

Some Thoughts on Sustainable Agriculture

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Sustainability Needs and Challenges

The Big Picture

Some Assertions

#1: Human quality of life and environmental quality are inextricably intertwined.

#2: Despite major progress during last century, environmental degradation and human poverty have not been overcome.

#3: The situation is dynamic. Human activities have changed the Earth system already and many further changes are projected.

Sustainability Needs

Human

- Alleviate Poverty
- Reduce Violence
- Improve food security
- Improve access to clean water
- Improve access to health care
- Improve access to clean energy
- Improve efficiency of urban, energy and transportation systems
- Develop new technologies

Sustainability Needs

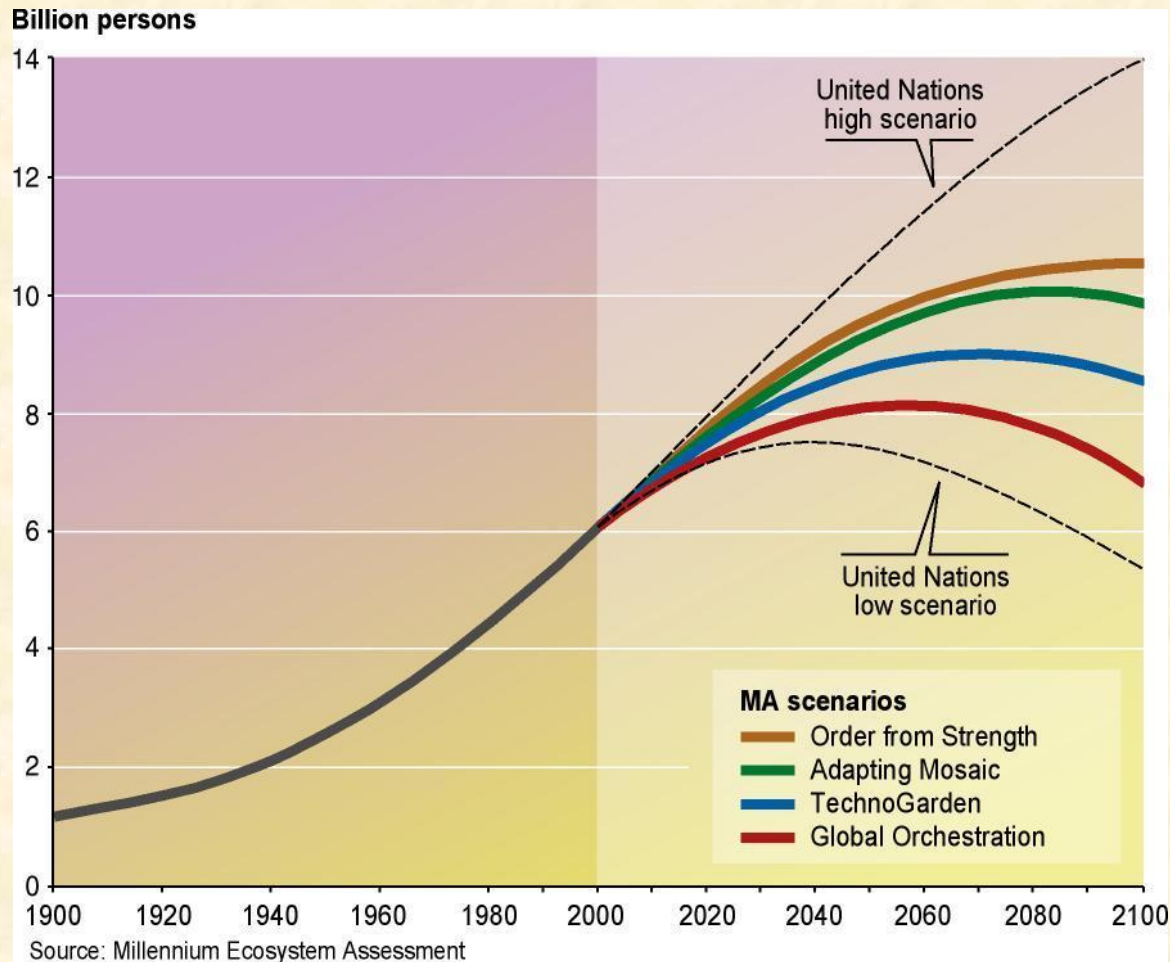
Environmental

- Preserve/Conserve “Wilderness” and other lightly managed areas
- Improve efficiency & productivity of heavily managed ecosystems
- Maintain critical ecosystem services (clean water, air, food, etc.)
- Reduce GHG emissions; stabilize atmospheric & ocean chemistry
 - Slow climate change
- Reduce “conventional” pollution
- Reduce rate of species loss
- Maintain soil quality

Sustainability Challenges

- 2.4 billion people still living on less than \$2 per day (in 2010); about 1 billion live on less than \$1.25 per day
- Poor air quality estimated to contribute to 3 million premature deaths each year
- 1.9 billion hectares (and 2.6 billion people) are affected by significant levels of land degradation.
- Ecosystems and species stressed worldwide; it is estimated that 60% of the world's ecosystem services have been degraded
- “Footprint” analyses estimate that current global resource consumption exceeds the Earth's carrying capacity by about 30%.

Sustainability Challenges



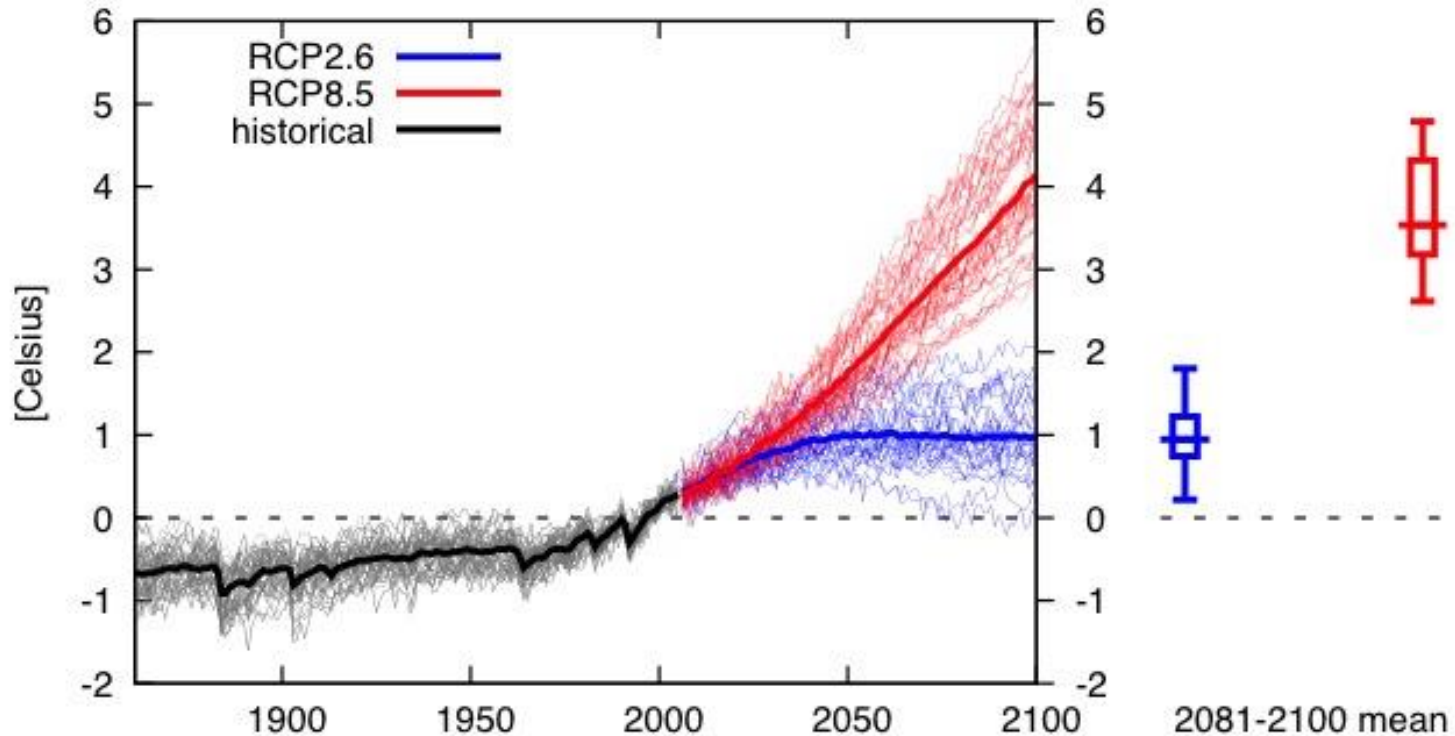
Global population expected to increase to about 9 billion by 2050 (compared to about 7 billion today, and a bit more than 2 billion in 1950).

