

**Horizon 2020 of European Union:** Call 2016, SFS 44 : “A joint plant breeding programme to decrease the EU's and China's dependency on protein imports”

*This project has received funding from the European Union's Horizon 2020 Programme for Research & Innovation under grant agreement n°727312.*



**Breeding forage and grain legumes  
to increase EU's and China's protein self-  
sufficiency**

Bernadette Julier

**INRAE**

[www.eucleg.eu](http://www.eucleg.eu)

# Horizon 2020 of European Union



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forage  
animal-feed  
performance  
productivity  
protein  
human-food  
EU  
biotic-stress  
climate-change  
variety  
legume  
diversification  
stability  
breeding-strategies  
quality  
breeding-tools  
geography  
long-term  
abiotic-stress  
species  
climate  
genetic-base  
methods  
crop  
phenotyping  
grain  
China  
environment  
gene-banks

EUCLEG: 09/2017 – 12/2021

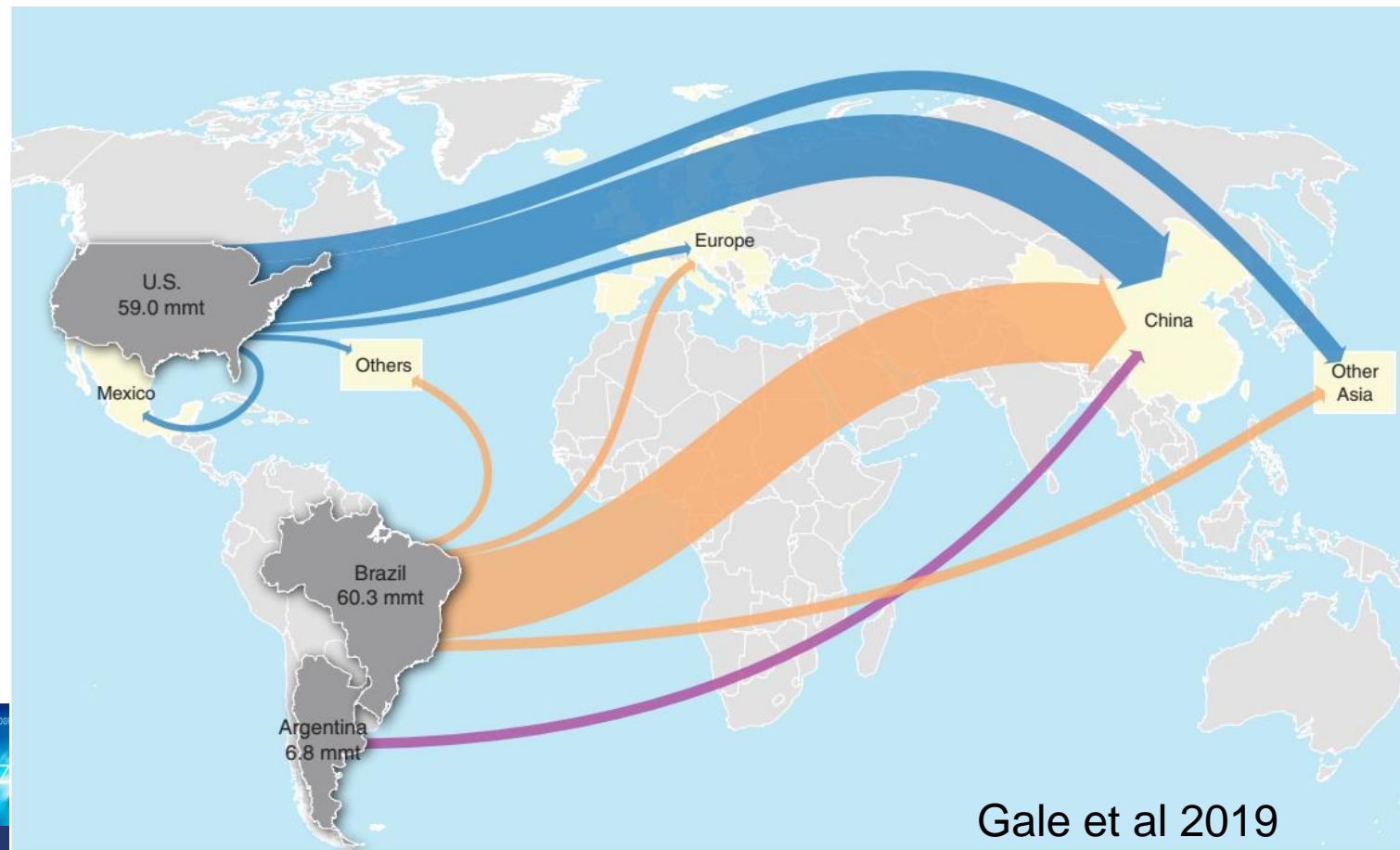


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# Protein imports in Europe and China

Europe dependency : 69%

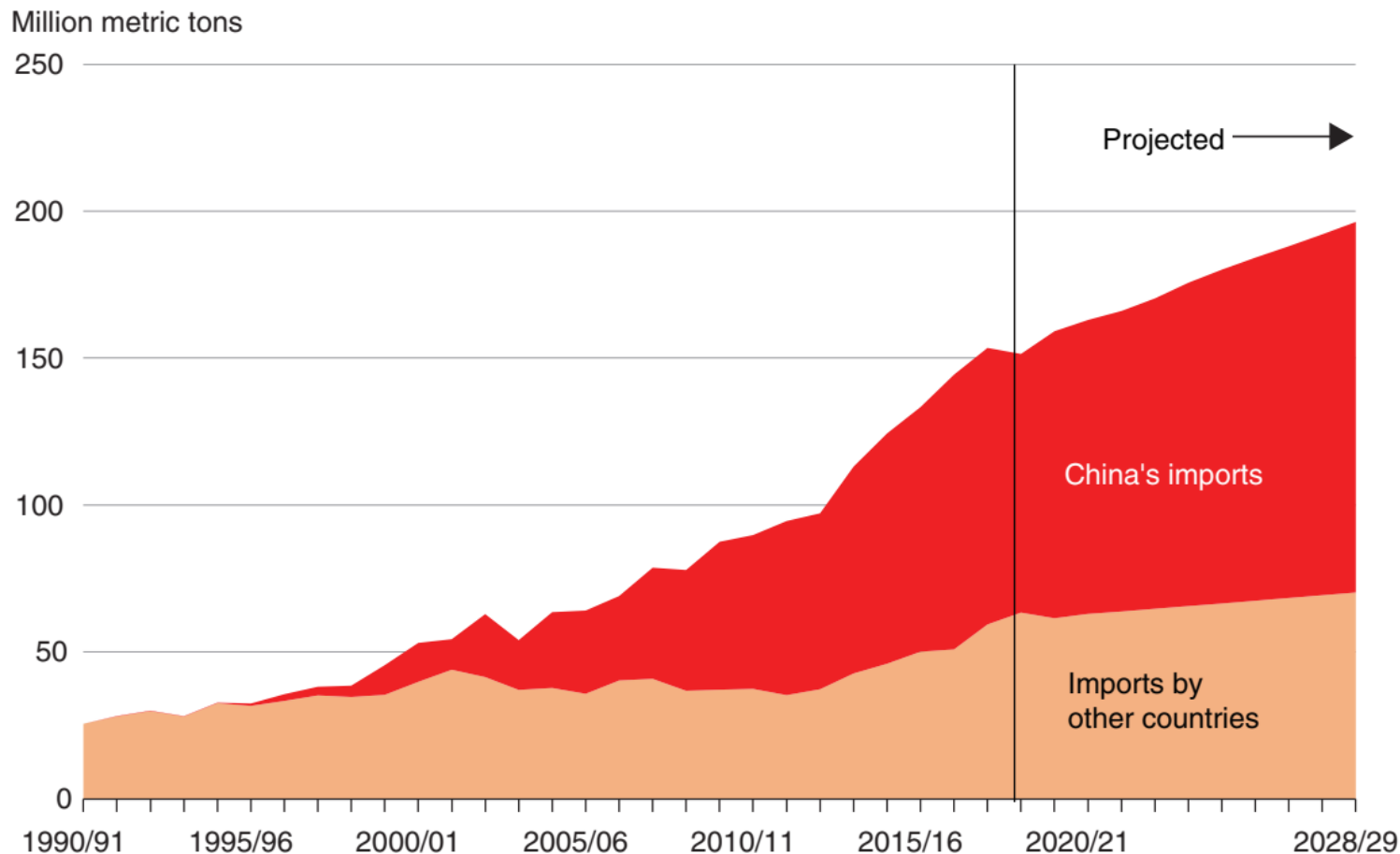
China imports 60% of soybean world market trade



