The Future of the Food System
–
Whereto from here?

8TH Trondheim Conference on Biodiversity
31 May – 3 June 2016

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The Trends

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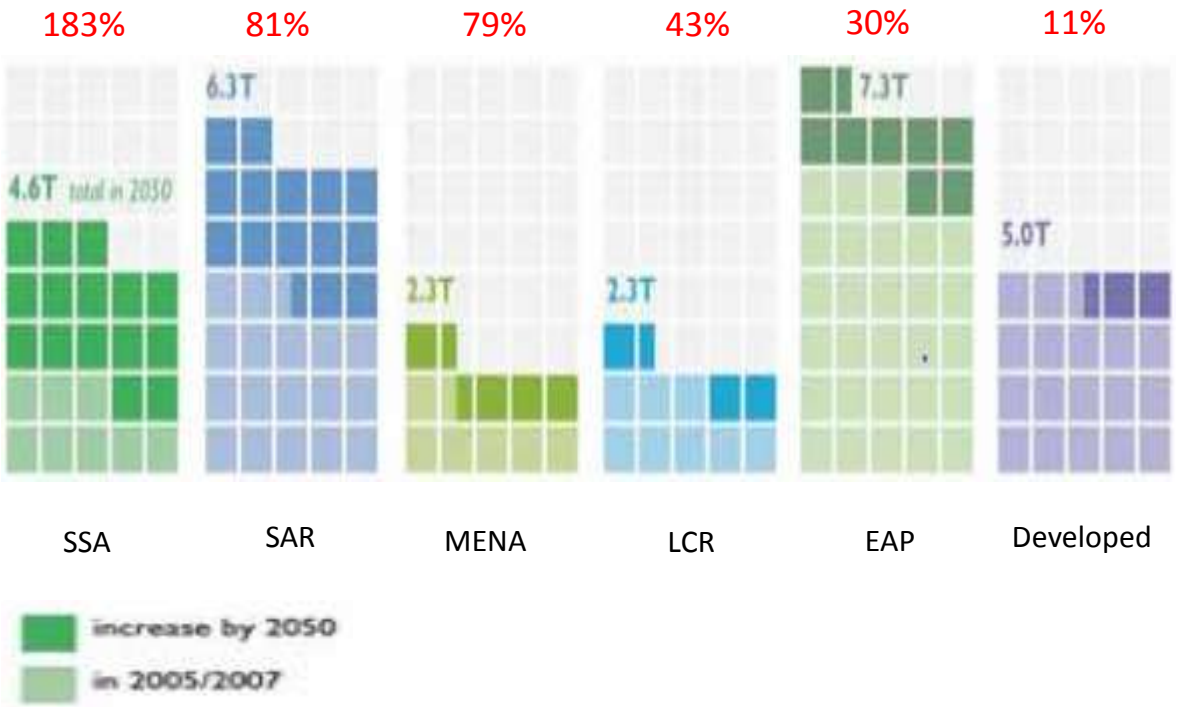
Feeding 9 Billion People in 2050

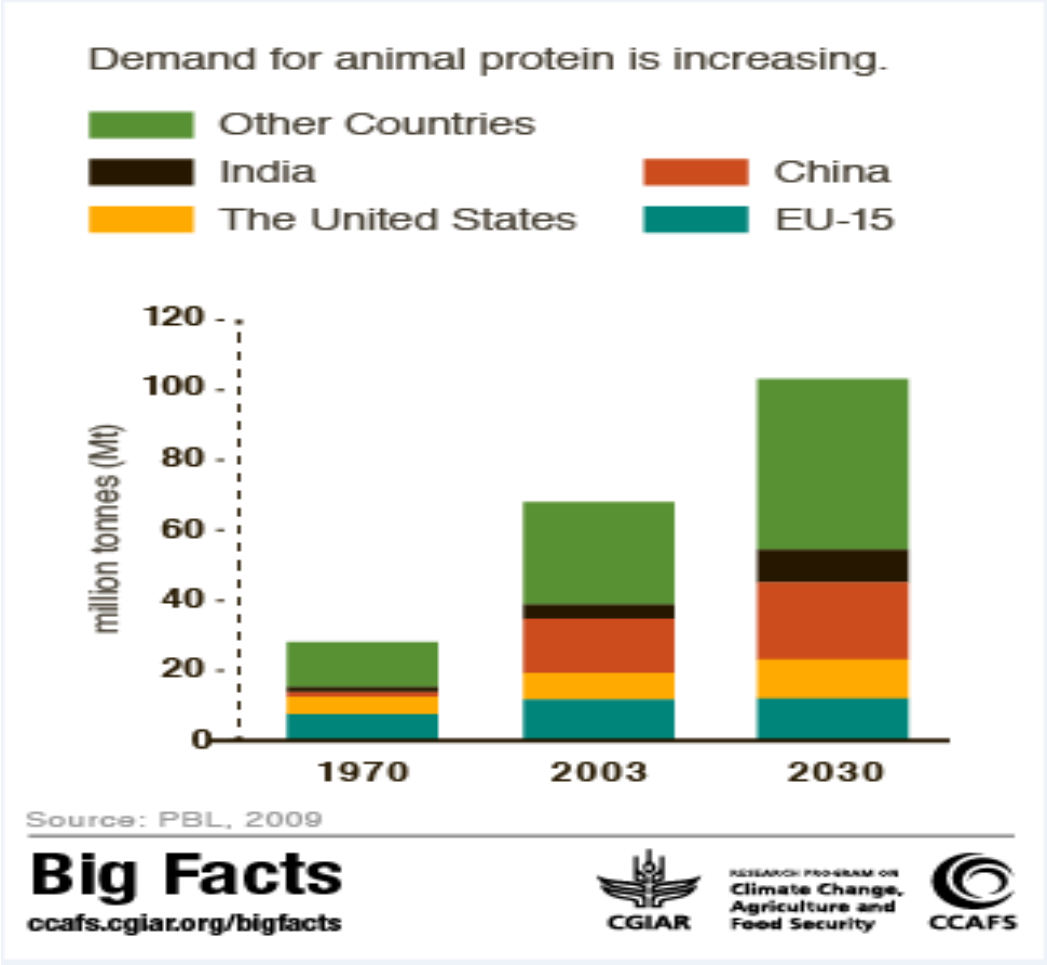
Changing Consumption

Food Consumption by Region 2005/07 vs 2050

Percentage Increase 05/07 – 2050



Changing Diets



CEA 2013 based on FAO 2012, CCAFS 2015

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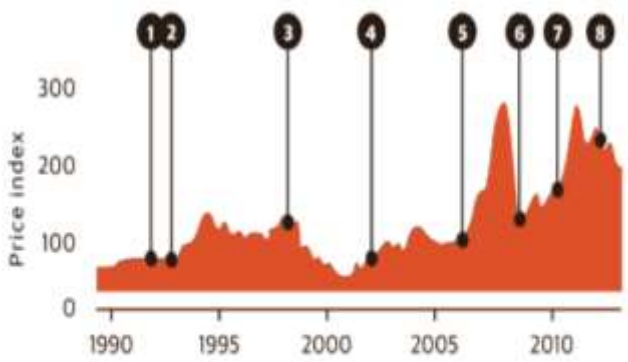
The Impacts of Climate Change on Food Systems

Problems Today:

Short Term Volatility

Recent price spikes for food commodities have been linked to extreme weather events

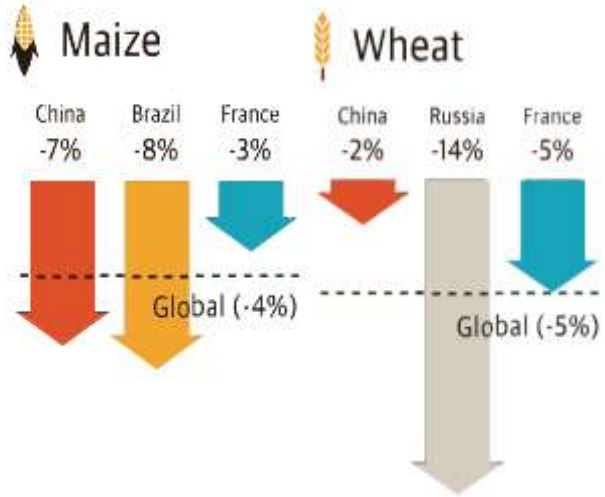


1. Australia wheat. **2.** US maize. **3.** Russia wheat. **4.** US wheat, India soy, Australia wheat. **5.** Australia wheat. **6.** Argentina maize, soy. **7.** Russia wheat. **8.** US maize.

