

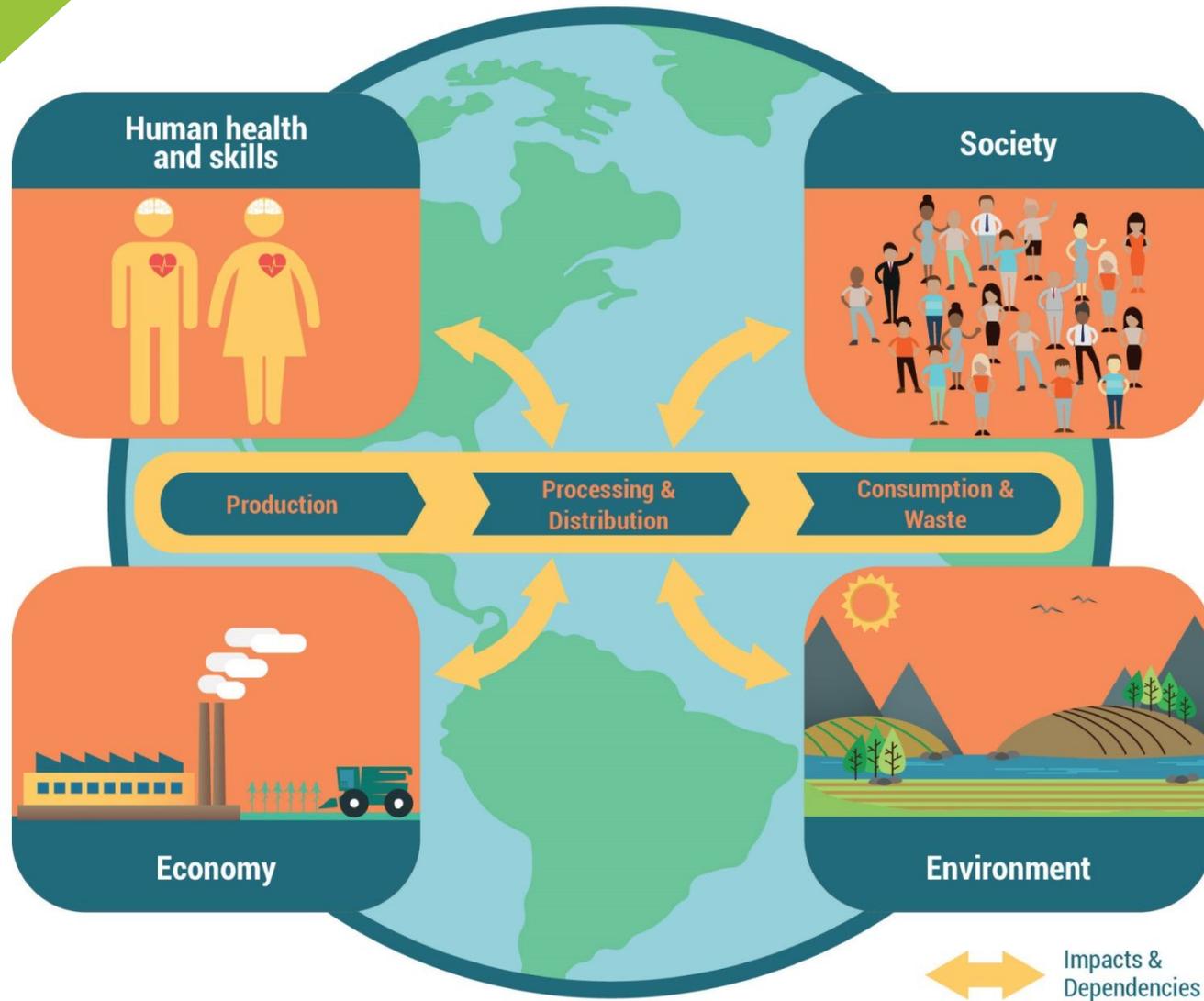


Setting the Scene

TEEBAgriFood
Workshop
Cambridge, 13-15 February 2016

Alexander Müller

Eco-agri-food systems complex – impacts and dependencies



The visible and invisible flows of agricultural production

AGRICULTURE & FOOD SYSTEMS



The visible and invisible flows of agricultural production

HUMAN SYSTEMS

AGRICULTURE & FOOD SYSTEMS

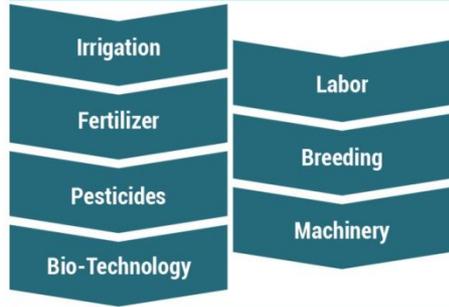


BIODIVERSITY & ECOSYSTEMS

■ Inputs ■ Outputs ■ Invisible positive flows ■ Invisible negative flows