Gale et al 2019

# Protein imports in Europe and China

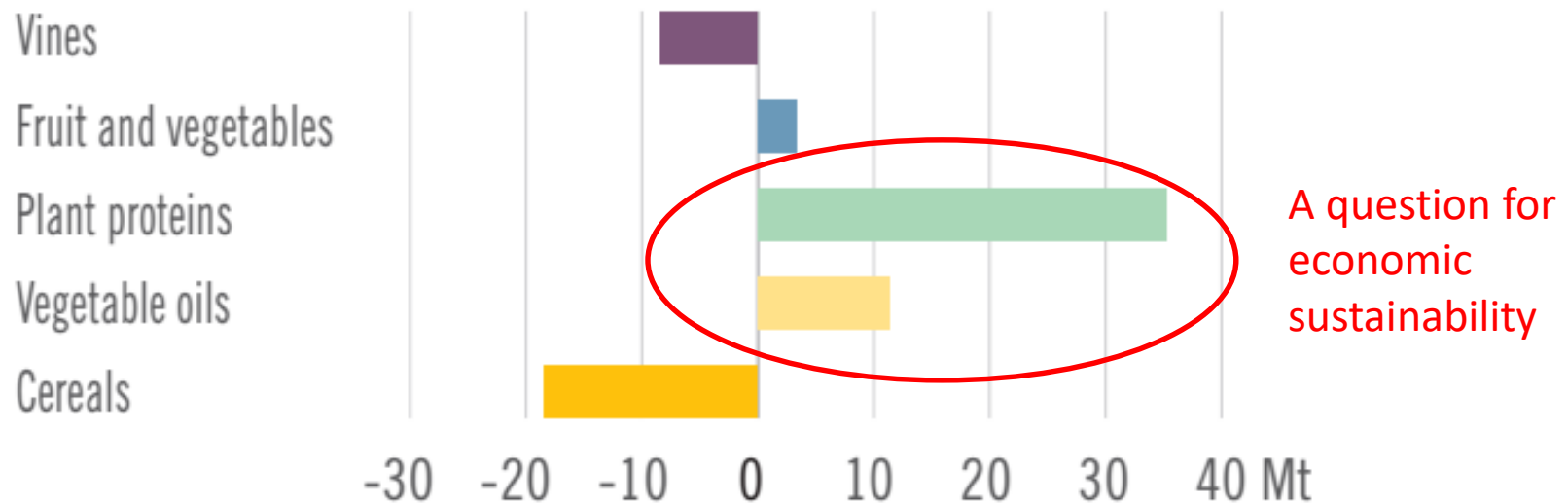
## Imports of soybeans, 1990–2028



Gale et al  
2019

# Import/export balance for EU food products

Poux & Aubert 2018, TYFA, IDDRI



Source: Eurostat. 2010

# From Nitrogen (N<sub>2</sub>) to proteins

Dinitrogen: very stable molecule, 78% of the atmosphere



N is a component of proteins, vital molecules

Two ways to transform N<sub>2</sub> into reactive Nitrogen:

