What Research for what agriculture?

Quelle recherche pour quelle agriculture?

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Président
Millennium Institute Washington, USA et Fondation Biovision Zurich, Suisse

La France s'engage
> Rencontres internationales
Agricultures familiales & recherche

France is on board
> International Encounters
Family Farming & Research

Francia se compromete
> Encuentros Internacionales
Agriculturas familiares & investigación

Le Corum Montpellier France
1-3 Juin June Junio 2014

AGROPOLIS INTERNATIONAL
Consortium
CGIAR
WORLD RURAL FORUM
GFAR

Please NOTE

This is a draft….final version available on arrival in MPL

Few changes only (few additional charts…)

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Overview

1. Why do we need a new agriculture (and food system)?

2. What will drive the transformation?

3. Can it be done, and how/who

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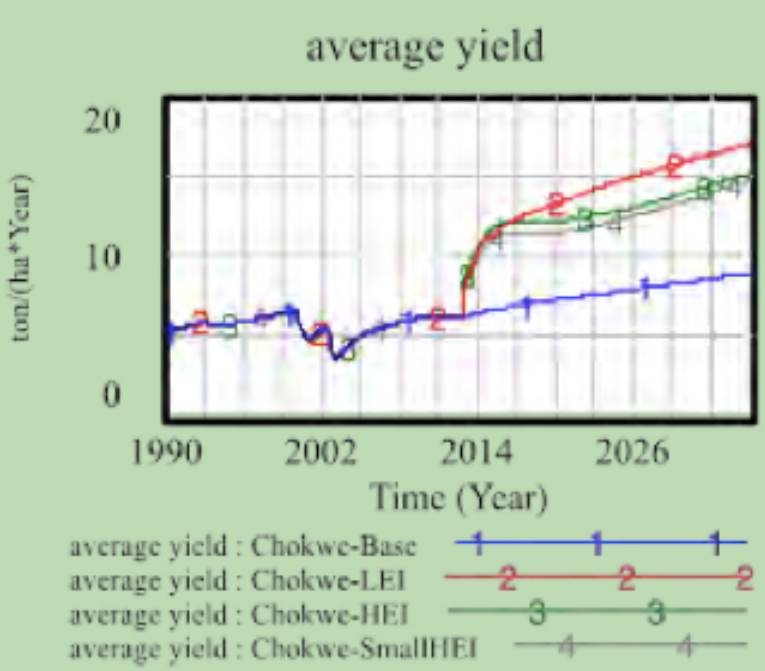
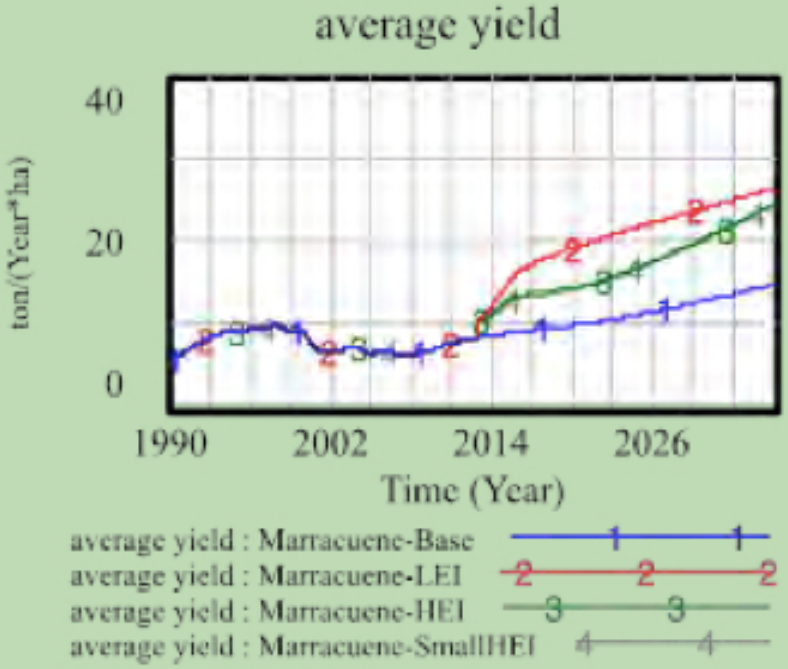
..introductory story (1)

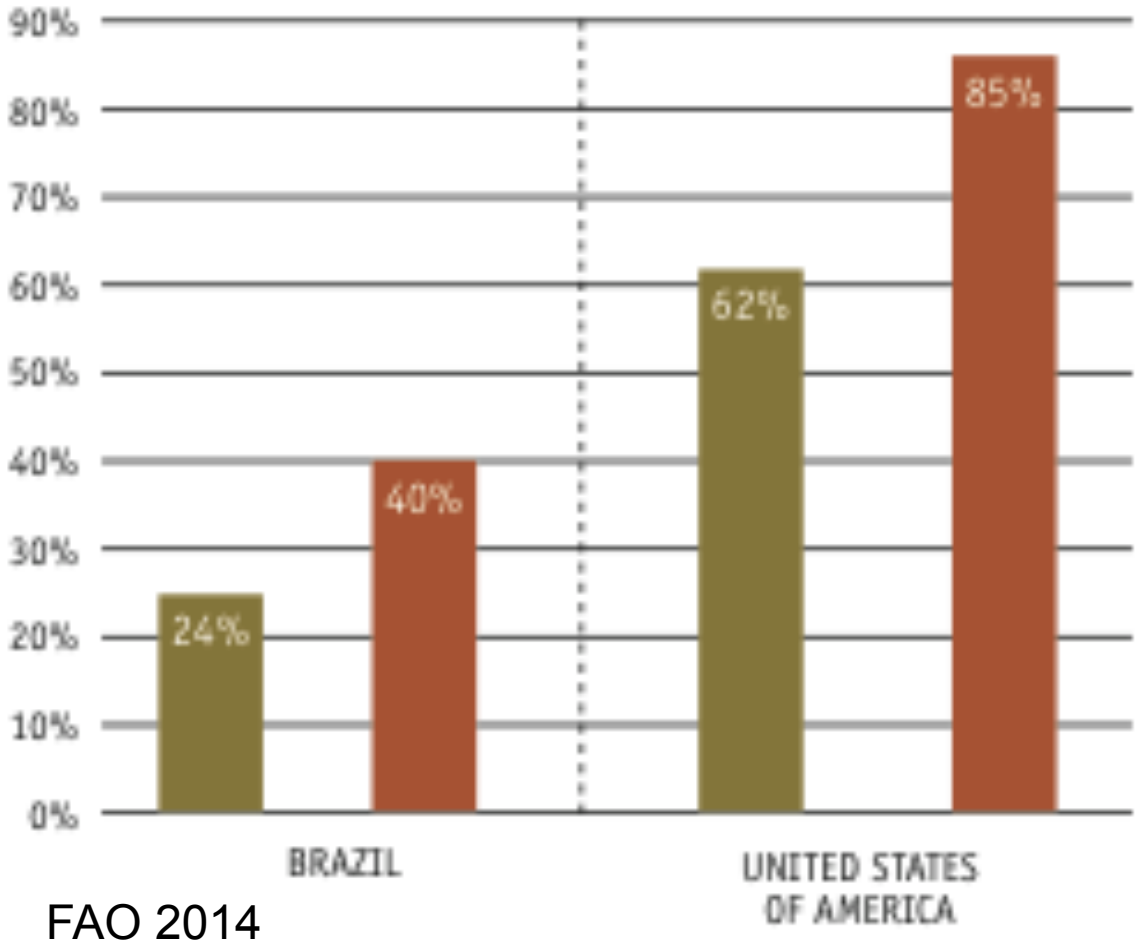
1. **Business As Usual (BAU) Scenario:** Assuming continuation of current farming practices, with not additional investments. The historical period of BAU results are also compared with the collected data for model validation.
2. **Low External Input (LEI) Scenario:** Additional investments in small to medium scale multicultural farms characterized by sustainable agricultural practices (such as animal traction, natural fertilizers, biological pest control), and in diffusion and application of agricultural knowledge
3. **High External Input (HEI) Scenario:** Additional investments in large-scale monoculture characterized by a high consumption of external inputs (such as machinery, mineral fertilizers, pesticides and seeds)



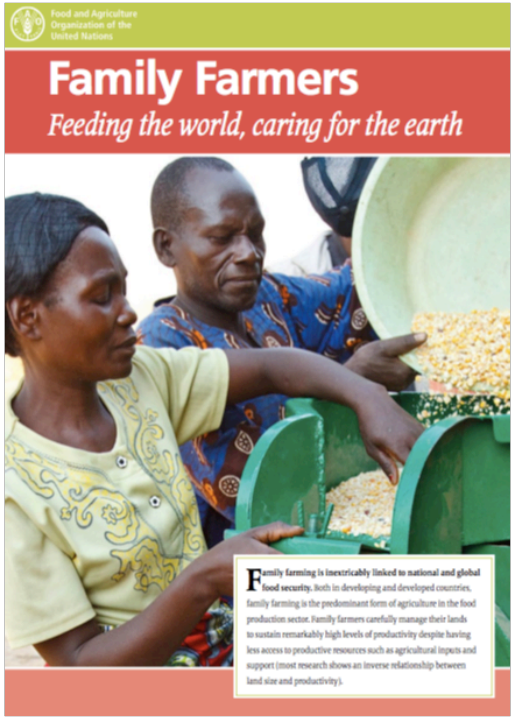


..introductory story (2)

Fig. 2 **Share of Land Farmed and of Agricultural Production of Family Farmers in the United States of America and Brazil**