The visible and invisible flows of agricultural production

HUMAN SYSTEMS



AGRICULTURE & FOOD SYSTEMS



BIODIVERSITY & ECOSYSTEMS



The visible and invisible flows of agricultural production

HUMAN SYSTEMS



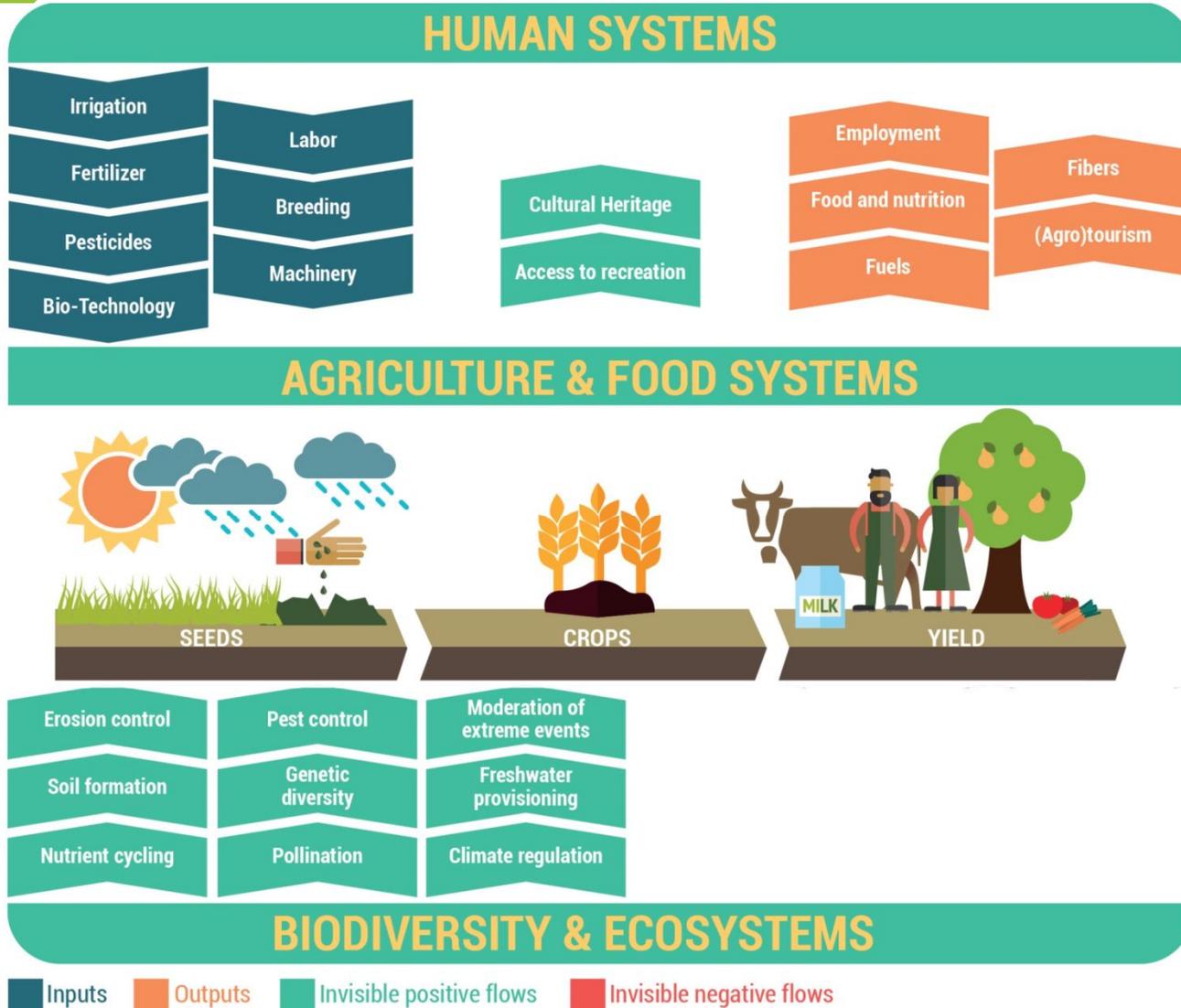
AGRICULTURE & FOOD SYSTEMS



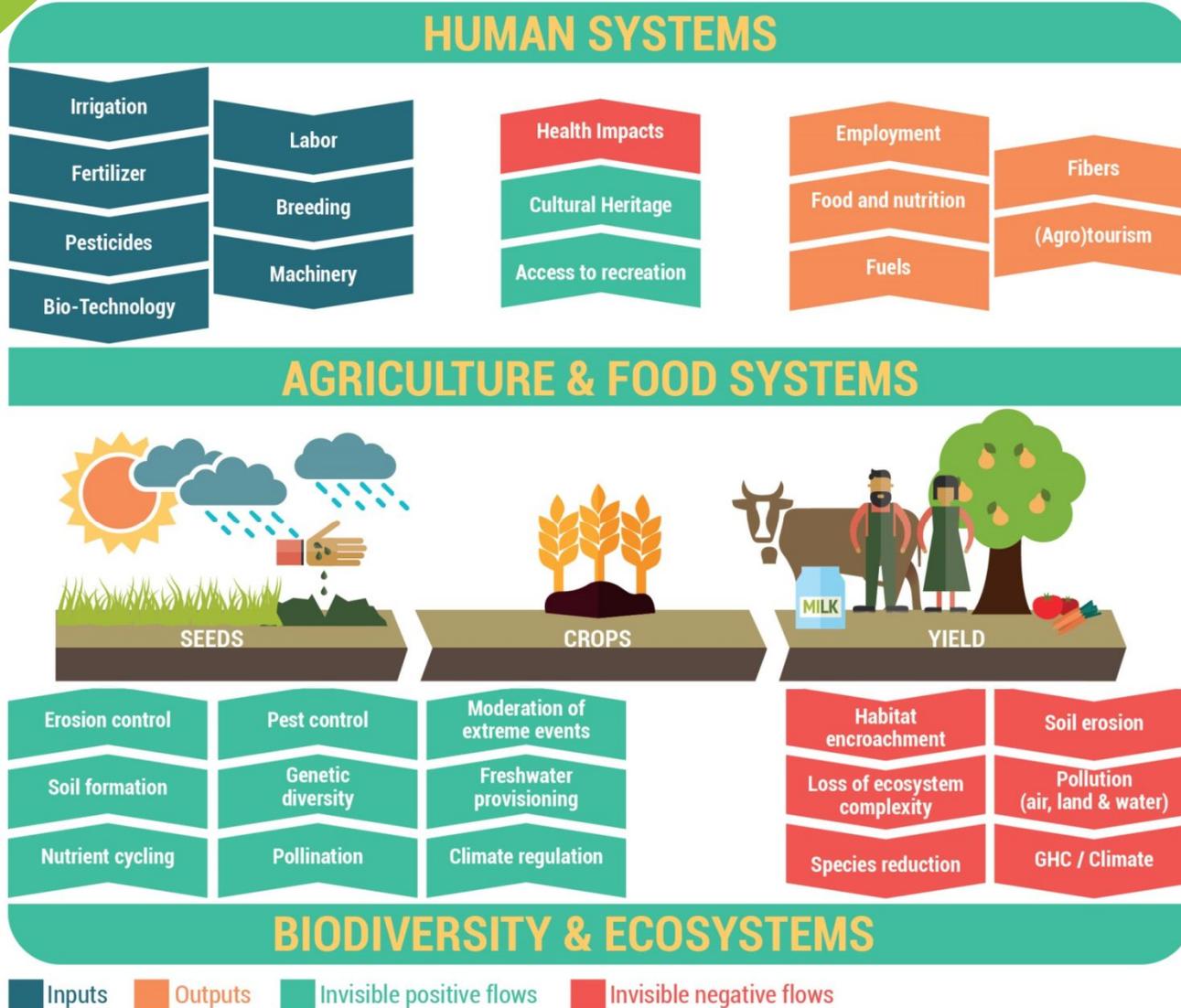
BIODIVERSITY & ECOSYSTEMS



The visible and invisible flows of agricultural production



The visible and invisible flows of agricultural production



Setting the Scene

- **There is not one global food system – variety and complexity of different food systems in the world. TEEBAgriFood has to take different systems into account**
- **Production and consumption of food is based on culture, regional, socioeconomic and environmental conditions**
- **However, there is a trend towards globalization and western diets**
- **Growing consensus: Current ag. production is not sustainable**
- **Growing population will increase the pressure on natural resources**
- **Climate change has the potential to multiply existing threats and risks**