Issues Tomorrow:

Yield Losses Increasing Cost Structures

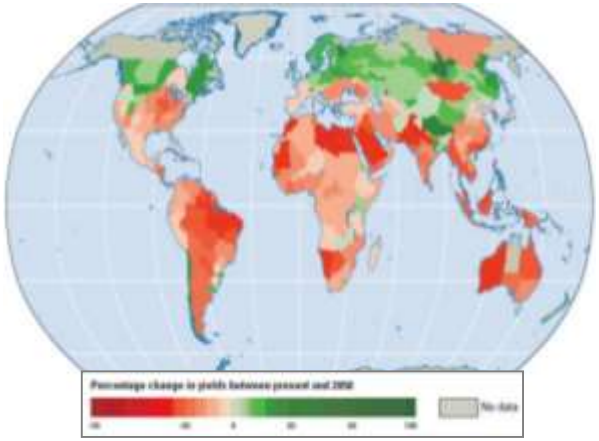
Maize and wheat yields show climate impacts



Uncertain Future:

Production Collapse

Maize and wheat yields show climate impacts



CCAFS 2014; World Bank 2008

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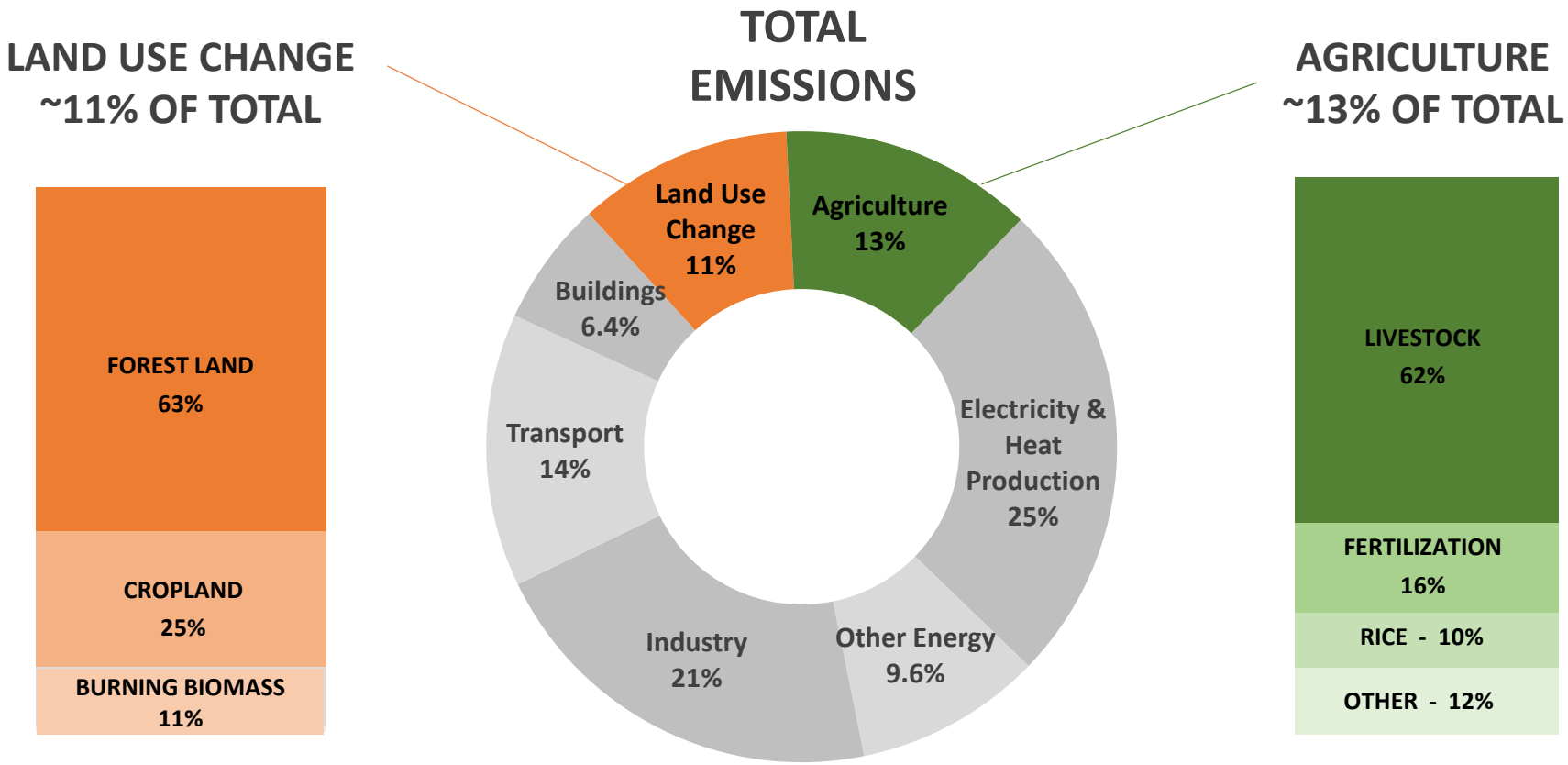
Today - The Impacts of Agriculture on Climate Change



IPCC 2014

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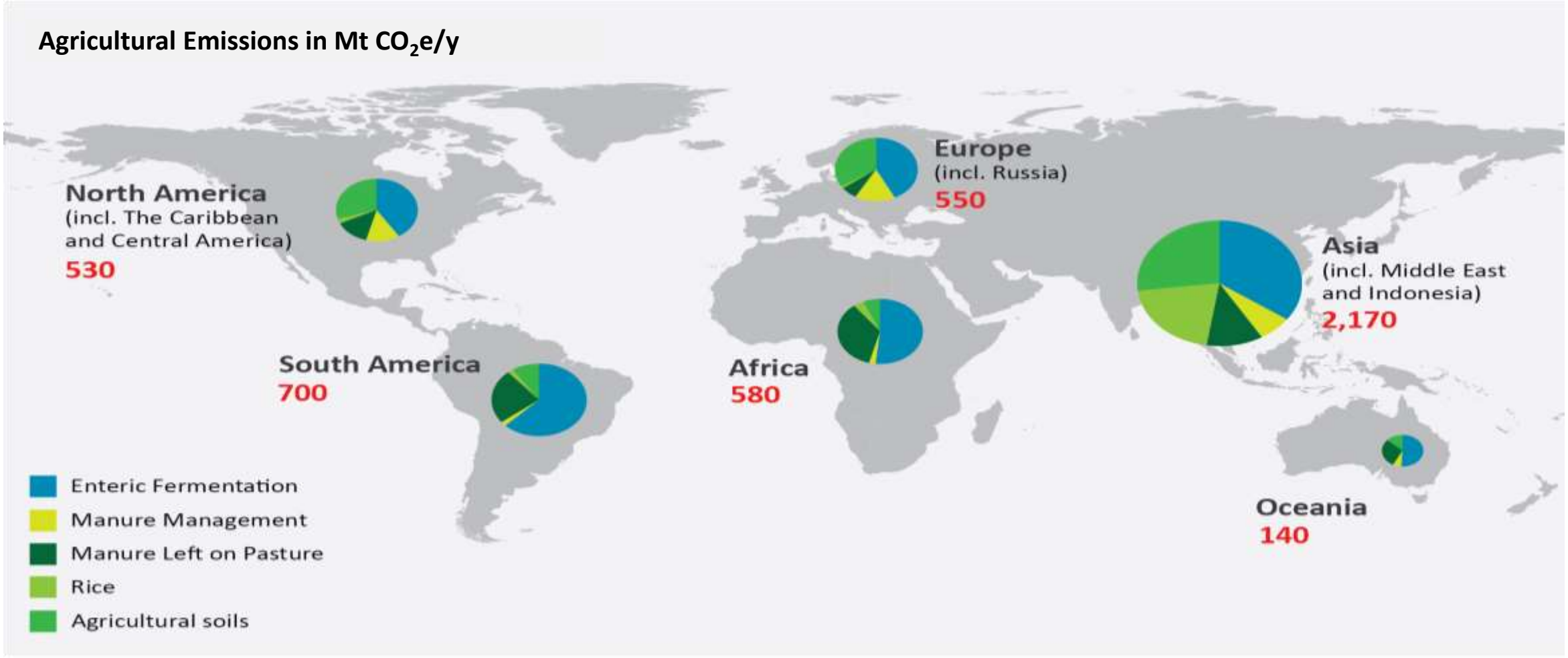
Who's Emitting in Food Systems?



Source: FAOSTAT data from 2010 (accessed 2013); area of pie charts scaled to regional emissions.

California Environmental Associates 2013, *unpublished.* Based on data from FAOSTAT 2010.