FAO 2014



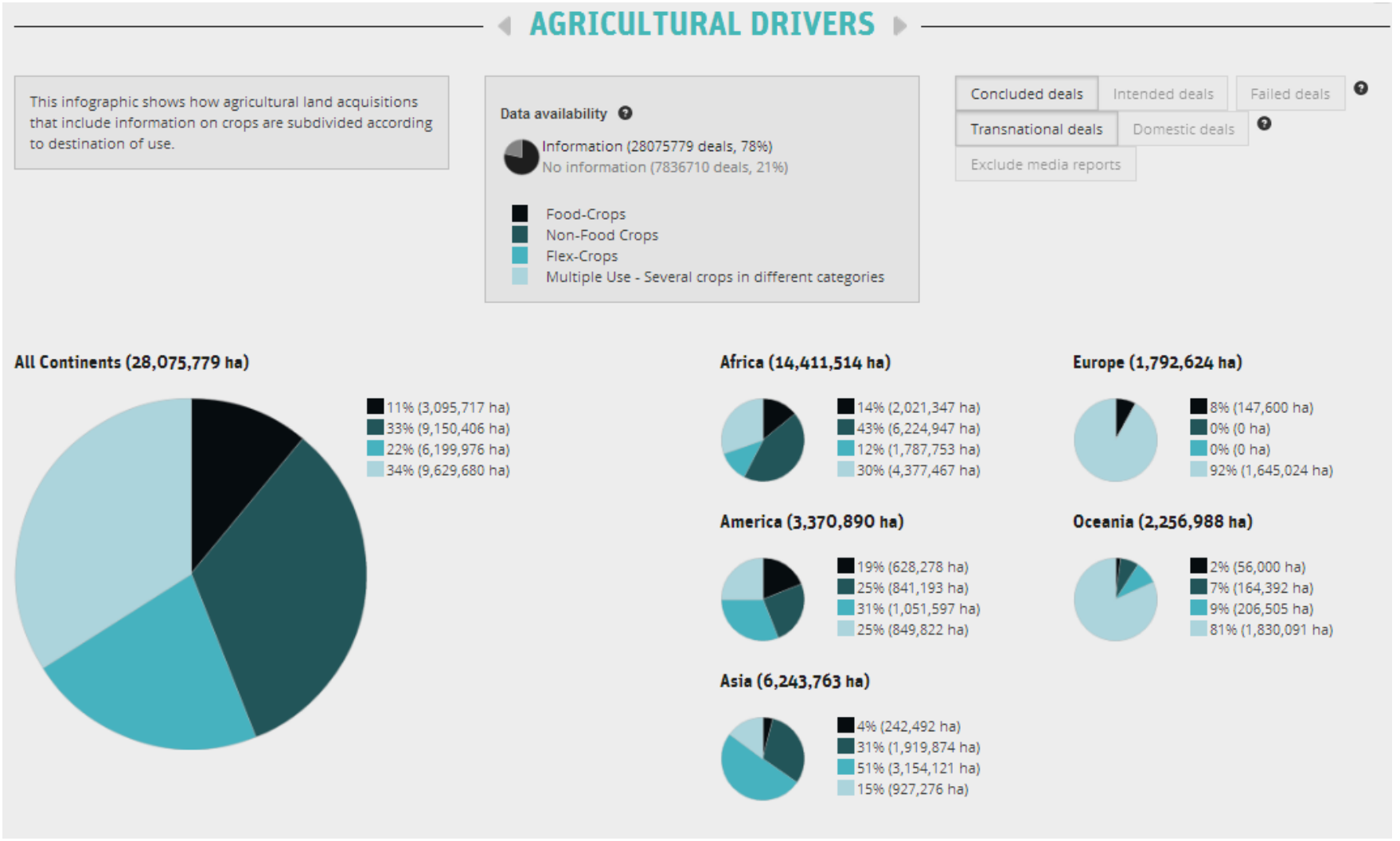
..introductory story (3 a)

PRIMARY INVESTOR COUNTRIES OF LAND INVESTMENTS IN AGRICULTURE

TARGET COUNTRIES FOR LAND INVESTMENTS IN AGRICULTURE

Source: Landmatrix.org, database filtered by confirmed cases of land investments in agriculture (including biofuels, sugar).

..introductory story (3 b)



Problem statement – current agriculture and food systems as part of the problem

- 842 million undernourished – 1.5 billion obese – 300 million diabetes type 2 cases, etc. **=> health problem**
- The industrial food system uses 10 kcal to produce 1 (empty)

  => energy problem
- The conventional food system is a major part of the

  =>climate change problem
- Soil degradation, water shortages, biodiversity loss underlie food insecurity **=> natural resource problem**
- Industrial agriculture has emptied the rural areas instead of providing quality jobs **=> social problems**

Business as usual is not an option!

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Challenges ahead

- **Productivity:** (quantity and quality of crops), agricultural practices (changes of water use, irrigation and agricultural inputs such as herbicides, insecticides and fertilizers)
- **Environmental effects**: frequency and intensity of soil drainage (nitrogen/nutrient leaching), soil erosion; reduction of crop diversity and ecosystem services
- **Rural space**: through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- **Adaptation**: organisms may become more or less competitive, humans may develop urgency to develop more competitive organisms, such as flood, drought, pest and/or salt resistant crop varieties

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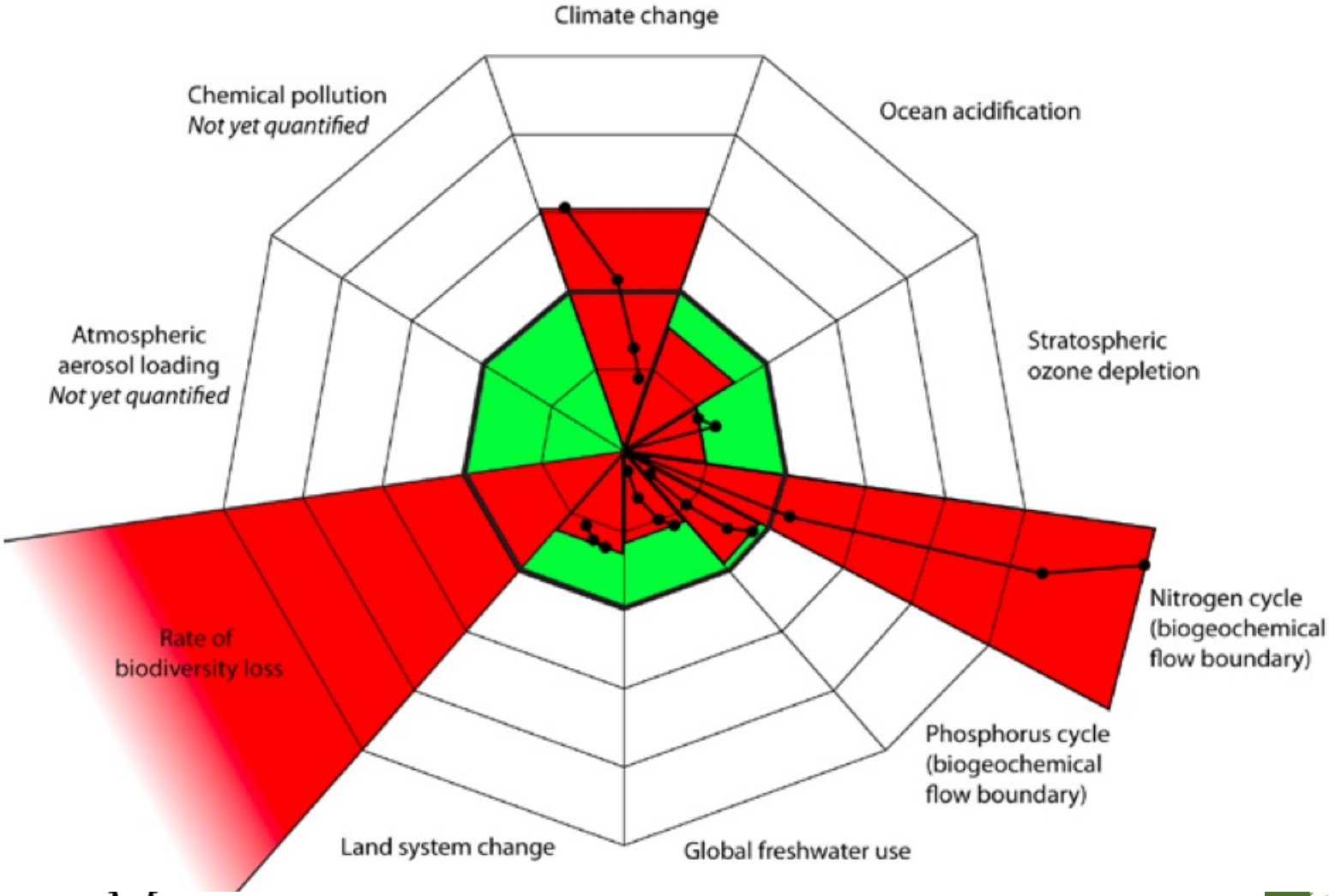
The main problem (too much damages)



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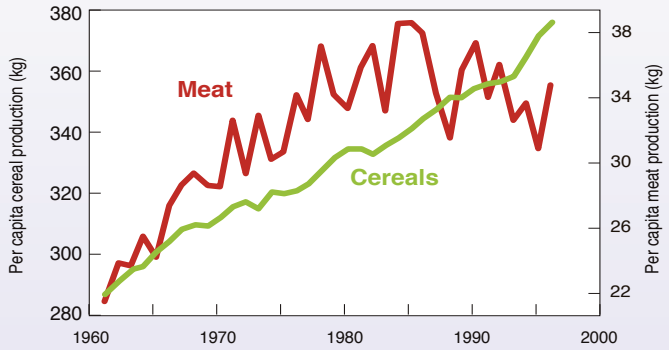
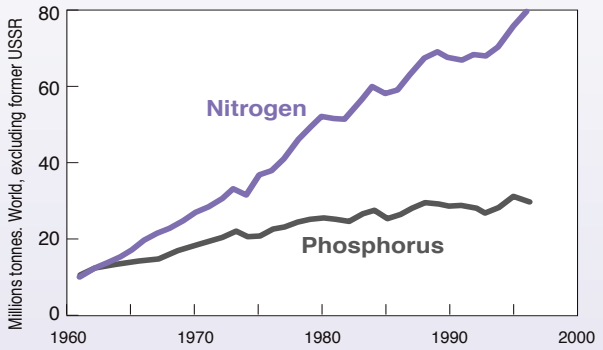
The main problems (too much external / non renewable inputs)

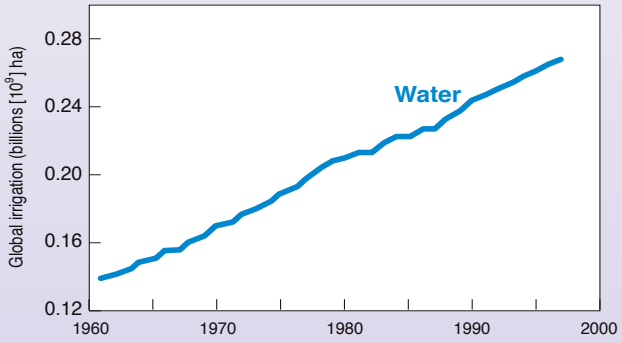
Global trends in cereal and meat production



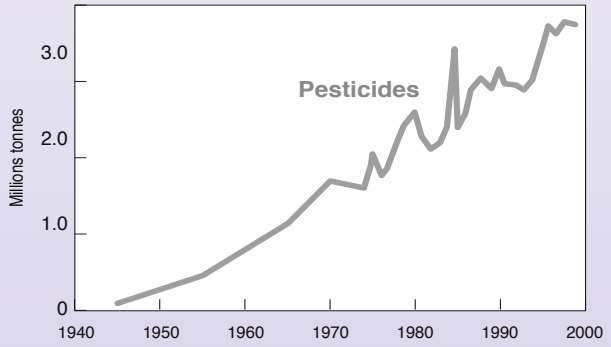
Global total use of nitrogen and phosphorus fertilizers.