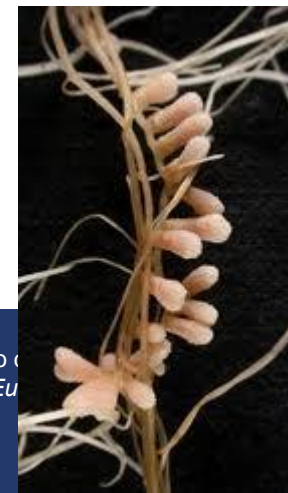
- Industrial chemical synthesis



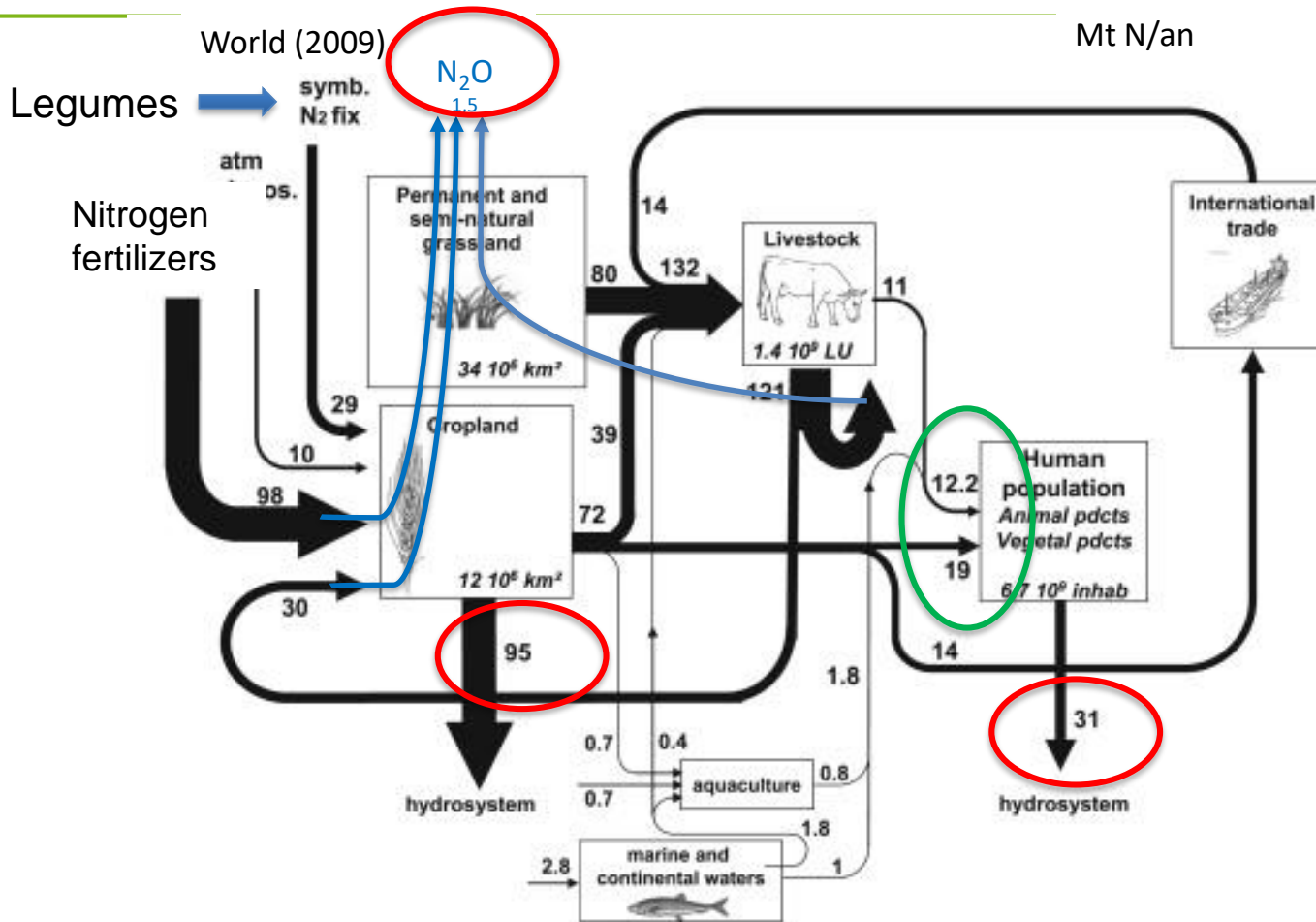
- Symbiosis plant + *Rhizobium*



Legume species  
(*Fabaceae*)



# Protein and N cycle at the world level



A question for environmental sustainability

Billen et al, 2014, Global Food Security 3, 209-219

An open nutrient cycle with huge losses

# A global statement

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A need to expand plant protein production

