http://croptrust.org

GLOBAL CROP DIVERSITY TRUST
A FOUNDATION FOR FOOD SECURITY

Adapting to climate change: the importance of *ex situ* conservation of crop genetic diversity

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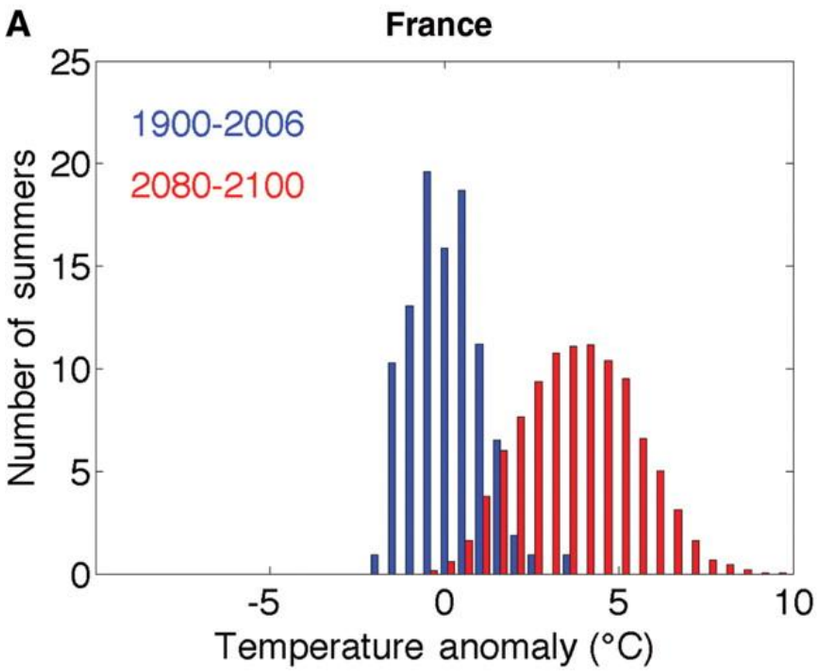
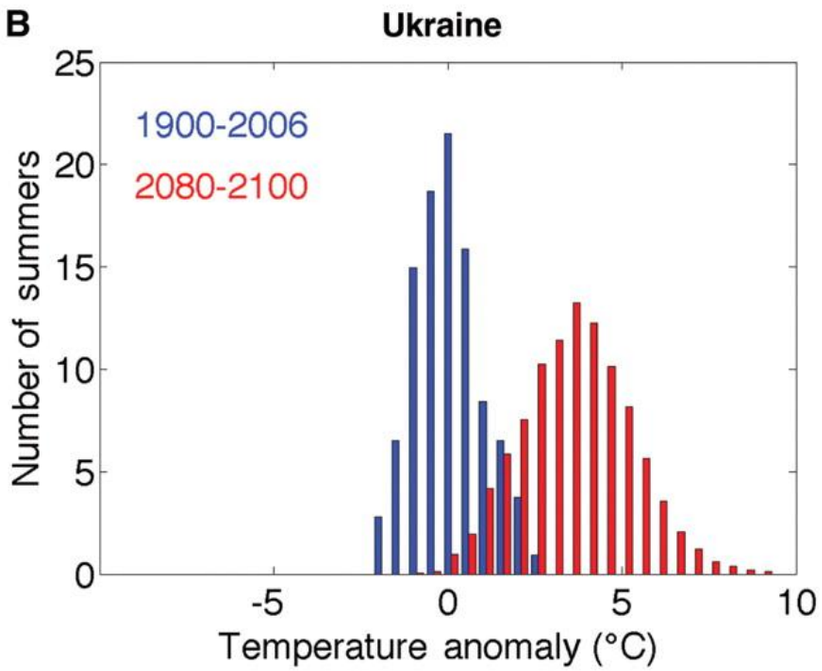
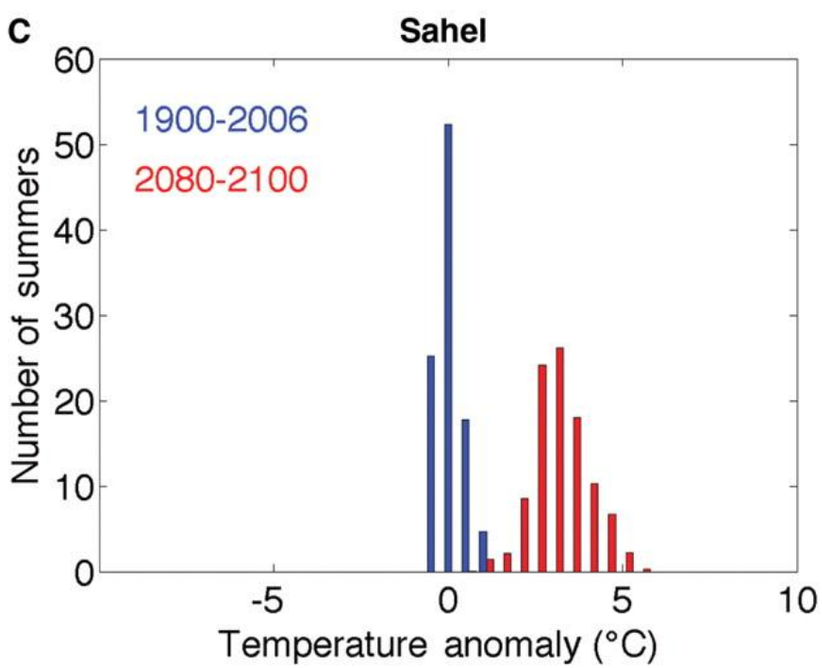
A new world



