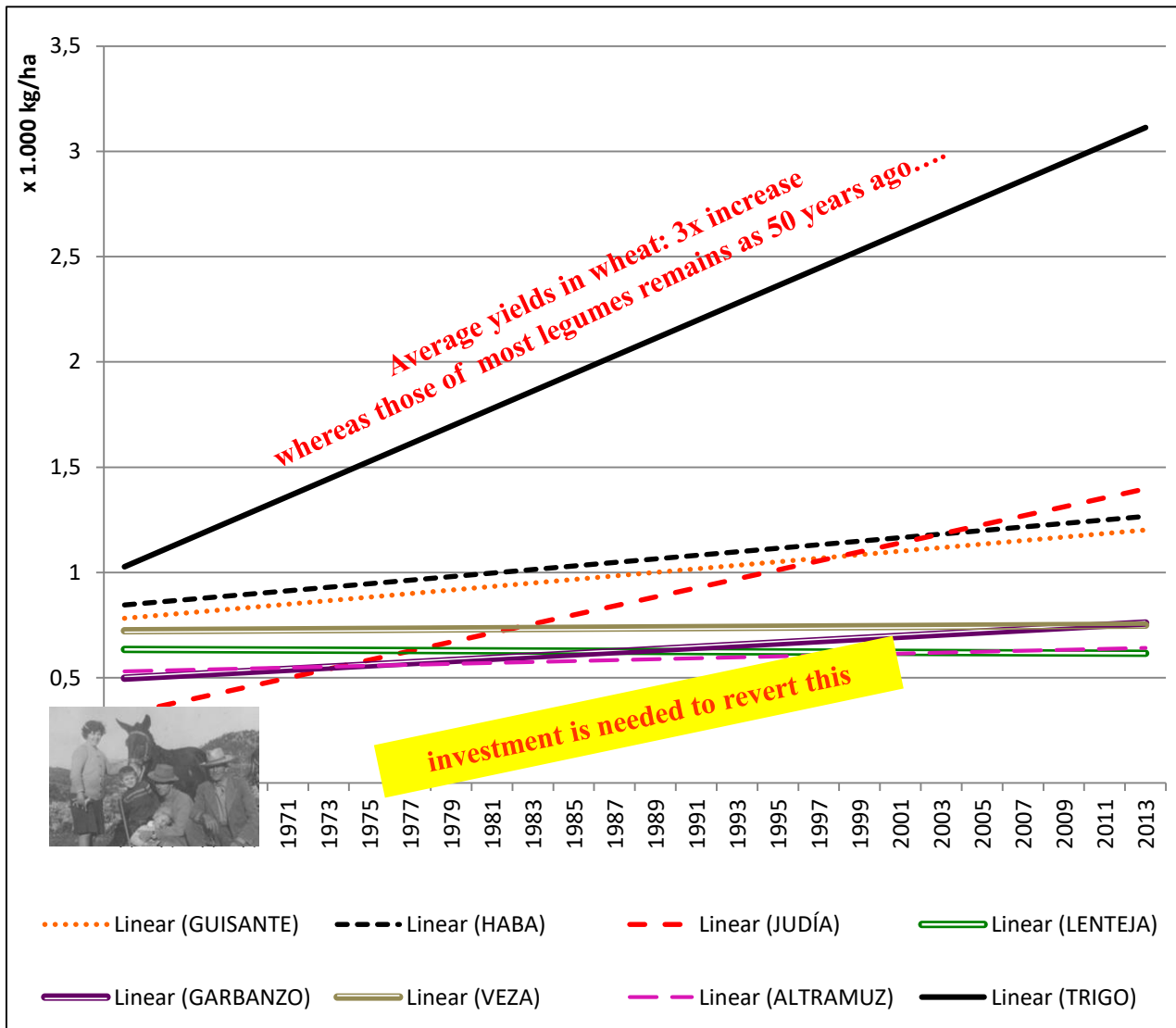


# Subsidies?

## dry pea in Spain



# Legume investment has been neglected in benefit of other crops that have been better incorporated to “modern agriculture”:



## Spain

### Annual yield gain (Kg/ha/year)

Pea 8

Faba bean 9

Common bean 22

Lentil 0

Chickpea 5

Vetch 1

Lupin 2

**Wheat 52**

# Major limitations for legume cultivation/breeding:

Relatively low **yield potential-stability**

Numerous species multiplying breeder's investments

**Breeding priorities:** genetic resources, proper phenotyping, selection (MAS)

- **Grower satisfaction:**

Good yield, disease resistance, lodging, herbicide tolerance, high prize

- **Consumer satisfaction**

colour, size, appearance, nutrition, ..... low cost

## GENETIC RESOURCES

Never enough... but great germbank collections available

	No. accessions in European genebanks
<i>Pisum</i>	30.455
<i>Lens</i>	9.260
<i>Vicia</i>	28.084
<i>Lathyrus</i>	6.791
<i>Cicer</i>	11.956
<i>Phaseolus</i>	52.179
<i>Glycine</i>	16.281
<i>Vigna</i>	6.437
<i>Arachis</i>	3.349
<i>Lupinus</i>	13.187
<i>Trifolium</i>	27.963
<i>Medicago</i>	16.744
<i>Onobrychis</i>	1.880
<i>Ornithopus</i>	1.197
<i>Lotus</i>	2.643

Fully available on request <https://eurisco.ipk-gatersleben.de/>

although probably insufficiently characterized for agronomic value or traits of interest



# Genomic resources becoming available

LegumeInfo.org provides genome browsers for legumes with sequenced genomes.



