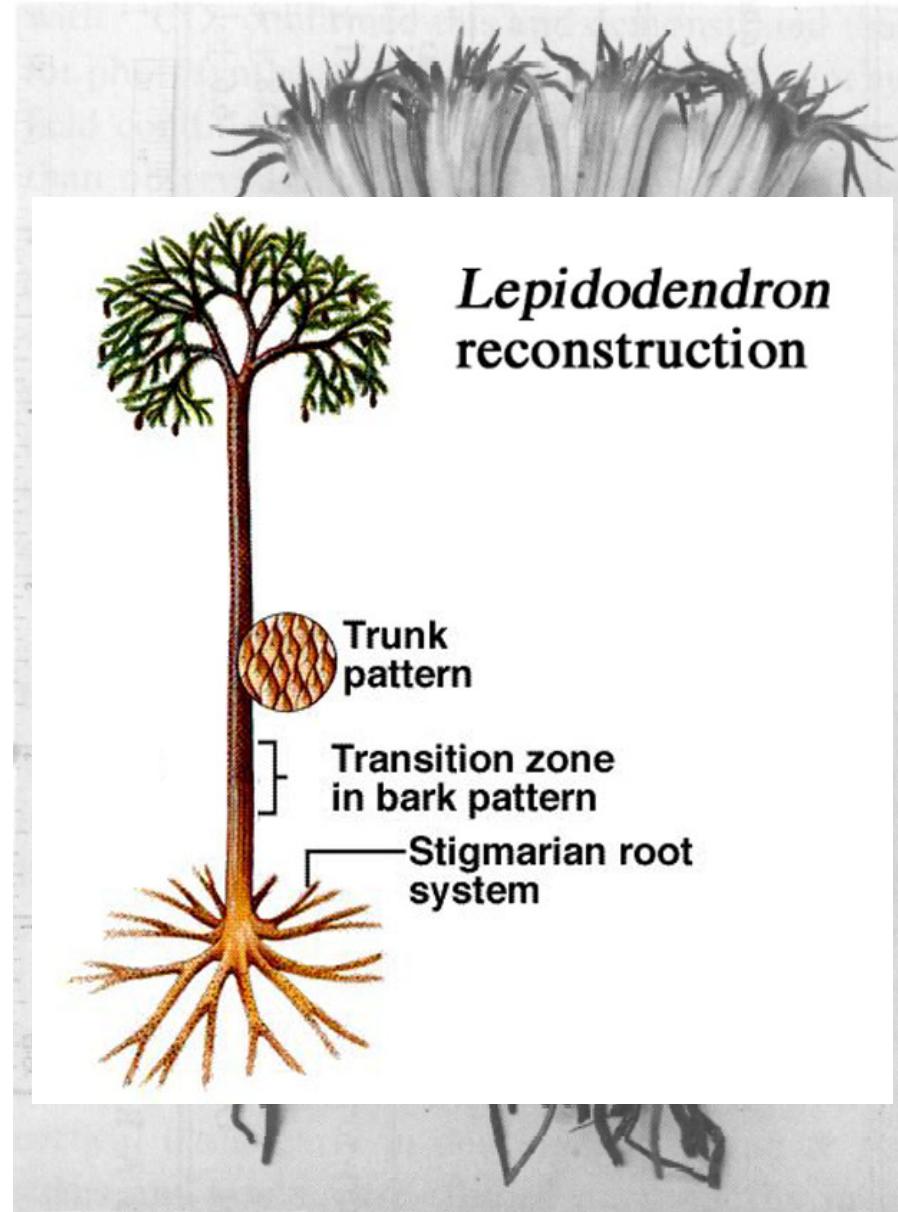


# Plant of the Day

*Isoetes andicola*

- Lycophyte endemic to Peru at high elevations
- Restricted to the edges of bogs and lakes
- Leaves lack stomata and so CO<sub>2</sub> is obtained from sediment via the roots
- Carbon fixation occurs via the C<sub>3</sub> pathway by day, but via a CAM-like process at night
- Members of the quillwort family (*Isoetaceae*) are the nearest living relatives of the ancient “scale trees” (e.g. *Lepidodendron*)





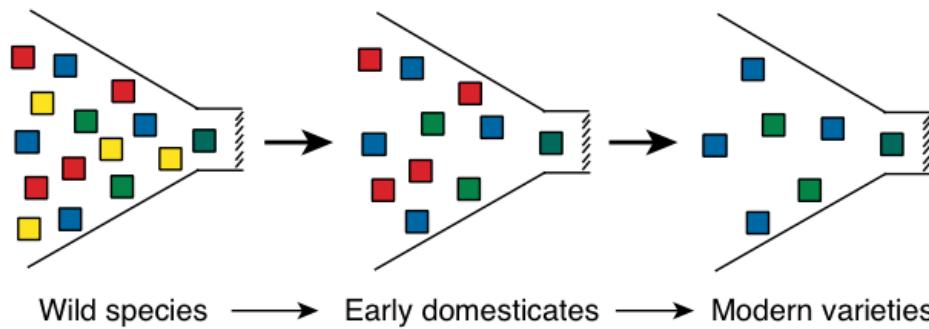
Crop diversity

# Big Questions

- Why is crop diversity/agrobiodiversity important?
- What changes have occurred/are predicted to occur in global crop diversity?
- What are the major threats to crop diversity?
- What solutions do we have to these threats?

# Crop diversity

- Most crop species have lower genetic diversity than their wild progenitors due to the ‘domestication bottleneck’



- However, crop species commonly harbor many distinct varieties and landraces that arose as a result of artificial, diversifying selection.

