

Agricultural biodiversity for sustainable livelihoods



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Bioversity International



Alliance of CGIAR
Centres

“Improving lives
through biodiversity
research”

How we work

No laboratories or field sites

Research with partners
(NARIs, NGOs, IGOs, Universities, local communities and others)

Also a catalyst,
coordinator, facilitator,
consensus broker,
think tank

Interact with networks



Where we work

A staff of over 350 operating from 18 locations around the world



Diversity for Well-Being

- Focus on people
- Agricultural biodiversity:
 - Conservation and use
 - Sustainability, resilience, nutrition
- Commodity based production systems (banana, coconut, cacao)
- Policy and public awareness

The challenges we face

Increasing number of hungry and poor
Threats of climate change
Malnutrition



A growing world

By 2050...

World population grows to
9.2 billion = growth of 37%

Increased consumption of
animal proteins →
increased demand on feed



Warming up: climate change

Temperatures rise up to 2.5 C

Changes in growing
conditions

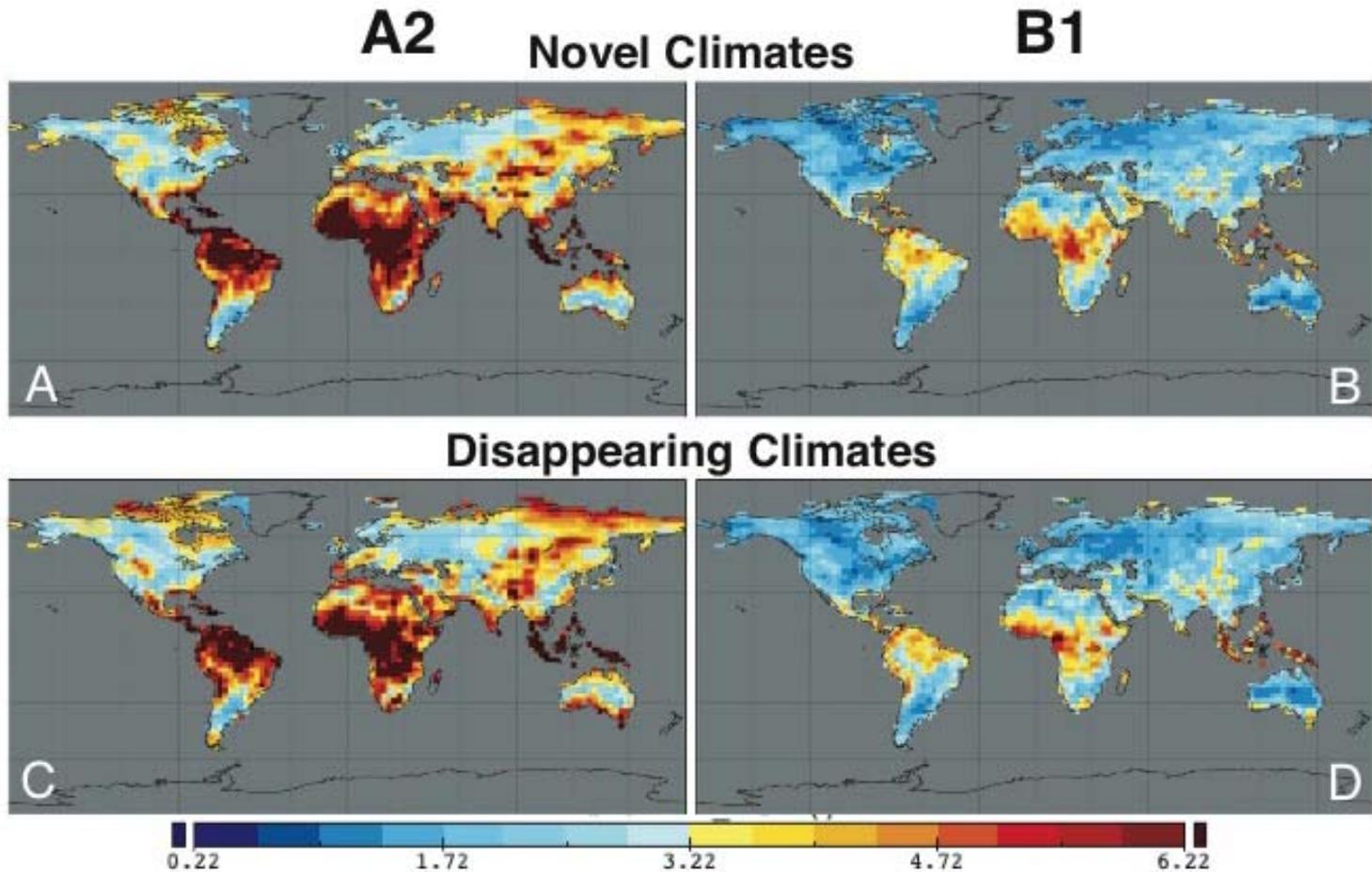
New pests and diseases

Water scarcity and
desertification

Greater weather fluctuations



Entirely new climates: where?