Increased use of irrigation



Total global pesticides production



SOURCE: Tilman et al., 2002

IAASTD/Ketill Berger, UNEP/GRID-Arendal

David Tilman et al. Science 2001

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The main problems (too much production, too much waste)

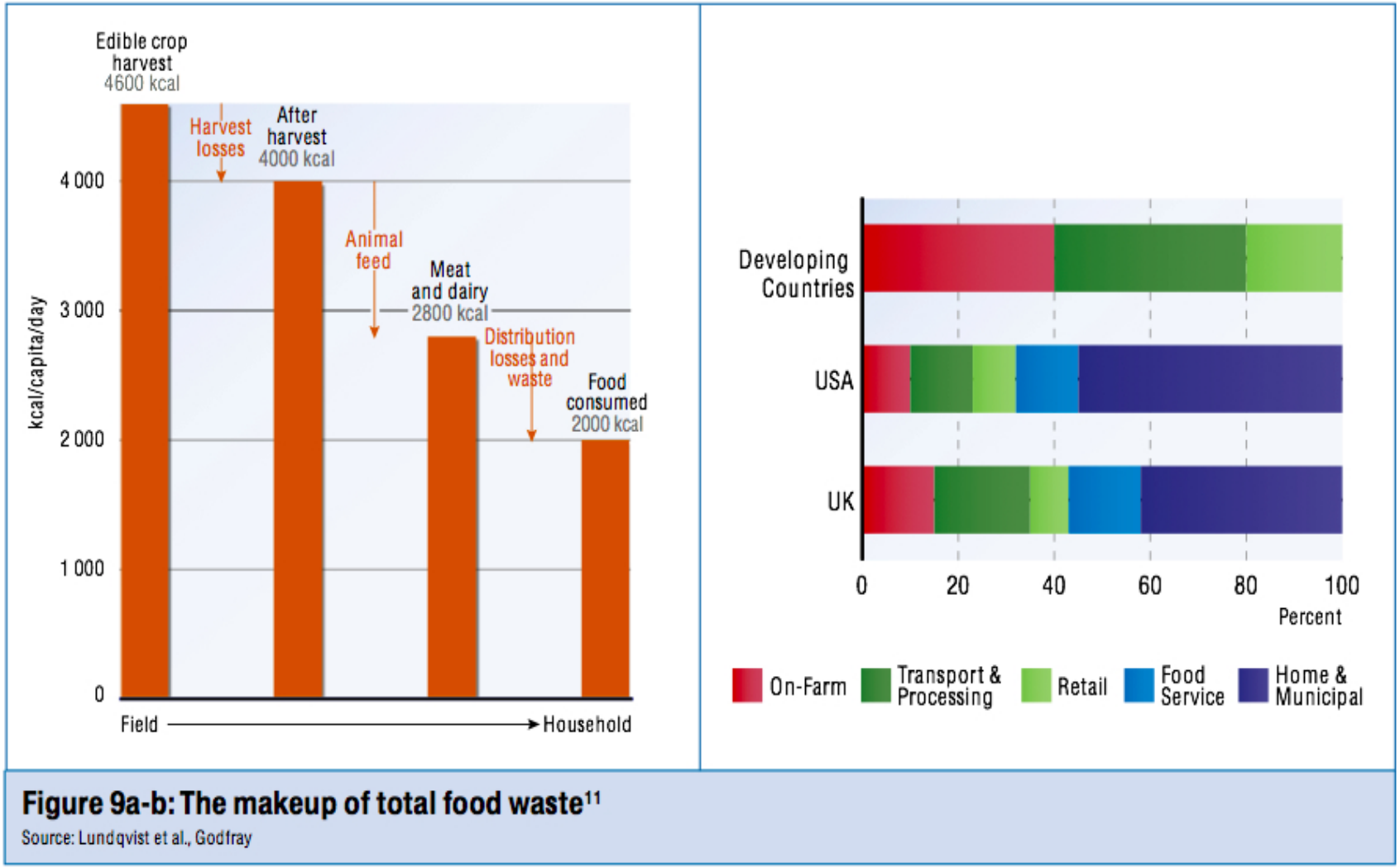

Figure 9a-b: The makeup of total food waste[11]

Source: Lundqvist et al., Godfray

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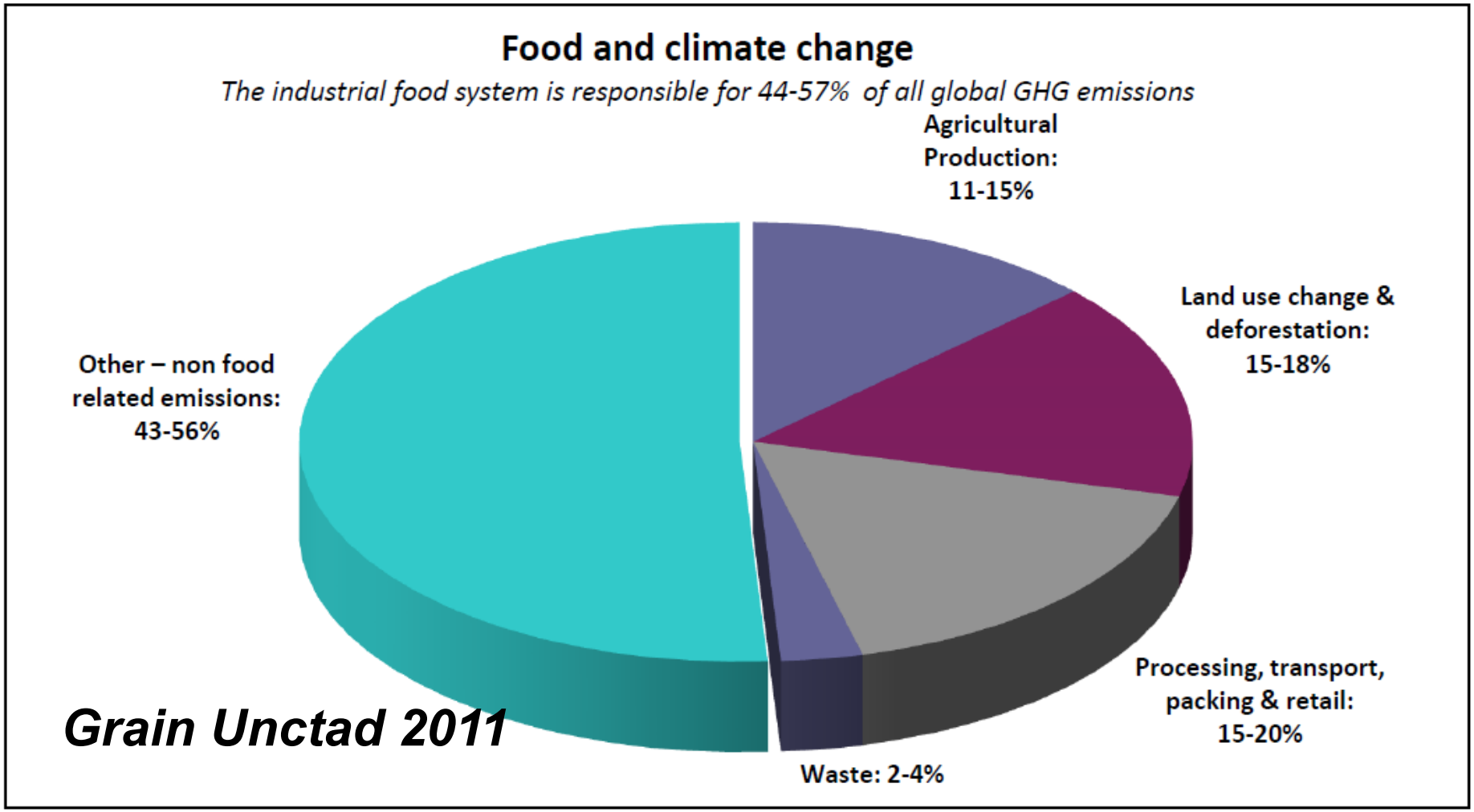
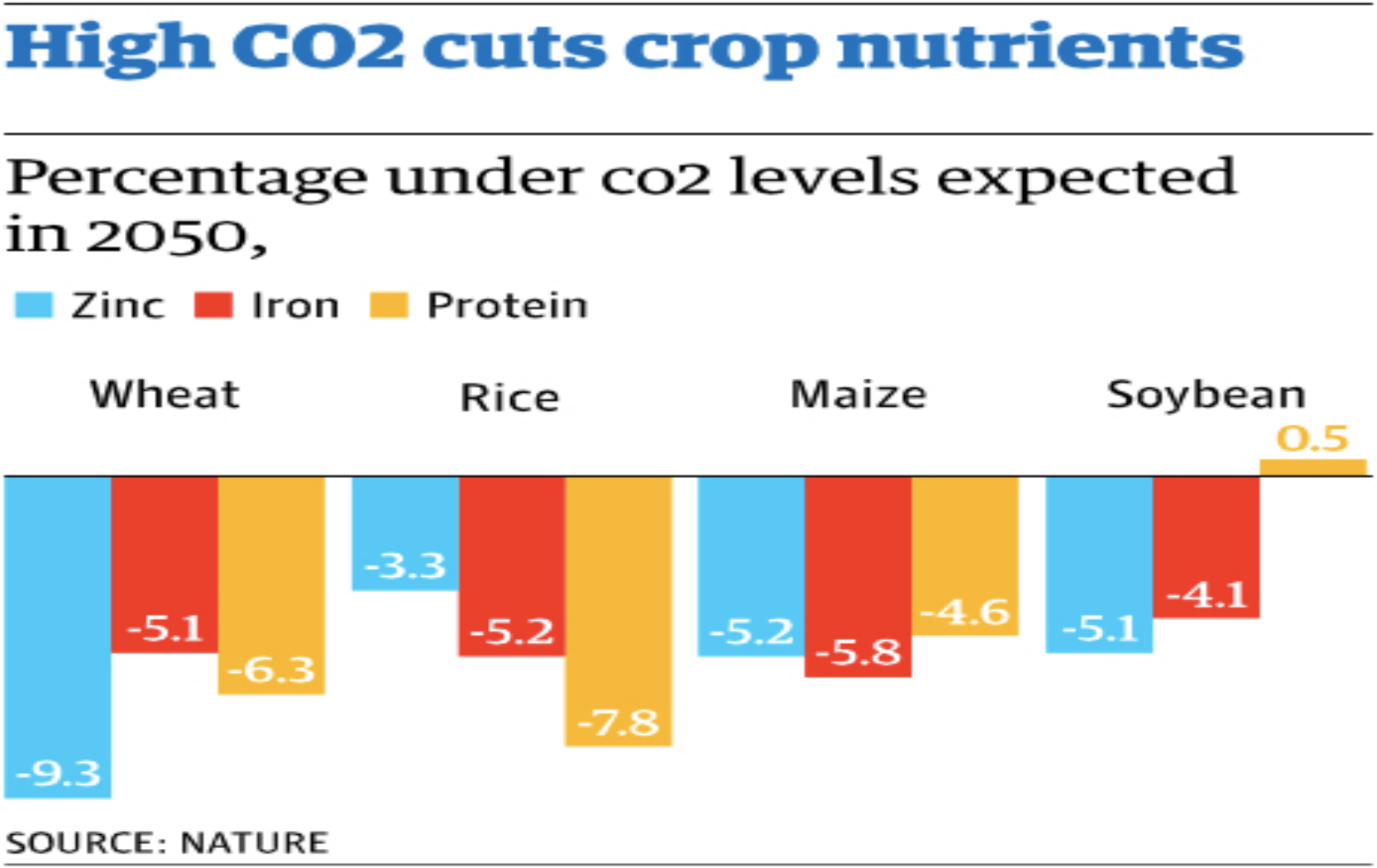
The main problems (too much GHG)



The main problems (too much GHG, less nutrients)