# Crop diversity

- e.g. potatoes (*Solanum tuberosum*)

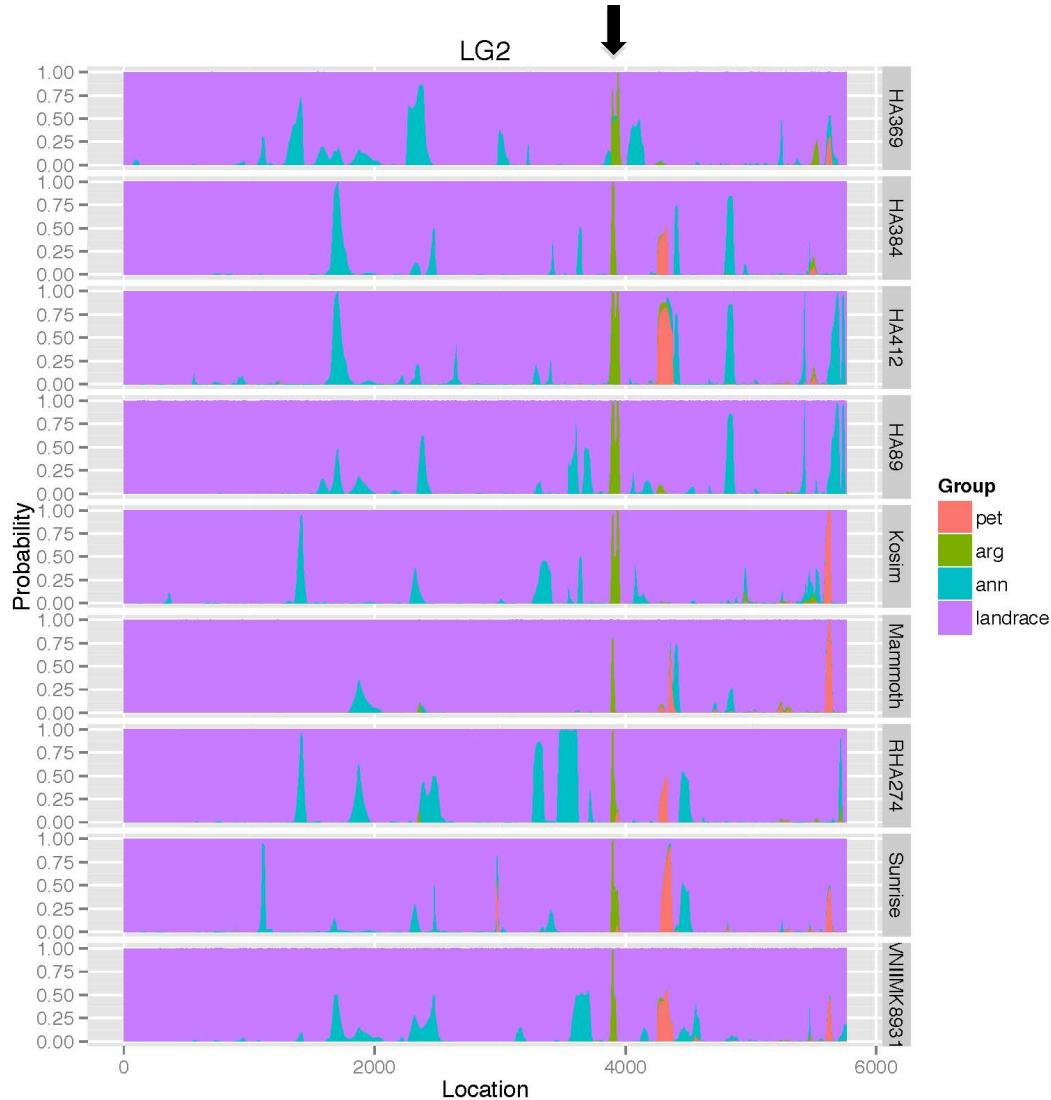


# **Major uses of crop diversity**

- Interspecific diversity (crop wild relatives) as well as intra-specific diversity are an important source for new alleles (such as disease resistance) in crop improvement efforts.

# From last week: Where does the cultivated gene pool come from?

## Sclerotinia resistance locus



## Wild Introgressions



# Major uses of crop diversity

- Interspecific diversity (crop wild relatives) as well as intra-specific diversity are an important source for new alleles (such as disease resistance) in crop improvement efforts.
- Different landraces and varieties are often well adapted to their local/regional agro-ecological niche and are unique in many phenotypic traits, such as stress response/resistance.



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- Agro-biodiversity is thought to have the potential to play a major role in climate-change adaptations of agro-ecosystems