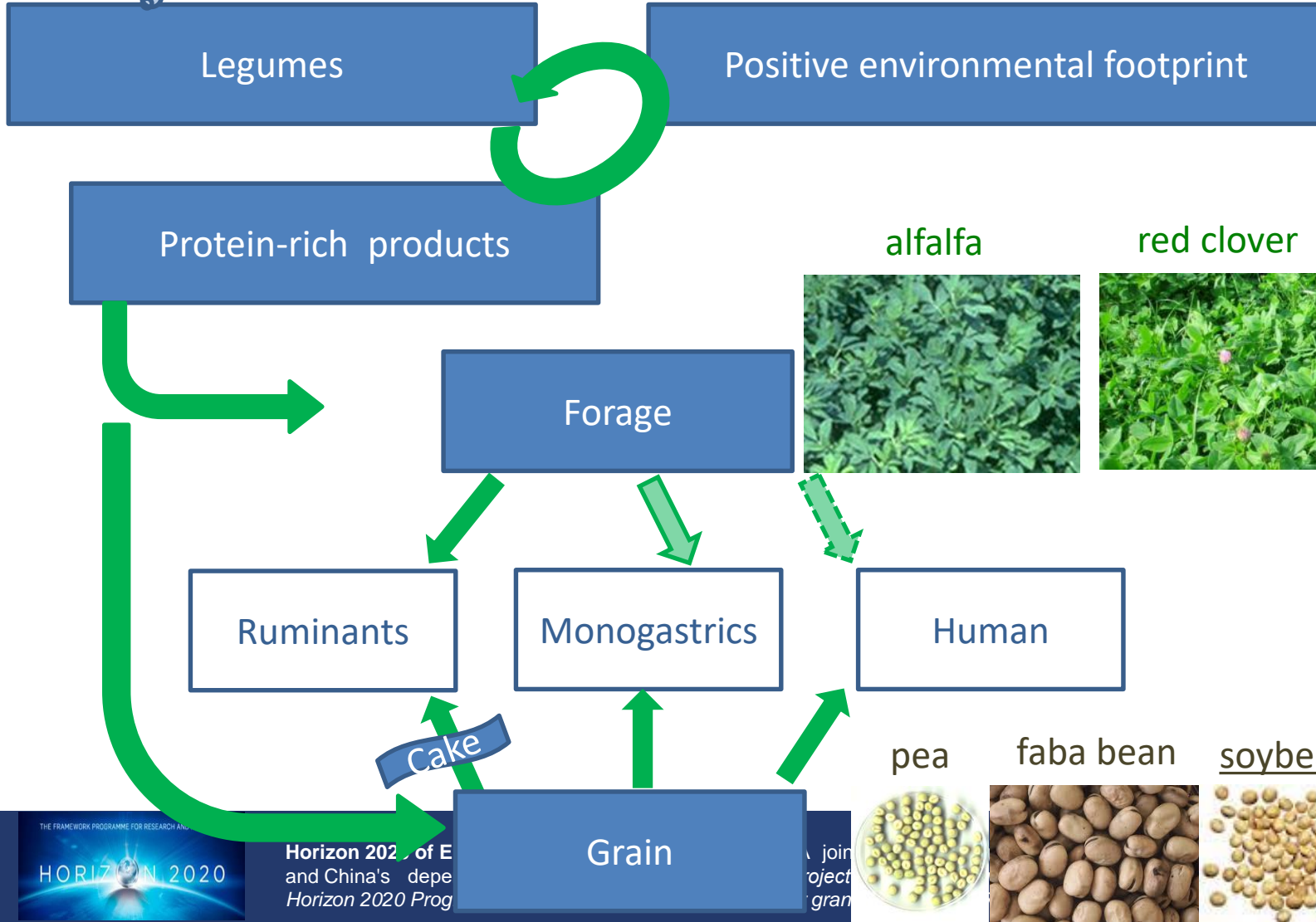
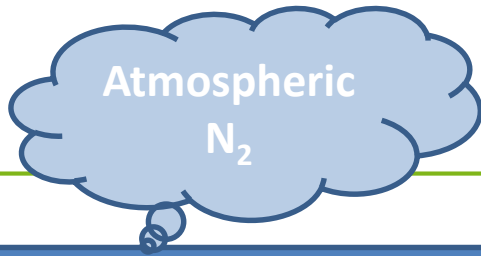
A need to increase nitrogen fixation