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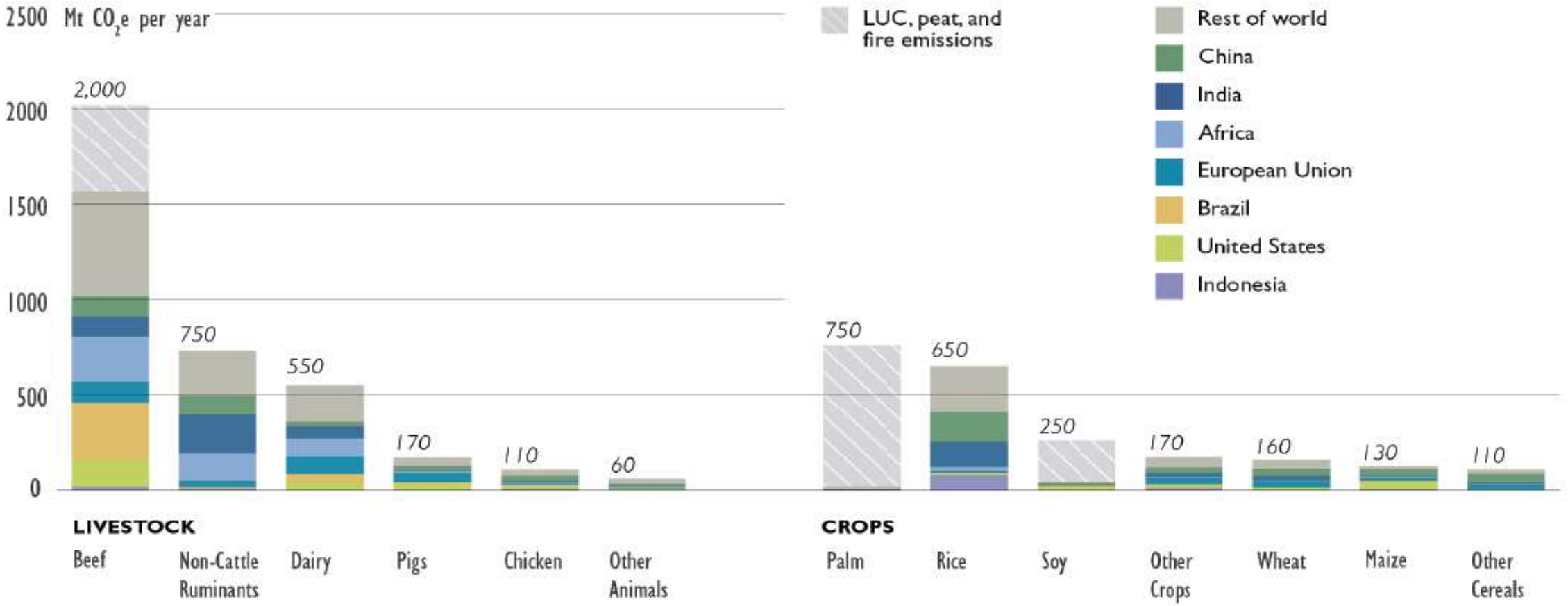
What's Emitting in Food Systems?

Global emissions by commodity, 2008



Source: CEA analysis based on: FAOSTAT 2008; Gerber et al., and personal communications with Paul West; Institute on the Environment, University of Minnesota.

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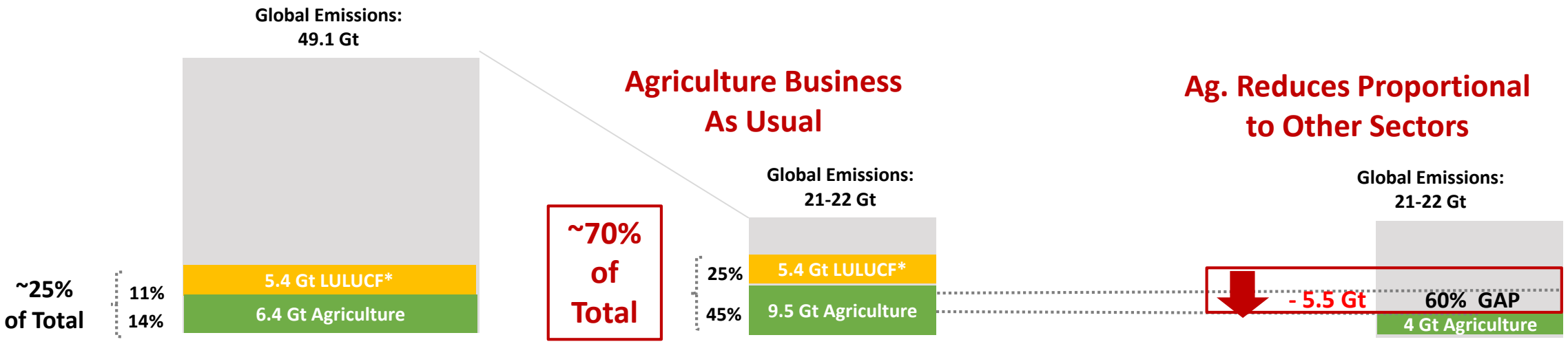
Tomorrow – Agriculture Driving Climate Change

Projections of Global, Agriculture and Land Use Change Related Emissions towards 2050 (Gt CO_2e)



By 2050, Agriculture and Land Use Change could represent 70% of Global Emissions - if global emissions are reduced in accordance with a 2C goal, while Agriculture were to remain in business as usual.

By 2050, Agriculture will have to reduce its emission intensity by 60%, if it is to maintain its footprint in parallel with overall emissions reductions. **This assumes emissions from Land Use Change will have fallen to zero.**

WRI 2013

*Land Use, Land Use Change and Forestry

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The Backstory

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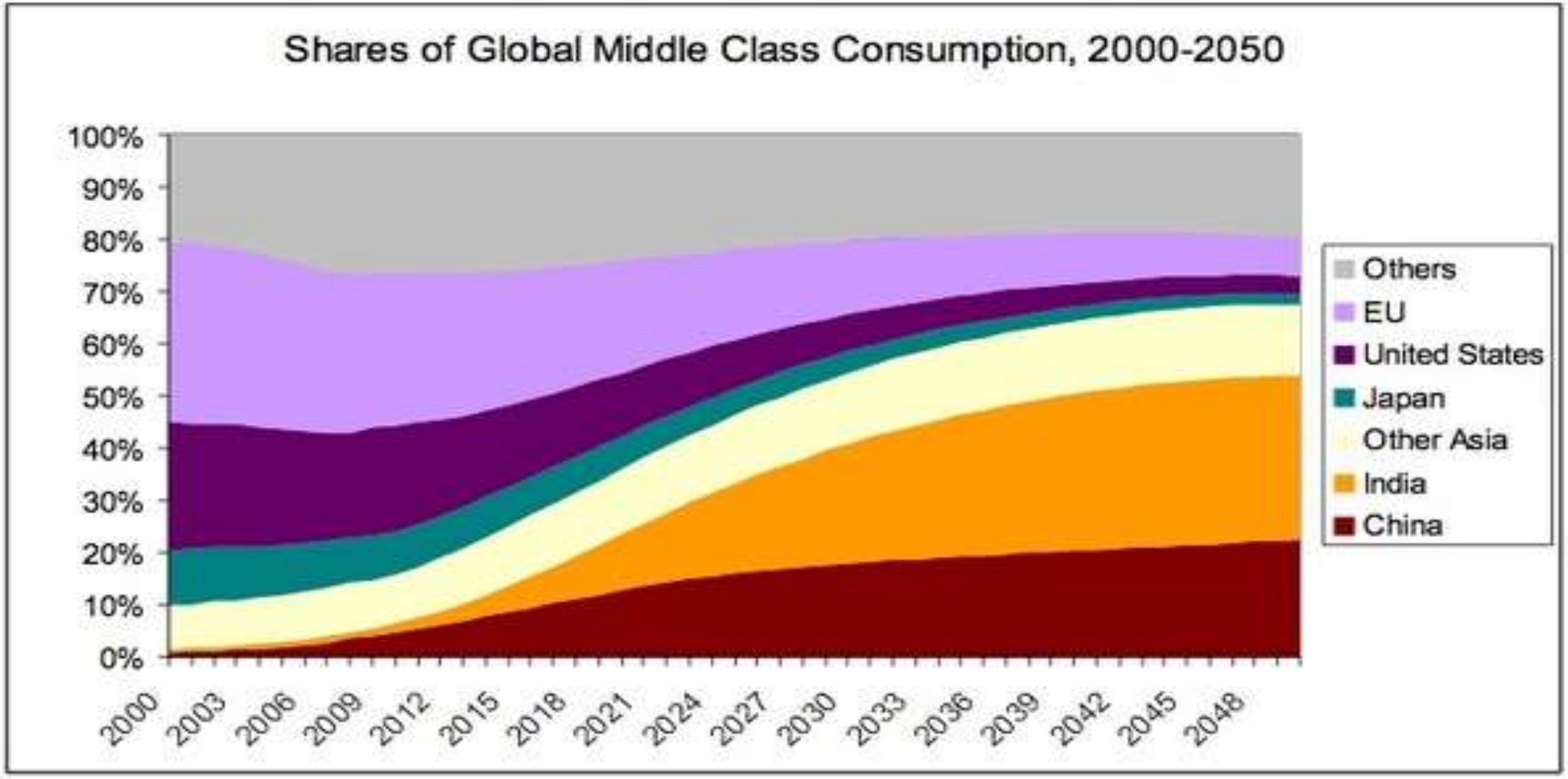
Changing Wealth and its distribution is driving demand dynamics