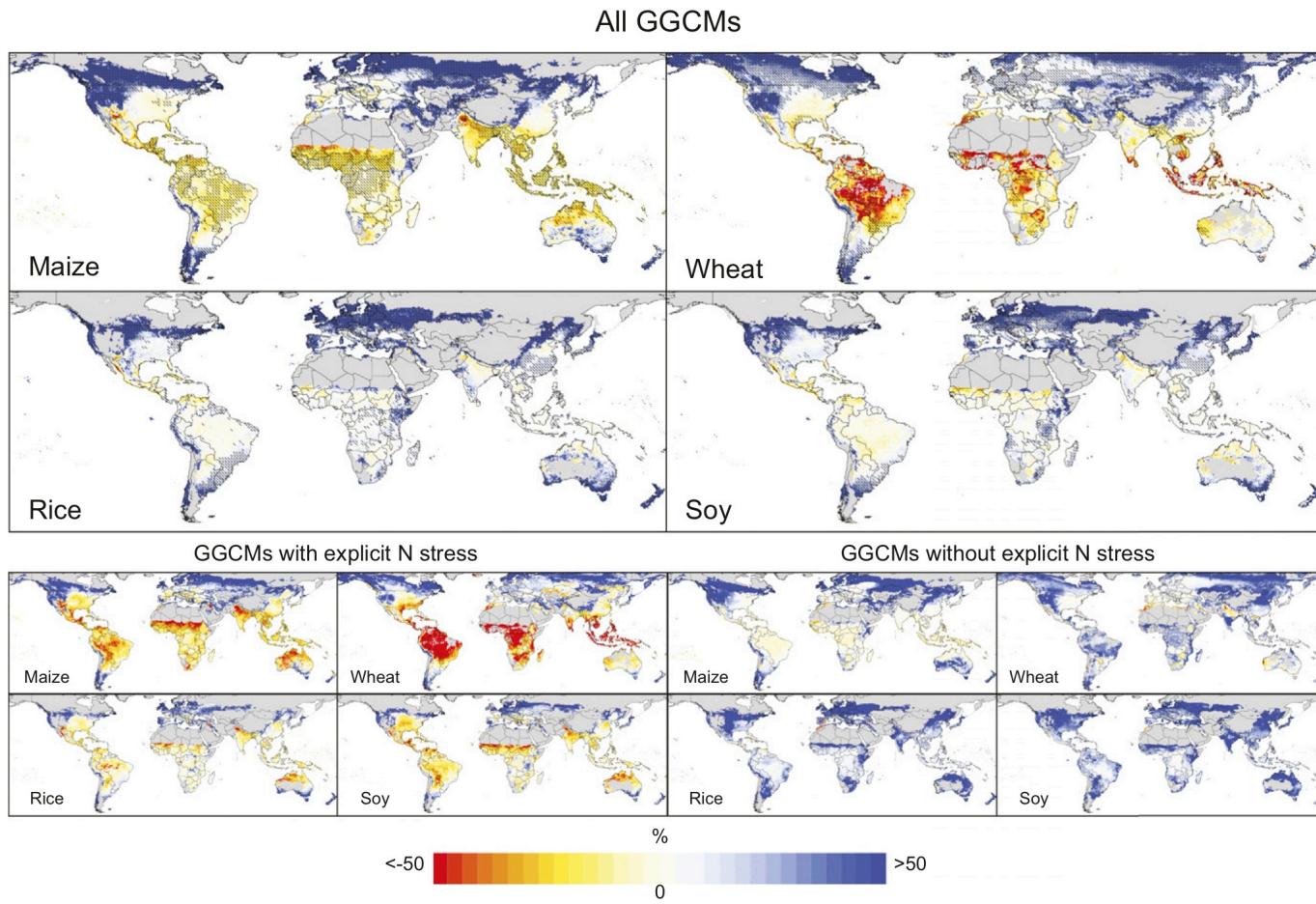
## Newsweek

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### Peruvian Farmers Adapt to Global Warming

By Newsweek Staff | 3/13/10 at 7:43 PM

# Global gridded crop models predict large reductions in yields of major crops (especially under nitrogen stress)



# **Major uses of crop diversity**

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- Different landraces and varieties are often well adapted to their local/regional agro-ecological niche and are unique in many phenotypic traits, such as stress response/resistance.
- Agro-biodiversity is thought to have the potential to play a major role in climate-change adaptations of agro-ecosystems
- Indigenous people who cultivate much of the world's traditional crop diversity have often unique knowledge about uses of such diversity unknown to western society

# Major uses of crop diversity



Chuño, a variety of “freeze-dried” potato that can be stored long term

Wild relatives of millet in Uganda  
(Global Crop Diversity Trust)

*P. unisetum*



*With the heavily cultivated ecosystems, local elders helped in tracing the remnants of the species*

# Major uses of crop diversity



Mexican maize

# **Major uses of crop diversity**

Although we emphasize the benefits of using diversity in crop breeding, it's not always used.

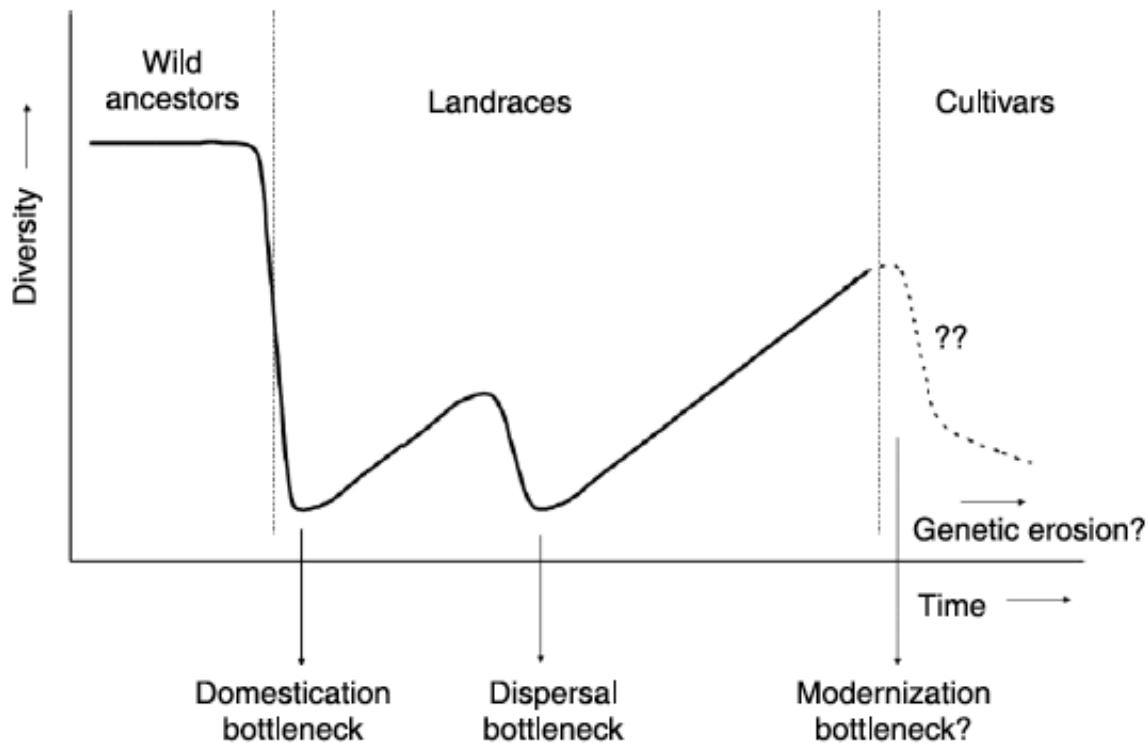
## **THINK – PAIR - SHARE**

What are some reasons why crop wild relatives aren't used?