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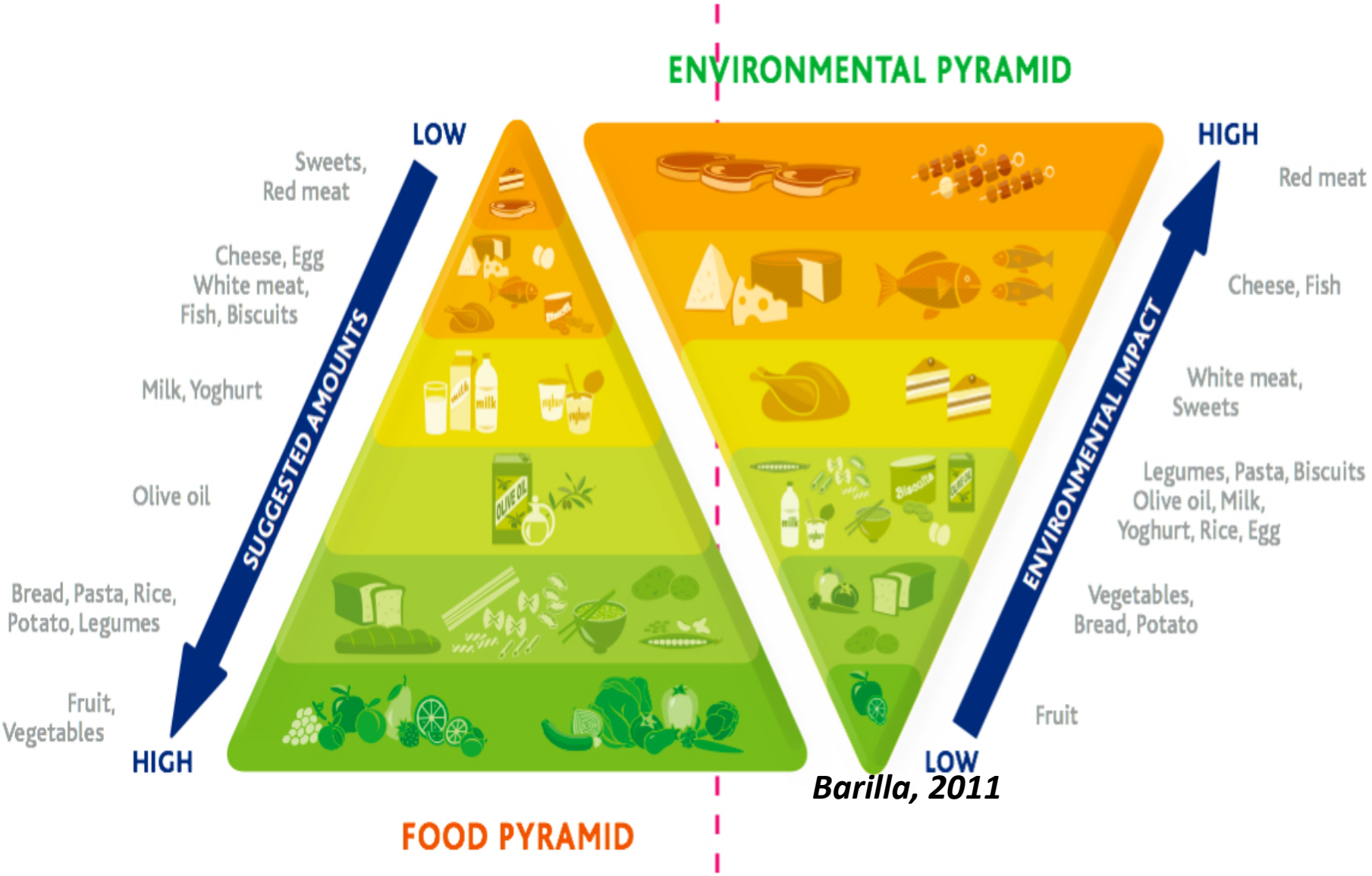
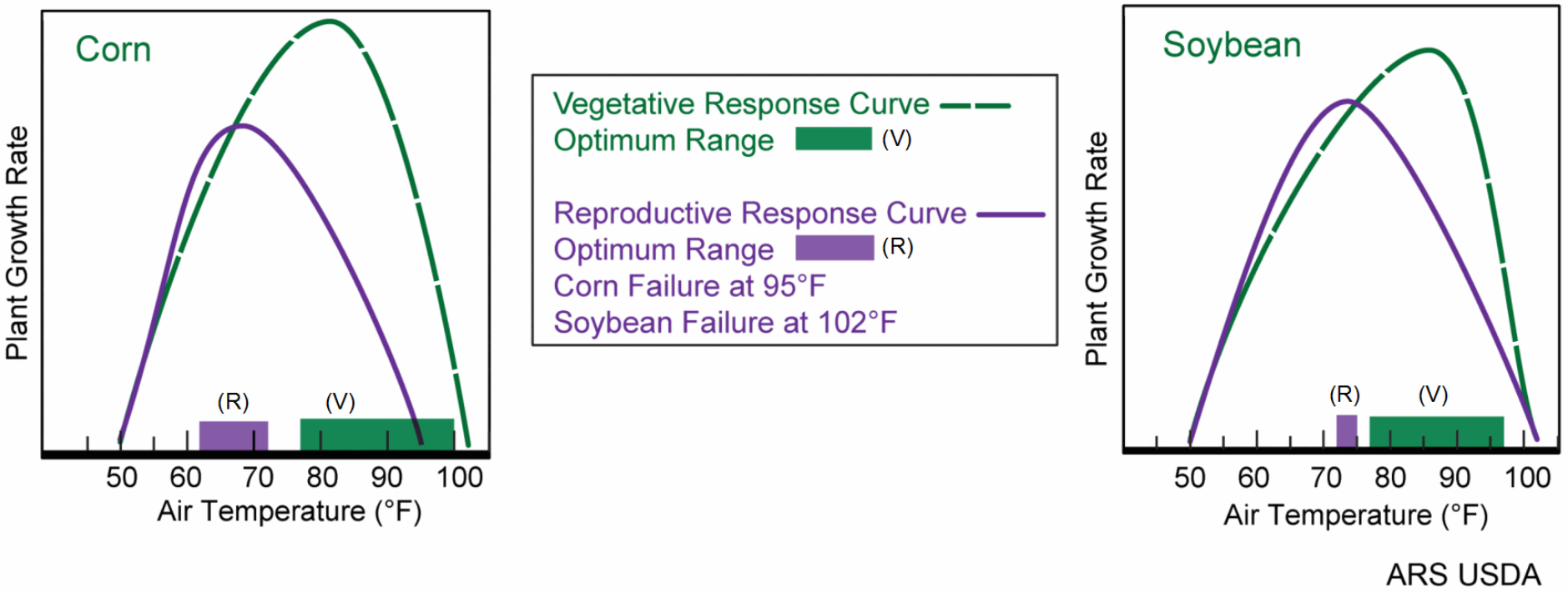
The main problems (too little diversity, unsustainable consumption patterns)



Barilla, 2011

The main consequences (Temperature and plant physiology)



ARS USDA

For each plant species/variety, there is an optimal temperature for vegetative growth, with growth dropping off as temperatures increase or decrease. Similarly, there is a range of temperatures at which a plant will produce seed.

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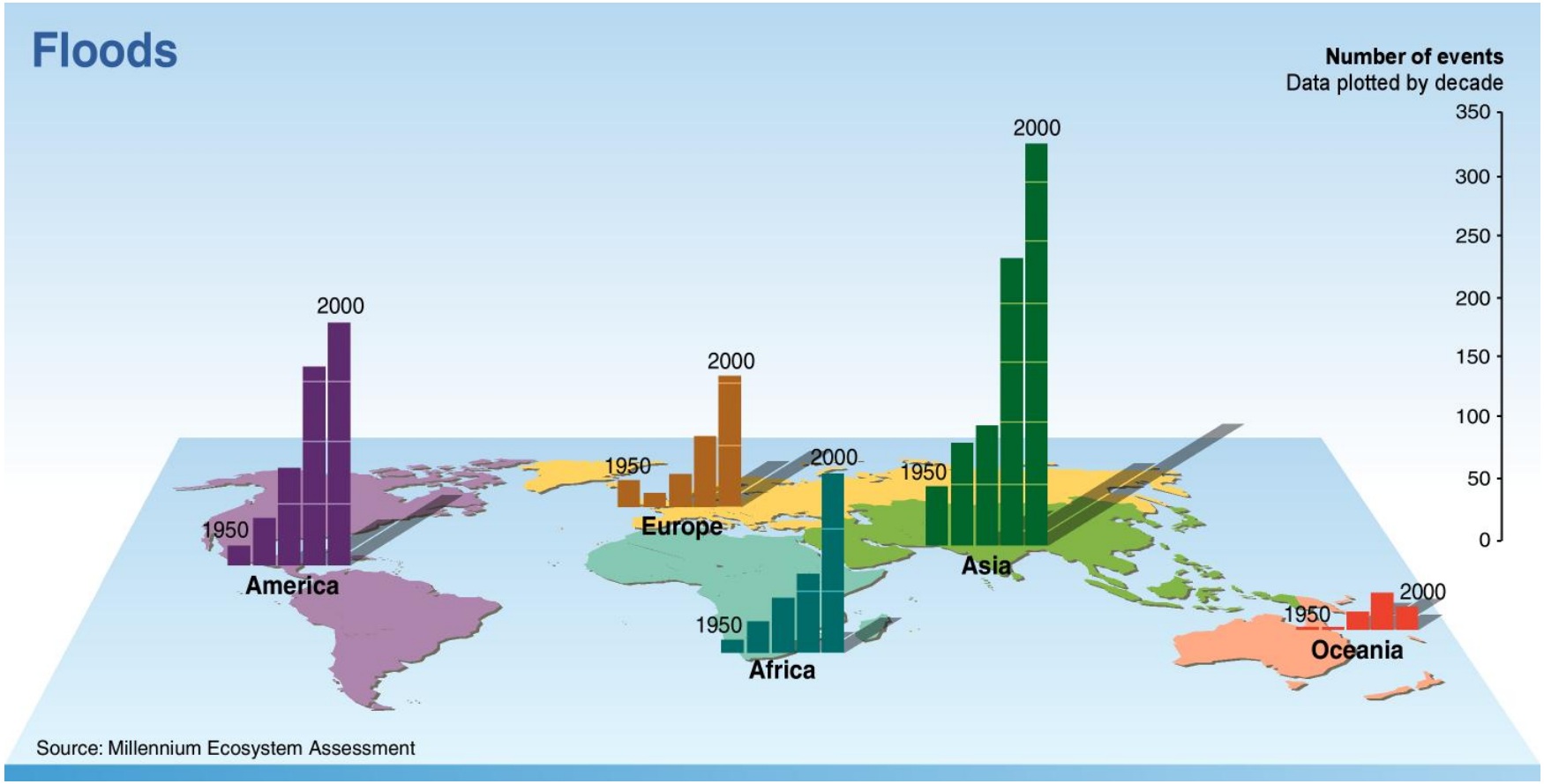
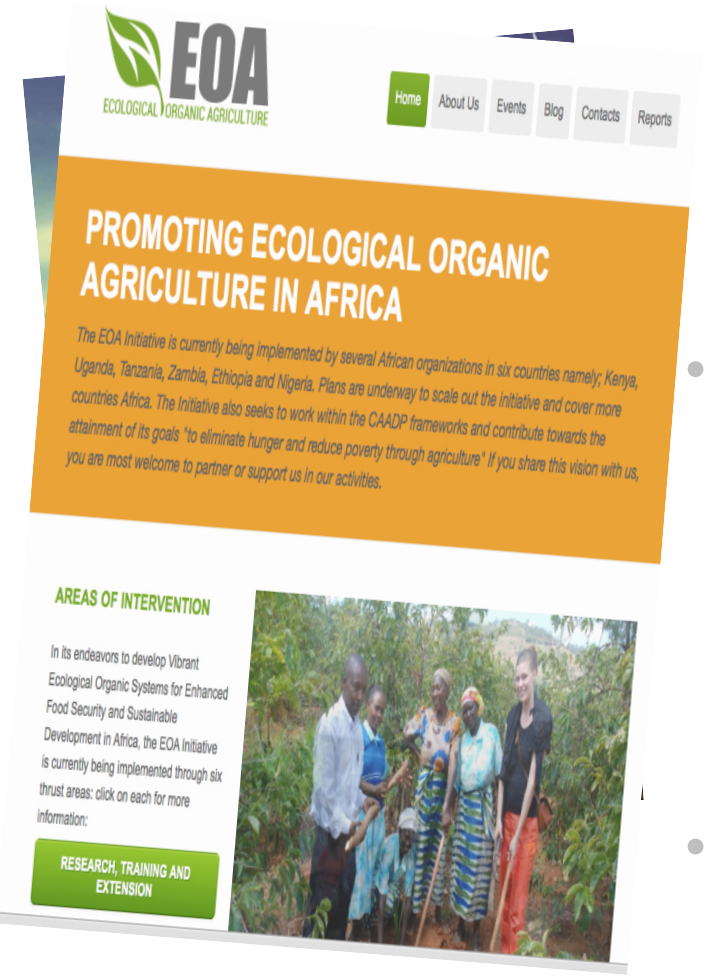
The main consequences (Natural and human systems failing under pressure)