Kharas, 2011

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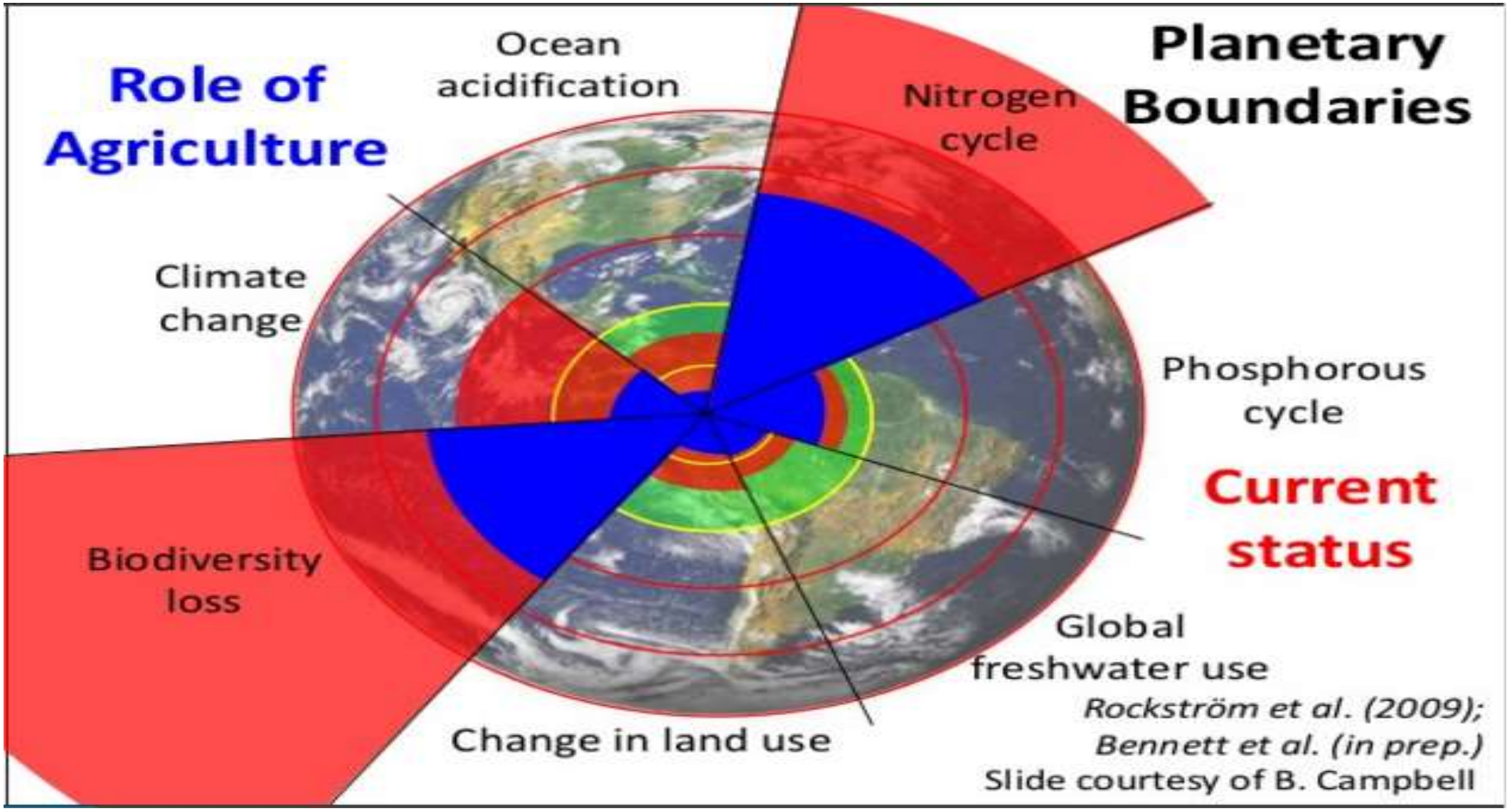
Meeting current demand already unsustainable (green = safe space)



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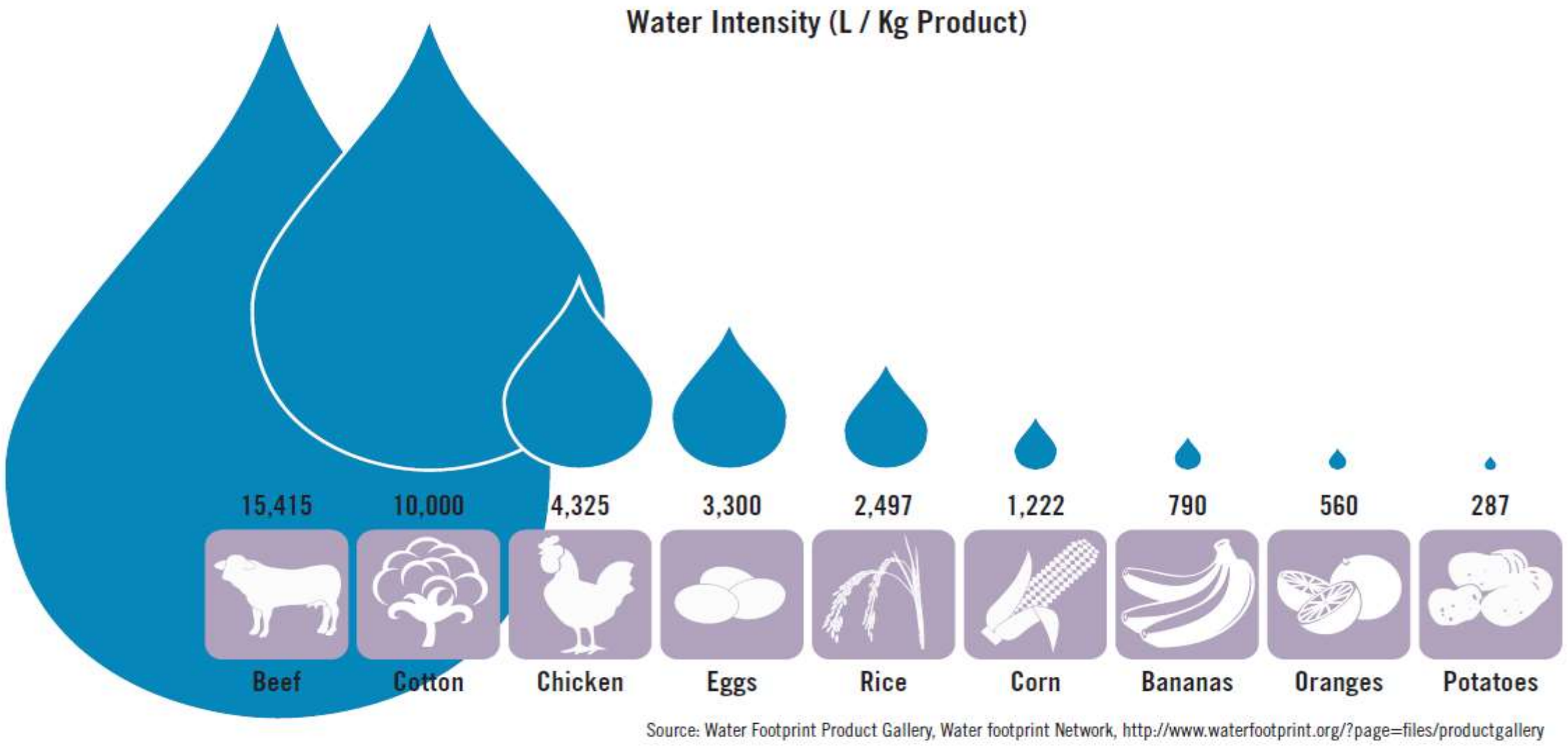
Not All Water in Agriculture is Consumed Equally