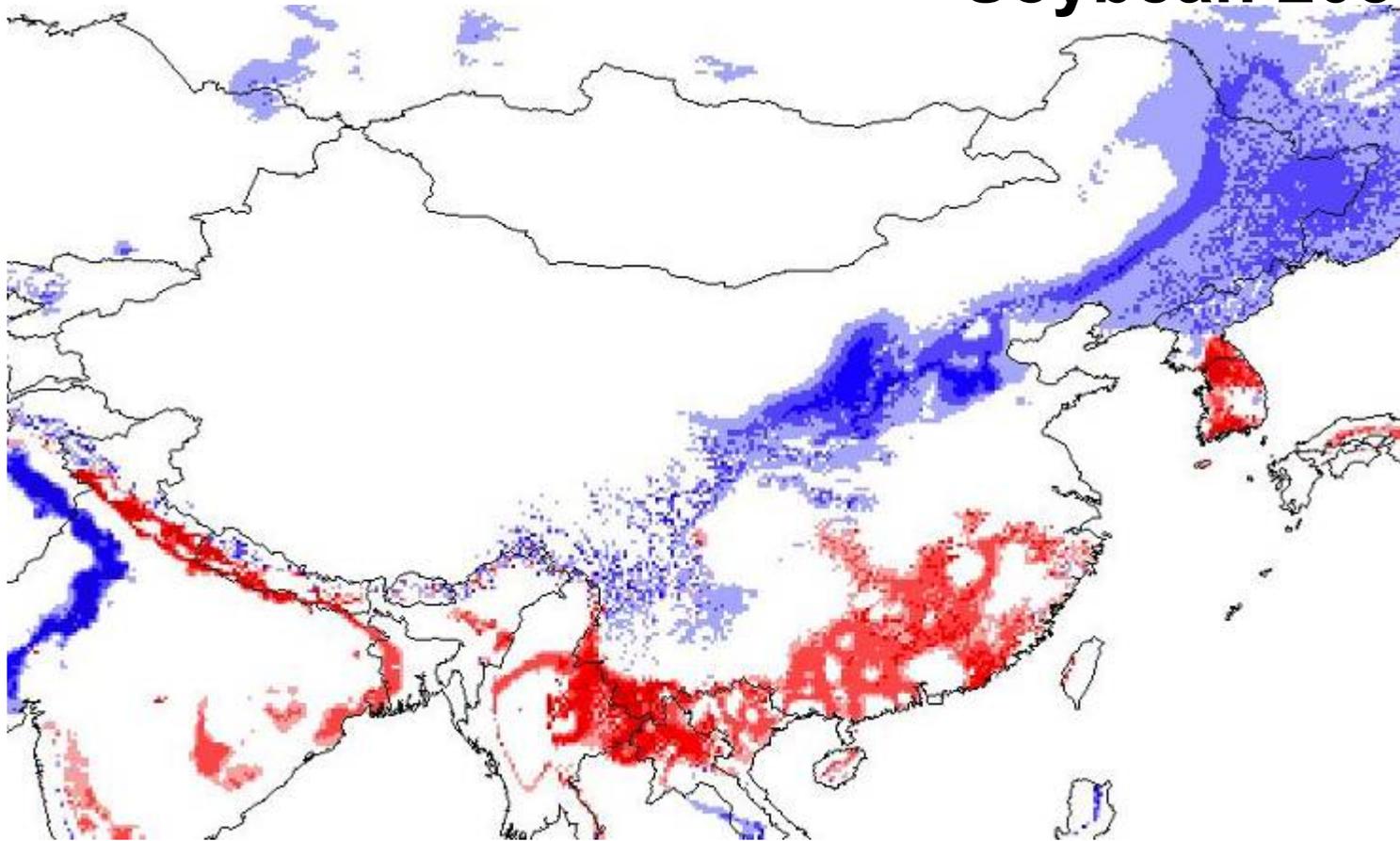


Hot colours, high risk of climate change

Changing conditions



Soybean 2055

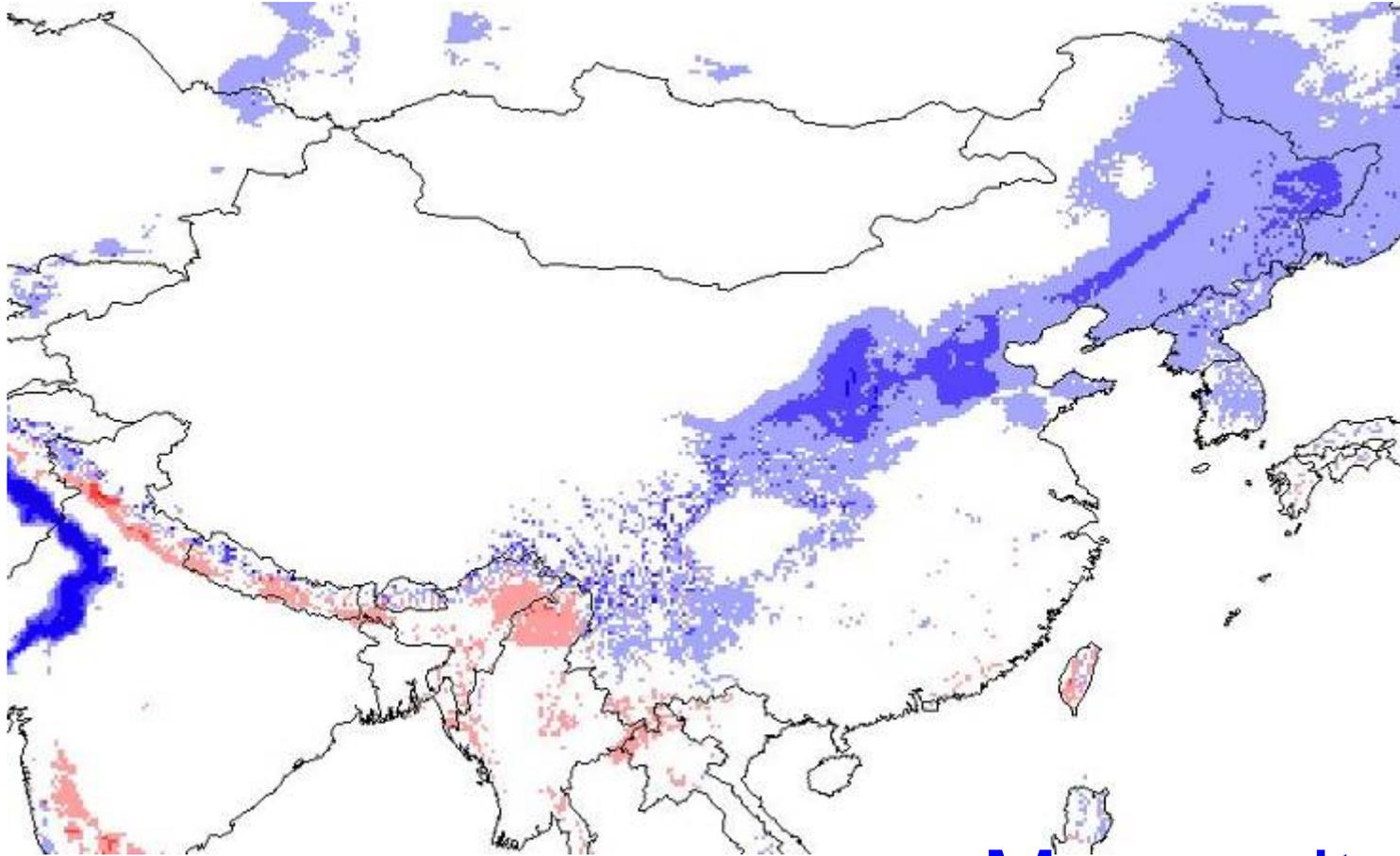


Less suitable

More suitable

Changing conditions (2)

Peanut 2055



Less suitable

More suitable

How will agriculture cope?

We need to adapt...

Agricultural systems that produce more under harsher conditions while protecting the environment



Agricultural Biodiversity



Three levels of Diversity

- Ecosystems
- Species
- Genetic

Agricultural Biodiversity