SDGs: How to manage complexity to achieve sustainability

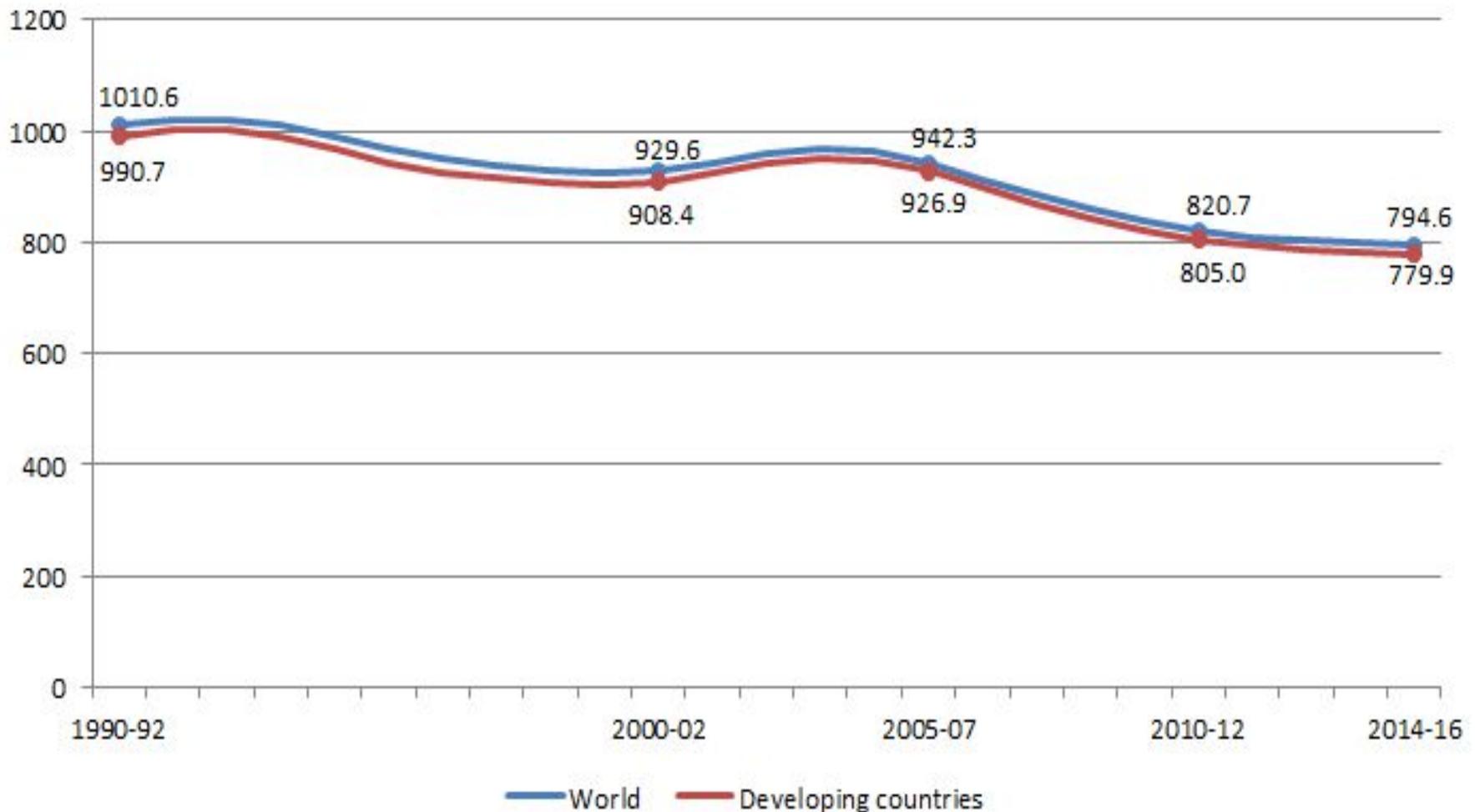
- **Eradication of hunger and poverty in the center of global efforts to achieve SDGs – what is the advantage of TEEBAgriFood?**
- **SDGs are designed to support transformation – definition?**
- **Is there an “alternative model” of ag development not following the predominant model of less farmers producing a lot more cheap food**
- **Demand for management systems for sustainable use of natural resources will grow**
- **Importance of biodiversity for human wellbeing is recognized – food production still responsible for 60% of biodiv. loss**
- **Role of technologies**