***A. duranensis***  
(wild peanut)



***A. hypogaea***  
(cultivated peanut)



***A. ipaensis***  
(wild peanut)



***C. cajan***  
(pigeon pea)



***C. arietinum***  
(desi & kabuli chickpea)



***G. max***  
(soybean)



***L. japonicus***  
(Lotus/bird's-foot trefoil)



***L. angustifolius***  
(narrow leafed lupin)



***M. truncatula***  
(Medicago / barrel medic)



***P. vulgaris***  
(common bean)



***T. pratense***  
(red clover)



***V. angularis***  
(adzuki bean)

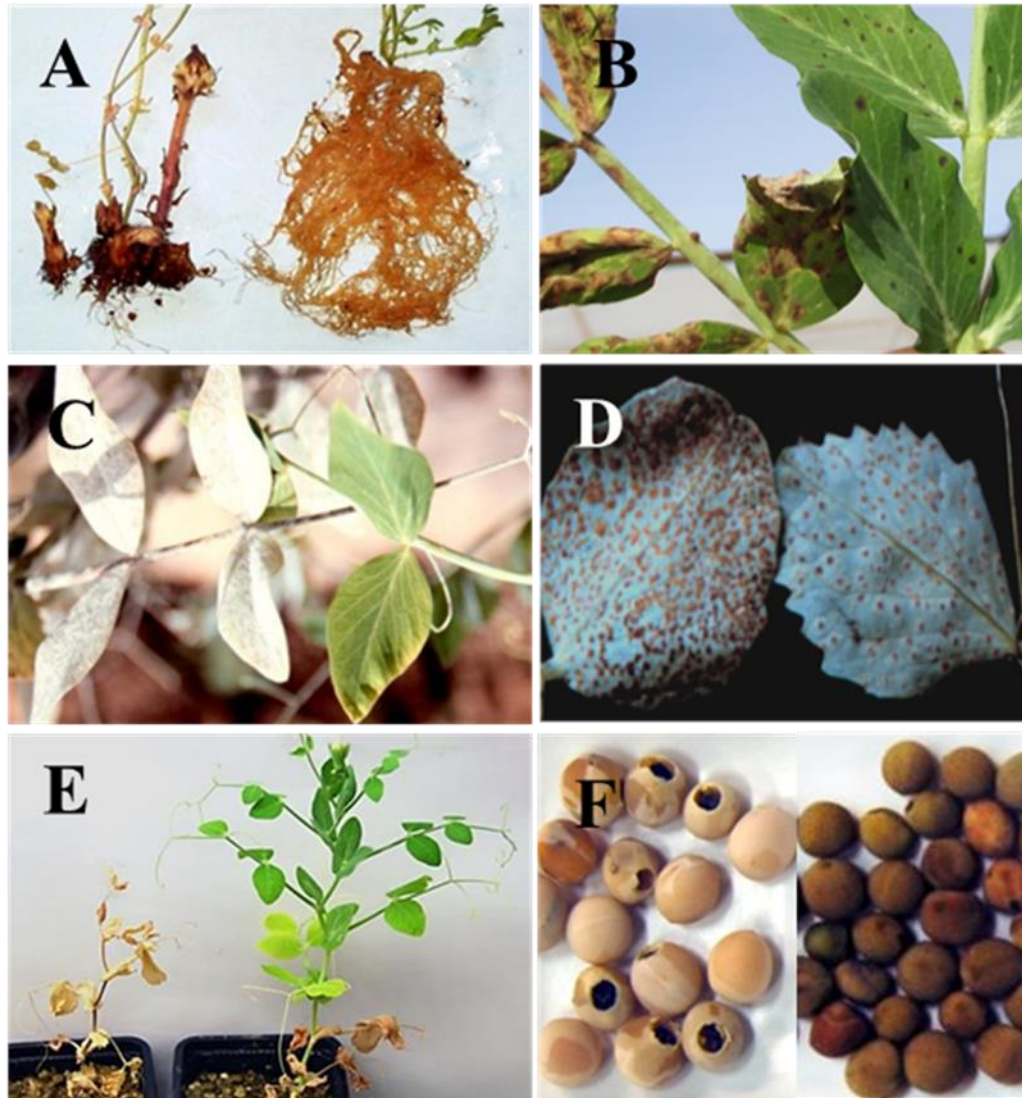


***V. radiata***  
(mungbean)



***V. unguiculata***  
(cowpea)

***The good news: resistance to most biotic and abiotic stresses has been identified now in all legume crops.***



## The success histories of Australia and Canada

**WA:** almost a dessert, poor soils

**Saskatchewan:** little growing season: snow from October till April

**NO tradition of legume cultivation neither consumption!**

**Grain growers were interested in having a legume in the rotation to improve soil fertility and were able to get organized to start legume programs starting from zero...**