Sustainability Challenges

Atmospheric composition is changing: CO₂ concentration has increased to nearly 400 ppm (up 40% since 1750). Low emissions scenarios project about 421 ppm by 2100; high about 930 ppm

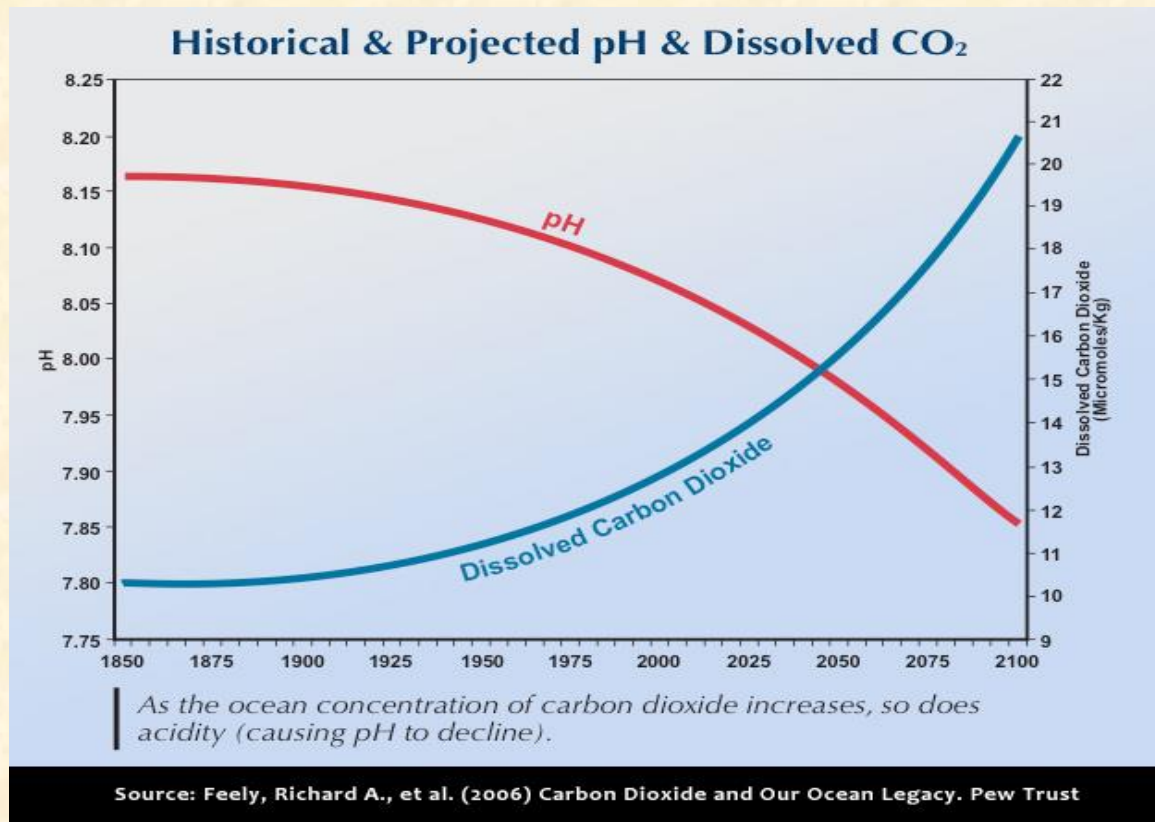
Sustainability Challenges

Temperature change World Jan-Dec wrt 1986-2005 full CMIP5 ensemble



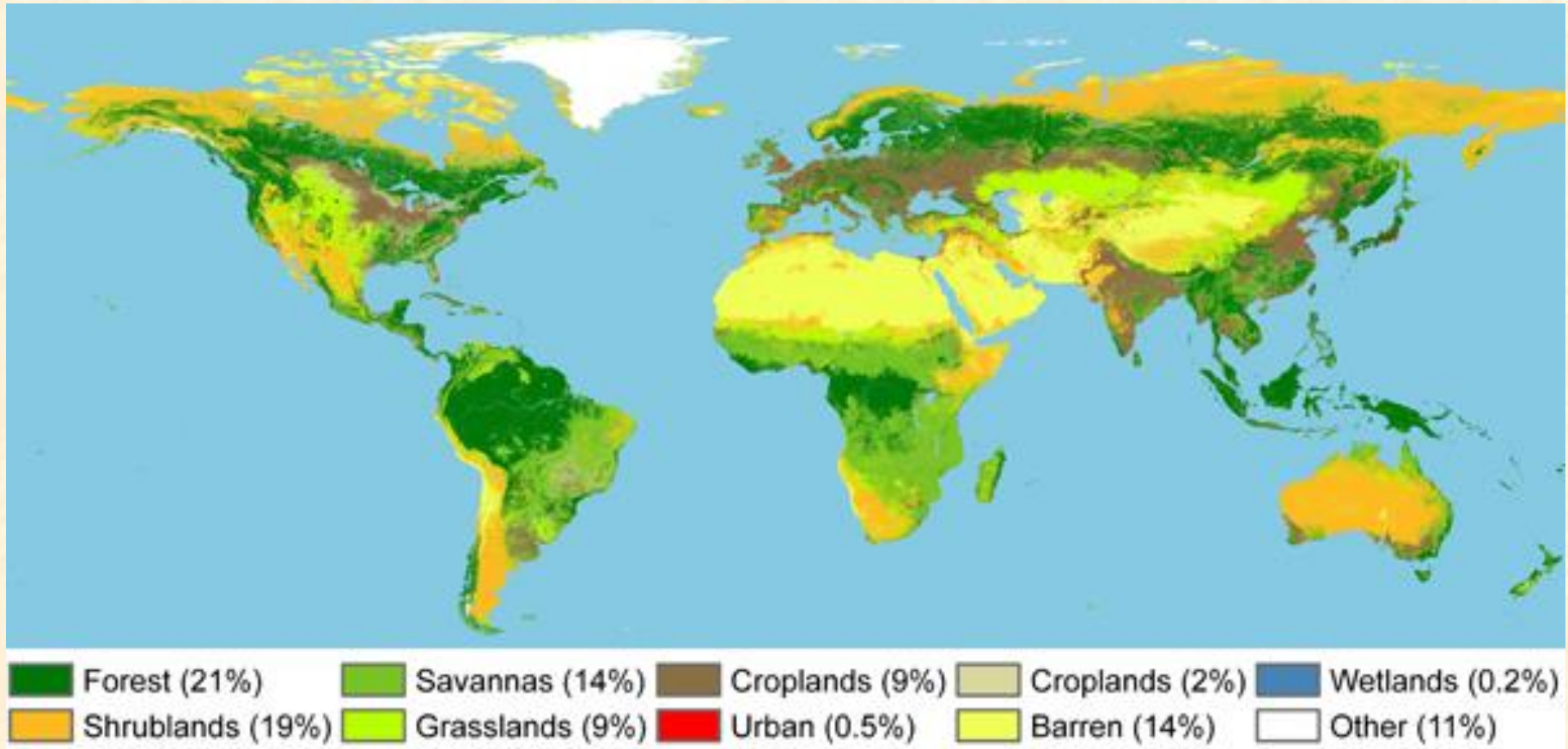
Global average temperature has increased by about .85 degrees C since 1880. It is estimated to increase by another 1 to 4 degrees C by 2100, depending on the amount of future GHG emissions.

Sustainability Challenges



Ocean and freshwater chemistry are also changing. The level of CO₂ in the oceans has increased, leading to increase of about 30% in ocean acidity compared to pre-industrial levels (1750). If CO₂ emissions remain high, ocean acidity could increase by almost 150% by 2100 compared to 1750.

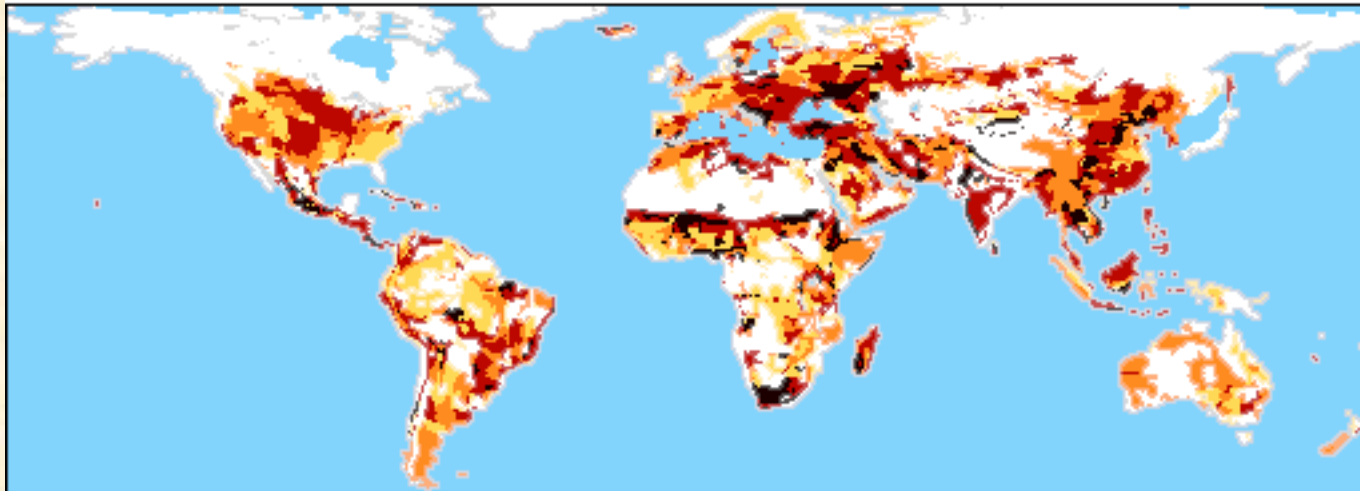
Sustainability Challenges



Humanity has altered more than half of the world's ice free land surface and land use and land cover will continue to change in the future.