TEEBAgriFood in a challenging political and socioeconomic environment

- 1. Eradication of hunger and population growth**
- 2. Business as usual – a forecast to the end of the century**
- 3. Replacing soil biodiversity by inputs?**
- 4. TEEBAgriFood: Extending valuation from ecosystems and biodiversity to inclusion of social issues and human health**
- 5. Today's agricultural systems at risk – the threat of climate change**
- 6. Human health and the cost of unhealthy diets**

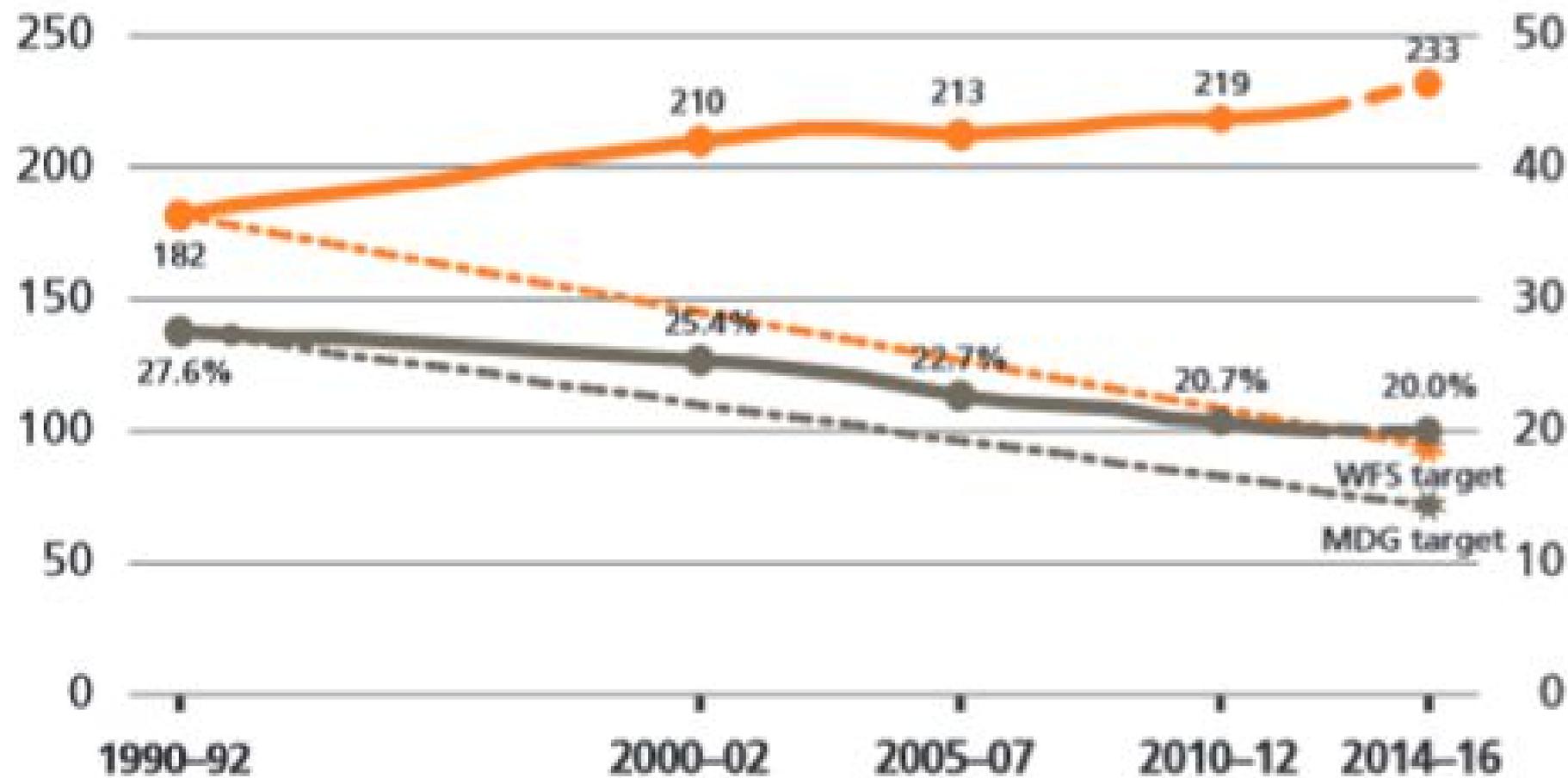
- **795 million** undernourished people **in the world in 2014-16**
- **780 million** in developing regions
- Decline by 216 million since 1990-92 and by 167 million over the last 10 years (faster rate of progress)