- Two broad categories
- Managed
 - Unmanaged

Benefits of Agricultural Biodiversity

- Conventional view
 - Source of traits for crop and livestock improvement
- Unconventional, but gaining ground
 - As a source of resilience and stability
 - As a source of increased incomes, improved livelihoods and better nutrition (and health)

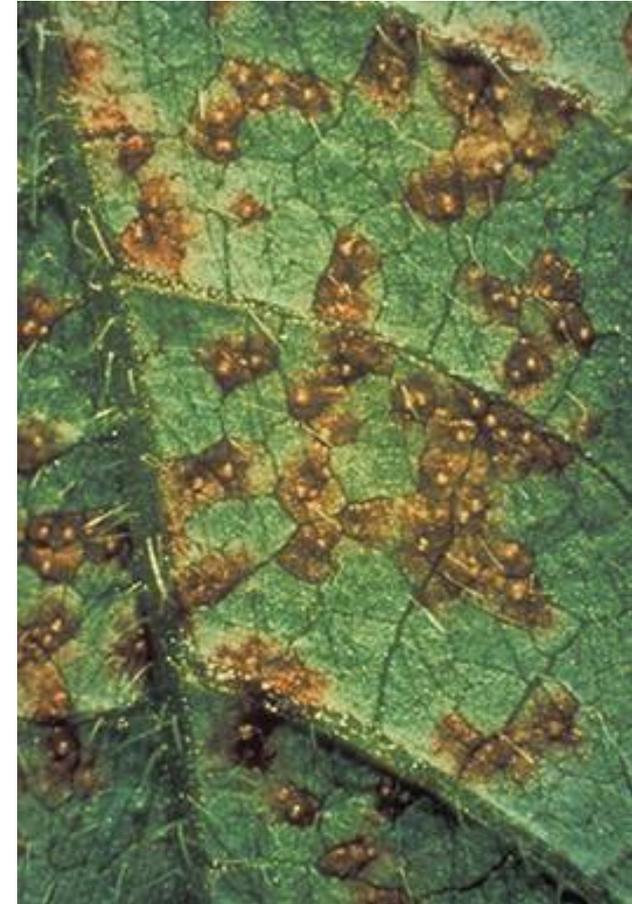
Genetic diversity

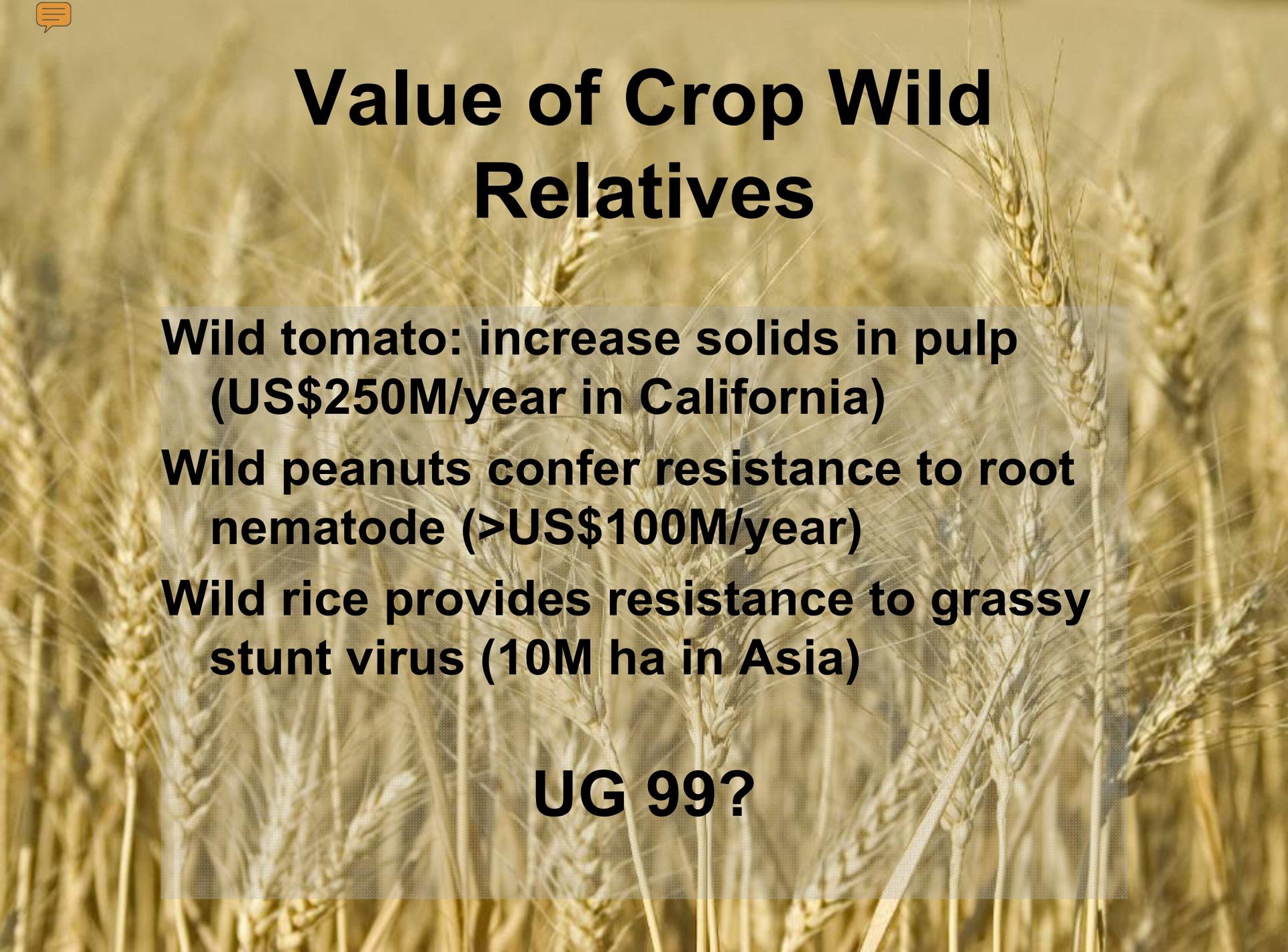
- Foundation of all improvements
- Generations of farmers
- Source for breeders too