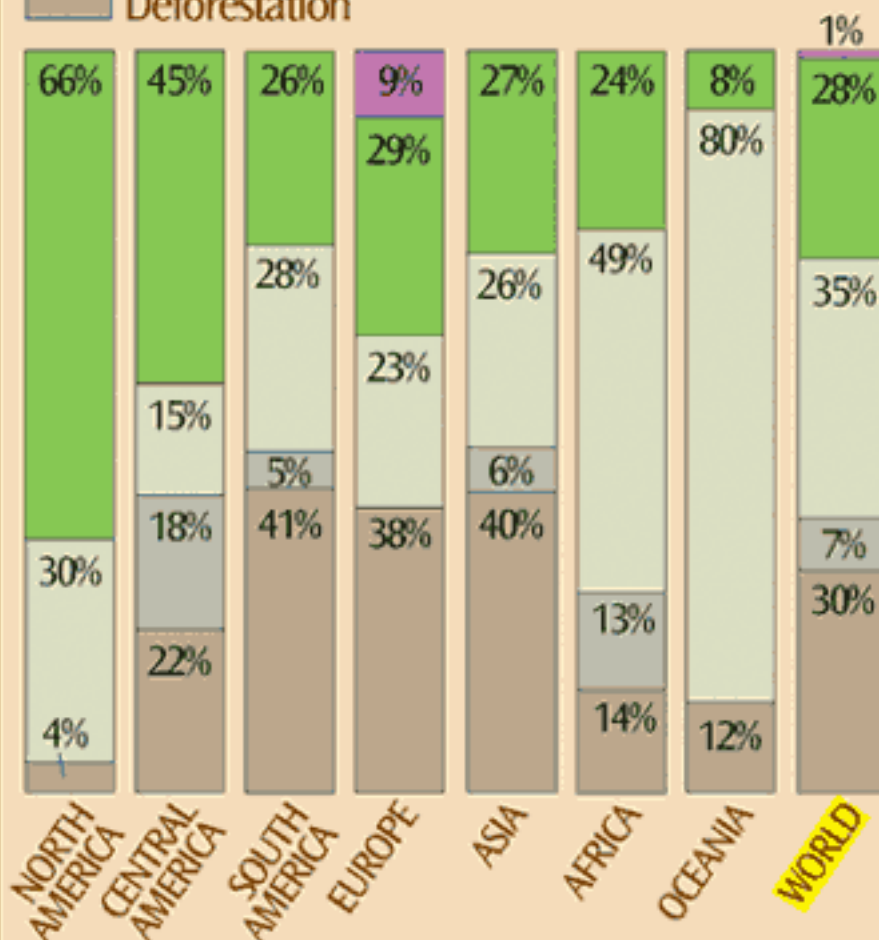
Sustainability Challenges

Soil Degradation Severity



Low Medium High Very High Non-degraded

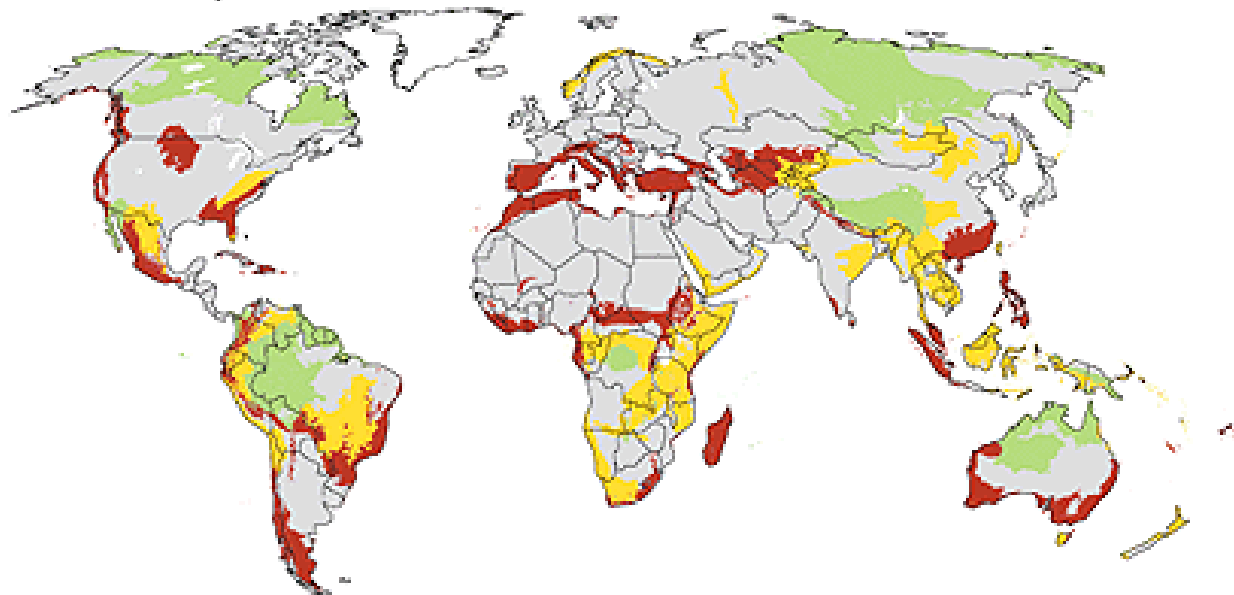
PROJECTION: Geographic
SOURCES: UNEP/ISRIC



SOURCE: International Soil Reference and Information Centre,
<http://www.isric.nl>

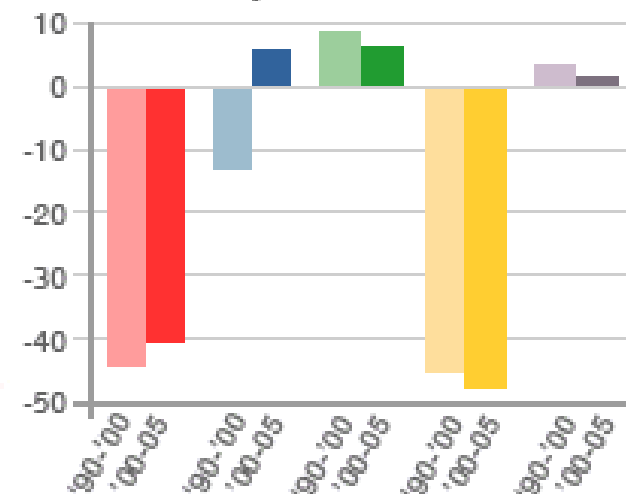
Sustainability Challenges

ECOSYSTEMS, 2006



■ Critical and endangered ■ Vulnerable
■ Relatively stable and intact ■ Ecoregions with no ongoing threat

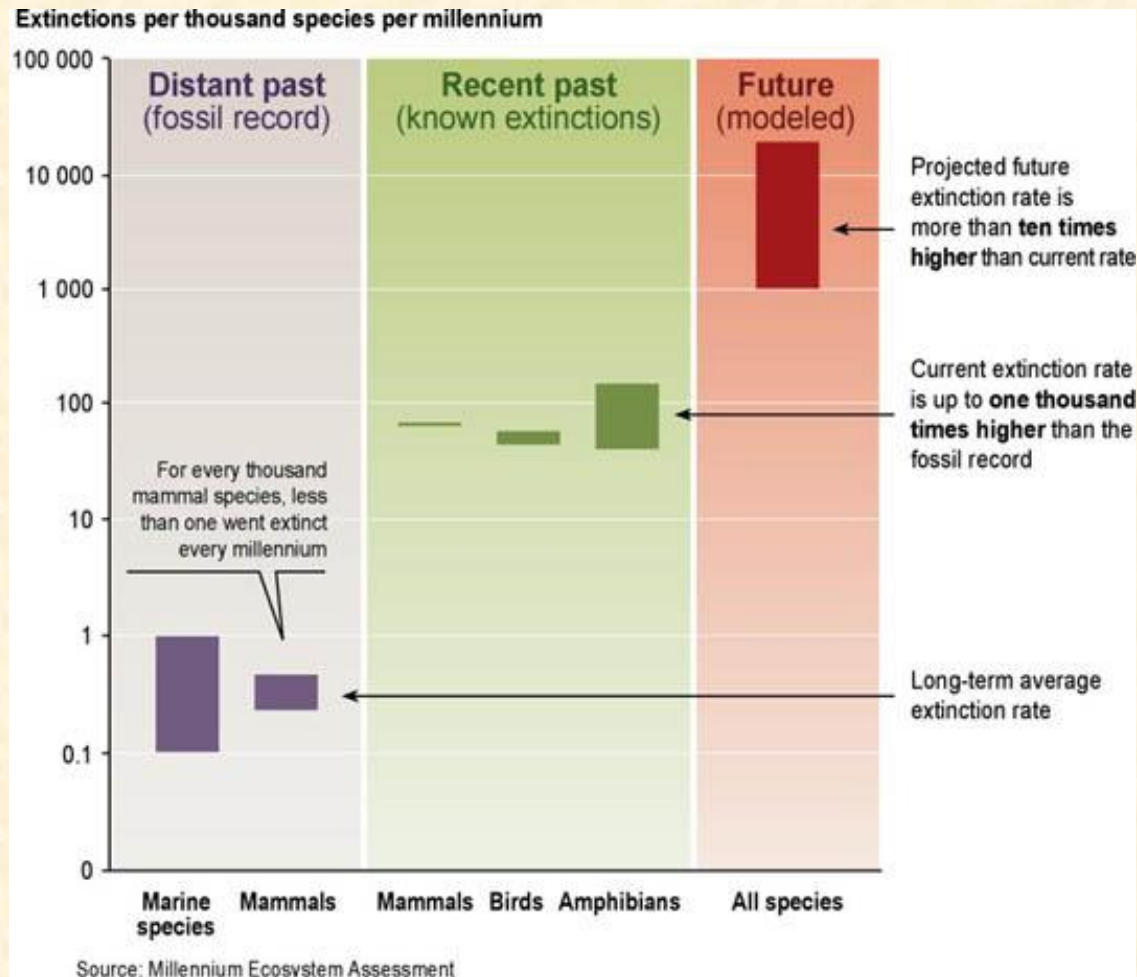
AVERAGE ANNUAL FOREST CHANGE
Thousand km²/year