→ To grow more legumes





# 5 major species

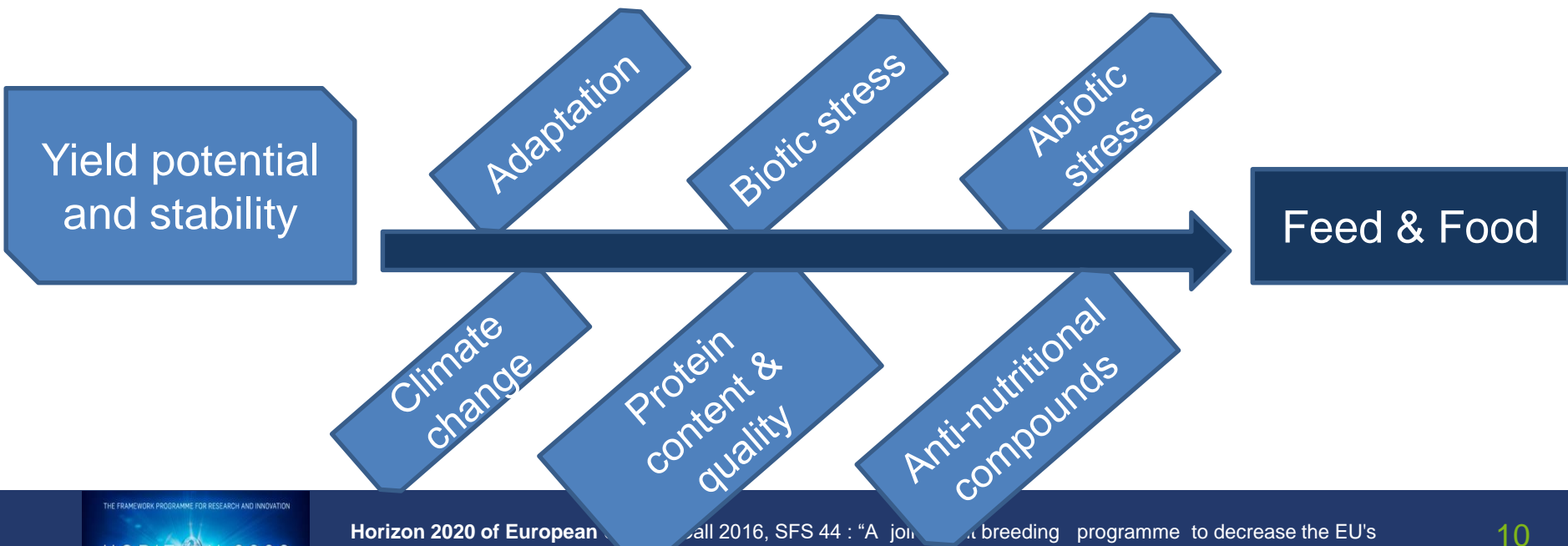


Horizon 2020 of E and China's dependence on Horizon 2020 Prog

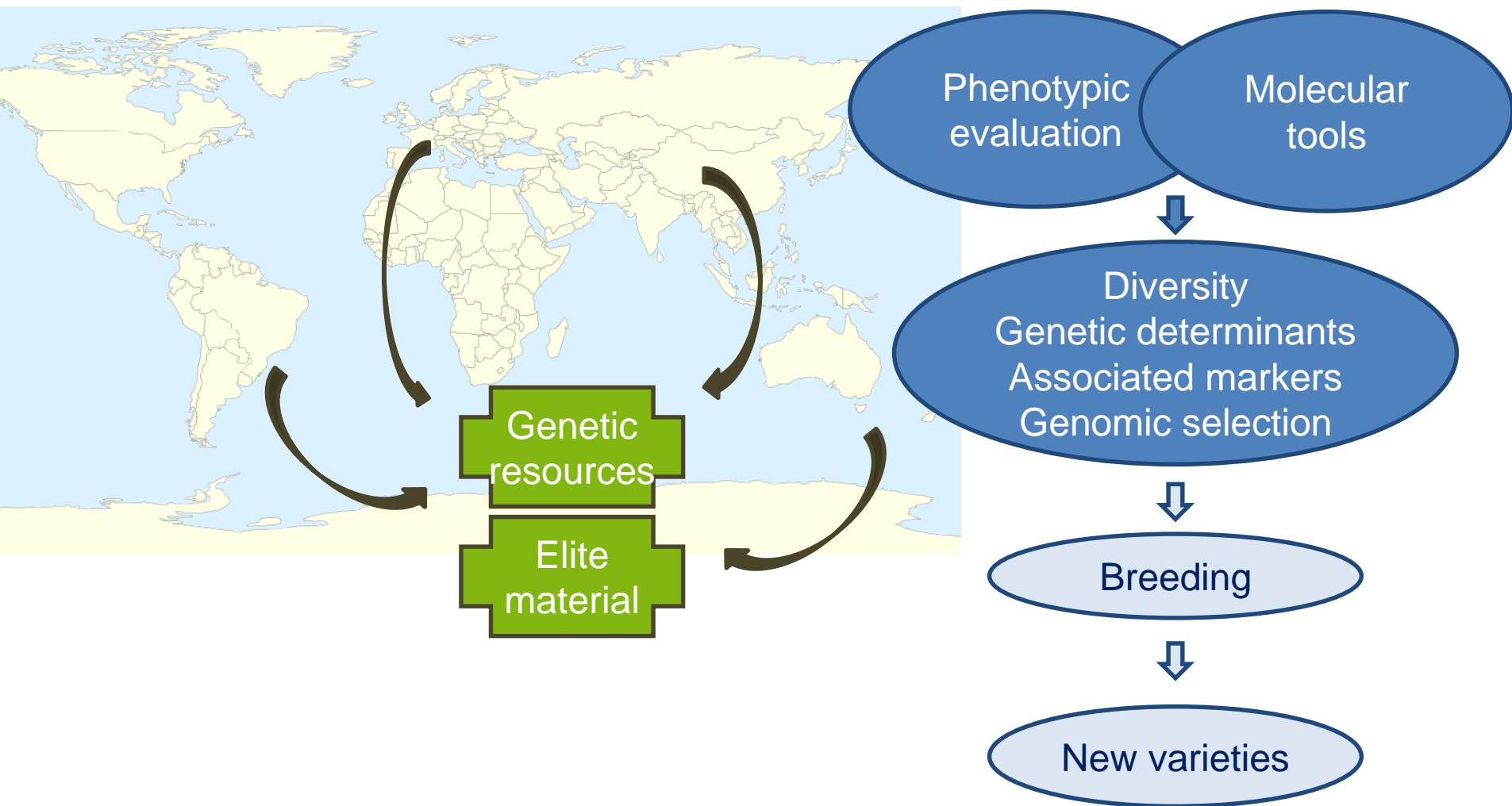
joint project gran

To increase protein production where legumes are already grown

To increase adaptation of legumes to more pedoclimatic regions



# EUCLEG: Genetics as a lever



## At the scientific level:

- **Broaden the genetic base of legume crops and analyse the genetic diversity** of European and Chinese legume accessions using phenotypic traits and molecular markers
- **Analyse the genetic architecture of key breeding traits** using association genetics (GWAS)
- **Evaluate the benefits brought by genomic selection (GS)** to create new legume varieties