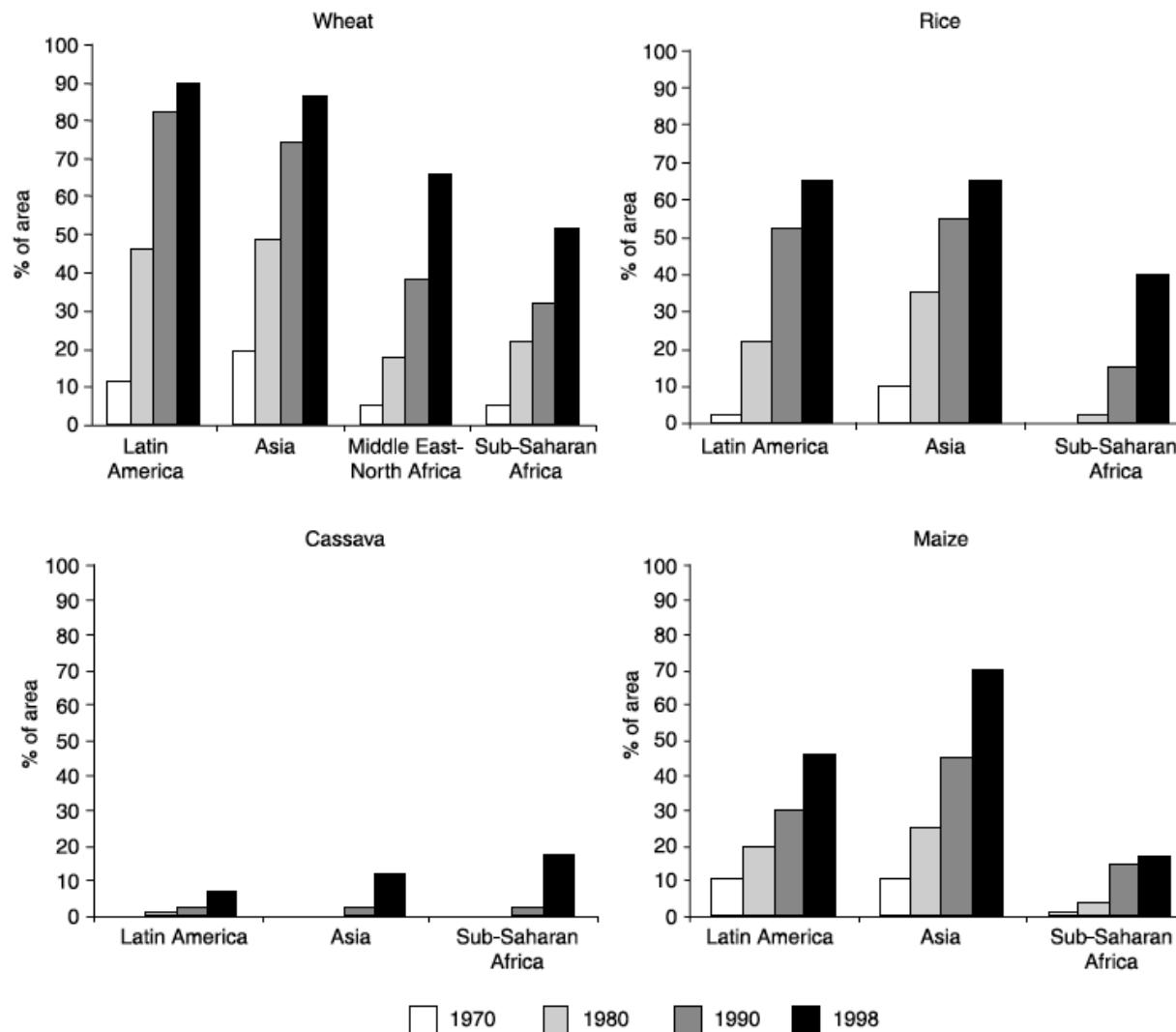
Is it better to use wild relatives or other cultivars?

# Major threats to crop diversity

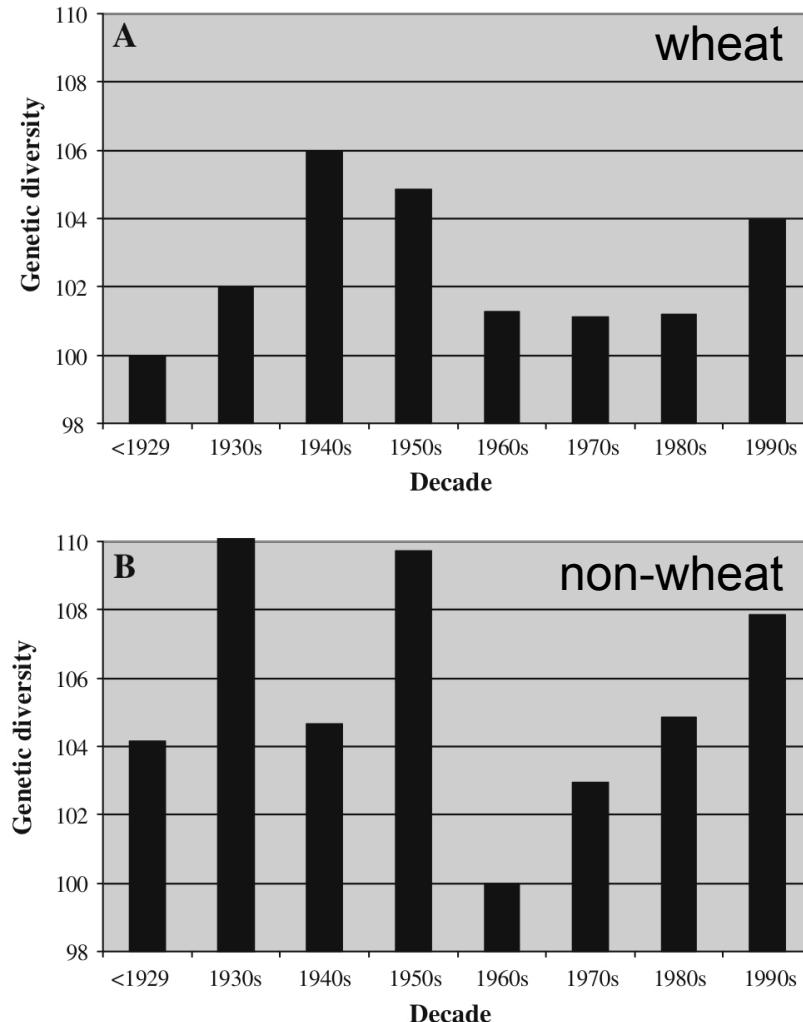
- Agricultural intensification and crop monocultures can lead to genetic erosion (loss of genetic diversity) in crops



# Uptake of modern varieties



# However, the evidence for a modernization bottleneck is equivocal



From a meta-analysis of 24 wheat and 20 non-wheat studies of crop genetic diversity through time.