CERES, 2015

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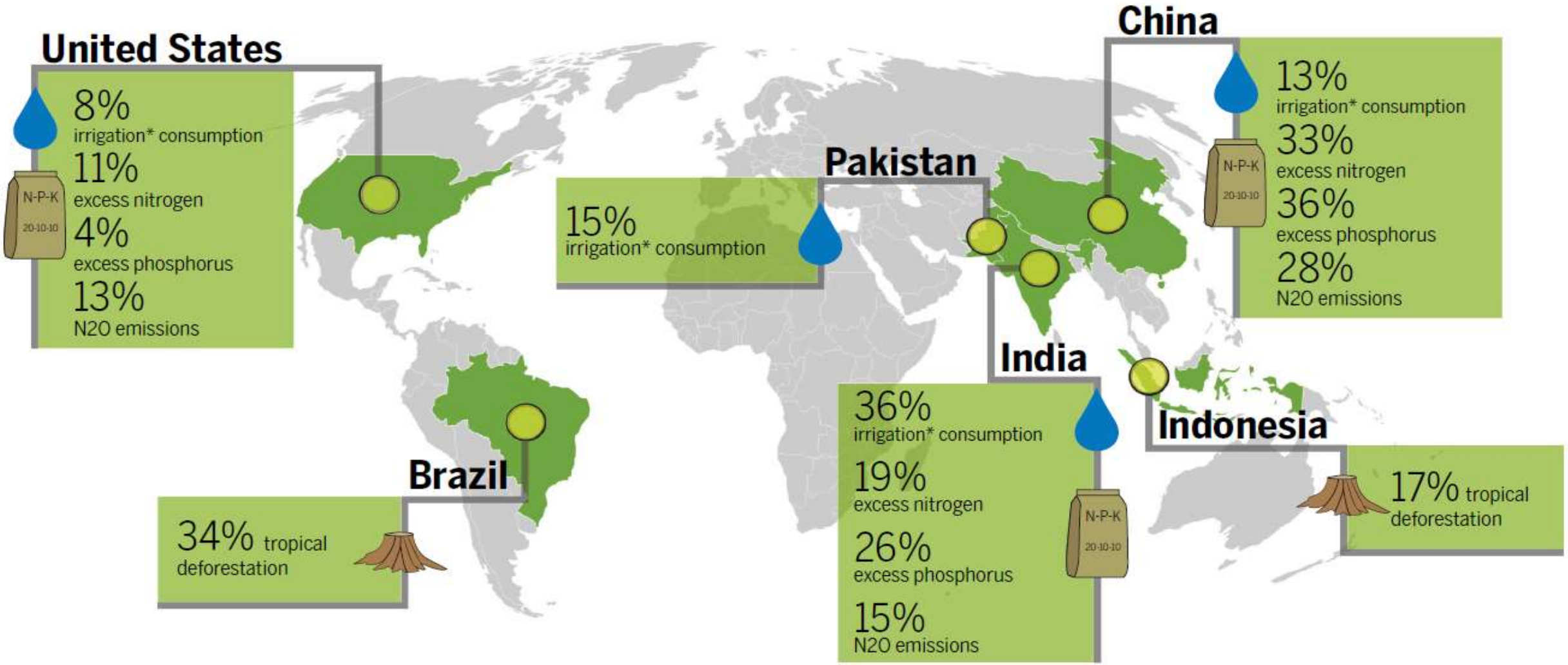
Global problems, related to some big local problems



West et al 2014

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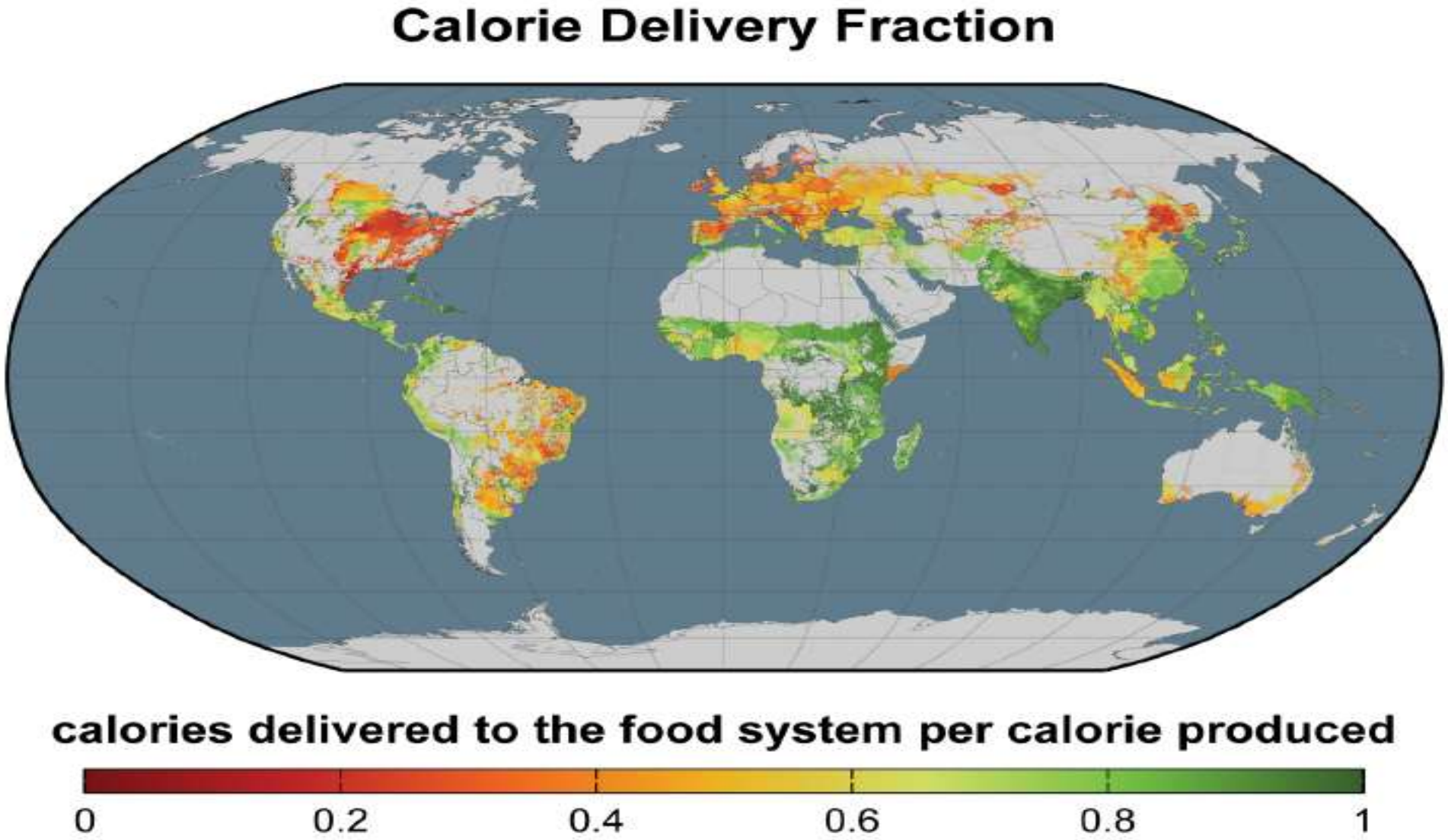
Efficient production does not always lead to “efficient” allocation