Reduced capacity of ecosystems to buffer from extreme events through loss of wetlands, forests, mangroves

The main solutions



- **A fundamental shift** in Agricultural Knowledge Science and Technology and => agri-food system policies (UNSG), => institutions => capacity development => investments (UNCTAD)
- **Paradigm change:** transition to sustainable / ecological agriculture addressing the multi-functionality and resilience needs of small-scale and family farmers (eco-intensification, vs smart)
- Need to use **a systemic and holistic approach** / National multistakeholder assessments (IAASTD)

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Sustainable development dimensions

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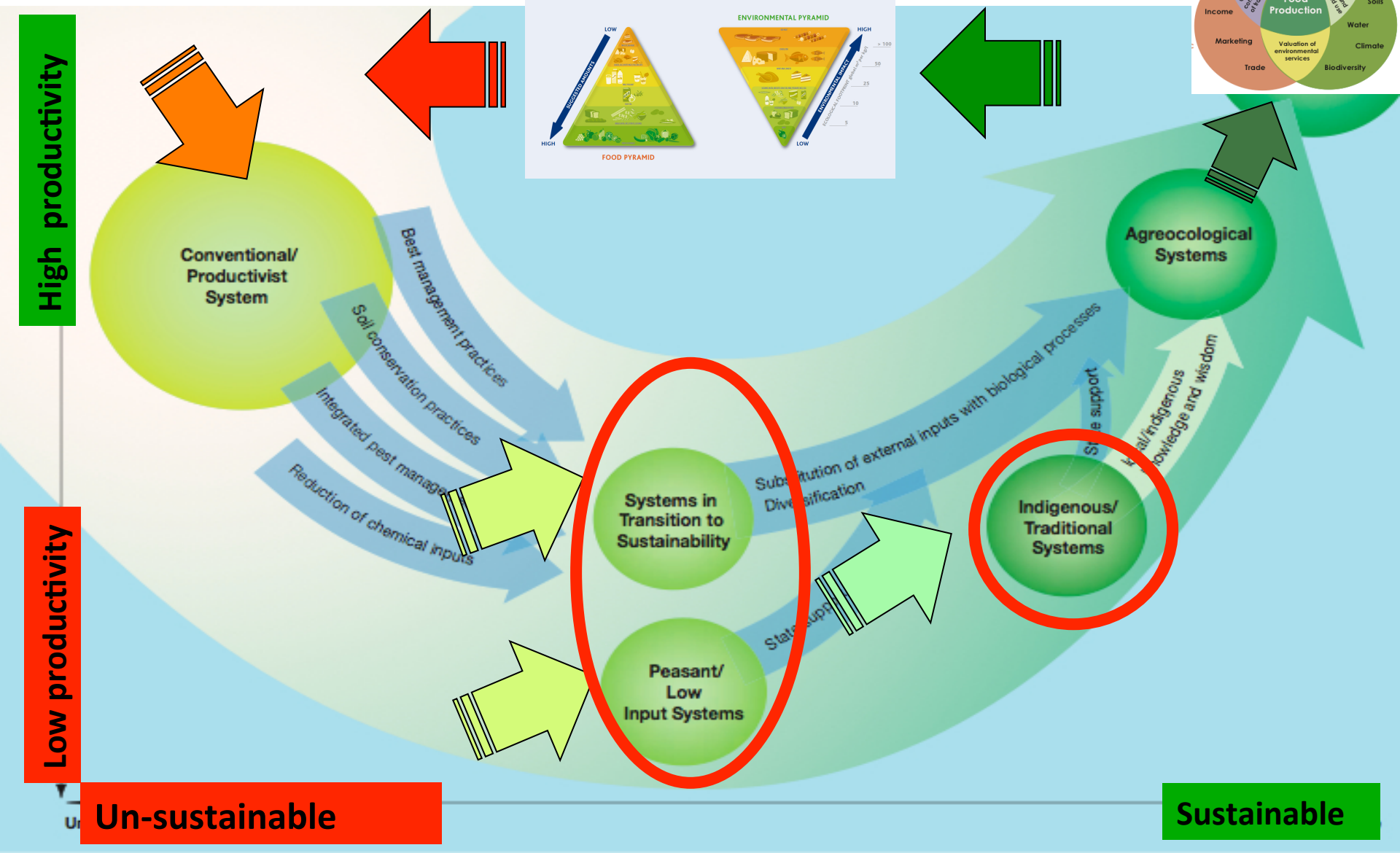
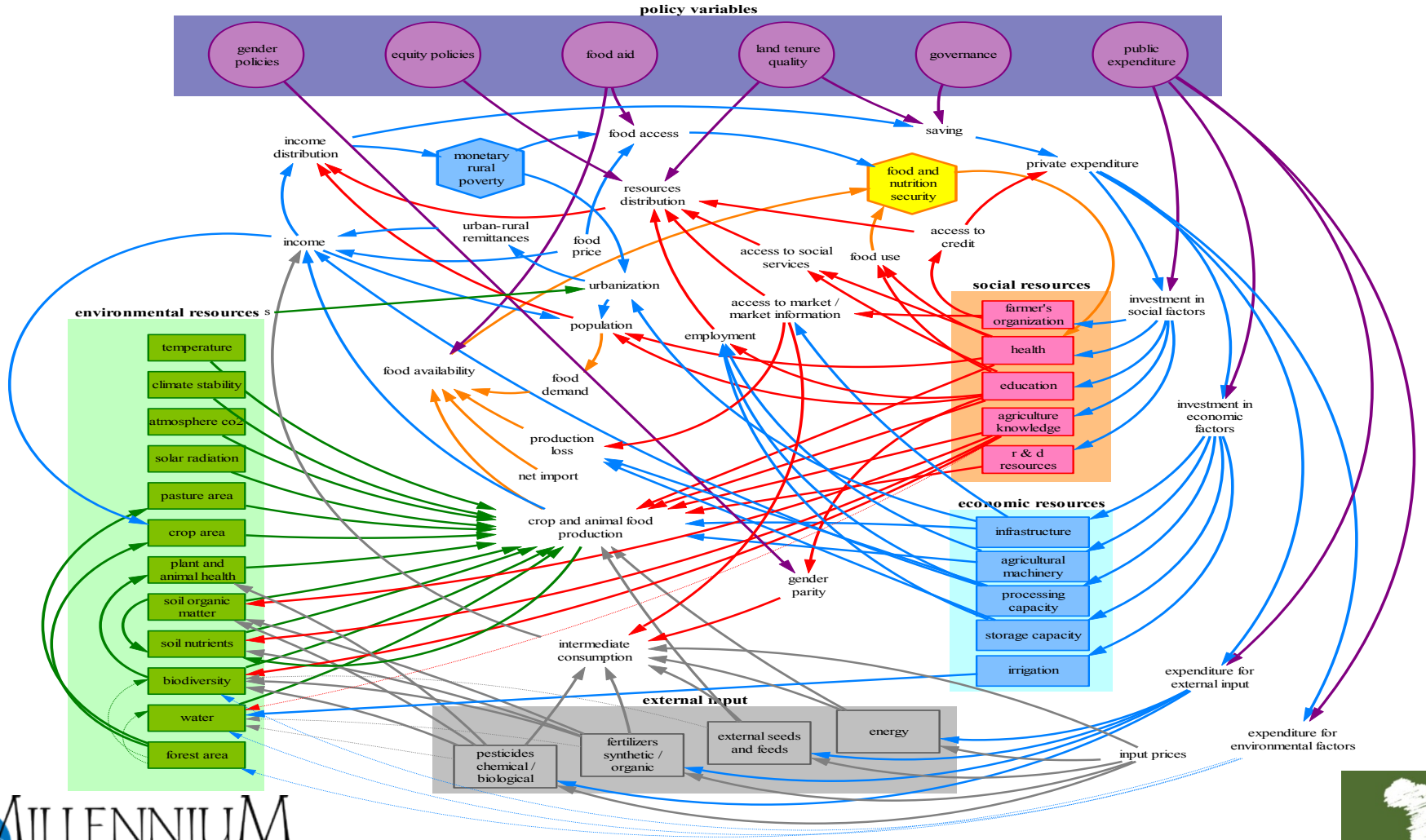
The main solutions: R&D
1. Paradigm shift / all inclusive



The main solutions: R&D
2. System's approach to problem analysis and solving, cause vs symptom)