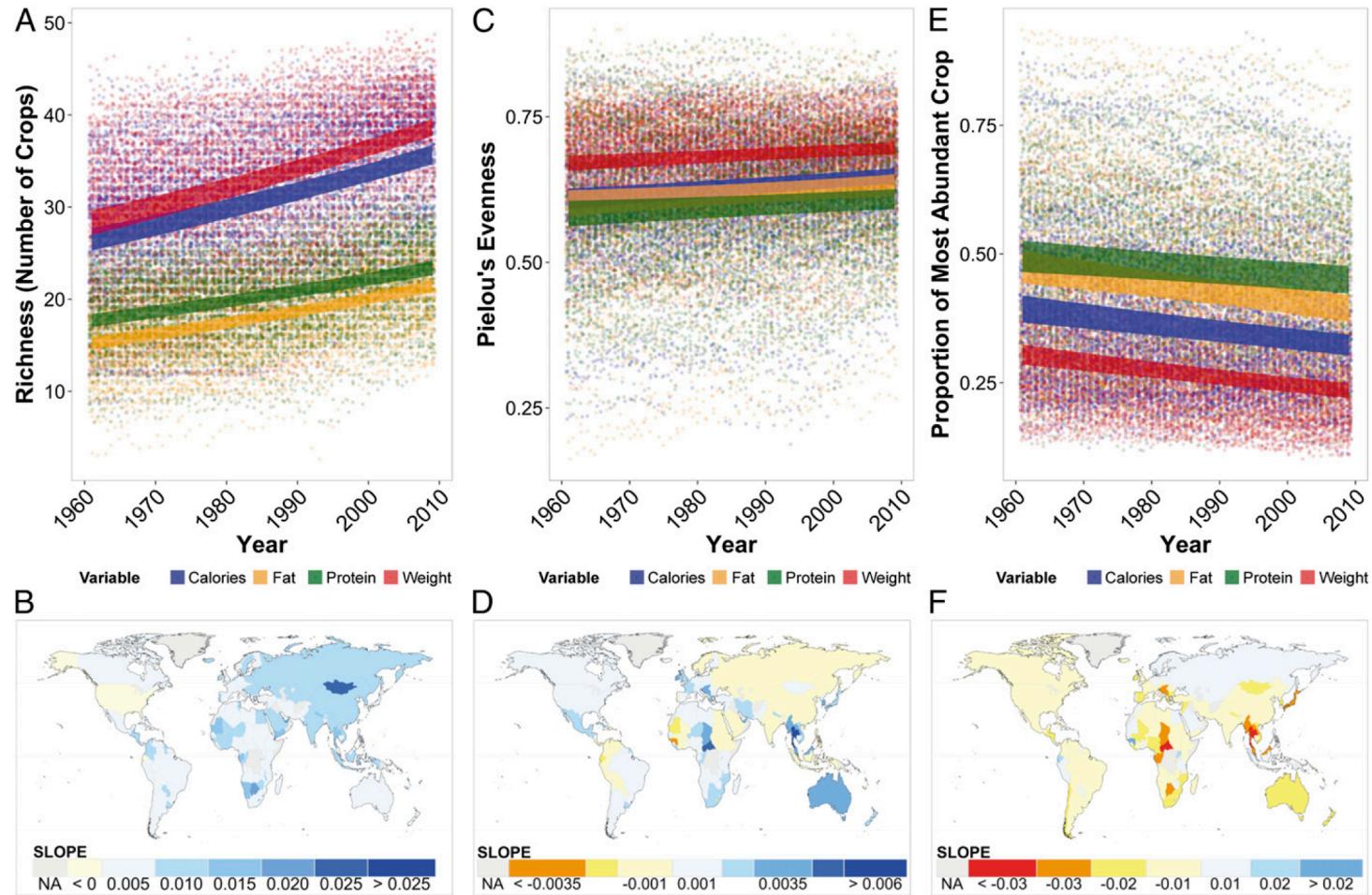
Van der Wouw *et al.* 2010

# Major threats to crop diversity

- Agricultural intensification and crop monocultures can lead to genetic erosion (loss of genetic diversity) in crops
- Crop replacement as dictated by the global marketplace or as development strategy can lead to the loss of entire crop species