Managing pests and diseases

- One third of global harvest lost to pests and diseases
- Soybean Rust US\$ 2 billion projected losses in US
- Black sigatoka US\$ 350 million over 8 years
- UG 99 more than US\$ 1 billion projected in losses





Value of Crop Wild Relatives

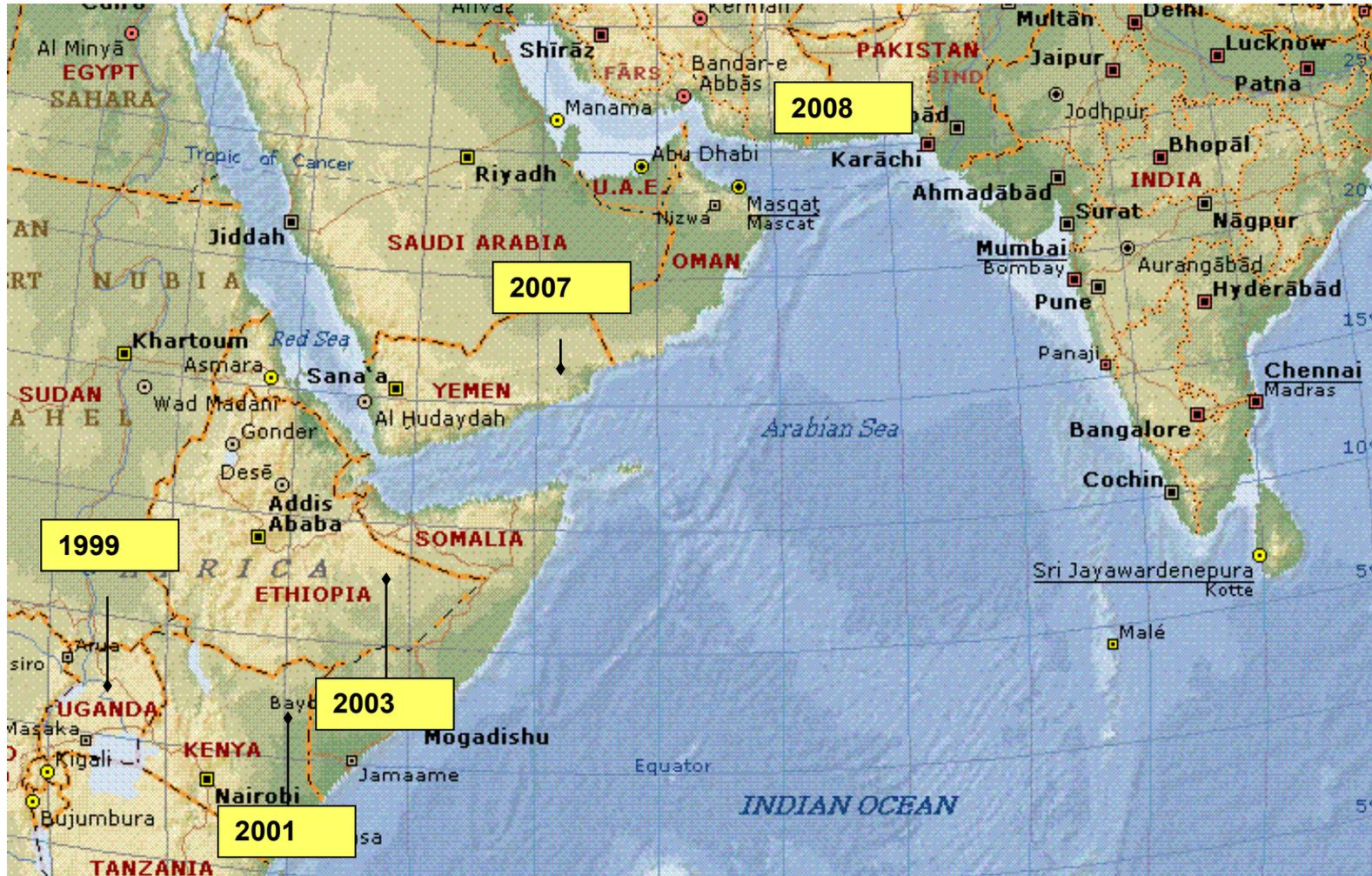
**Wild tomato: increase solids in pulp
(US\$250M/year in California)**