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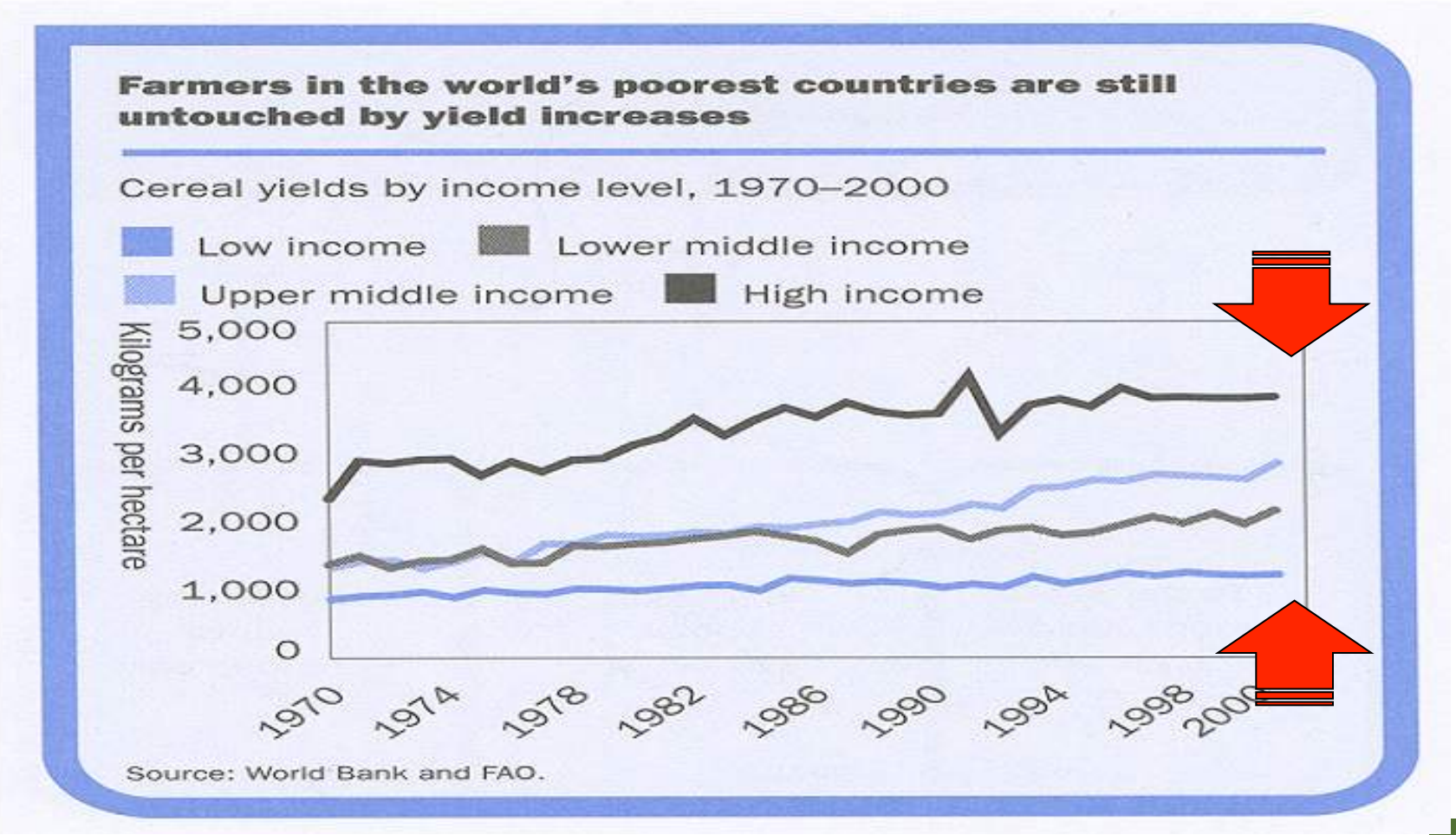
The main solutions: R&D
3a. Beating the biotic stresses ie, closing the yield gap)



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The main solutions: R&D
3 b: Beating the biotic stresses (improving soil fauna and flora, ie, organic matter)

Increase soil structure/ air spaces / SOM-SOC

- Turn the nitrogen in the air into nitrate and ammonium (air is 78% N)
- Soil carbon dioxide increases plant growth
- SOM helps plant and microbial growth through growth stimulating compounds
- Helps root growth, by making it easy for roots to travel through the soil
- Improves growth through easy access to deep nutrients and water

After Andre Leu 2014

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The main solutions: R&D
3b. Beating the biotic stresses ie, (Soil OM and N, and Water)

Table of the amount of organic nitrogen held in the soil

1% SOC	2,400 kg of organic N per hectare	1.72% SOM
2% SOC	4,800 kg of organic N per hectare	3.44% SOM
3% SOC	7,200 kg of organic N per hectare	5.16% SOM
4% SOC	9,600 kg of organic N per hectare	6.88% SOM
5% SOC	12,000 kg of organic N per hectare	8.50% SOM

1 % SOM = 160,000 litres (common level)
5 % SOM = 800,000 litres (levels pre farming)
Per ha (to 30 cm)

After Andre Leu 2014 Bhutan

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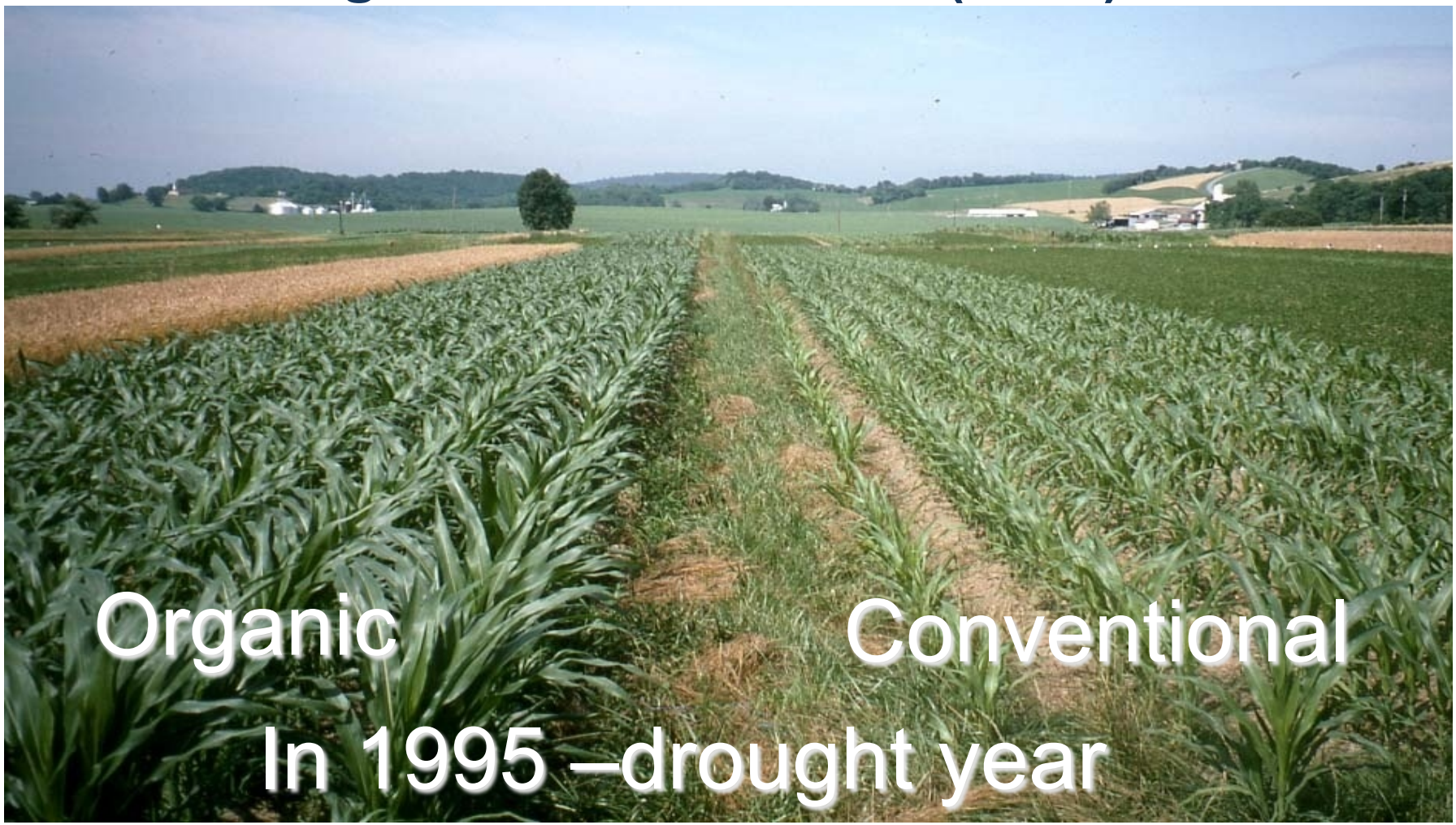
The main solutions: R&D
3 c: Beating the biotic stresses (SOM)



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The main solutions: R&D
3 b: Beating the biotic stresses (SOM)

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The main solutions: R&D
3 b: Beating the biotic stresses (SRI)

The main solutions: R&D
3 b: Beating the biotic stresses (SOM)

The main solutions: R&D
3b. beating the biotic stresses biological / natural pest and disease control

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The main solutions: R&D
3b. beating the biotic stresses promotion of pollinators

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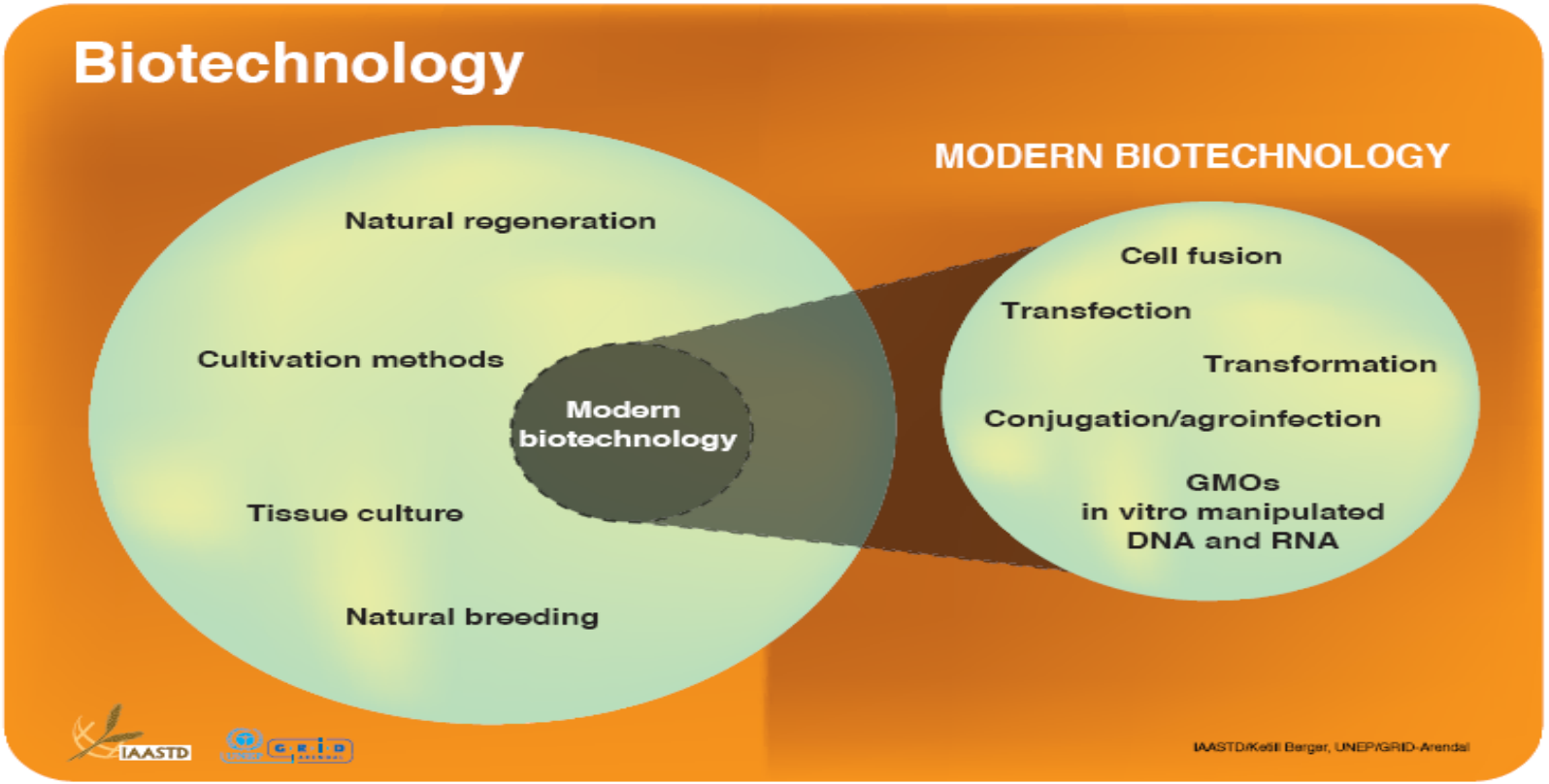
The main solutions: R&D
3b. beating the biotic stresses ? GMOs?
Reductionism vs complexity (resilience)