West et al 2014

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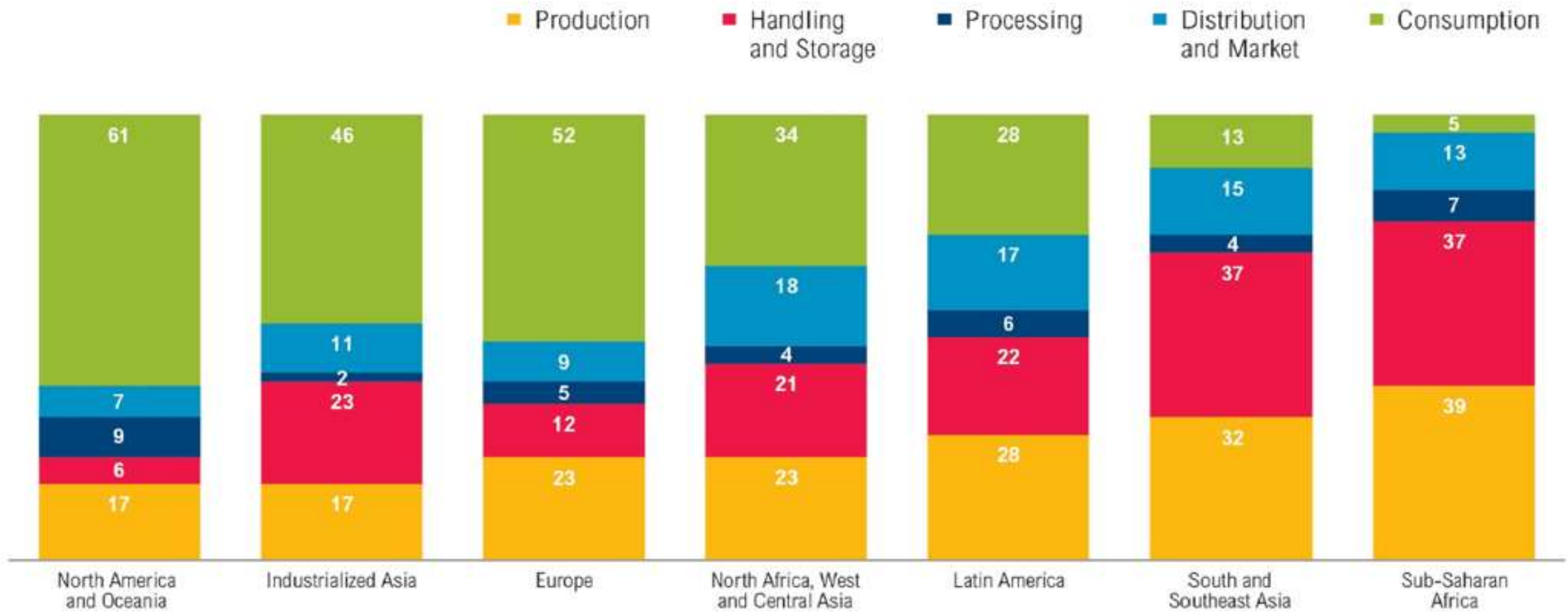
Efficient production definitely does not correspond with efficient consumption



SHARE OF AVAILABLE FOOD THAT IS LOST OR WASTED

WRI 2015

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Affecting the change

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Poverty, Hunger, Climate and Climate Smart Agriculture

WHAT IS THE CHALLENGE?

To build food systems that meet increasing demand while remaining profitable and sustainable in the face of Climate Change.

WHAT WILL IT TAKE?

1. ***Increasing productivity sustainably***
2. ***Enhancing the resilience of producers and supply chains***
3. ***Reducing Emissions***

CAN IT BE DONE?

Yes, but we need to connect Climate Change with the bottom line of farmers and food businesses

CSA = SUSTAINABLE AGRICULTURE + RESILIENCE - EMISSIONS

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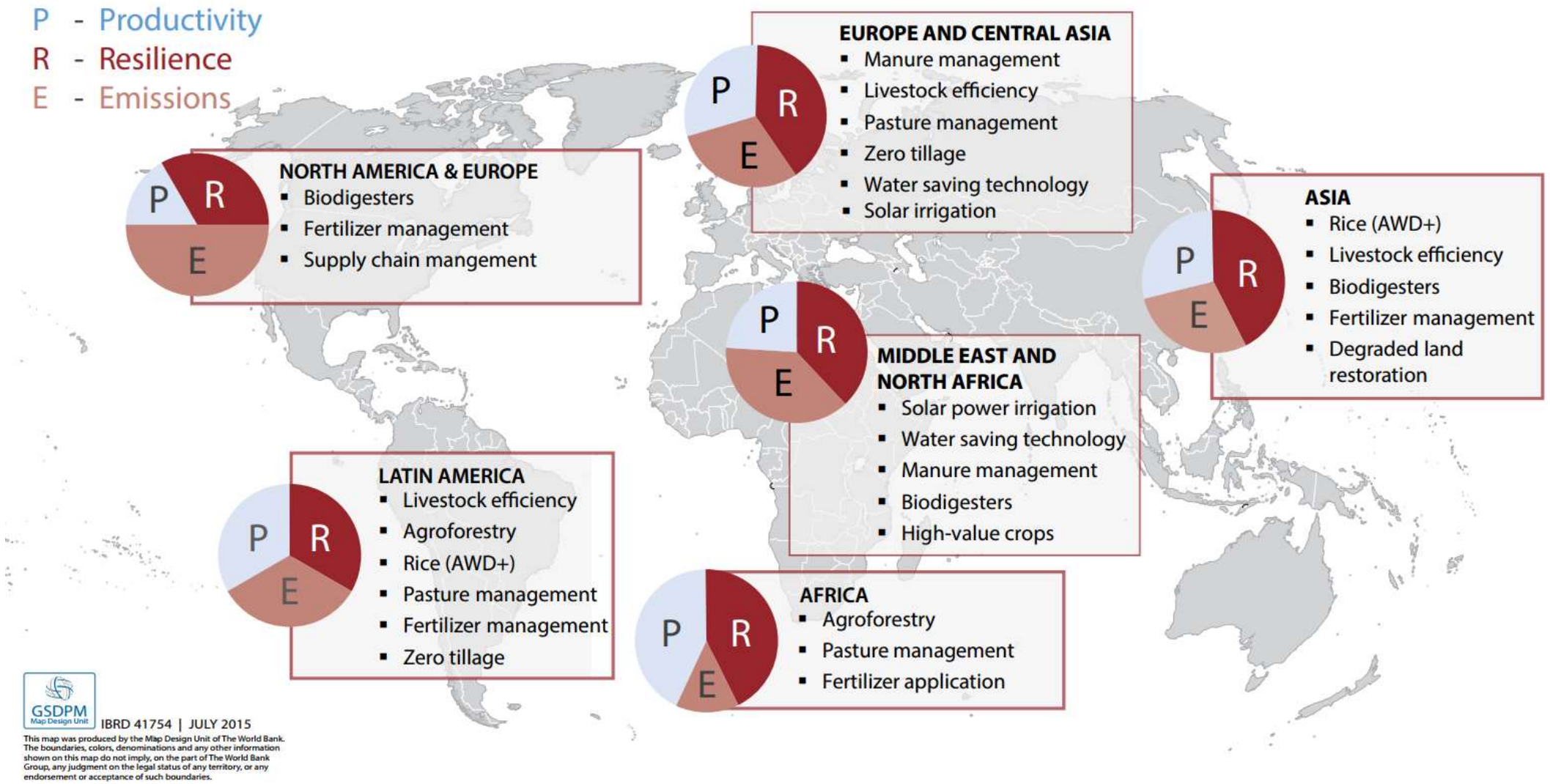
What and Where are the Opportunities to Deliver?



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The Role of Biodiversity in sustainable change

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Multiple Demands on Landscapes:
Food, Water, Biodiversity… need to be integrated

Ecoagriculture Partners, 2015

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It won't be easy

Optimizing plant functional biodiversity means complexification of cropping systems