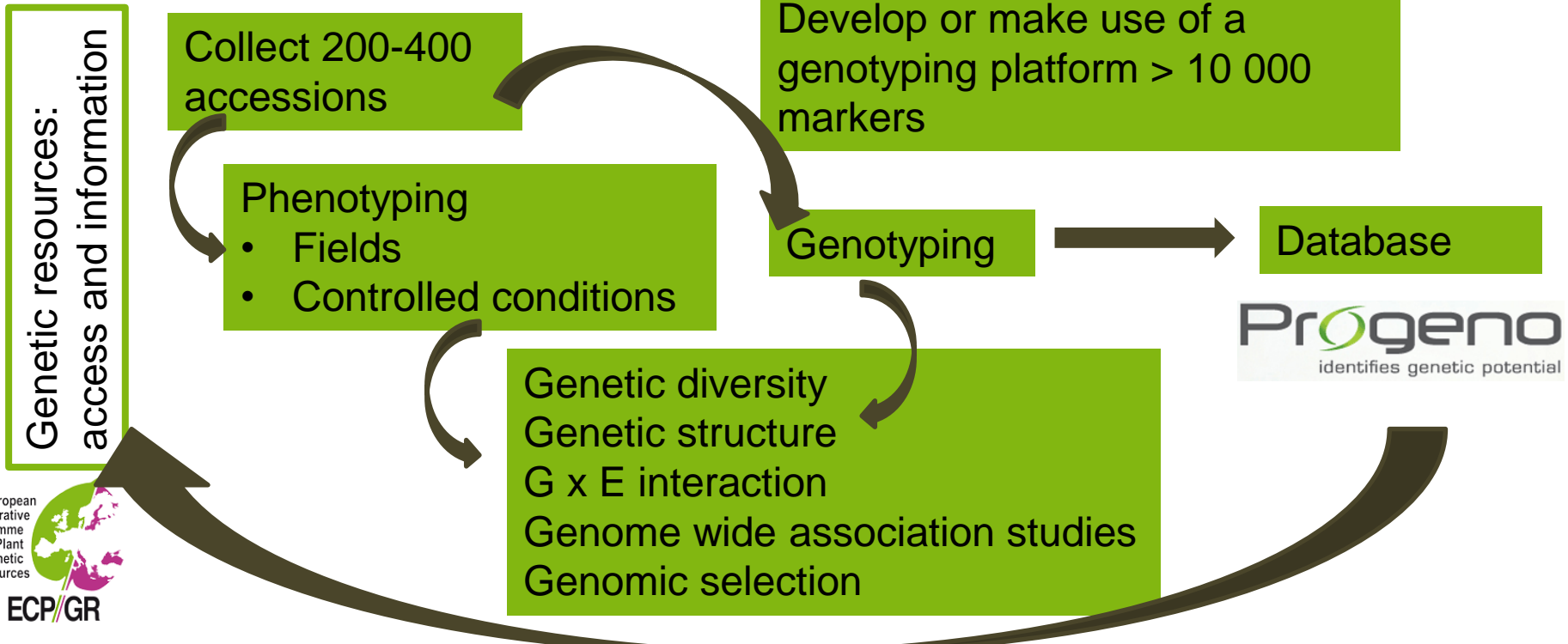
## At the technological level:

- **Develop searchable databases** containing passport data, as well as agronomic and genetic features
- **Develop molecular tools and data**

## At the applied level (breeding):

- **Develop tools for genotyping**
- **Implement data management and analysis**

# Eucleg workflow



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# Objectives of this workshop

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Disseminate the results obtained so far

- Progress on grain legumes (today)
- Progress on forage legumes (tomorrow)

Share general considerations:

- Design of multi-location experiments
- Genotyping methodologies
- Plant genetic resources

Talk and discuss with legume breeders to imagine future breeding  
« Post-Eucleg breeding »



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# Agenda – today : 30/09/2021



	<b>Speaker</b>	<b>topic</b>
09:00	Catherine Howarth IBERS	General Introduction
09:05	Bernadette Julier INRAE	Introduction to EUCLEG
09:20	Isabel Roldán-Ruiz EV-ILVO	Lessons learned on the design and planning of scale multi-location trials and phenotypic assessment for association studies
10:00	David Lloyd Germinal	Introduction to inbreeding species: traditional breeding methodologies
10:15		<b>break</b>
10:30	Hilde Muylle EL-ILVO	Genomics assisted breeding in soybean
11:10	David Lloyd Agro Seed Research	Genomics assisted breeding in pea (Presented on behalf of Radu Grumeza)
11:50	Ana Maria Torres IFAPA	Genomics assisted breeding in faba bean
12:30		close



# Agenda – tomorrow : 01/10/2021

## 1st October 2021

	<b>Speaker</b>	<b>topic</b>
09:00	Leif Skot Aberystwyth University	Selection of genotyping platforms: GBS and SNP arrays for individuals and populations
09:40	Stephan Weise IPK	Plant Genetic Resources and how to access their information through information systems
10:20	David Lloyd	Introduction to outbreeding species: traditional breeding methodologies
10:35		<b>break</b>
10:50	Bernadette Julier INRAE	Genomics assisted breeding in alfalfa
11:30	Roland Kölliker ETH Zürich	Genomics assisted breeding in red clover
12:10		General discussion and close

**It is still time to register**

<https://app.livestorm.co/inrae/eucleg-workshop>





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