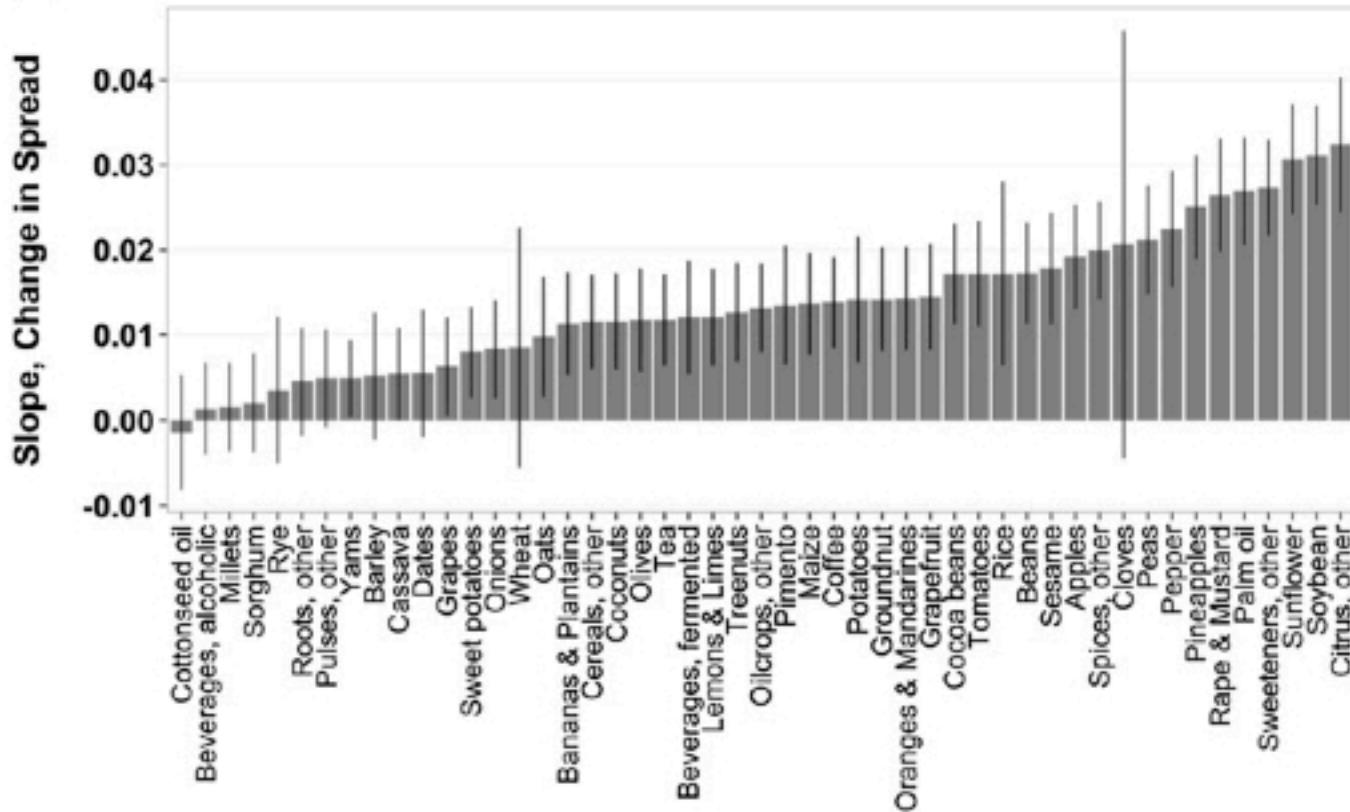
# Changes in crop commodities worldwide



National food supplies contain more crop species (A & B), slightly increased evenness of crop contribution to calories (C & D), and reduced dominance by a single crop (E & F) over the last 50 years

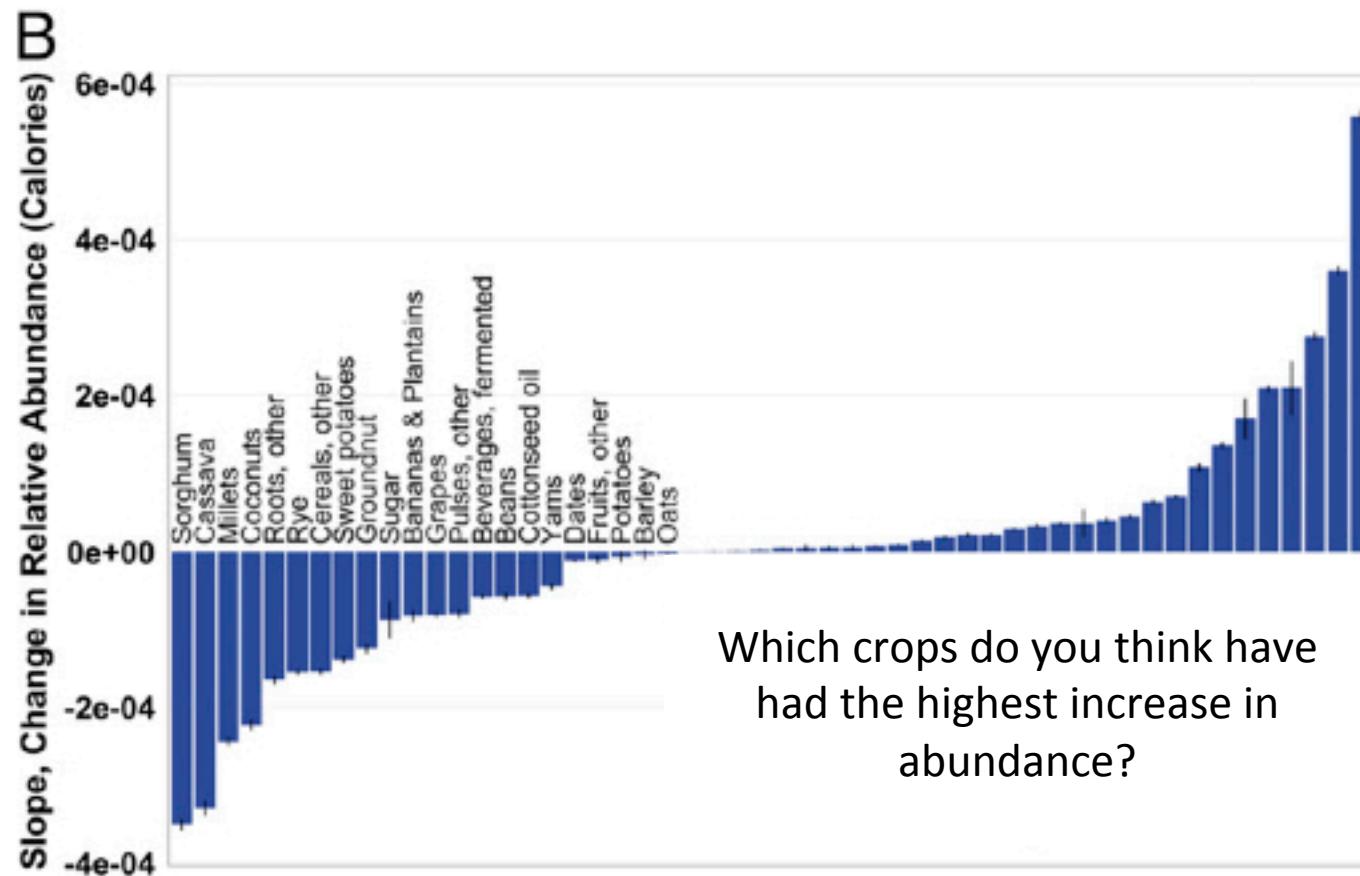
# Change in crop geographic spread in national diets, 1961–2009