Increased number of cultivated species

Source: Hainzelin, 2013

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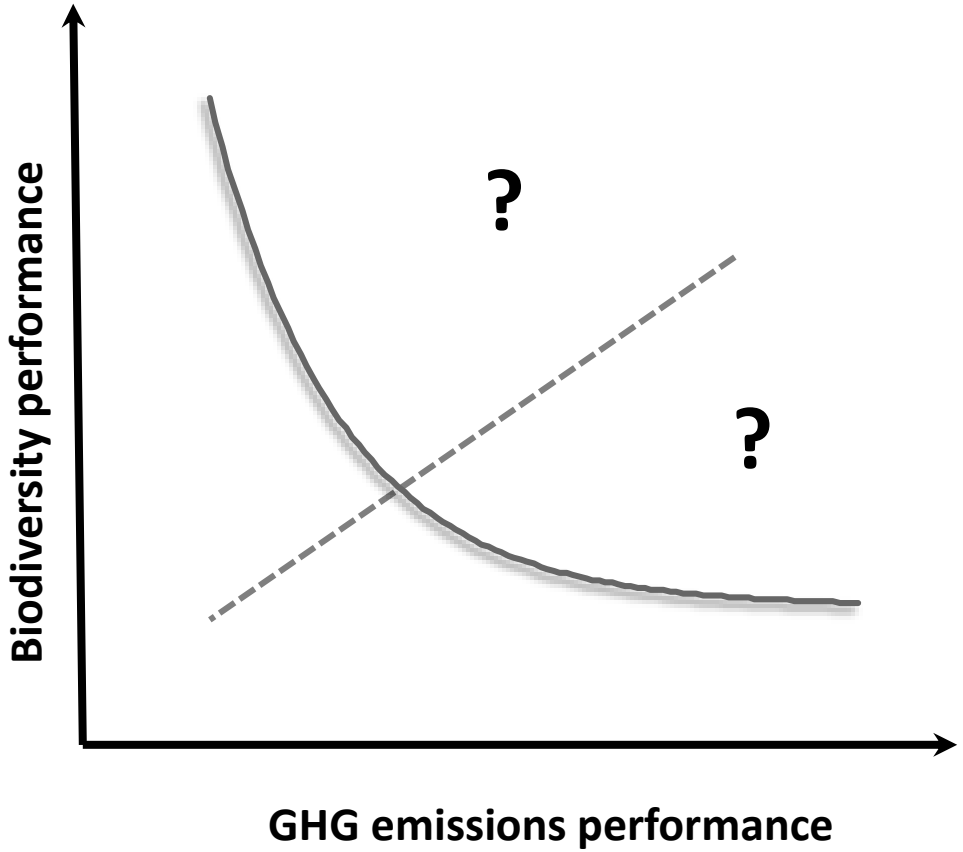
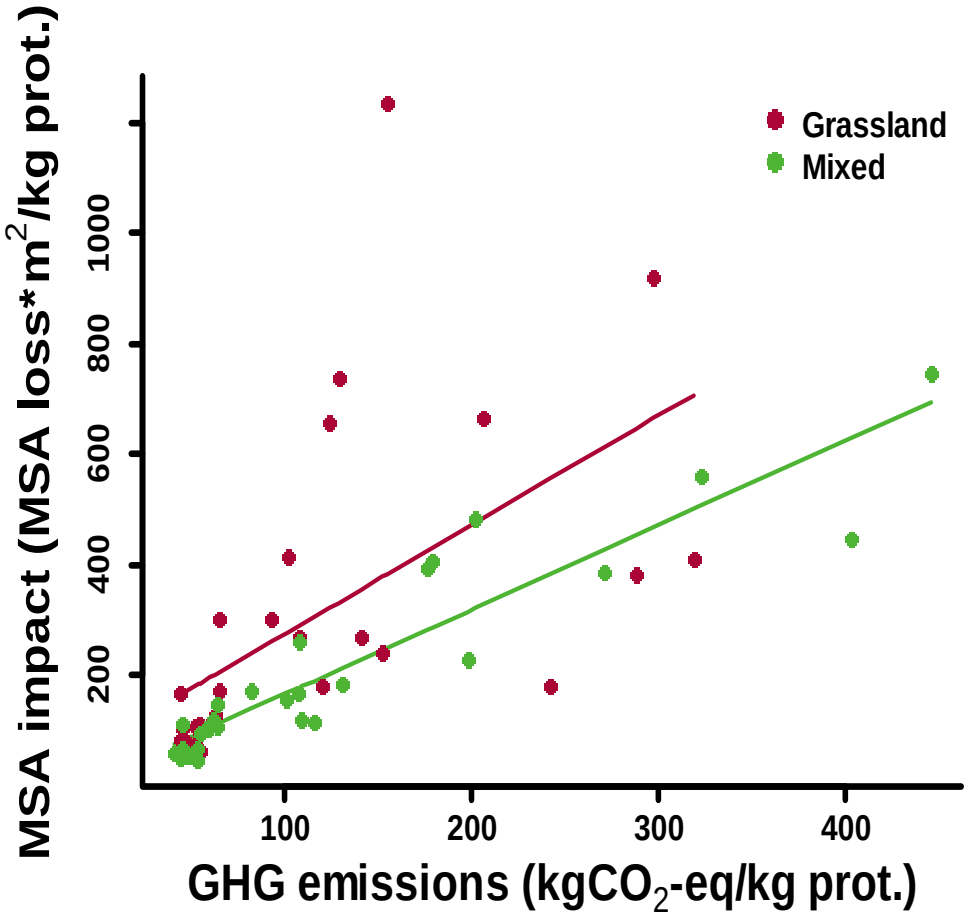
But very often incentives align very positively and synergies exist





There is a strong positive correlation between emissions and biodiversity loss – and the inverse also holds true

Source: Teillard et al., 2014

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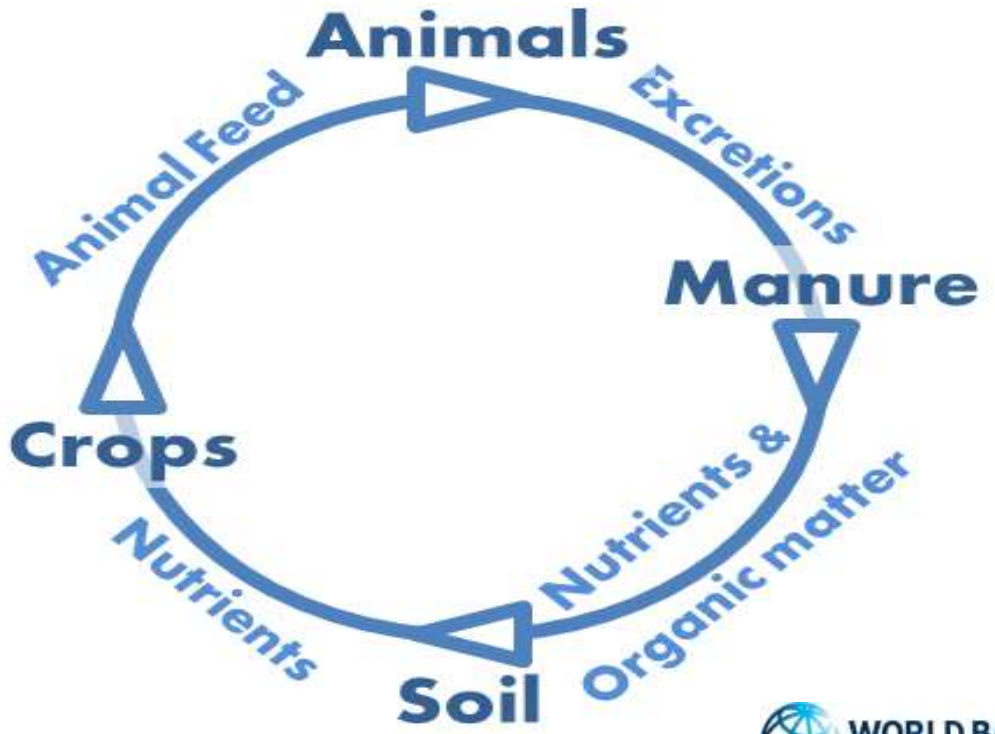
Solutions exist: Synergies between emissions & biodiversity in manure management

The Livestock Waste Management Project in China, Vietnam, and Thailand aims to reduce livestock-induced pollution and environmental degradation of the South China Sea.

GHG & Biodiversity Outcomes

- Reduced impact on habitat and species in the South China Sea
- Improved agrobiodiversity and soil health
- Reduced greenhouse gas emissions

Manure Management Framework



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Synergies between emissions and biodiversity in agroforestry

Working with 300 farmers, a Regional project in Columbia, Costa Rica, and Nicaragua works to convert degraded pastures by establishing silvopastoral systems that combine fodder plants, such as grasses and leguminous herbs, with trees and shrubs.

GHG & Biodiversity Outcomes

- Carbon sequestration increased (3.5 tonnes of CO2e hectare/year)
- Methane emissions decreased (21%)
- Nitrous oxide emissions decreased (36%)
- Number of bird, mollusk, and butterfly species doubled
- Water quality improved substantially

Indices of main land use types

Land use	Carbon index	Biodiversity index	Total
Degraded pasture	0	0	0
Live fences	0.3	0.3	0.6
Fodder banks	0.3	0.5	0.8
Natural pasture with low tree density	0.1	0.1	0.2
Improved pasture with high tree density	0.6	0.7	1.3
Secondary forest	1	1	2

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Making the Argument

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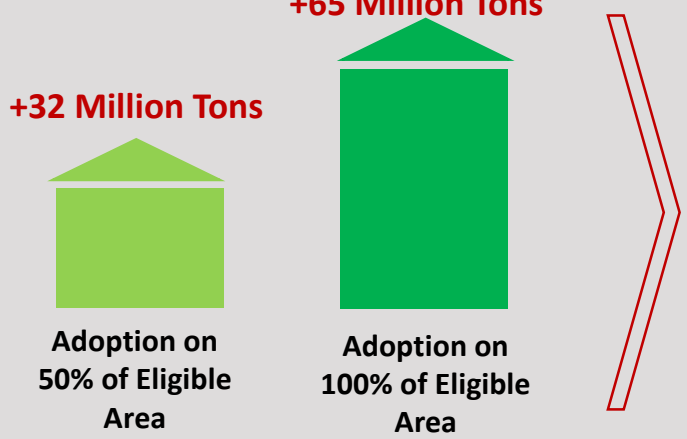
What if we applied AWD+ Across the World?