■ Africa ■ Latin America and the Caribbean
■ Asia and the Pacific ■ North America
■ Europe

SOURCE: UN

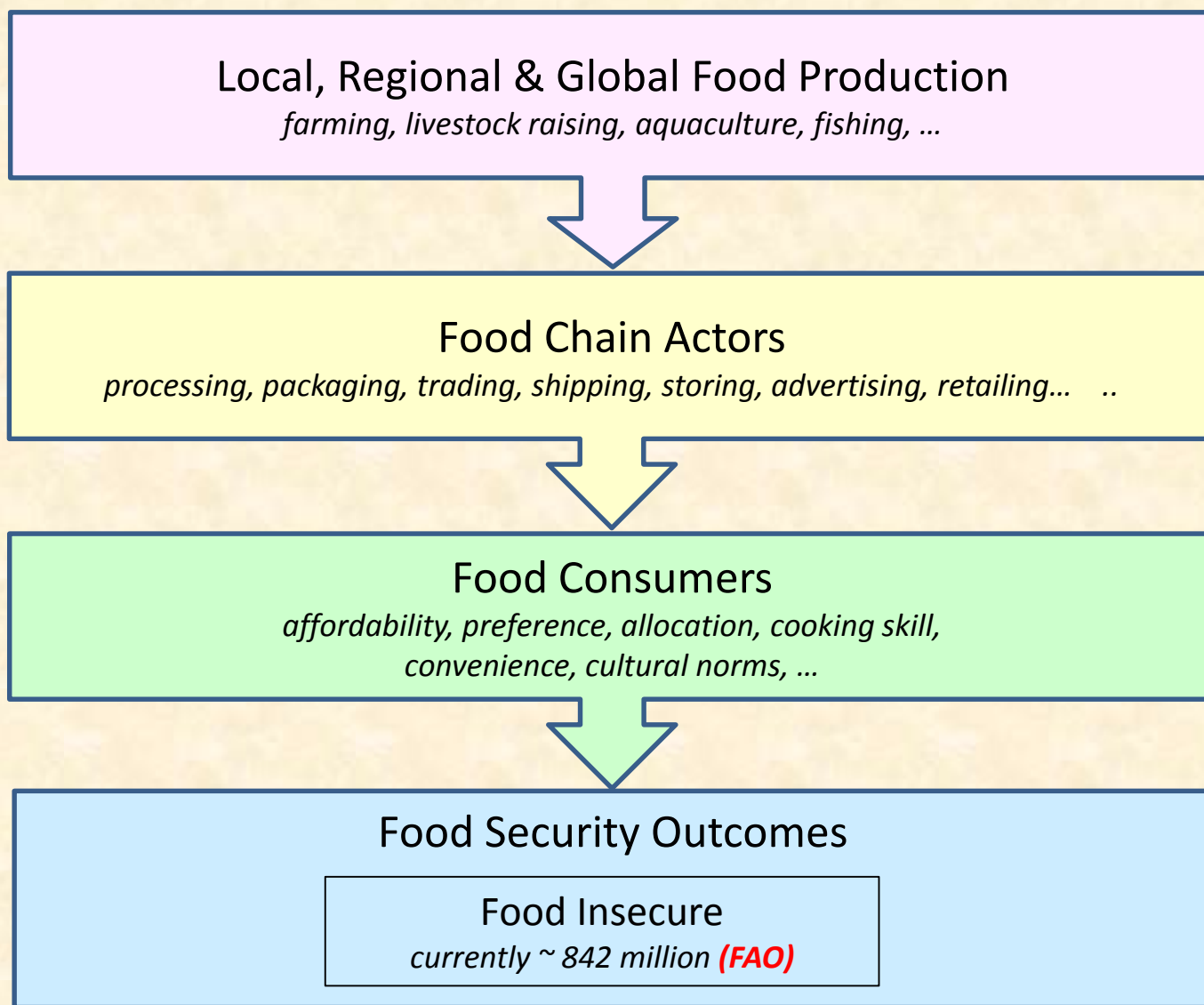
Sustainability Challenges



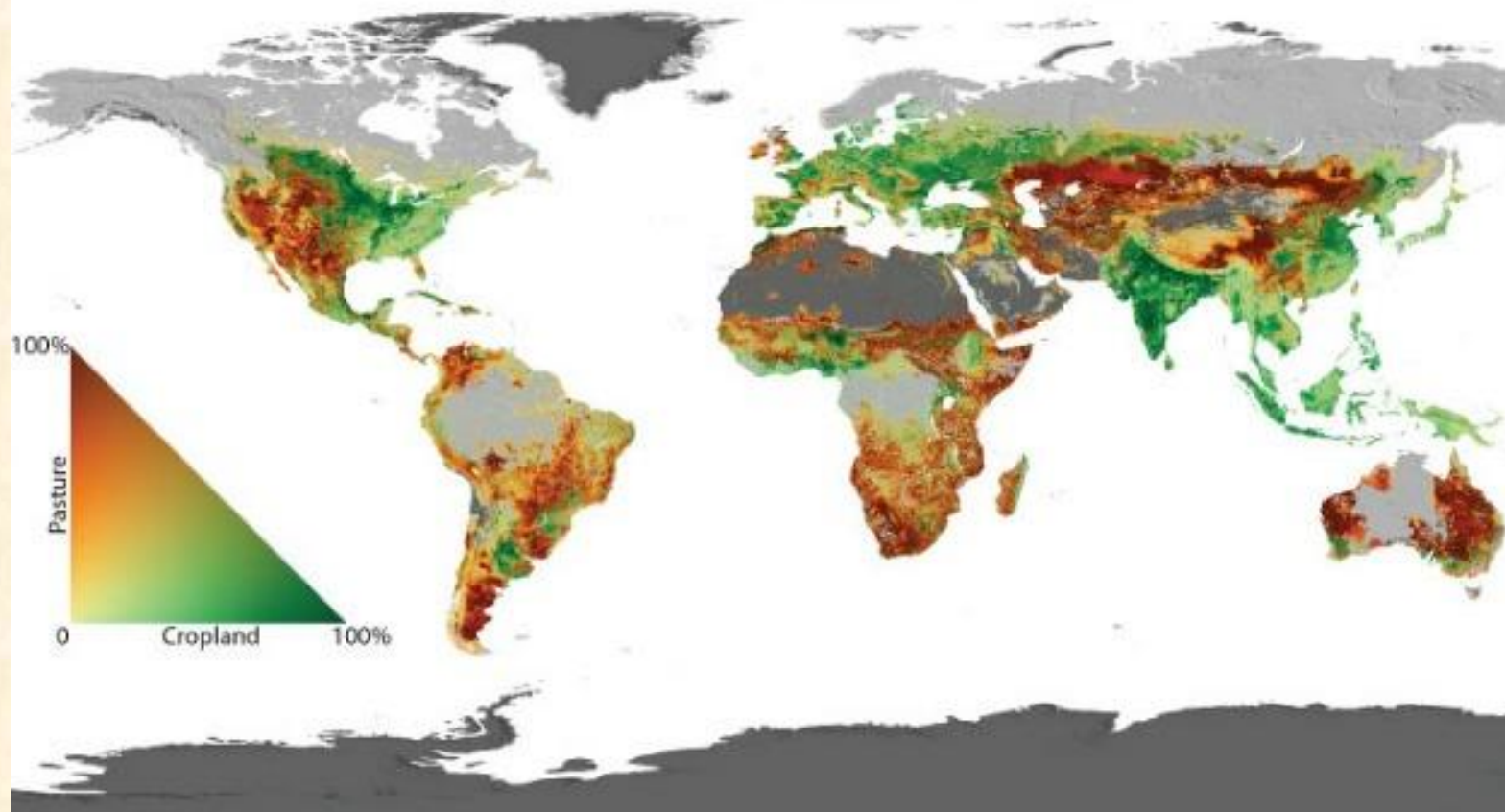
The rapid loss of species we are seeing today is estimated by experts to be around 1,000 times higher than the *natural extinction rate*.*

Sustainability Issues for Agriculture

The Global Food System



Agricultural Lands of the World



Agriculture estimated to use about 33% of the world's land area.

Facts and Figures

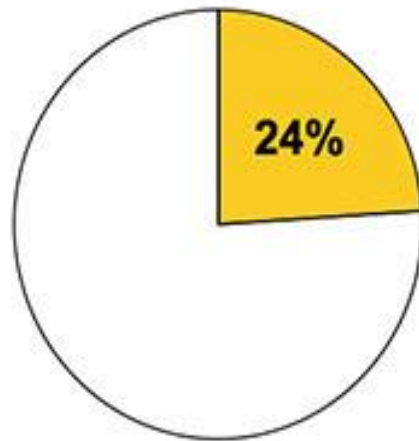
- **About 850 million people currently lack food security**
- **We need about a 70% increase in available food calories to keep up with anticipated population growth by 2050**
- **It is estimated that 25-40% of food grown each year is wasted**

Facts and Figures

- **Agriculture employs (directly or indirectly) about 28% of the world's population**
- **Agriculture and land use change resulted in about 25% of global greenhouse gas emissions in 2010 (WRI)**
- **Agriculture's share of this was around 13% (~11 billion metric tons of GHG emissions CO₂-equivalent (FAO))**
- **Agricultural removals were about 2 billion tons (FAO)**