**Wild peanuts confer resistance to root
nematode (>US\$100M/year)**

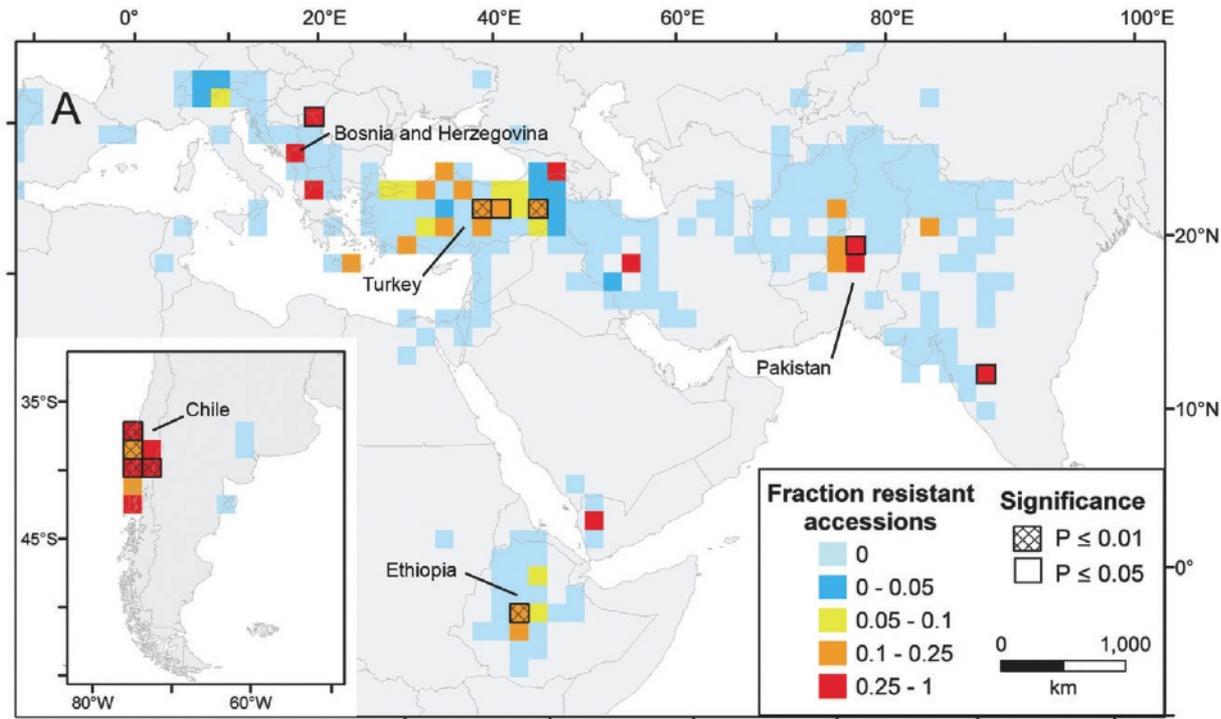
**Wild rice provides resistance to grassy
stunt virus (10M ha in Asia)**

UG 99?

Sustainable use and genetic vulnerability – Ug99



Search for resistance



- Screened 5700 common wheat and 2719 durum wheat landraces (old data)
- Mapped resistance geographically
- Looked for excess presence of resistant accessions