**Today, they are the larger producers and exporters**

*Pulse Canadá*

*GRDC- Pulse Australia*

Producers fund the research,  
They establish the priorities and monitor the progress



2.6k  
Shares

## Hollywood director James Cameron invests in Saskatchewan pea processing plant

Plant expected to be the largest organic pea protein facility in North America

The Canadian Press - Posted: Sep 18, 2017 11:54 AM CT | Last Updated: September 19, 2017



Saskatchewan Premier Brad Wall with James Cameron and Suzy Amis Cameron at the launch of the new plant in Vanscoy, Sask. (Don Somers/CBC News)

# European Association for Grain Legumes Research



**President**  
2008-2013



**Vice-president**



# International Legume Society



**President**  
2012-2016



**Vice-president**



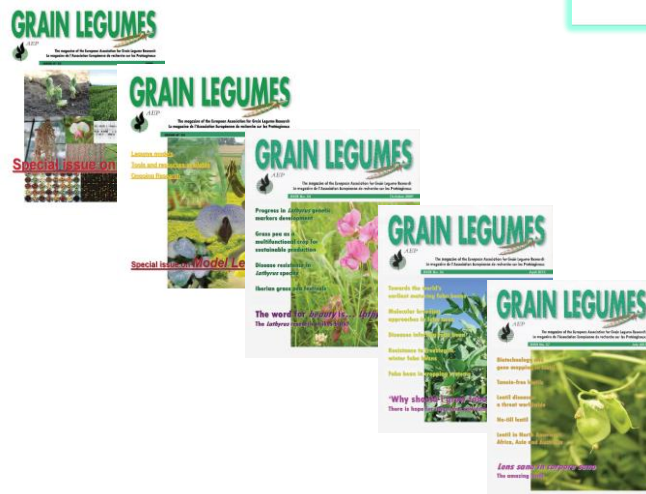
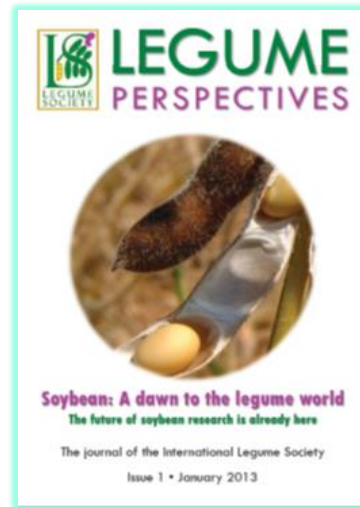


# Communication

## Legume Perspectives

<http://ils.nsseme.com/#journals>

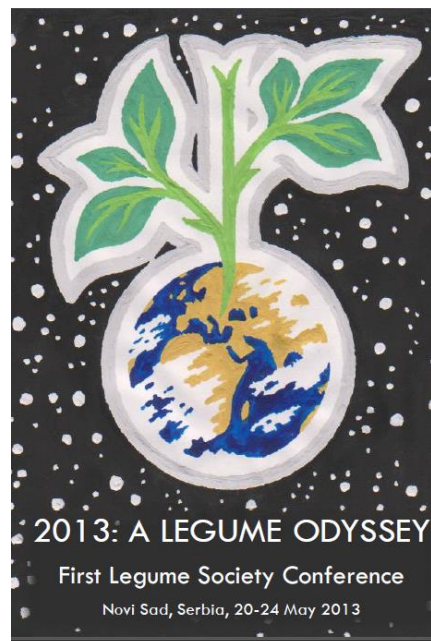
ISSN 2340-1559



*Several issues being currently edited*



# *International Legume Society Conferences*



## Second International Legume Society Conference



# Responsibilities in other international projects



**CYTED (Iberoamerican)**  
Phaseolus genome project, 2009-2012



**GRDC Australian project**  
Managing on-farm biosecurity risk through pre-emptive breeding



**Global Crop Diversity Trust project.**  
Using Crop Wild Relatives for Future Lentil Breeding  
2014-2017



**Genome Canada.**  
2015-2019

APPLICATION OF GENOMICS  
TO INNOVATION IN THE LENTIL ECONOMY

## Recent EU research projects covering (partly) legume breeding activities



**Is this sufficient? Will this impact the legume industry?  
What else is needed?**

**At present Europe exports science but imports grains**