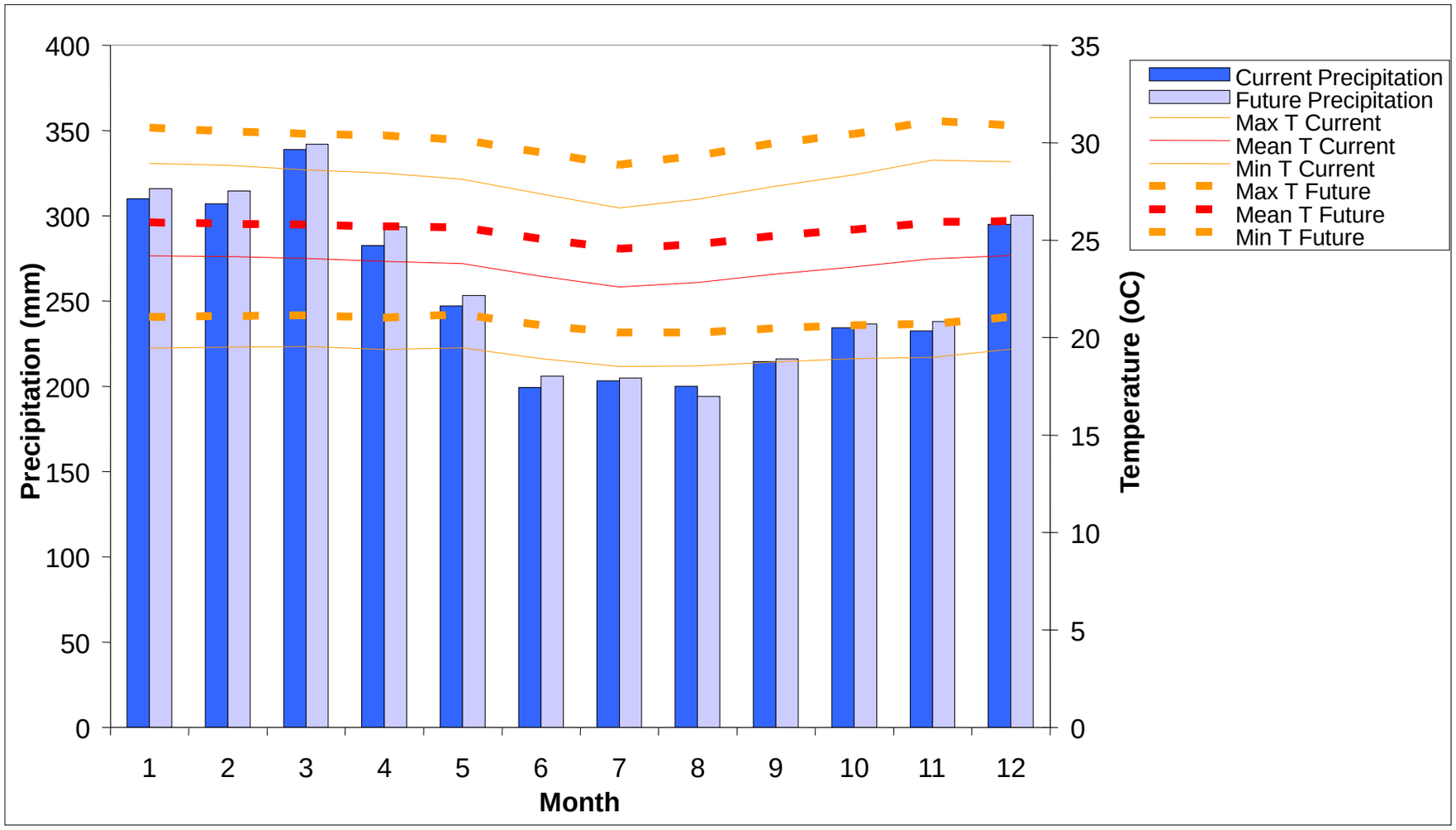




Distributions of average (summer) temperature for 20th century (blue), and climate model projections for 2080-2100 (red) (y = number of summers, x = departure from long-term 20th century mean)

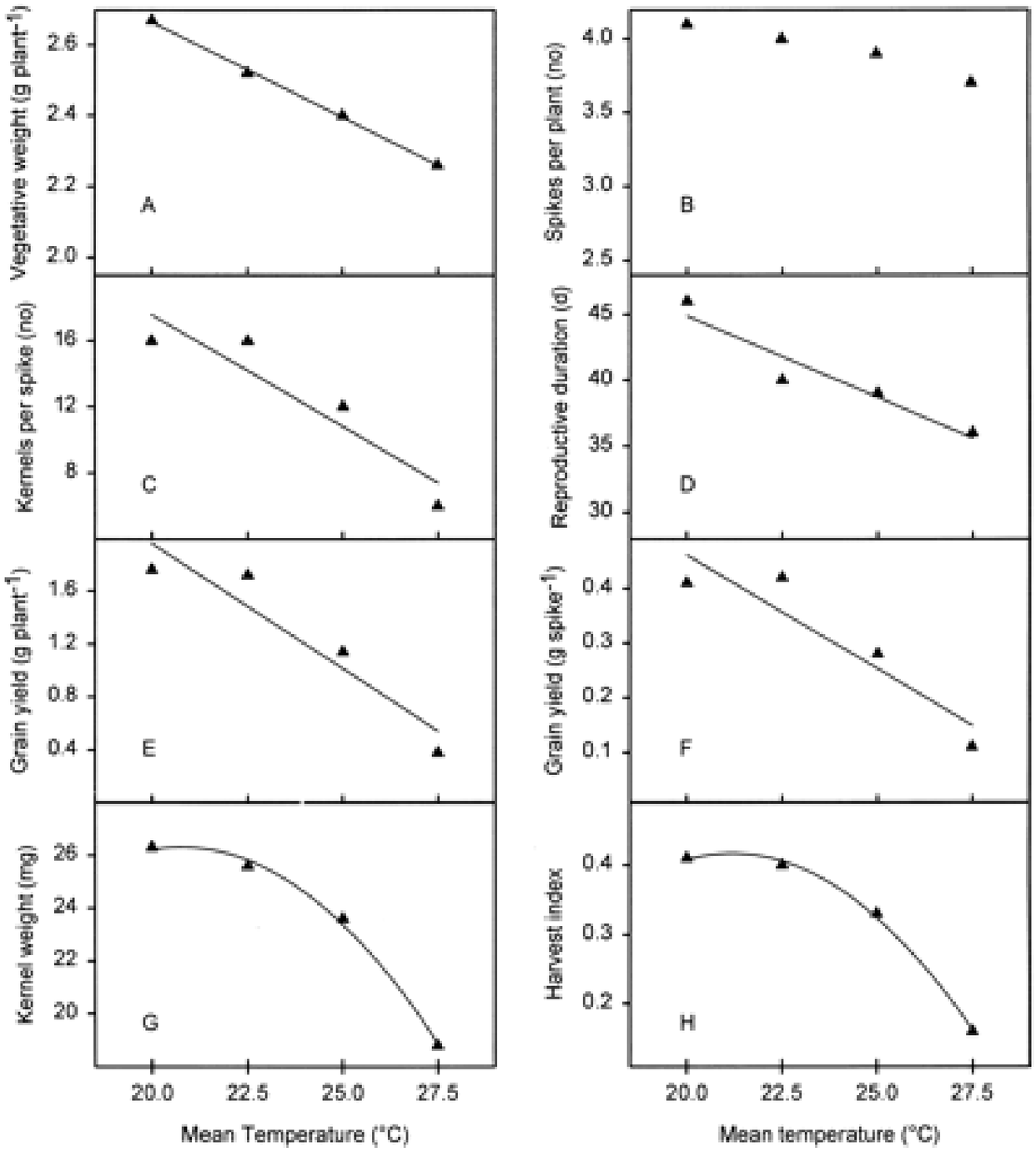
Source: Battisti, D.S., and R.L. Naylor. 2009. Historical warnings of future food insecurity with unprecedented seasonal heat. *Science*, 323, 240-244.