Biodiversity delivers

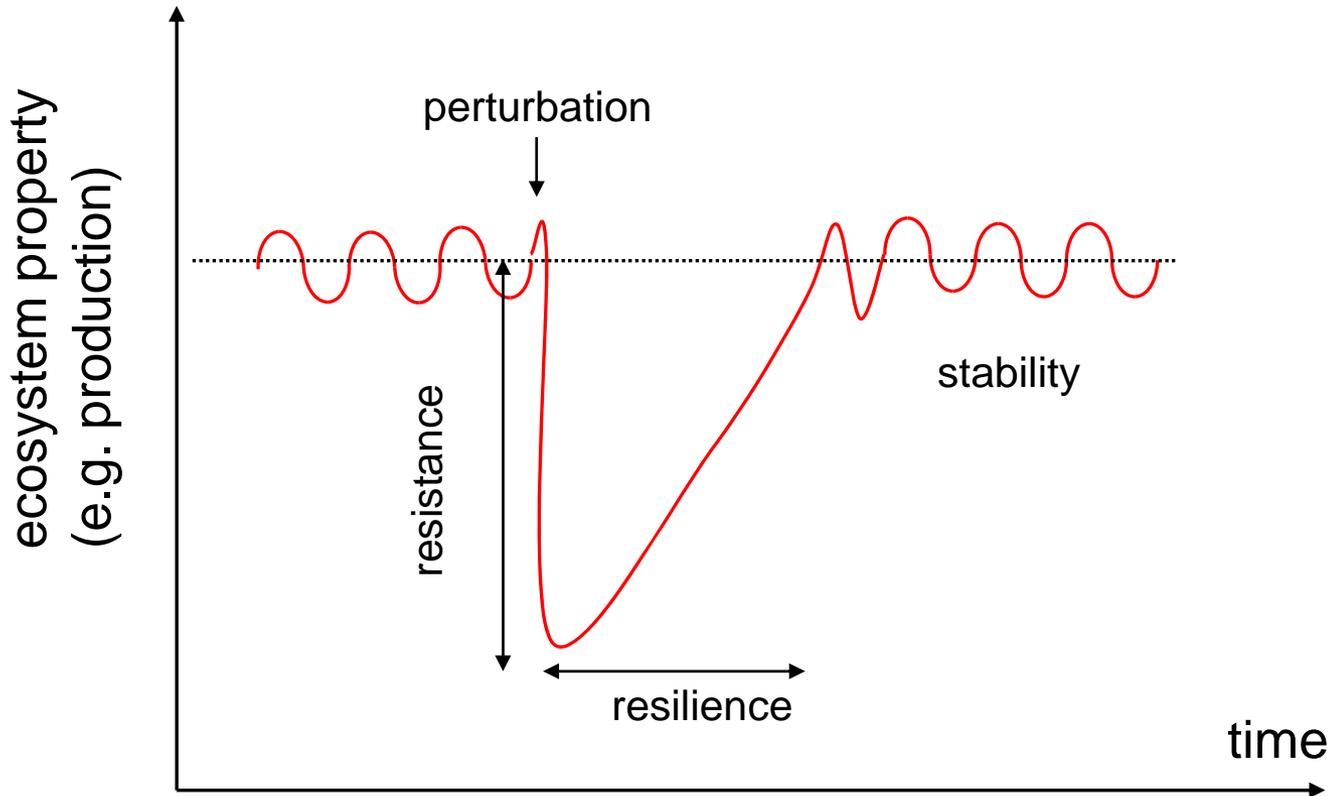


Diversity for ...

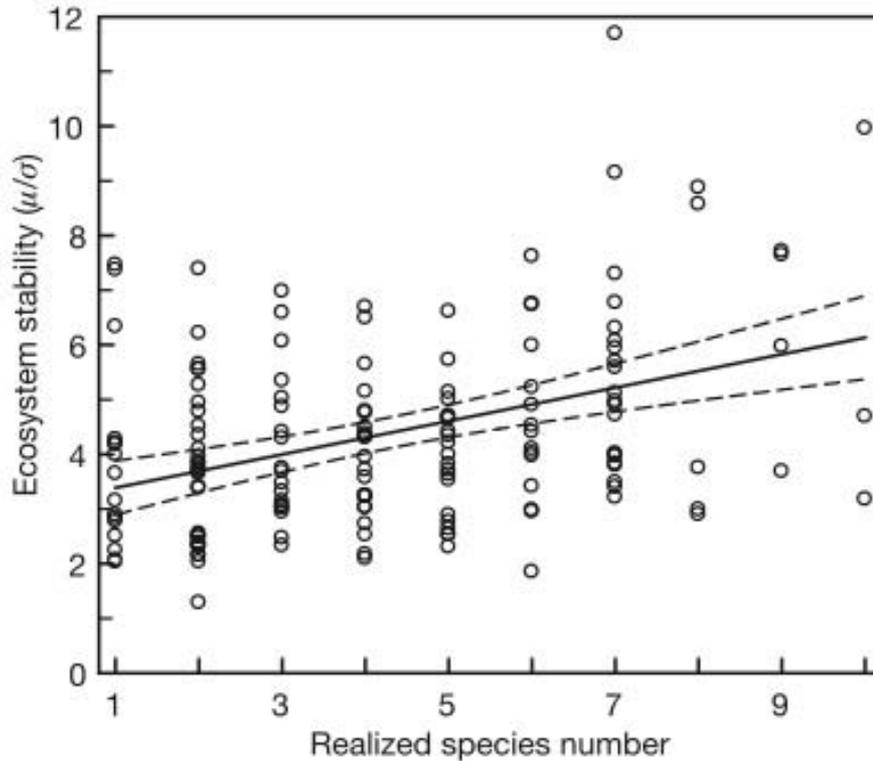
- Resistance to disturbances, pests and diseases
- Stable and productive harvests
- Environmental services

Intensification without simplification

Diversity and production



Diversity and stability



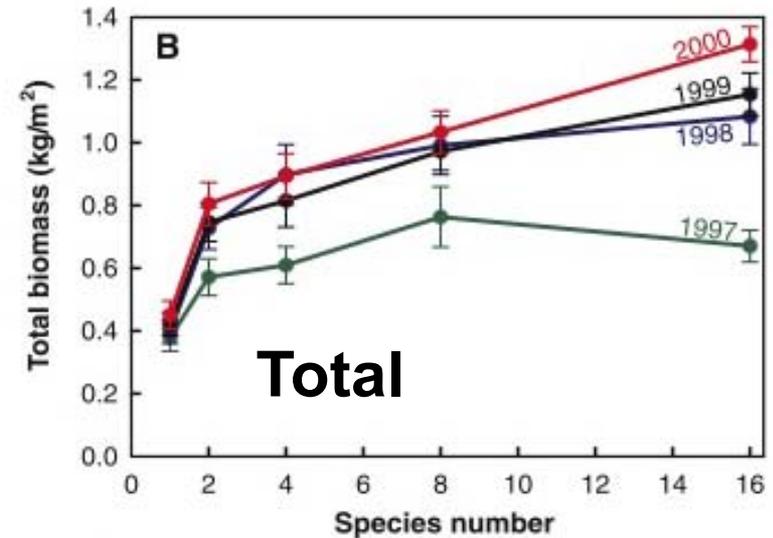
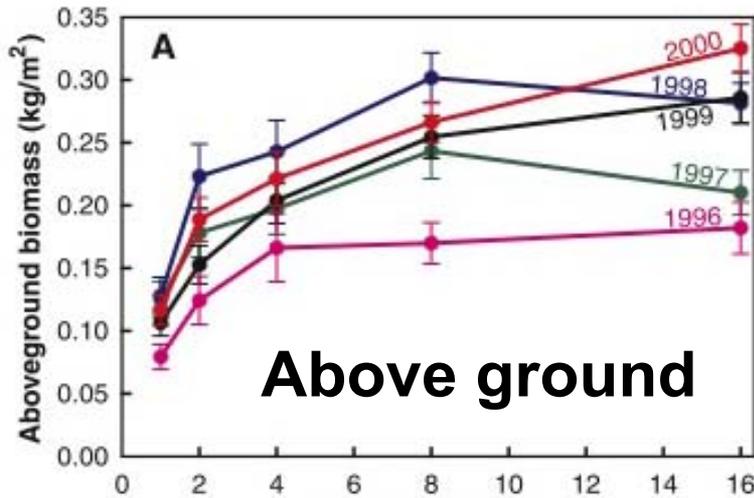
Long-term plots