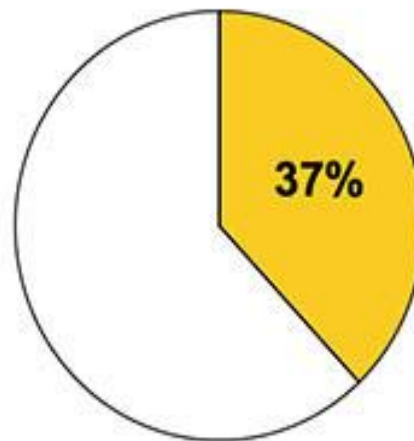
Agriculture's Share of Global Environmental Impact (2010)

**GREENHOUSE GAS
EMISSIONS**



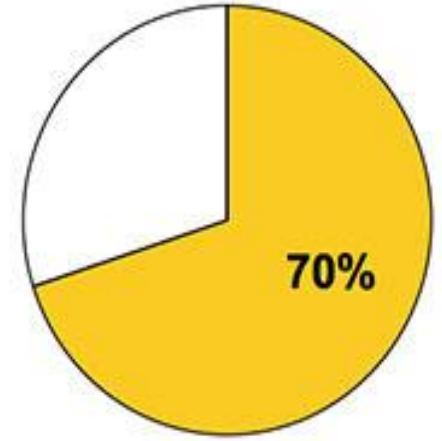
100% = 49 Gt CO₂e

**EARTH'S LANDMASS
(EX-ANTARCTICA)**



100% = 13.3 bn ha

**WATER
WITHDRAWAL**



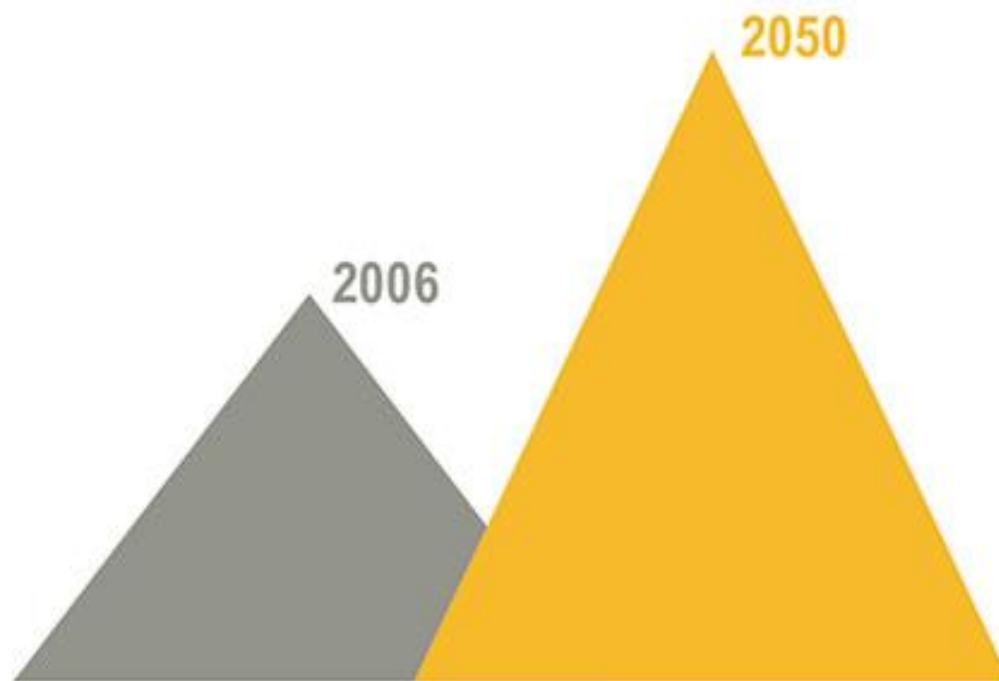
100% = 3862 km³ H₂O



WORLD RESOURCES INSTITUTE

Sources: <http://ow.ly/rpfMN>

Problems/Challenges

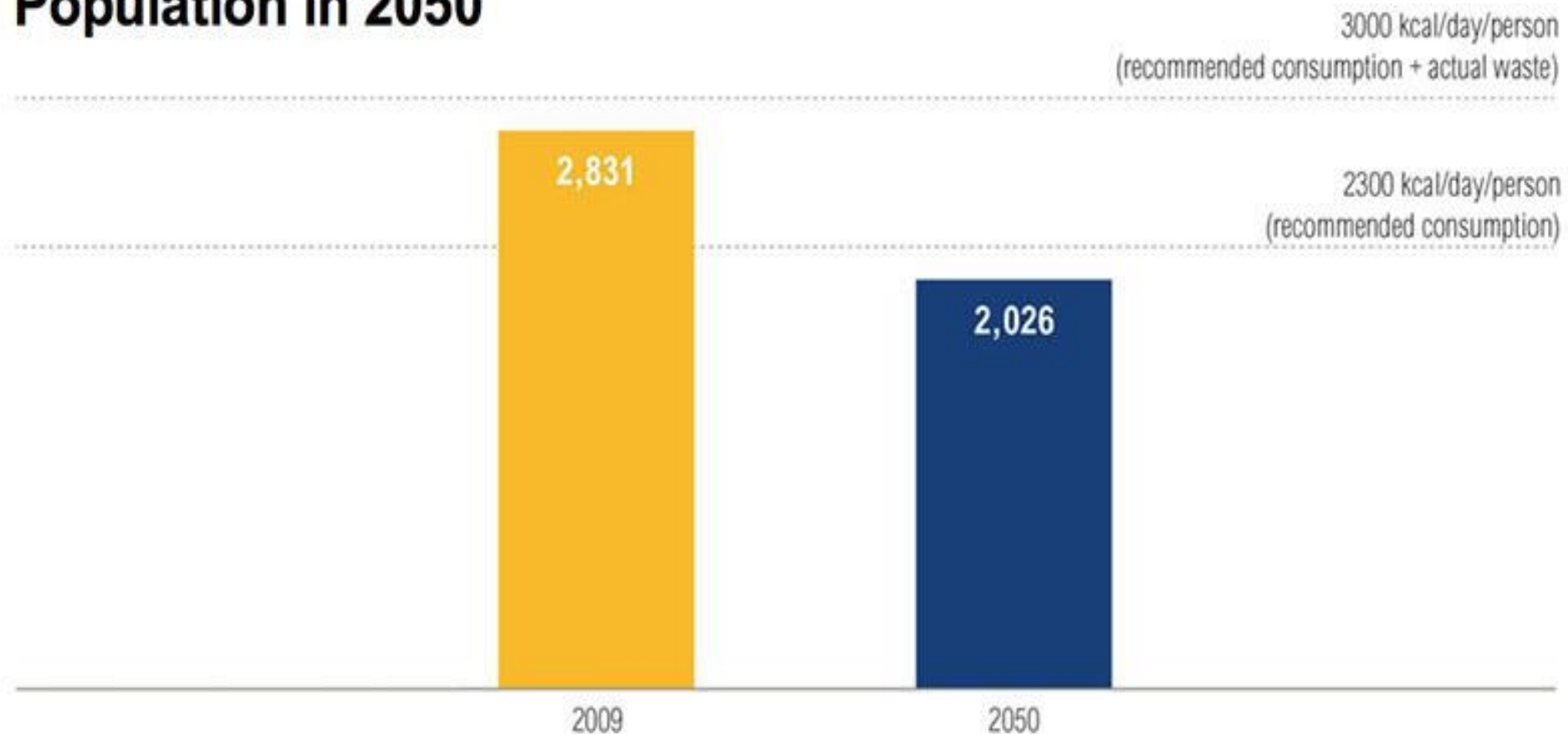


69%

Required increase
in food calories
to feed 9.6 billion
people by 2050



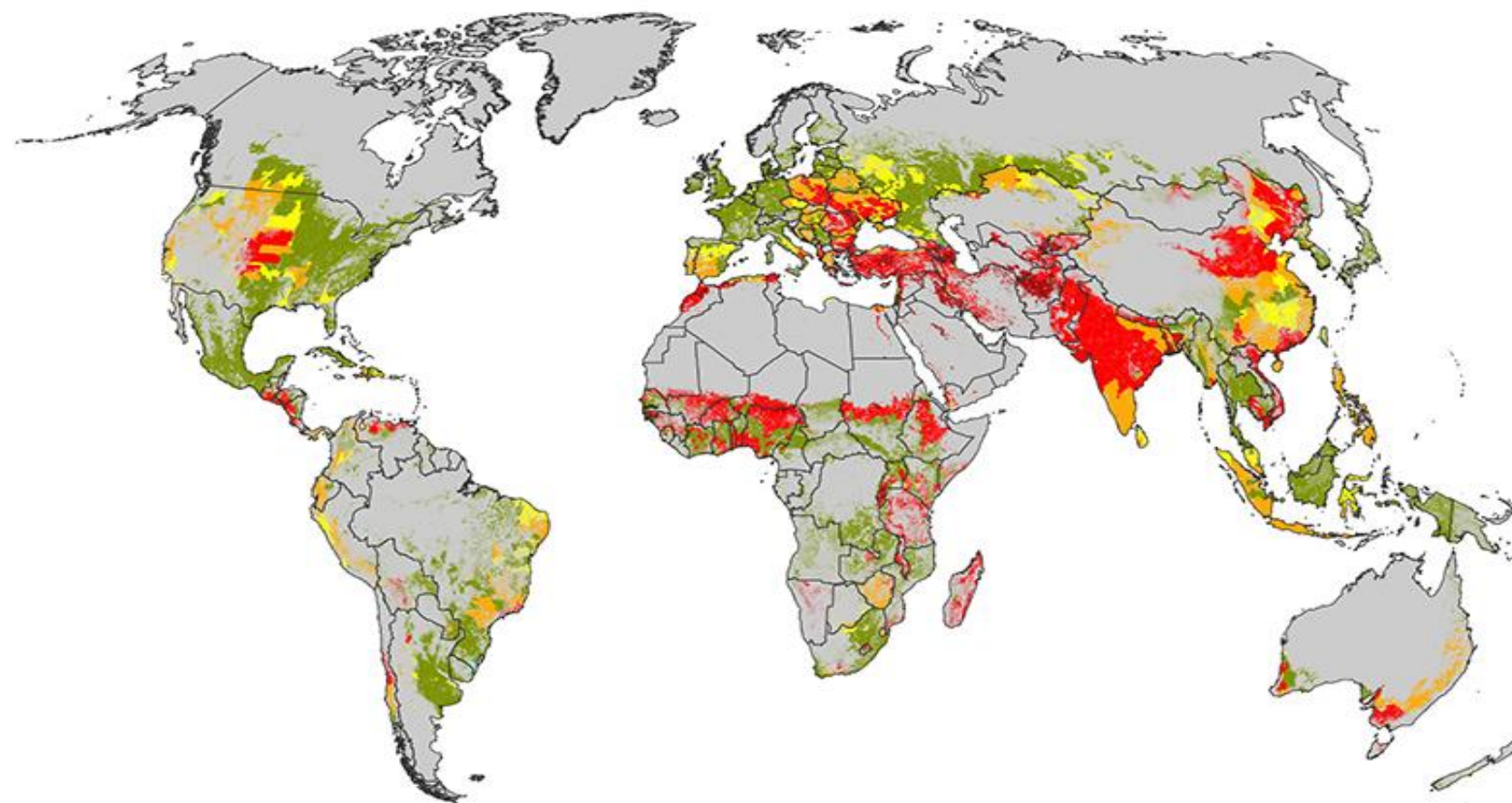
Even Distribution of All Food Produced in 2009 to World Population in 2050