PRODUCTIVITY

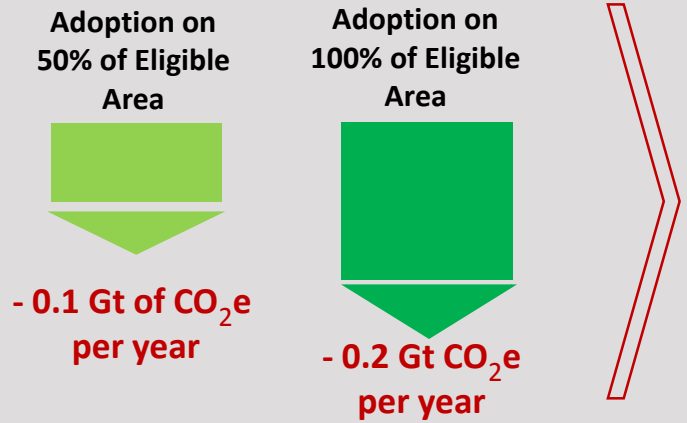
Food Production



- **15%** increase in yield
- **+ US$ 178 income** per ha for farmers
- **+ 70% of rice growers are smallholders**
- **~100 million ha** affected

EMISSIONS

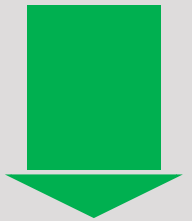
Emission Reduction



- Reductions correspond to **>2.5% of global direct Ag. emissions**
- Reduction significant for major rice producers including Vietnam and the Philippines

RESILIENCE

Irrigation Water Savings



- 100% adoption would lead to **water savings of ~400 thousand Gigaliters.**
- Additional impact in combination with micro-dose fertilizer and other practices

AWD+ can be applied in all irrigated areas with flexible water management systems.

Source: CCAFS 2014, Yan et al. 2009

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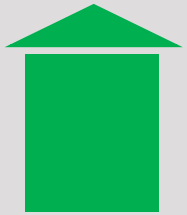
What if We Reduced China's excess and Applied it in Africa Instead?

PRODUCTIVITY

Africa Production Increase

+175 Million Tons



Increased Fertilizer application to maximum efficiency

- Potential to increase grain yields by **+100%, increasing to ~1800 pounds crop/acre**
- **+~550 calories** per day for **280 million people**
- **Income could double or greater.**

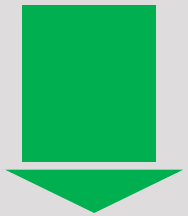
EMISSIONS

China Emissions Reduction

Reduction of 50% emissions from synthetic fertilizer

- 0.2 Gt CO_2e per year

Reduction of 50% emissions + reduced nitrogen production



- 0.36 Gt CO_2e per year

- Reductions for crops emissions correspond to **>2.5% of global direct Ag. emissions**
- Emissions may decrease further with reduced need for and improved efficiency of nitrogen production.

Reduced Nitrogen Leaching in China

-30%

- Efficiency could reduce nitrogen use and leaching by -30-60%, and reduce cost by $10-20/acre.
- Reduced harmful algal bloom outbreaks in lakes

ENVIRONMENT

Reducing nitrogen over-application has major benefits to the environment besides reducing carbon emissions.

FAOSTAT, National Geographic, Charles 2013

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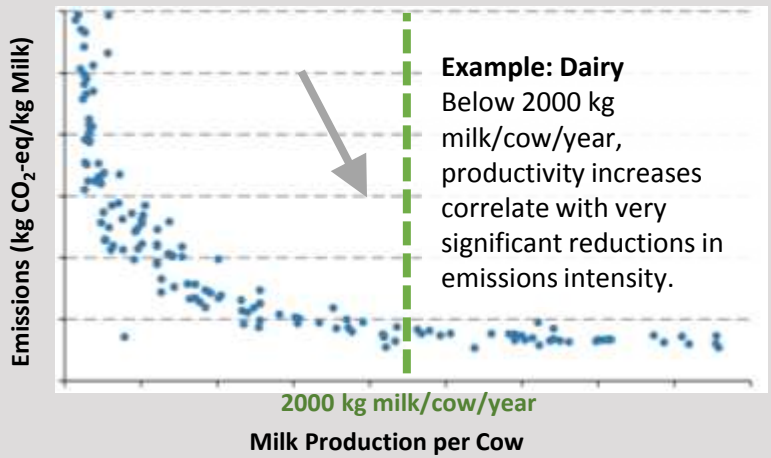
What if we made all livestock farmers as efficient as the Top 10%?

PRODUCTIVITY

In Livestock, Higher productivity ⇒ Lower Emission Intensity



- Lowering emissions intensity **also** contributes to food security.
- In Africa higher productivity would have **major impact on poverty**.

RESILIENCE

- **Higher incomes for farmers**
- Healthier animals
- Biodiversity conservation due to reduced land pressure

EMISSIONS

Global Livestock Emissions

Potential for reduction of livestock emissions if all producers became as efficient as the Top 10%:

- **- 1.8 Gt** CO_2e/yr in **2010**
- **> 3 Gt** CO_2e/yr in **2050**

Using only currently available technologies:

- Feeding practices,
- Animal husbandry
- Health management

Based on results of the GLEAM Model, FAO 2013, Extrapolations

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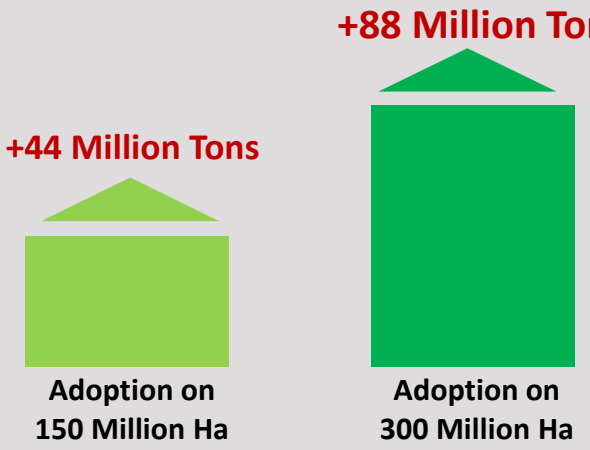
What if we spread agroforestry across Africa?

PRODUCTIVITY

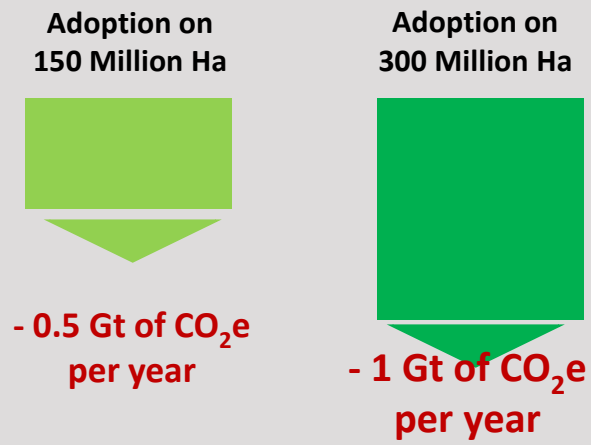
Food Production



- **+615 Calories per person/day for 140+ Million poor people**
- Average yield increase 50%
- Savings of over 6 Million tons of synthetic fertilizer

EMISSIONS

Carbon Sequestration



- 2 Gt Co_2e storage per year corresponds to **~1/3 of Global Direct Ag Emissions**
- Significantly higher mitigation potential by further increasing tree density and in humid systems

RESILIENCE

Multiple benefits include:

- Reduced soil erosion
- Additional diversified income from wood products
- Strengthened draught resistance from increased water storage

Agroforestry can be combined with other practices such as water harvesting for additional impact.

Nair et al. 2012, WRI 2013

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The question?

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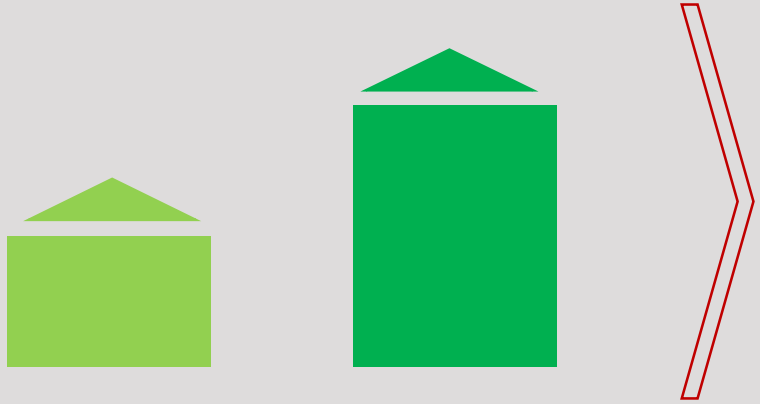
What if we mainstreamed biodiversity in agriculture?

PRODUCTIVITY

Food Production



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Multiple benefits include:

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RESILIENCE

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