The rainfall increases from 3064.37mm to 3129mm
The wet season gets wetter with 373.92mm instead of 364.09mm in the wettest quarter and is 1.92C hotter
The dry season gets dryer with 152mm in the dryest quarter and an increase in temperature of 2.04C
Overall this climate becomes more seasonal in terms of variability through the year in precipitation
Temperatures increase, with a mean increase of 2C
The maximum temperature of the hottest month increases from 29.2oC to 31.43C
The minimum temperature of the coldest month increases from 18.43C to 20.1C
The daily range in temperature increases from 9.08C to 9.42C
The length of the dry season increases from 0.79 months to 0.87 months
The coefficient of variation of predictions between models is 2.99% for temperature and 4.64% for precipitation



Papua New Guinea

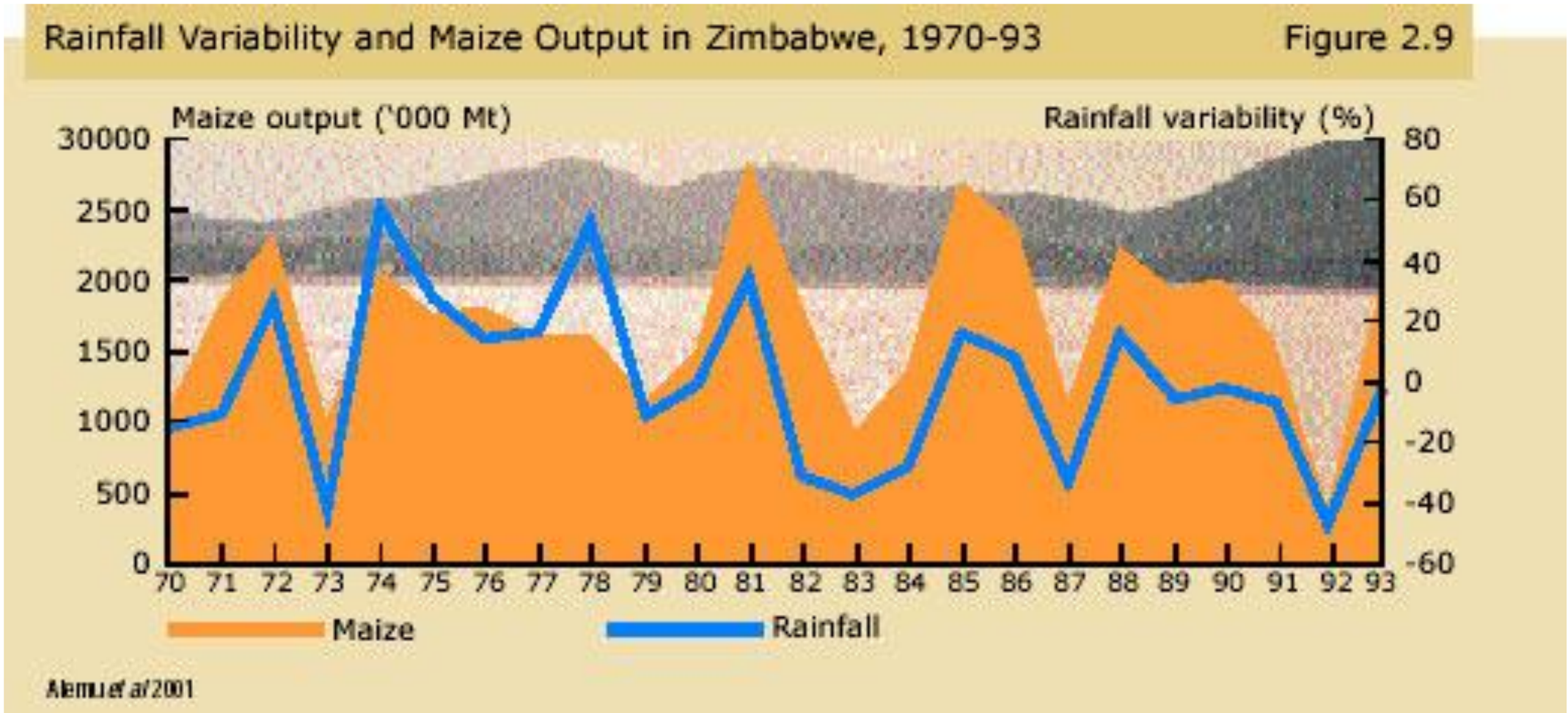
Yield and temperature



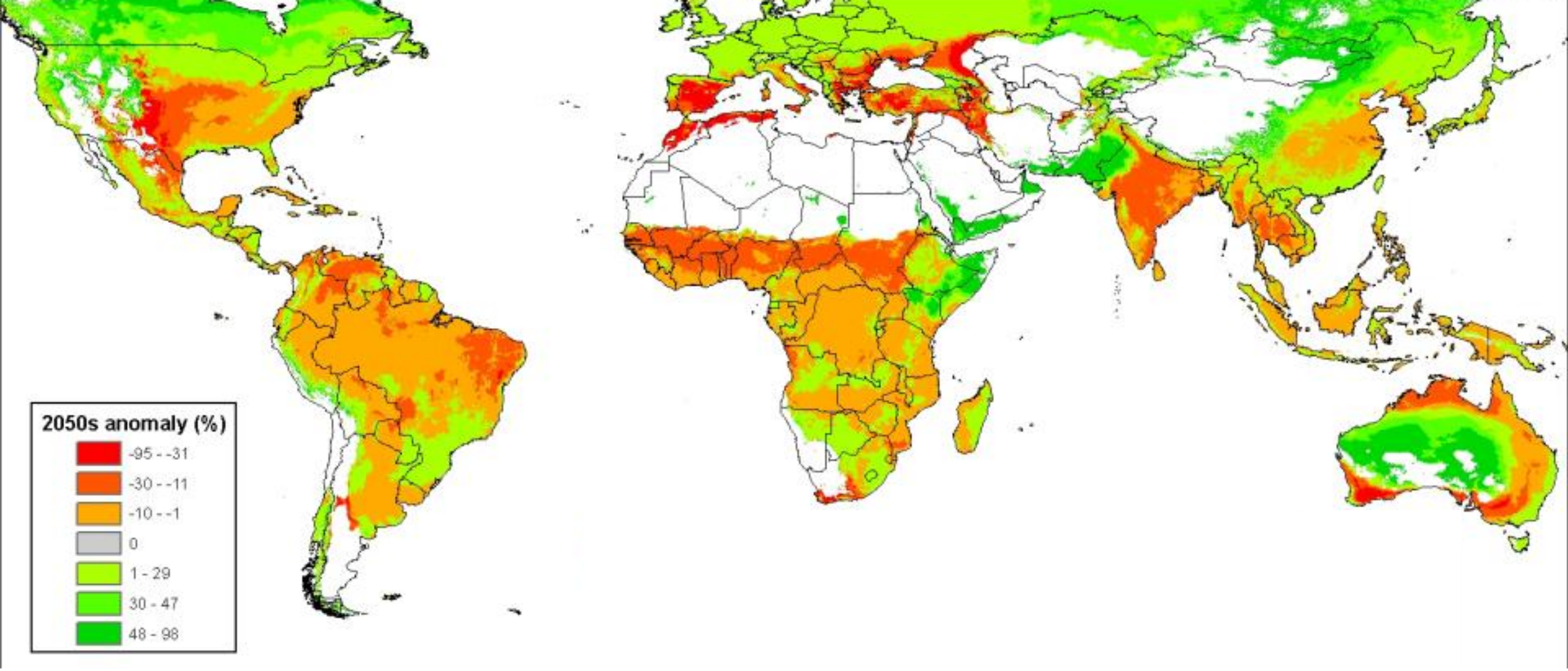
The response of vegetative weight (A), spikes per plant (B), kernels per spike (C), reproductive duration (D), grain yield per plant (E), grain yield per spike (F), kernel weight (G), and harvest index (H) of Karl 92 wheat to increasing temperature applied from 10 d after anthesis until ripeness.