Note: Data reflects food for direct human consumption. It excludes food crops grown for animal feed and biofuels. See endnotes for assumptions used to generate the global average daily energy requirement per person.



Water stress will increase in many agricultural areas by 2025 due to growing water use and higher temperatures (based on IPCC scenario A1B)



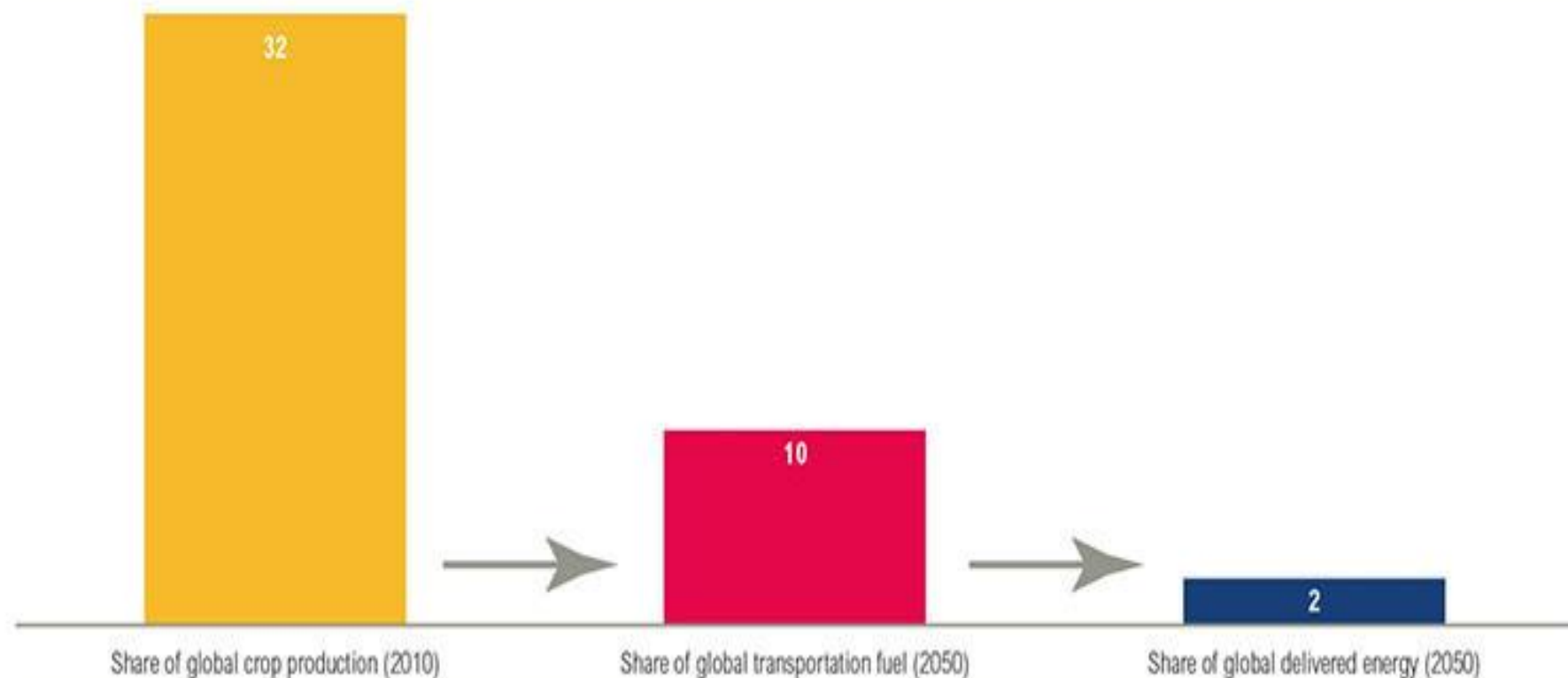
Water Stress Condition



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Sources: <http://ow.ly/rpfMN>

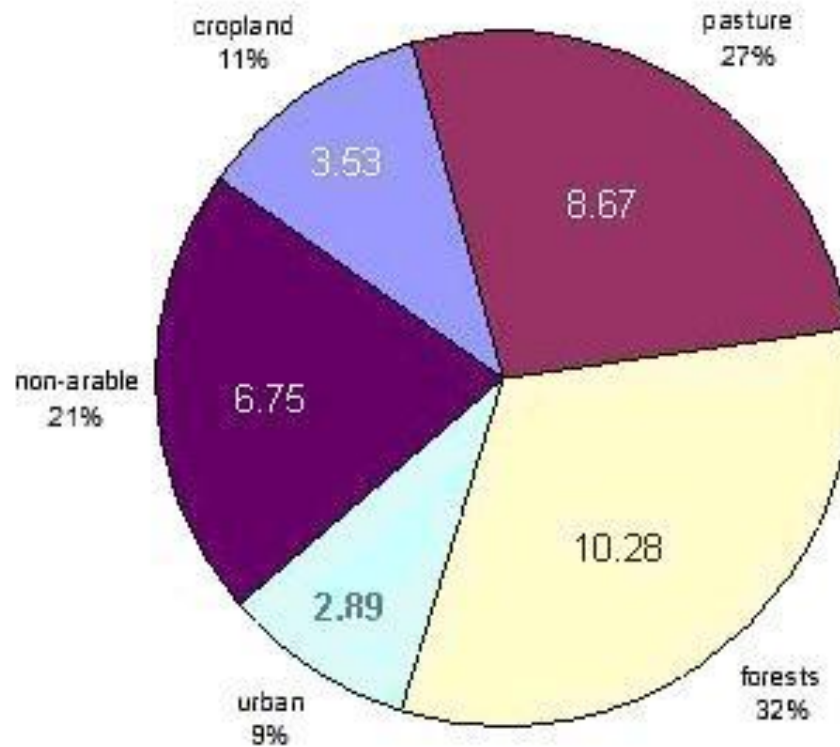
Share of Global Crop Production Needed to Produce 10% of Transport Fuel in 2050



Opportunities and Needs

Global Land Use

(Billions of Acres)