**University of
Minnesota**

Tilman *et al.* (2006)



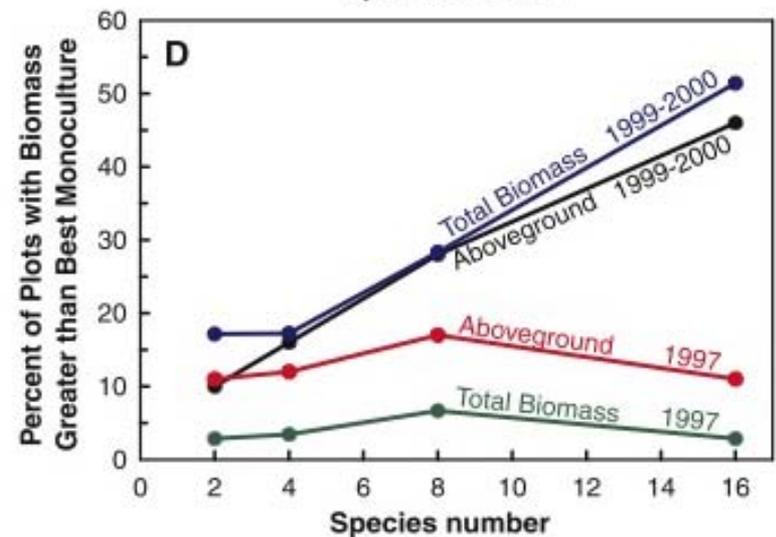
Diversity and Production



**Better than the best
monoculture**

**16 species = 2.7 x
monoculture**

Tilman *et al.* (2001)



Bullock *et al* : Hay

- Convert arable fields to hay meadows
- Two seed mixtures
 - Rich (25-41 species)
 - Poor (6-17 species)
- Species rich yields 60% higher from 2nd year
- No difference in quality



Woldeamlak *et al* : Hanfetz

- Hanfetz in Eritrea:
(67% barley 33% wheat)

Barley 1511 kg/ha

Wheat 1283

Hanfetz 1744

Also more stable year on year



Zhu *et al* : Rice blast

- Susceptible varieties in rows mixed with resistant varieties
 - 89% greater yield
 - 94% less severe disease
- Resurrecting traditional varieties
- Extended to species diversity



Wolfe *et al* : Barley mildew



East Germany

- Severity of mildew declined from 50% to 10%
- Yields maintained
- Post unification mixtures down, fungicides up

Diversity for managing pests and diseases

- UNEP-GEF Managing pests and diseases
 - Diversity to improve resistance and resilience
 - Maize, faba bean, rice, common bean, barley, cassava and banana
 - Begins with understanding farmer knowledge (participatory diagnostic tools)

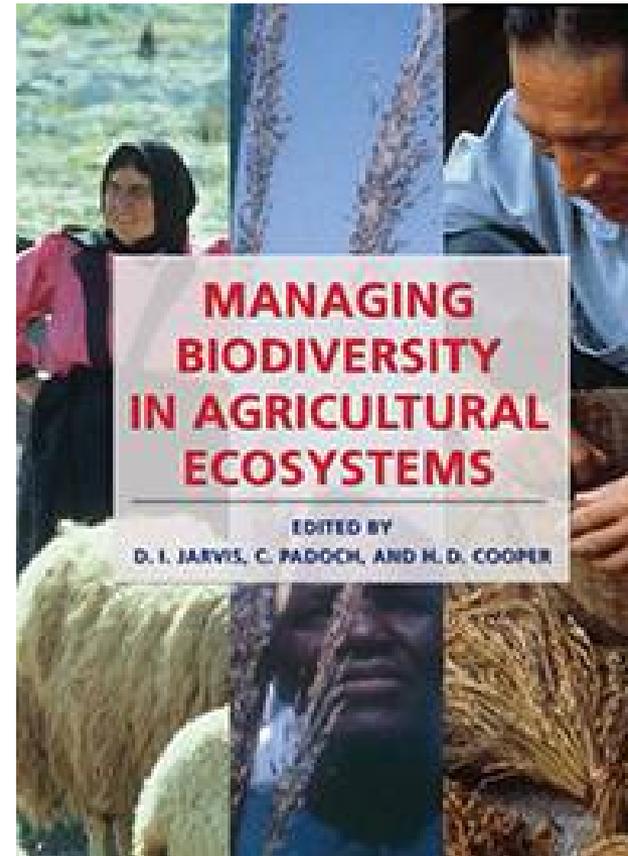


Diversity for ecosystem services

Agricultural biodiversity for ecosystem services

- CO₂ sequestration and climate regulation
- Nutrient cycling and soil fertility
- Pollination
- Water management
- Erosion control
- Pest and disease regulation

Improved ecosystem function



Valuing ecosystem services

- What is the value of these services?
- Difficult to measure in market terms (private/public good)
- Supporting and regulating services not valued: lack of policy
→ need tools

Biggest benefit: better nutrition

- Hidden hunger: missing micronutrients
 - At least 2 million worldwide
 - Mostly women and children
- Double burden: diseases of “affluence”
 - Type 2 diabetes, obesity, heart disease, cancers



Child deaths per year



- Out of 3.5M child death per year, 63% or 2.2M are caused by underweight births and inter-uterine growth restrictions
- These are strongly correlated to poor maternal nutrition