Source: Gibson L.R. and Paulsen G.M. 1999. Yield Components of Wheat Grown under High Temperature Stress during Reproductive Growth. *Crop Sci.* 39: 1841-1846.

Yield and precipitation

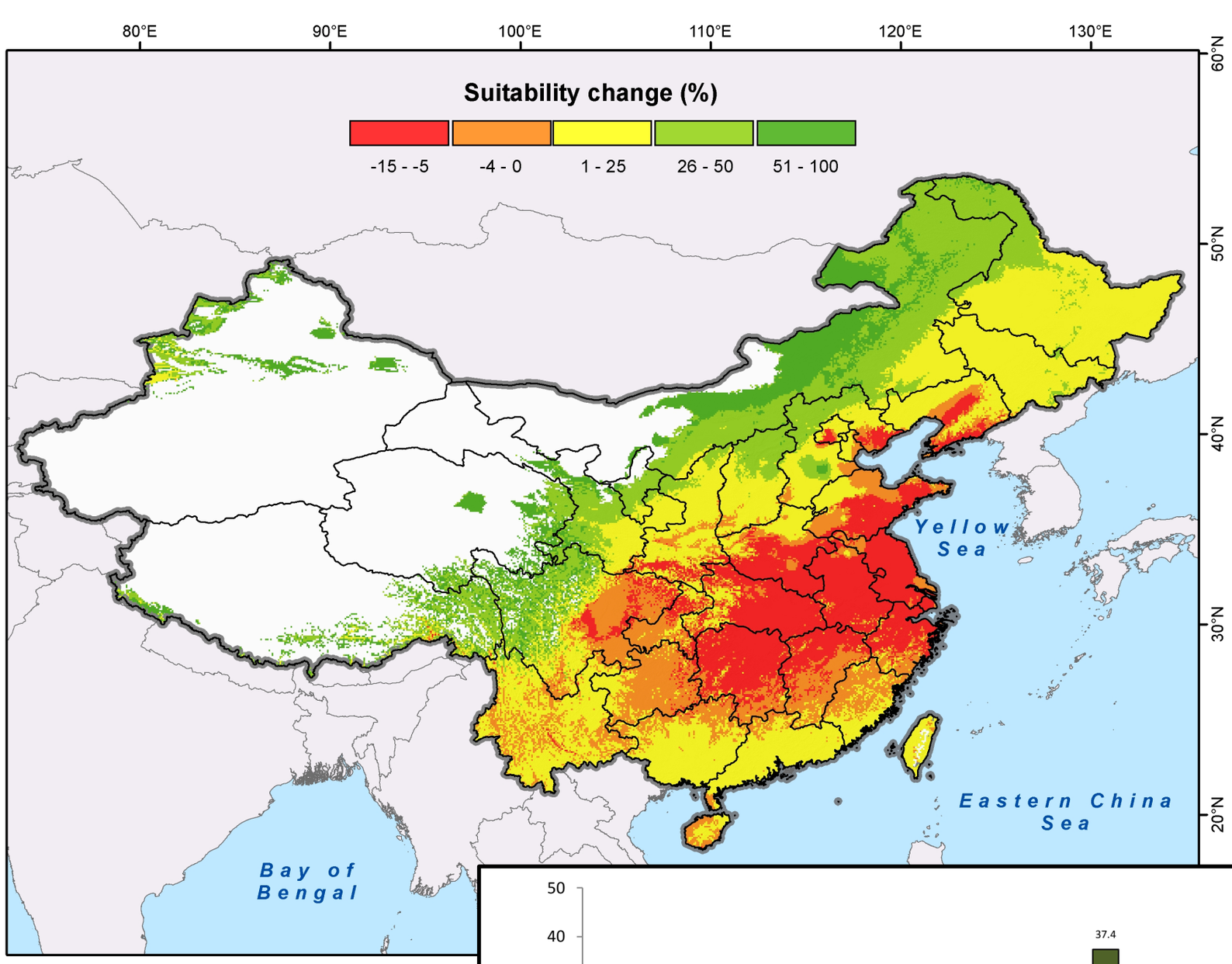


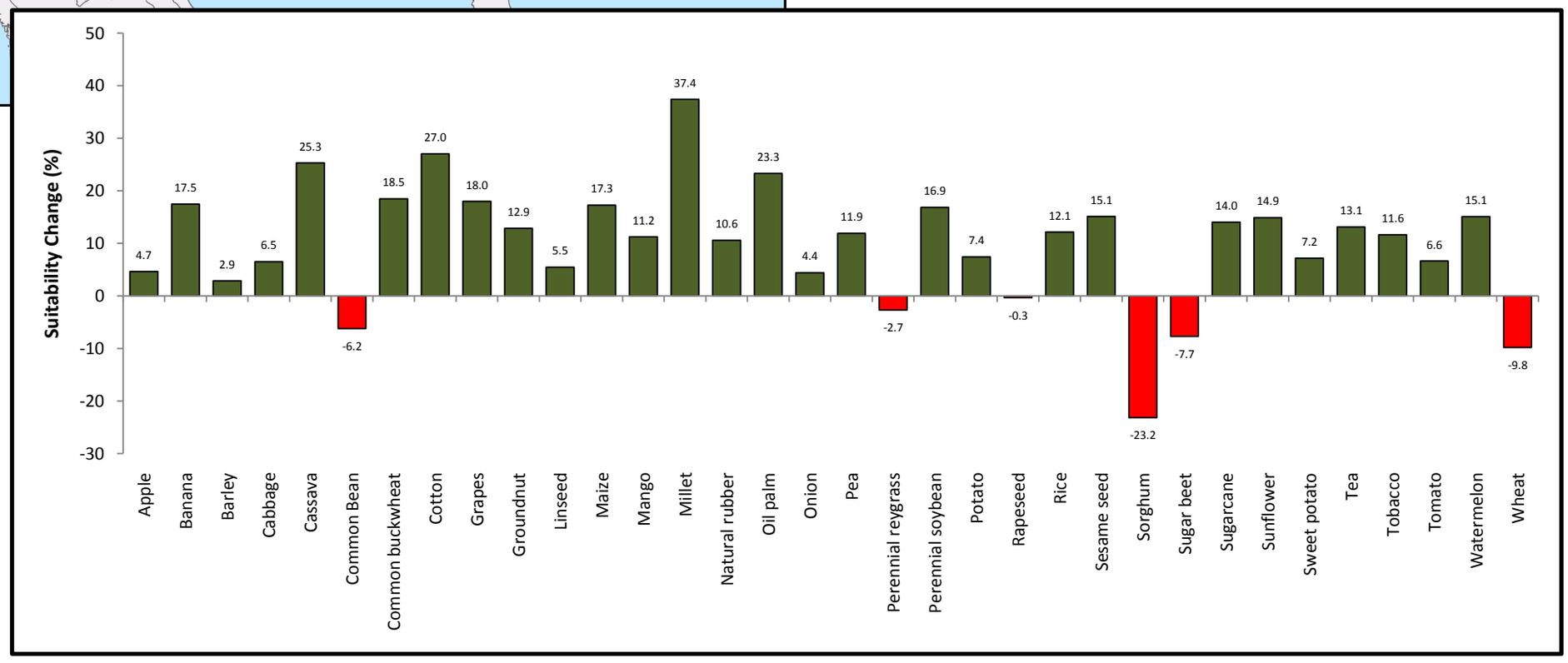
Alemu et al., 2001



Average projected % change in suitability for 50 crops, to 2050

Suitability change for 34 important crops in China





Courtesy of Emmanuel Zapata-Caldas (CIAT)

New varieties in farmers' fields

Seed systems

Breeding

Crop diversity

Breeding challenges

- Drought
  - Waterlogging
- High temperature
  - Frost (eg clear nights during drought in PNG)
- Biotic stresses

Missing in action

- Genebanks
- Crop wild relatives
- Information
- Policy
- Diversification

Genebanks

4.1 Status of Collections

China has 64 genebanks and repositories conserving nearly 400,000 accessions of crops

- 1 National long-term genebank in Beijing, with a duplicate in Qinghai – 351,332 accessions
- 10 National mid-term genebaks - 286,604 accessions
- 32 National field repositories – 38,803 accessions
- 2 National *in vitro* genebanks – 1,784 accessions
- 20 Provincial mid-term genebanks

Genebanks

Global Safety Backup