A



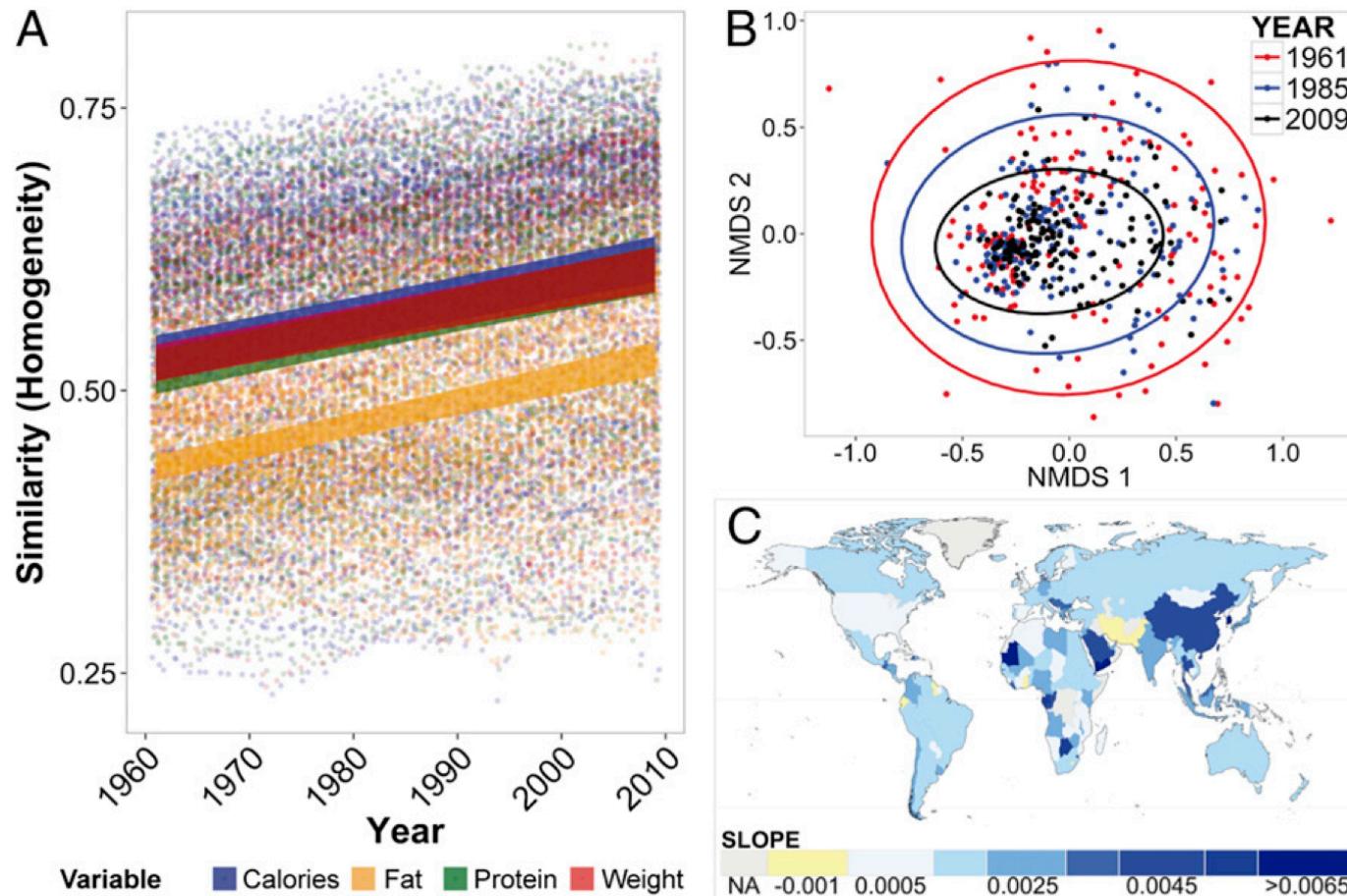
All crops (except cottonseed oil) are contributing to food supply in an increasing number of countries

# Change in crop abundance (calories) in national diets, 1961–2009

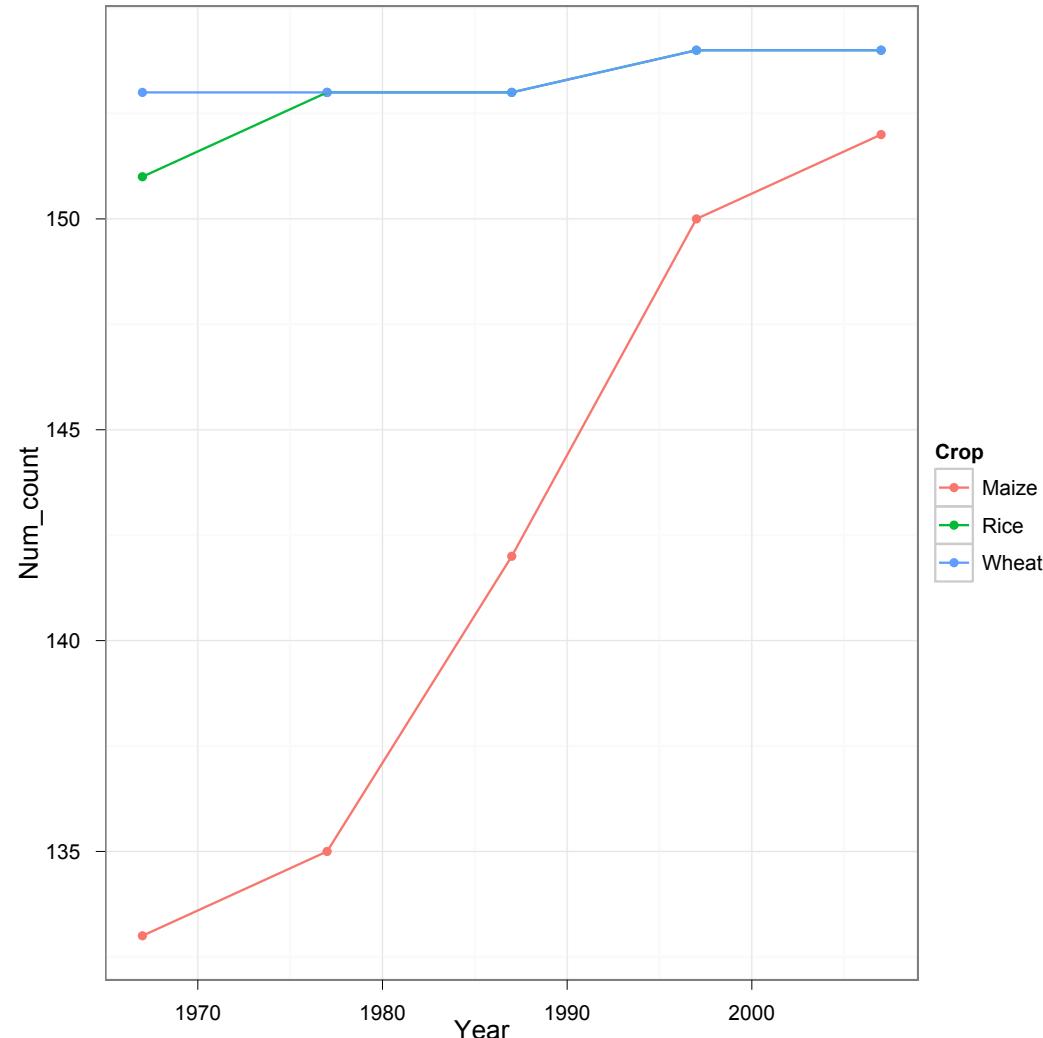


The degree of increase in spread (see previous slide) predicts the abundance of crop species in national food supplies.