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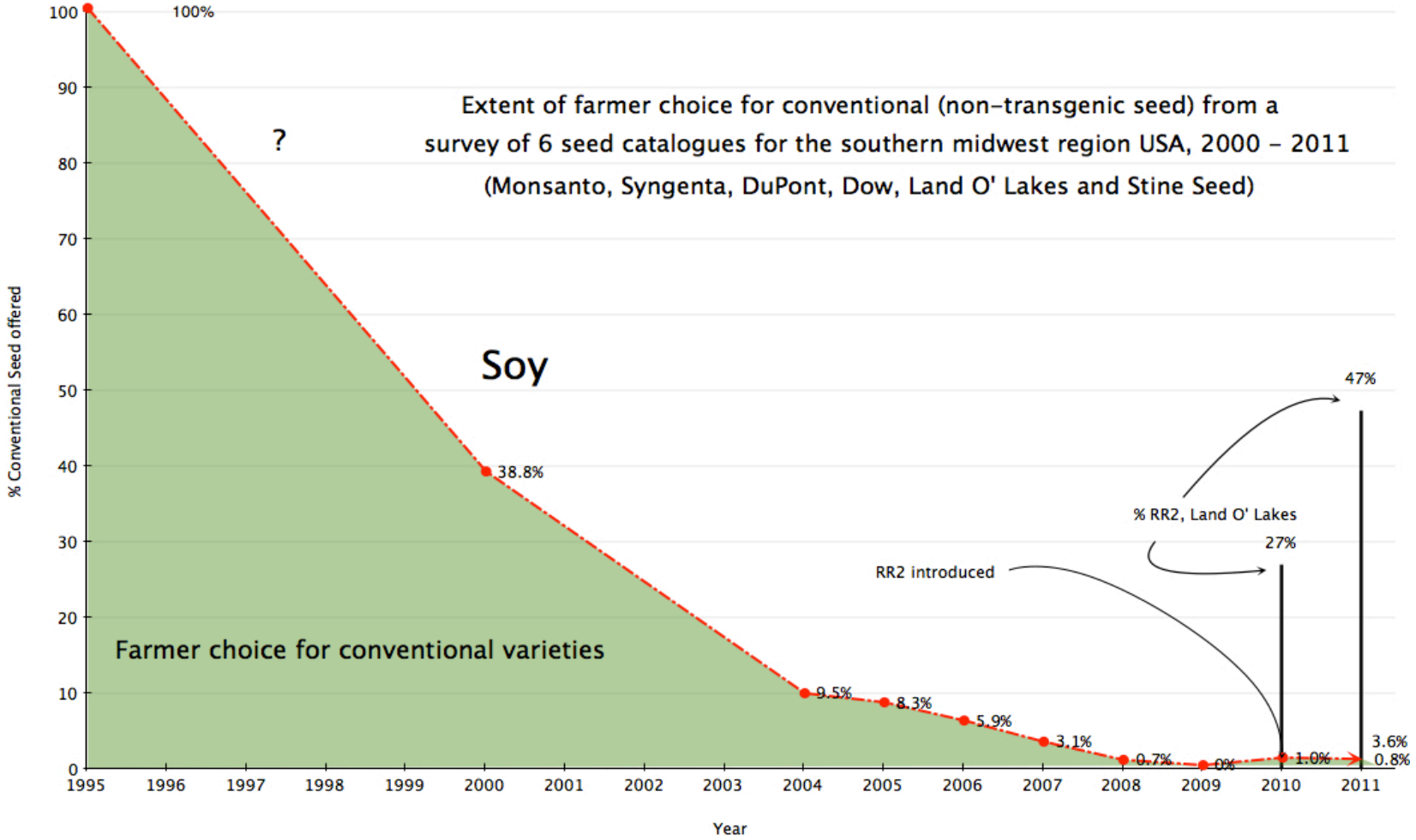
The main solutions:
3b. beating the biotic with less genetic diversity?



David Quist, 2010 pers com

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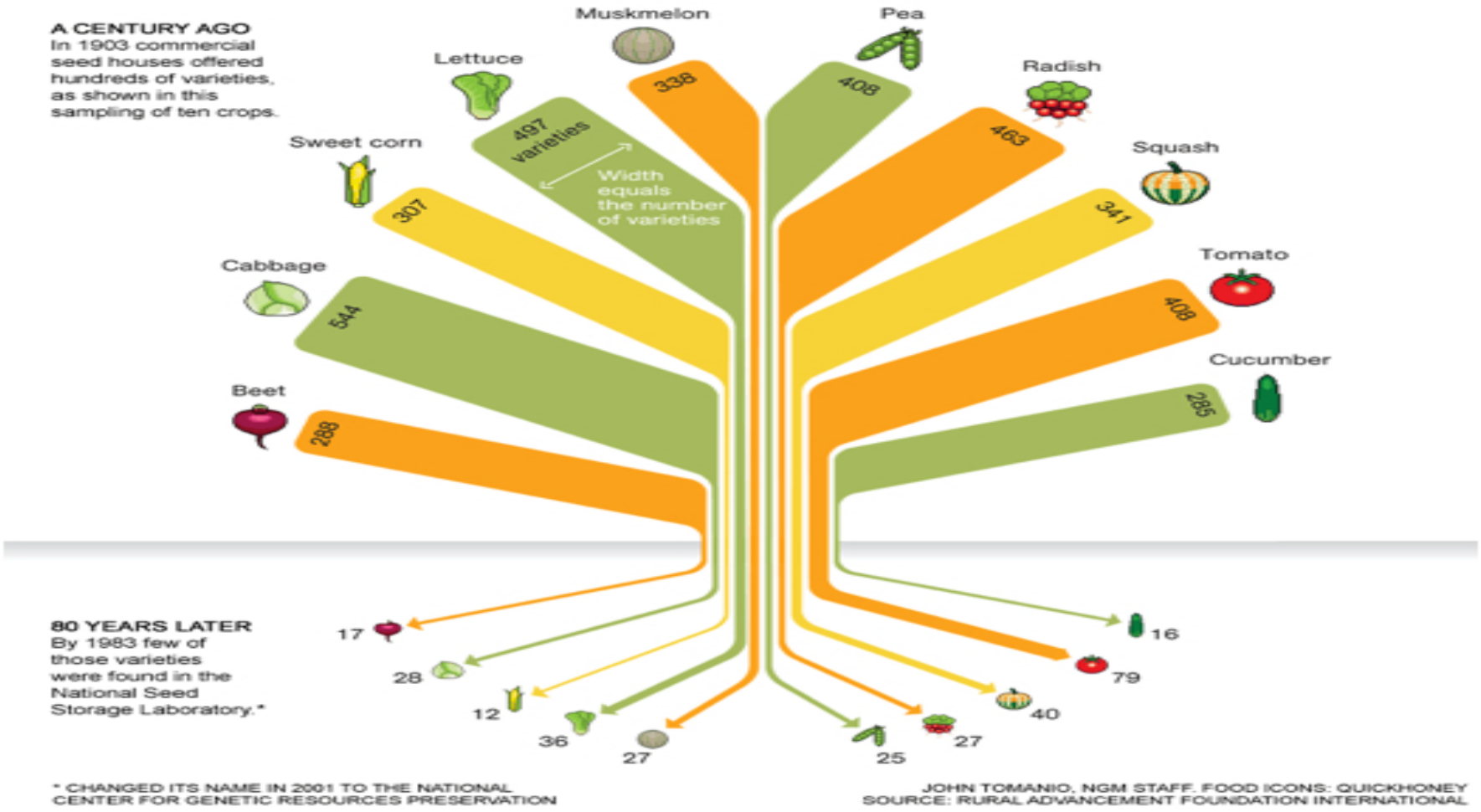
The main solutions:
3b. beating the biotic with less genetic diversity?



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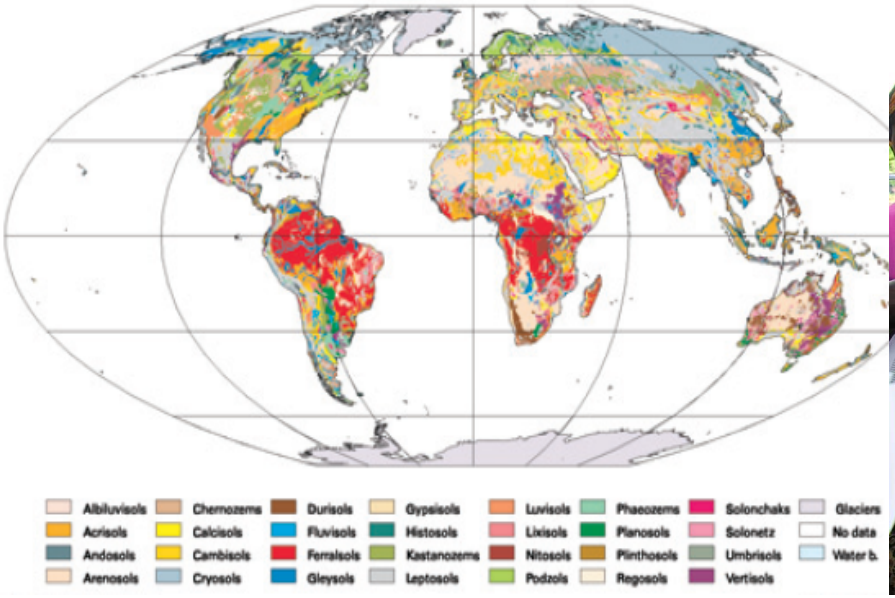
The main Solutions:
4. beating the biotic stresses through R&D + Edu

- Improve, expand extension services and capacity bldg
- Strengthen Institutions
- Emphasize local solutions



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Is such a transition possible and how?