Svalbard Global Seed Vault

Photo: Mari Tefre; Global Crop Diversity Trust

Photo: Mari Tefre; Global Crop Diversity Trust

Crop wild relatives

O. alta

O. officinalis

O. ridleyi

O. minuta

O. brachyanta

O. rufipogon

O. longistaminata

- Insect resistance
- Disease resistance
- Tolerance abiotic stresses
- QTLs for yield

Disease resistance from CWR of rice

Source: Brar D.S. (2010). What are the main bottlenecks to the use of CWR in breeding? How can they be overcome? Presentation for 'Adapting Agriculture to Climate Change: The Need for Crop Wild Relatives', Bellagio, 7-9 September 2010.

Pest and disease resistance from CWR

Aegilops tauschii- hessian fly resistance

Musa acuminata- black sigatoga resistance

Manihot glaziovii- cassava mosaic disease (CMD) resistance

Source: Okogbenin E (2010) The Use and Challenges of CWR in Breeding. Presentation for 'Adapting Agriculture to Climate Change: The Need for Crop Wild Relatives', Bellagio, 7-9 September 2010.

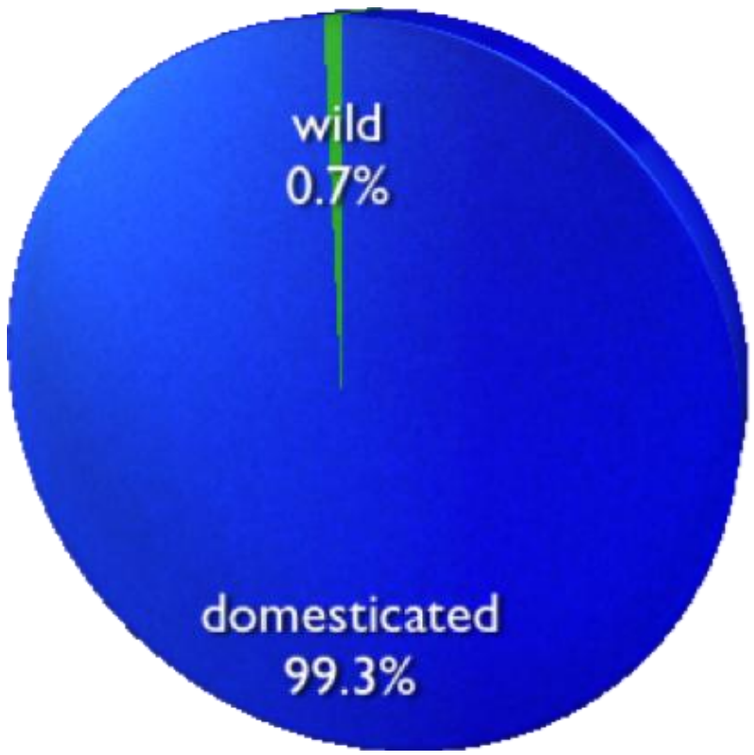
Pest and disease resistance from CWR

Cassava cultivar susceptible to green mites

Cassava cultivar containing QTLs for resistance to green mites from wild progenitor of cassava