# Increase in homogeneity among national diets (crop contribution to calories), 1961–2009



# Change in number of countries in which maize, rice and wheat are being eaten



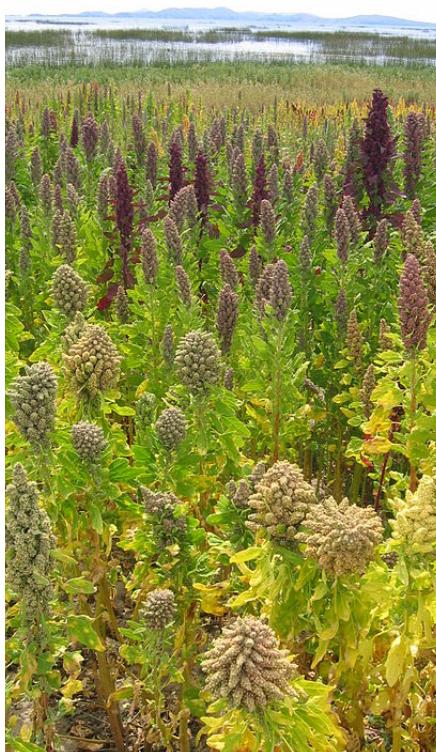
# Neglected and Underutilized Species



# **What are neglected and underutilized species?**

- At present, only 150 plant species are used and commercialised on a significant global scale
- Over 50% of the world's requirement for protein and calories are met by only three: rice, wheat and maize.
- There are an estimated 7,000 species that play a crucial role in poor people's livelihood strategies and may have a significant potential for commercialisation.
- Alongside their commercial potential, many of the underutilised plant species also provide important environmental services, as they are adapted to marginal soil and climate conditions.

# **Underutilized Species have the potential to contribute to livelihood improvement by:**



- increasing incomes
- ensuring food security
- improving nutrition
- enhancing biodiversity
- tolerating stress conditions
- occupying important ecological niches
- production with low external inputs
- stabilizing ecosystems
- creating new markets

# Conserving Crop Genetic Diversity

*in – situ* conservation



vs.

*ex – situ* conservation



# Global *ex situ* conservation

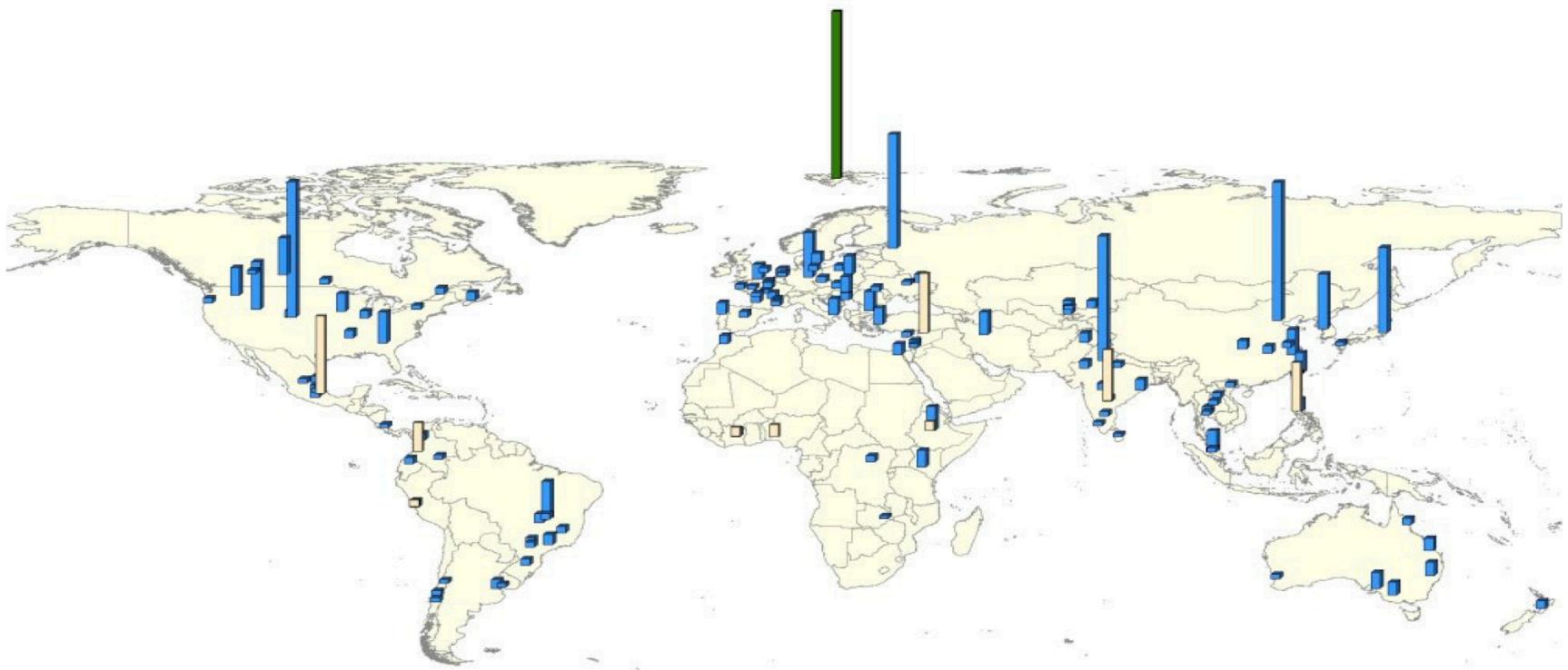


Fig. 1. Geographic distribution of genebanks with holdings of >10,000 accessions (*Source*: FAO, 2010)

From Dulloo *et al.* 2010

# An example of *ex situ* conservation

## The ‘Doomsday’ vault



Video of the vault: <https://www.youtube.com/watch?v=QHw4AxJX5Wo>

# Unanswered Questions

- Will global diets continue to homogenize?
  - In highly developed countries, a diverse diet is often a signal of wealth.
- Will our efforts to save genetic diversity of crops and wild relatives be enough?
  - To increase yield
  - To adapt to changing climates
- What will be (or will there be) the next revolution in crop breeding?