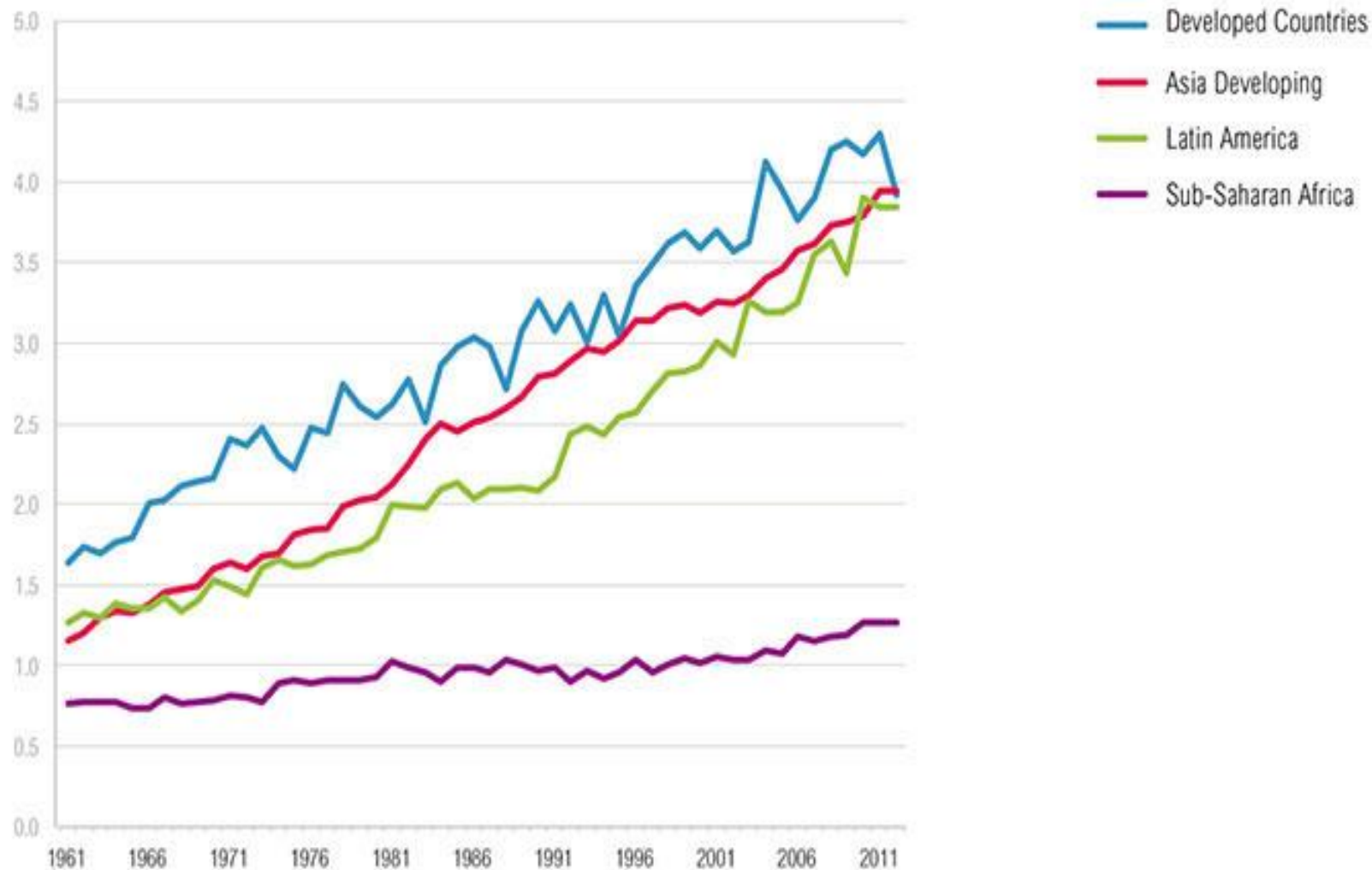


Derived from bit.ly/6USmo4

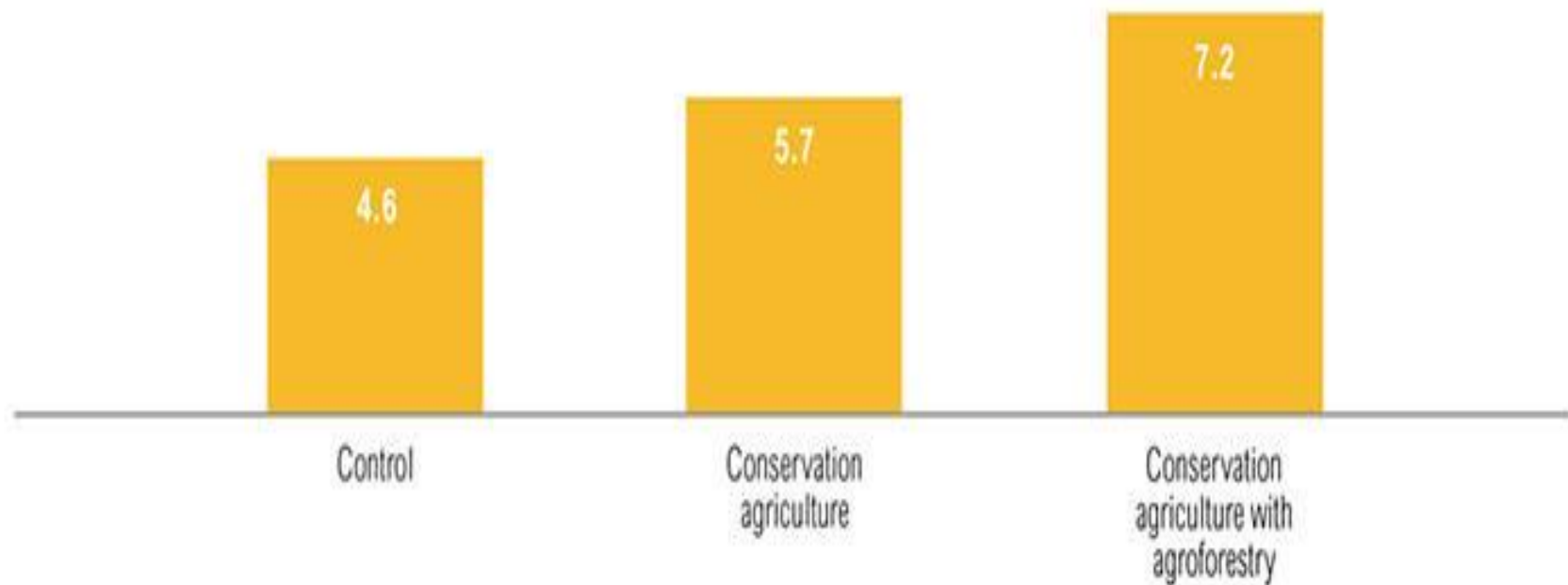
Total: 32 billion acres

It might be possible to expand cultivated area, but how will this affect GHG emissions, and soil and ecosystem quality?

Cereal Yields (in metric tons per hectare)



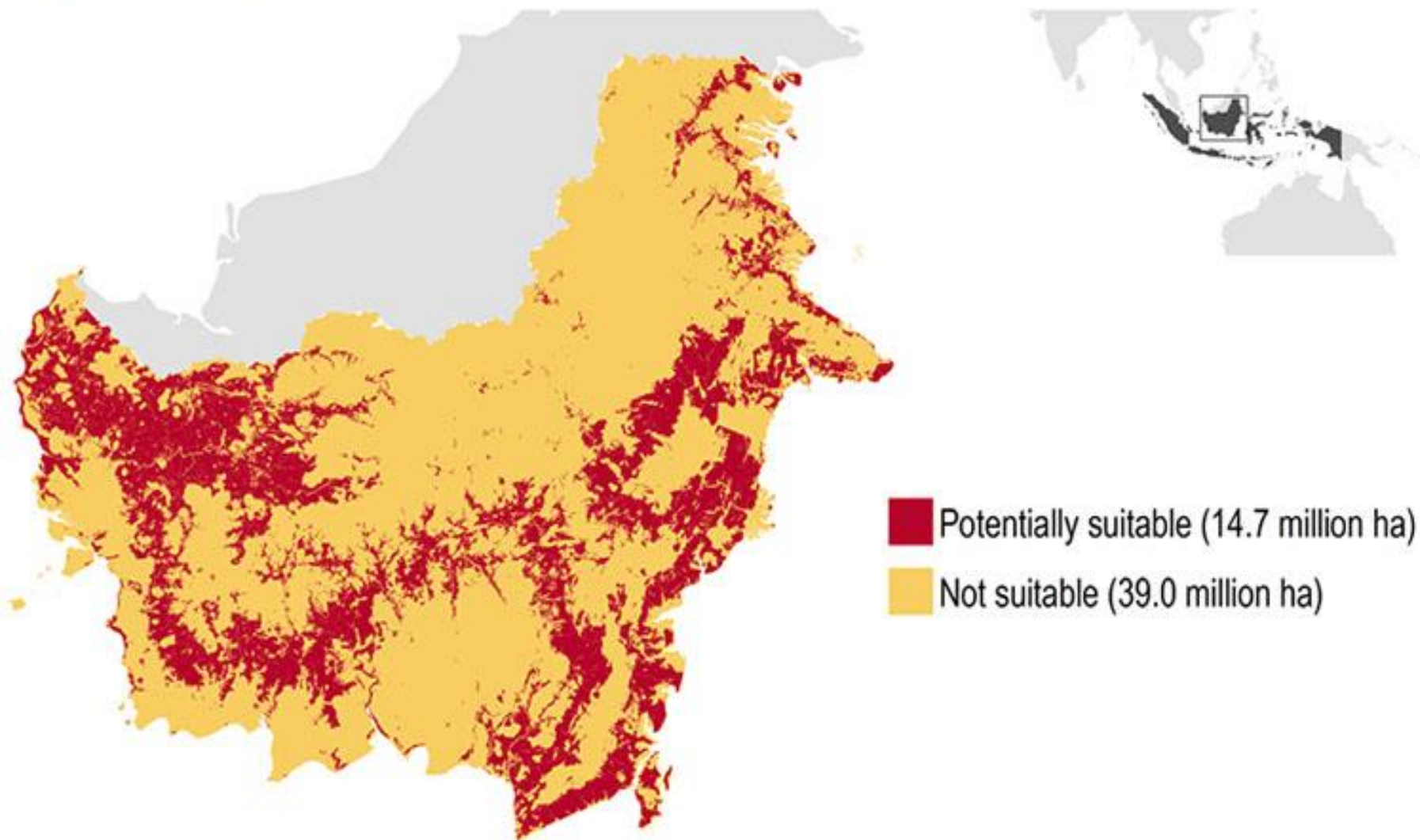
Maize Yields in Malawi (in metric tons per hectare)