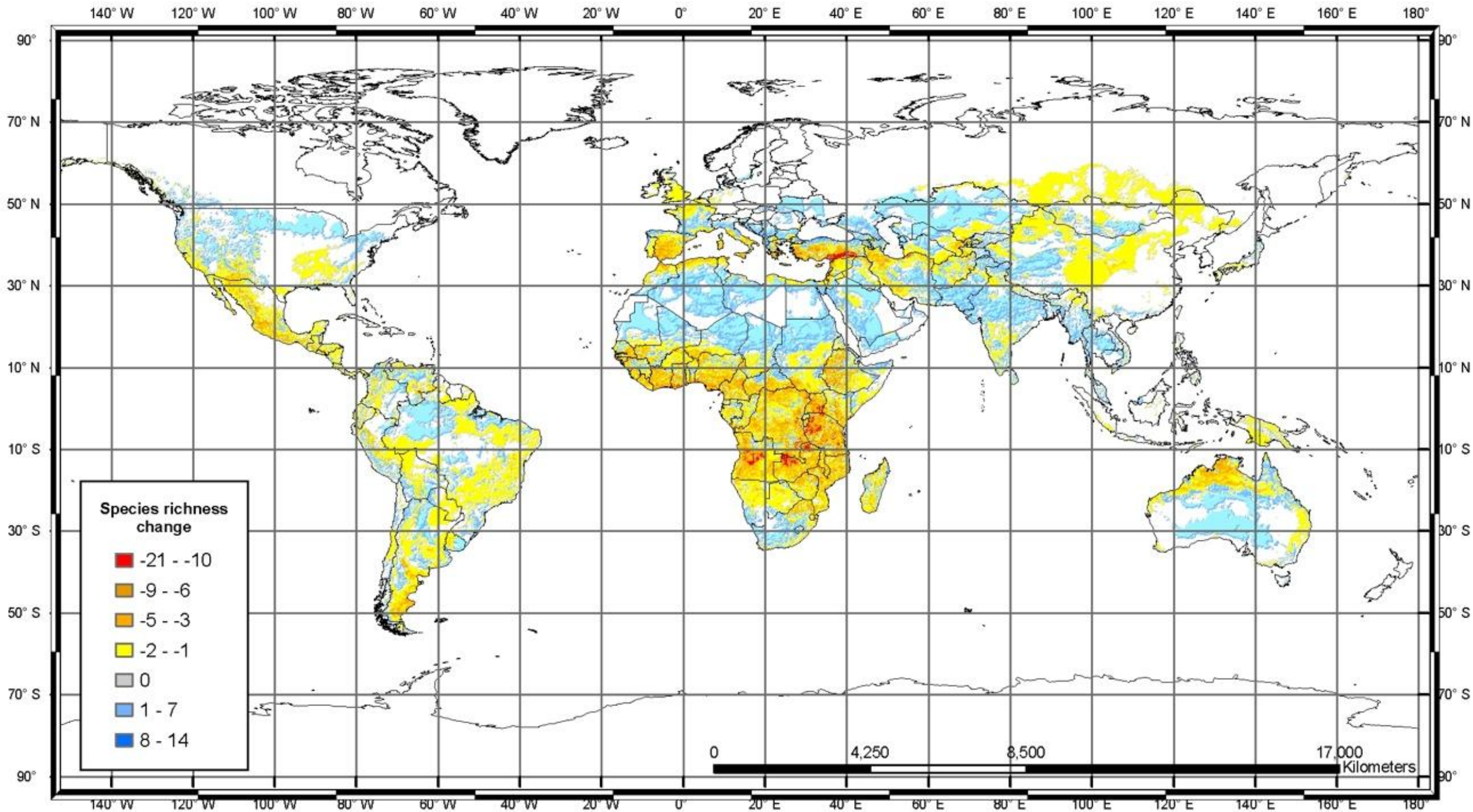
Source: Okogbenin E (2010) The Use and Challenges of CWR in Breeding. Presentation for 'Adapting Agriculture to Climate Change: The Need for Crop Wild Relatives', Bellagio, 7-9 September 2010.

Threats to CWR



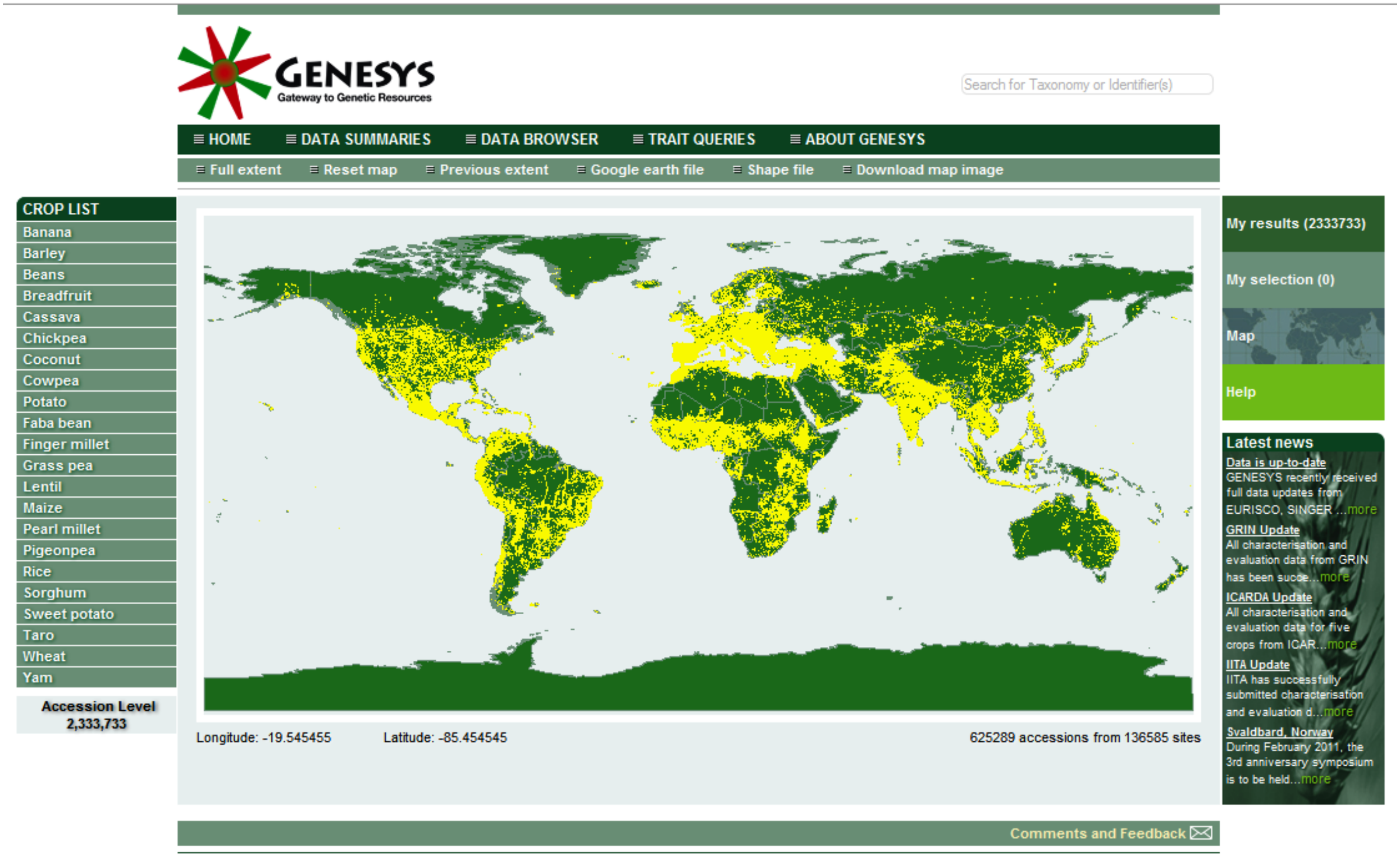
Of approx. 80,000 total accessions of annual *Cicer* species, there are 572 accessions of wild annual species, only **124** of which are unique and distinct.