A systems model for the transition: scenarios from the UNEP GER ag chapter 2011

Global investments across sectors (2% of GDP, Stern report); 0.16% of GDP (141 Bn $/year) invested in agriculture for:

- **Pre harvest losses** (training activities and effective pest management with bio-products, IPM)
- **Ag management practices** (cover transition costs from till to no till, organic, agroecological agriculture, training, access to small scale mechanization and irrigation)
- **R&D** (research in soil biology and agronomy, crop improvement (orphan crops), appropriate mechanization, irrigation, and more)
- **Food processing** (better storage and processing in rural areas, efficient processing, marketing, less waste)

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… the numbers: we can win-win-win by 2050

Investing 0.2% of total GDP ($141 Billion) / year

Indicator	Unit	Baseline	Green	BAU
Agricultural production	Bn US$/year	1'921	2'852	2'559
Crops	Bn US$/year	629	996	913
Employment	M people	1'075	1'703	1'656
Soil quality	Dmnl	0.92	1.03	0.73
Water use	Km^3 / year	3'389	3'207	4'878
Land	Bn ha	1.2	1.26	1.31
Deforestation	M ha/ year	16	7	15
Calories for consumption	Kcal/person/ day	2'081	2'524	2'476

Source: UNEP Green Economy Report (2011)

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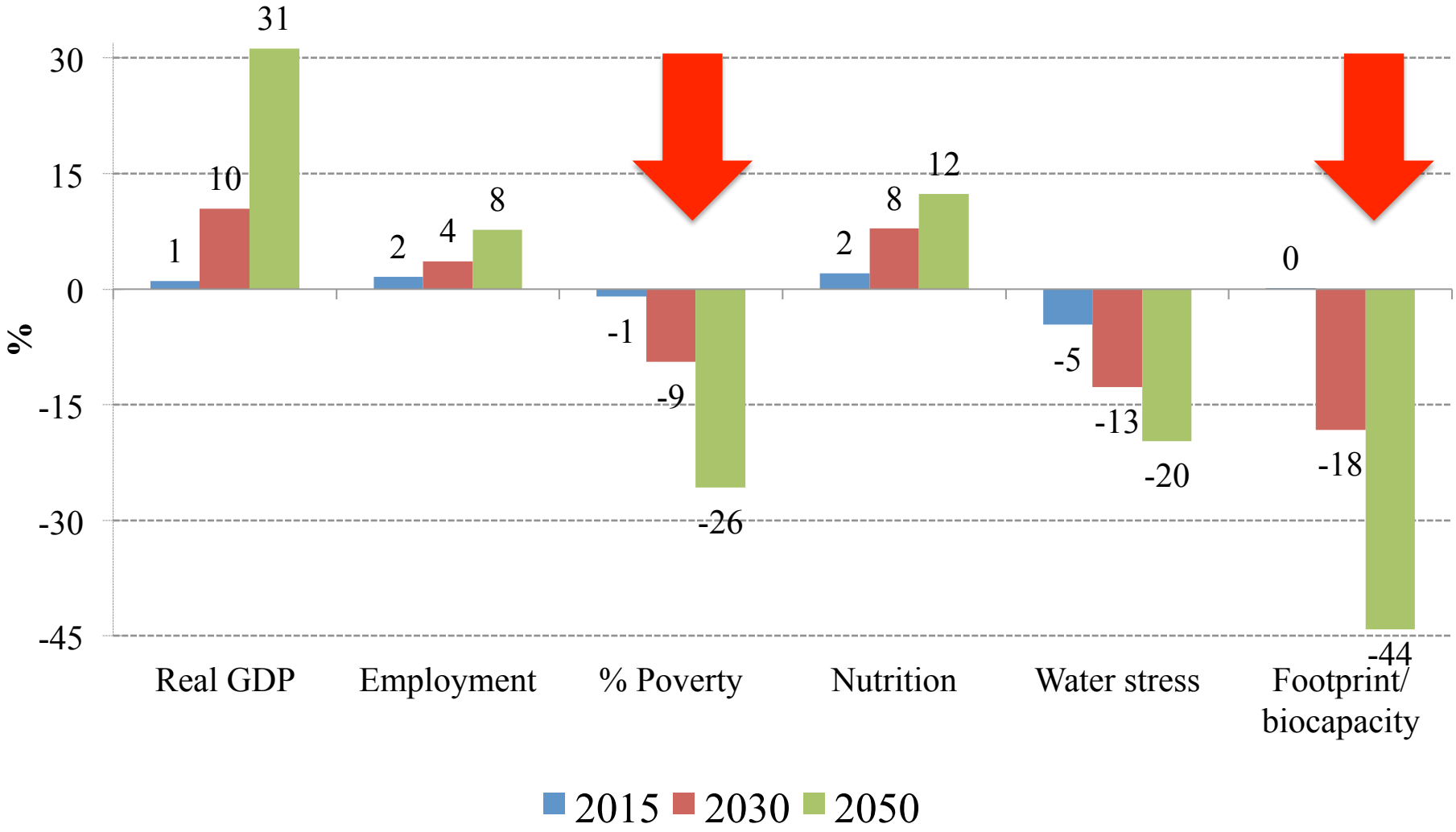
… the numbers: we can win-win-win by 2050



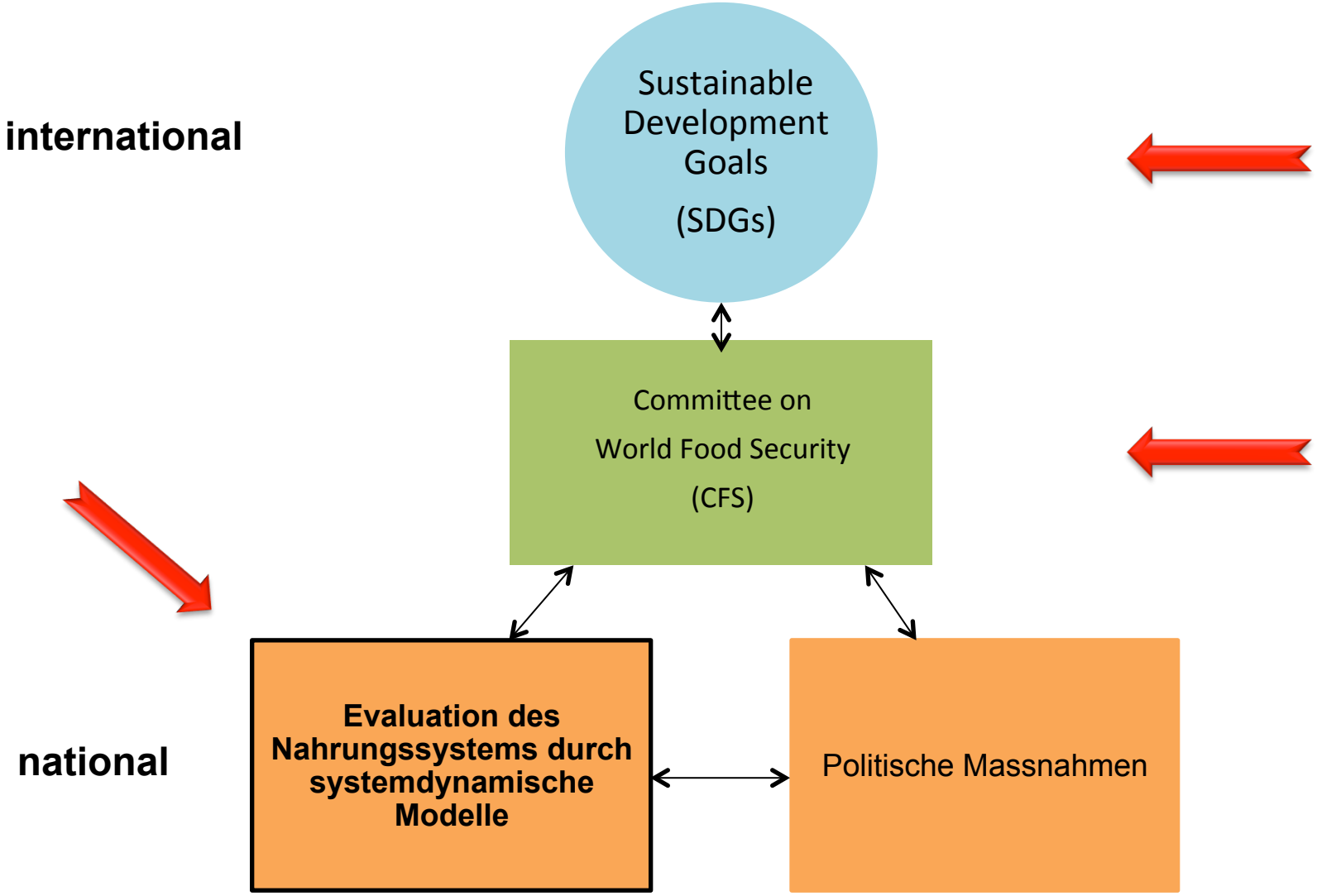
Changing course in global agriculture:

«The Future We Want» (Rio+20 Declaration) recognized

- the fact that «a significant portion of the world's poor live in rural areas»
- the role that agriculture plays in development
- the importance and utility of a set of Sustainable Development Goals (SDGs);
- and reaffirmed the necessity to promote, enhance and support more sustainable agriculture

§115 „We reaffirm the important work and inclusive nature of the Committee on World Food Security, including through its role in facilitating country-initiated assessments on sustainable food production and food security"

Changing course of global agriculture



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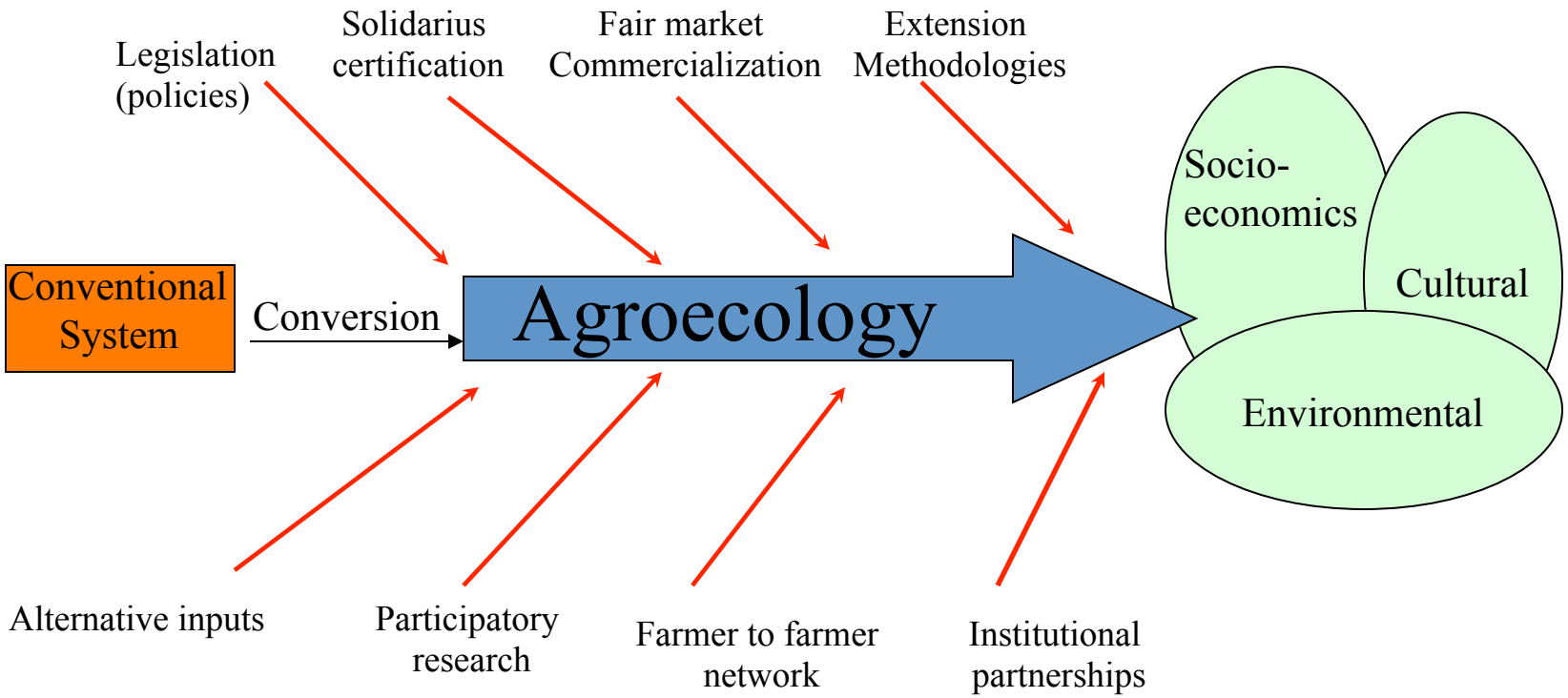
Agroecology and Sustainable Development



Source: Miguel Altieri 2011