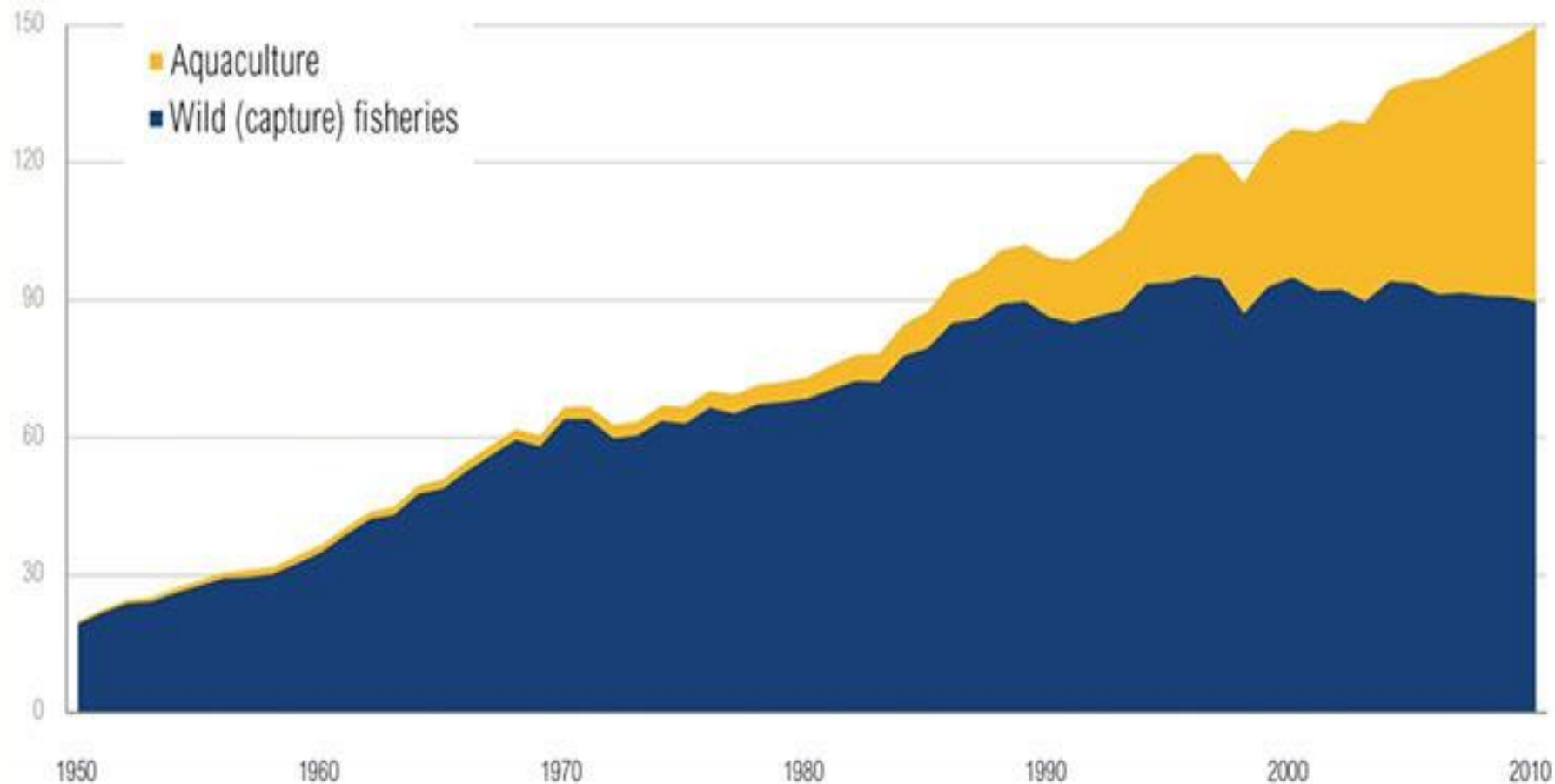
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Sources: <http://ow.ly/rpfMN>

Degraded Lands Suitable for Oil Palm in Kalimantan, Indonesia



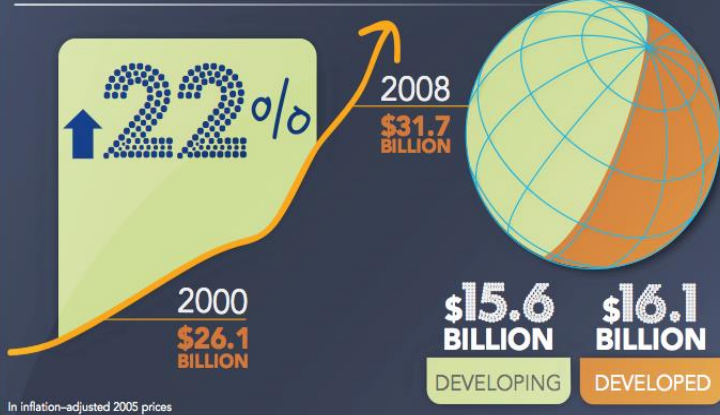
World Fish Production (in million tons)



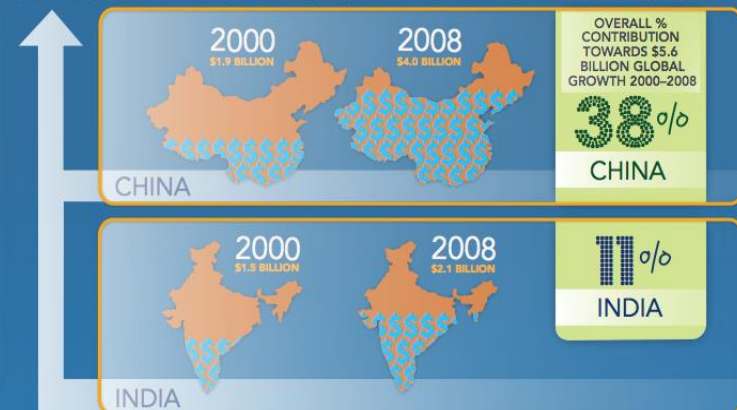
Are we investing enough?

ACCELERATED SPENDING IN AGRICULTURAL RESEARCH

GLOBAL PUBLIC SPENDING



DEVELOPING COUNTRIES DRIVE PUBLIC GROWTH



ARGENTINA
BRAZIL
IRAN
NIGERIA
RUSSIA

EACH COUNTRY
3-4%

R&D INVESTMENTS PAY OFF...



PRODUCTIVITY GROWTH 1970-2009



WHAT IS AGRICULTURAL R&D SPENDING?

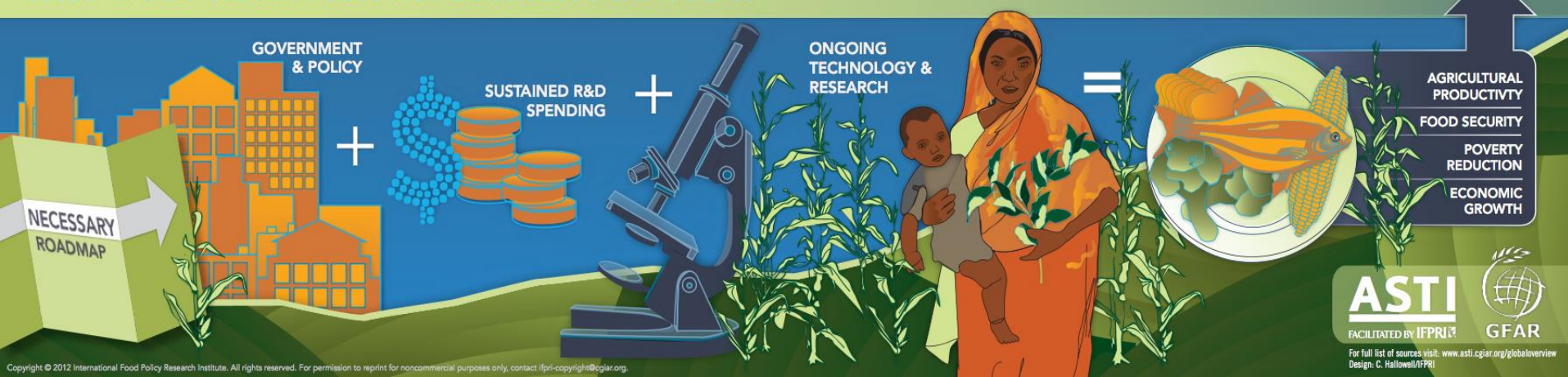
ACTORS



AREAS



WHY DOES RESEARCH INVESTMENT MATTER?



ASTI
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GFAR

For full list of sources visit: www.asti.cgiar.org/globaloverview
Design: C. Hallwell/IFPRI

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Conclusions

Agriculture and the global food system face many challenges: Population growth, bad policymaking, climate change, competition for water, etc.

Agriculture and the global food system are very adaptable

Key Questions:

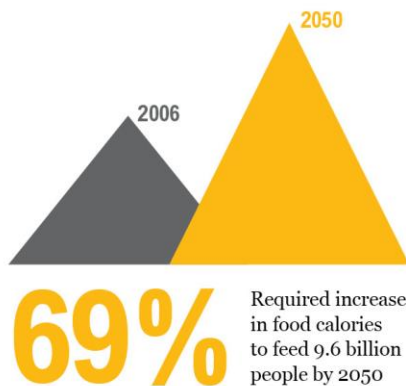
Can the rate of adaptation keep up with the rate of change?

Can we maintain balance among human needs, environmental needs, and economic development?

THE GREAT BALANCING ACT

The world must achieve a “great balancing act” in order to sustainably feed 9.6 billion people by 2050.
Three needs must be met at the same time.

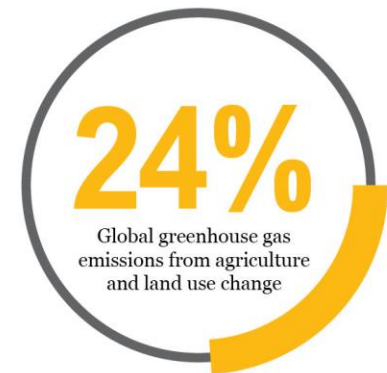
CLOSING THE FOOD GAP



SUPPORTING ECONOMIC DEVELOPMENT



REDUCING ENVIRONMENTAL IMPACT



And while we balance these needs we must more effectively provide food to those who lack food security

Thanks for listening!