Impacts of climate change on CWRs



Source: Jarvis A. 2009. personal communication.

Information



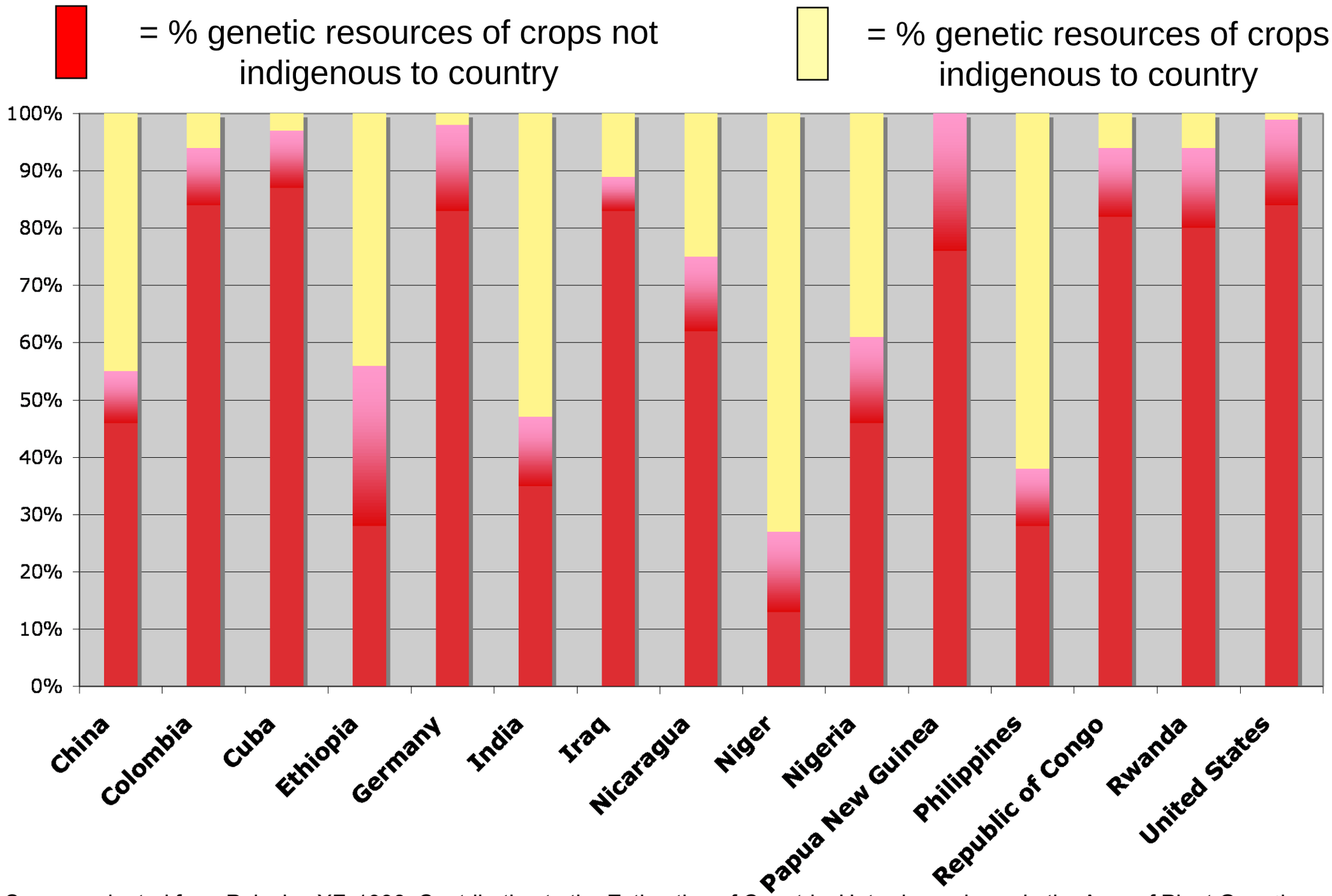
中国作物种质资源信息系统
Chinese Crop Germplasm
Resources Information System