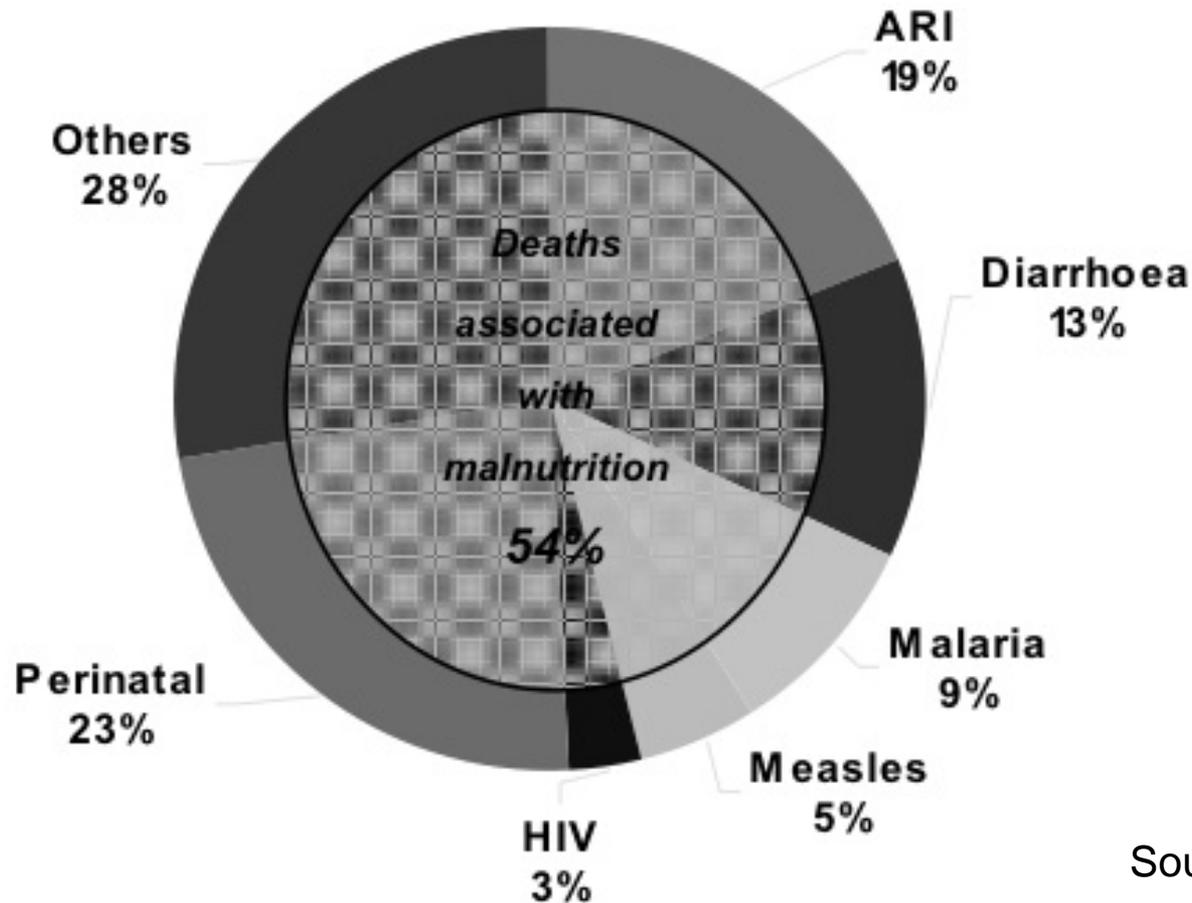
Long-term impact of mother and child nutrition



- In first two years,
irreversible
 - Worse health
 - Lower educational achievement
- Next generation
 - Underweight birth, even if nutrition is improved after 2



Deaths associated with malnutrition



Source: WHO



Dietary Simplification (1)



- Cheapest food is energy rich but nutrient poor
- Energy from fats and oils in Senegal
 - 1963: 8%
 - 1998: 20%



Dietary Simplification (2)



- Reduced access to traditional and indigenous foods
 - Rural pressures
 - “Backward”



Benefits of diverse diets

First world evidence

- USA
 - decreased risk of mortality
- Italy
 - decline in gastric cancer rate
- Sweden
 - a healthy diet increases longevity
- Sweden
 - decreased risk of colorectal cancer



Developing countries: only a few studies

- Kenya
 - Dietary diversity strongly and consistently correlated with anthropometric status
- Mali
 - Food Variety (no. of food items) and Dietary Diversity (no. of food groups) correlated with nutritional adequacy



Diversity of Diet

- Diverse diet protects
- Indigenous/traditional species/varieties offer nutritional advantages



Promote local
agricultural biodiversity
for improved diets and
health

→ Also more sustainable



Focus on neglected species

- Wide range of species, not all cultivated
- Indigenous, locally adapted, environmentally friendly, nutritious
- Perceived as backward
- Abandoned by scientists and ignored by policy makers
- Bioversity has slowly promoted and expanded to build a global project



African leafy vegetables

Per 100 gm	Amaranth (leaf)	Cleome	Nightshade	Cabbage
Iron mg	8.9	6.0	1.0	0.7
Calcium mg	410	288	442	47
β carotene μ g	5716	10452	3660	100



Kenya

- Traditional leafy vegetables
- Partnered with Family Concern (NGO) and Uchumi Supermarkets
- Seed supply and agronomy
- Training for cleaner, high-quality produce
- Leaflets to educate shoppers
- Sales increase 1100% in two years



Reinvigorating culture

- Old people know the value of these crops
- Specific varieties for specific maladies
 - Red rice for pregnancy and anaemia
 - Rich sorghum for lactating mothers...
- Information as important as availability
 - Recipe leaflets, cooking classes, promotion



Other examples

India: small millets



Bolivia: Andean grains



Impact on Nutrition and Health



- Need to build strong scientific evidence base at a sufficient scale to convince the major development actors



Conclusion

Agricultural biodiversity meets short term needs for the long term:

- Sustainable, resilient production systems
- More food, better nutrition, more income
- Environmental protection and sustainability

→ Agrobiodiversity: an essential tool for meeting tomorrow's challenges



Thank you