CGRIS

Http://www.CGRIS.net
Http: //crop.agridata.cn
Http: //icgr.caas.net.cn

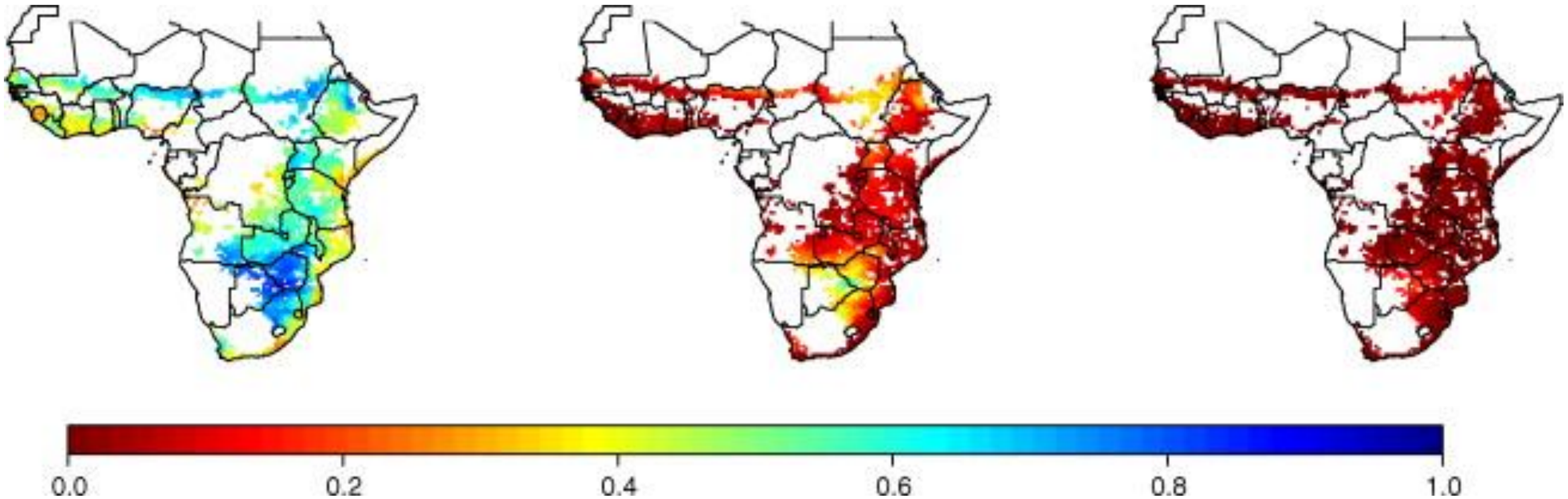
Global interdependence

Food Energy Supply (calories/day)



Source: adapted from Palacios XF. 1998. Contribution to the Estimation of Countries' Interdependence in the Area of Plant Genetic Resources. Rep. 7, Rev. 1, UN Food. Agric. Org. Comm. Genet. Resour. Food Agric., Rome, Italy. taken from Fowler C. and Hodgkin T. 2004. Plant Genetic Resources for Food and Agriculture: Assessing Global Availability. Annu Rev Environ Resour 29: 10.1-10.37.

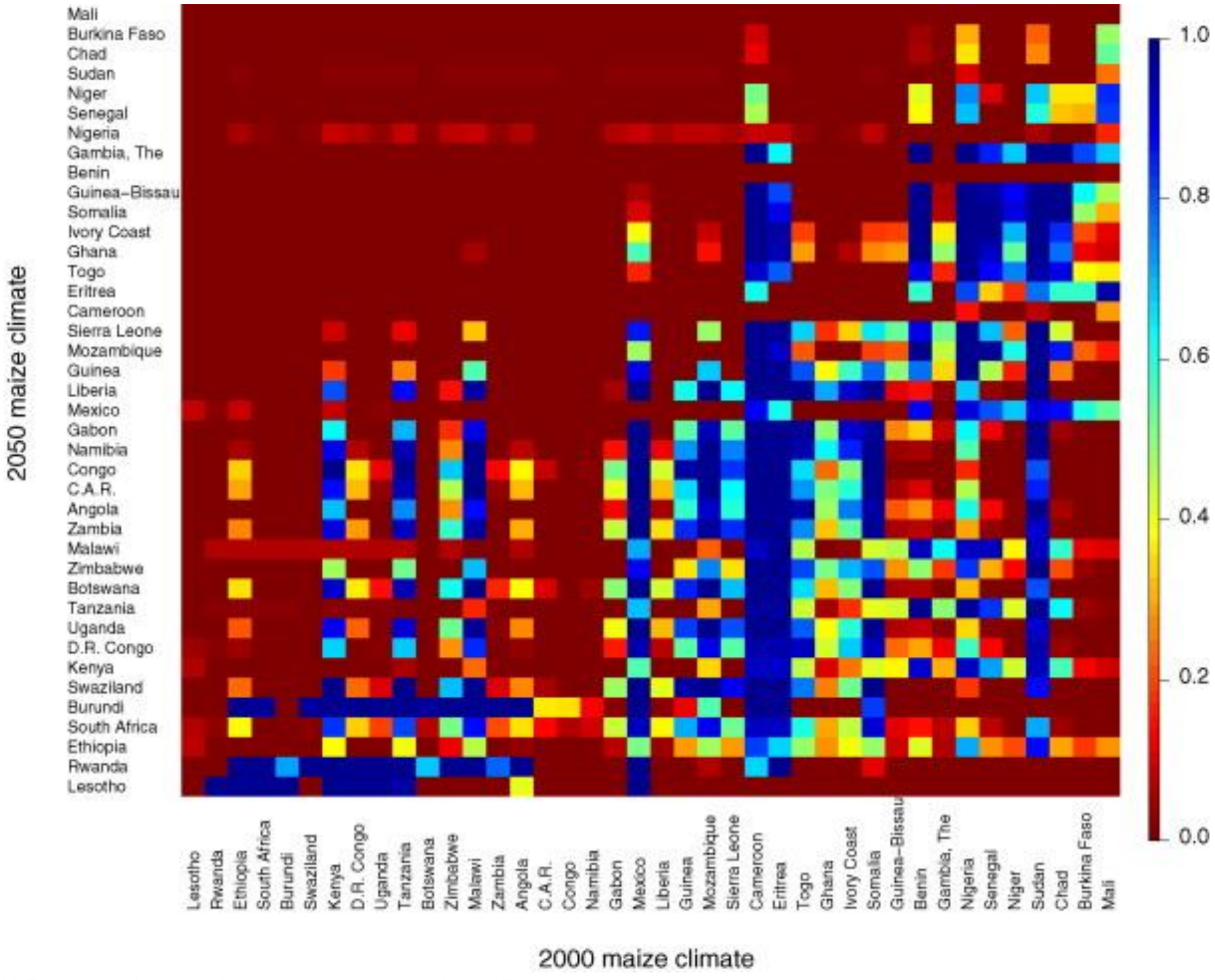
Climate change and crop adaptation



Percentage overlap between historical and 2025 (left), 2050 (middle), and 2075 (right) simulated growing season average temperature at over African maize area. Dark blue colors represent 100% overlap between past and future climates, dark red colors represent 0% overlap

Source: Burke, M.B., et al., Shifts in African crop climates by 2050, and the implications for crop improvement and genetic resources conservation. Global Environ. Change (2009), doi:10.1016/j.gloenvcha.2009.04.003

Climate change and crop adaptation



Source: Burke, M.B., et al., Shifts in African crop climates by 2050, and the implications for crop improvement and genetic resources conservation. Global Environ. Change (2009), doi:10.1016/j.gloenvcha.2009.04.003

International Treaty for PGRFA

Diverse farms, resilient farmers

Missing in action no longer

- Genebanks
  - Need ongoing support, should not be taken for granted
- Crop wild relatives
  - Need to be collected, evaluated, used in breeding programmes
- Information
  - Needs to be shared
- Policy
  - Ratify the Treaty!
- Diversification
  - Needs to be promoted at genetic, species and landscape level

The Global Crop Diversity Trust

"providing a permanent source of funds to support the long-term conservation of the *ex-situ* germplasm on which the world depends for food security"