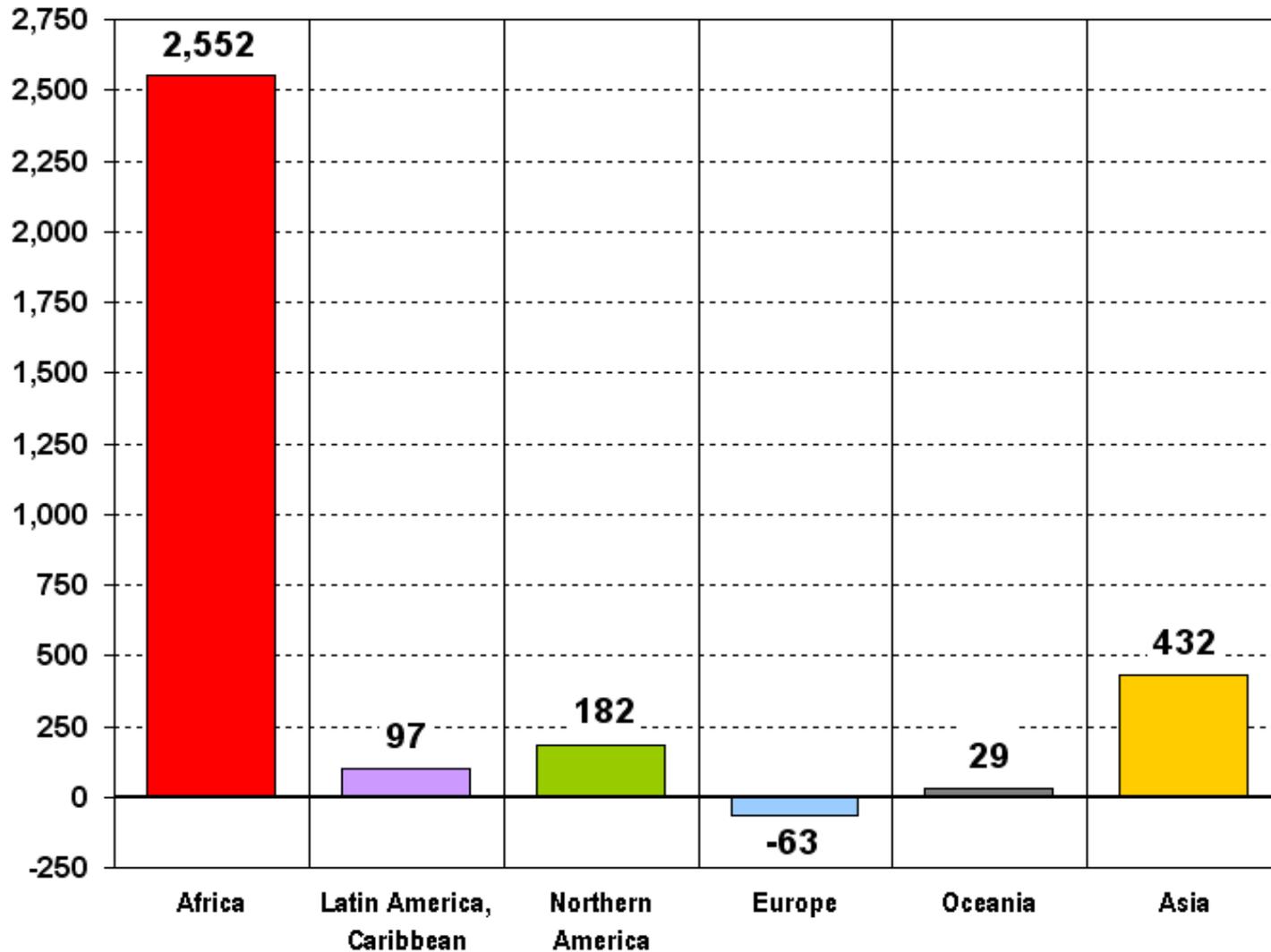
Africa

Millions

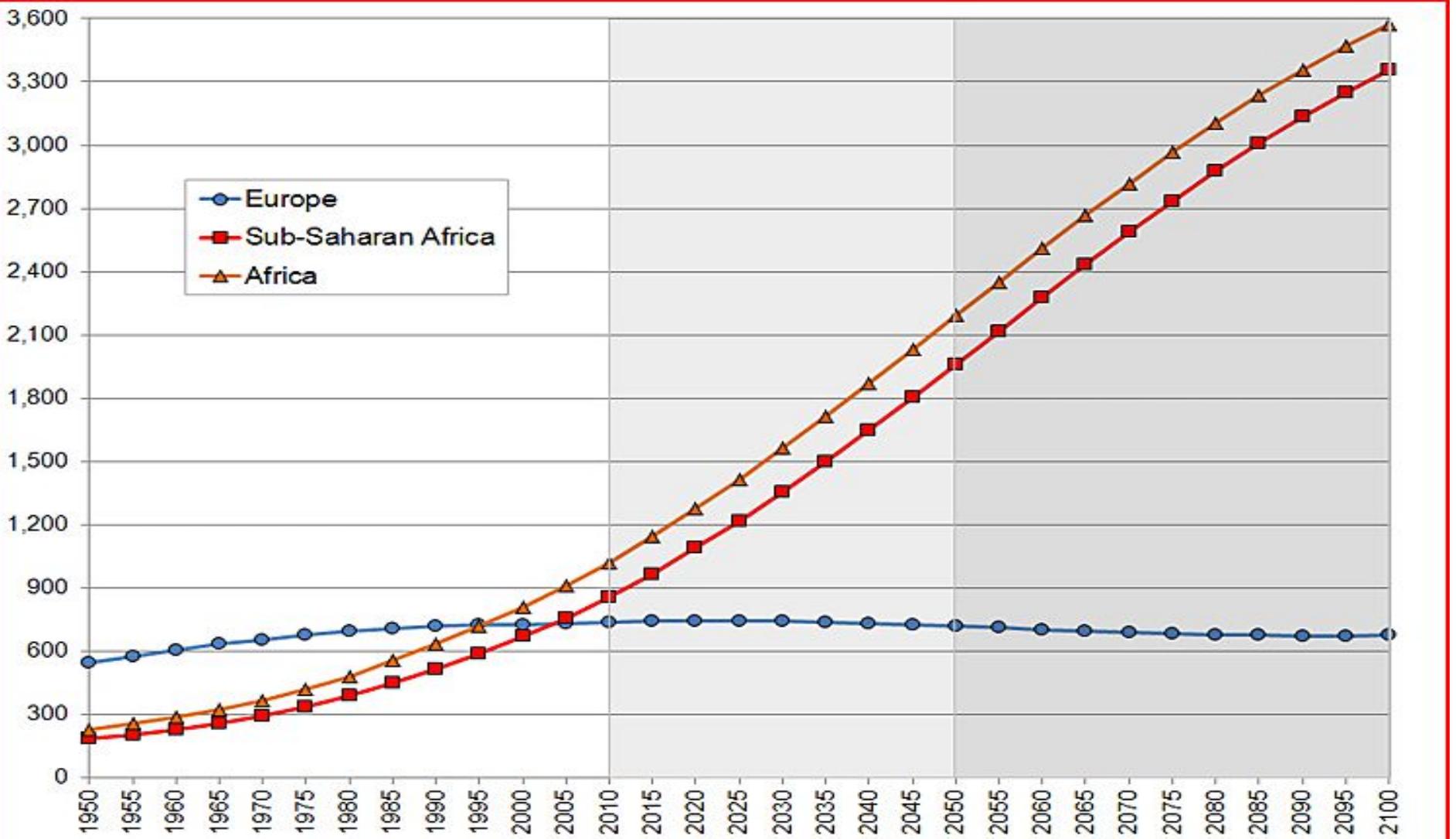
Percentage



World Population Prospects – Change between 2010 and 2100 (millions)



Population Prospect for Europe, Africa and Sub-Saharan Africa

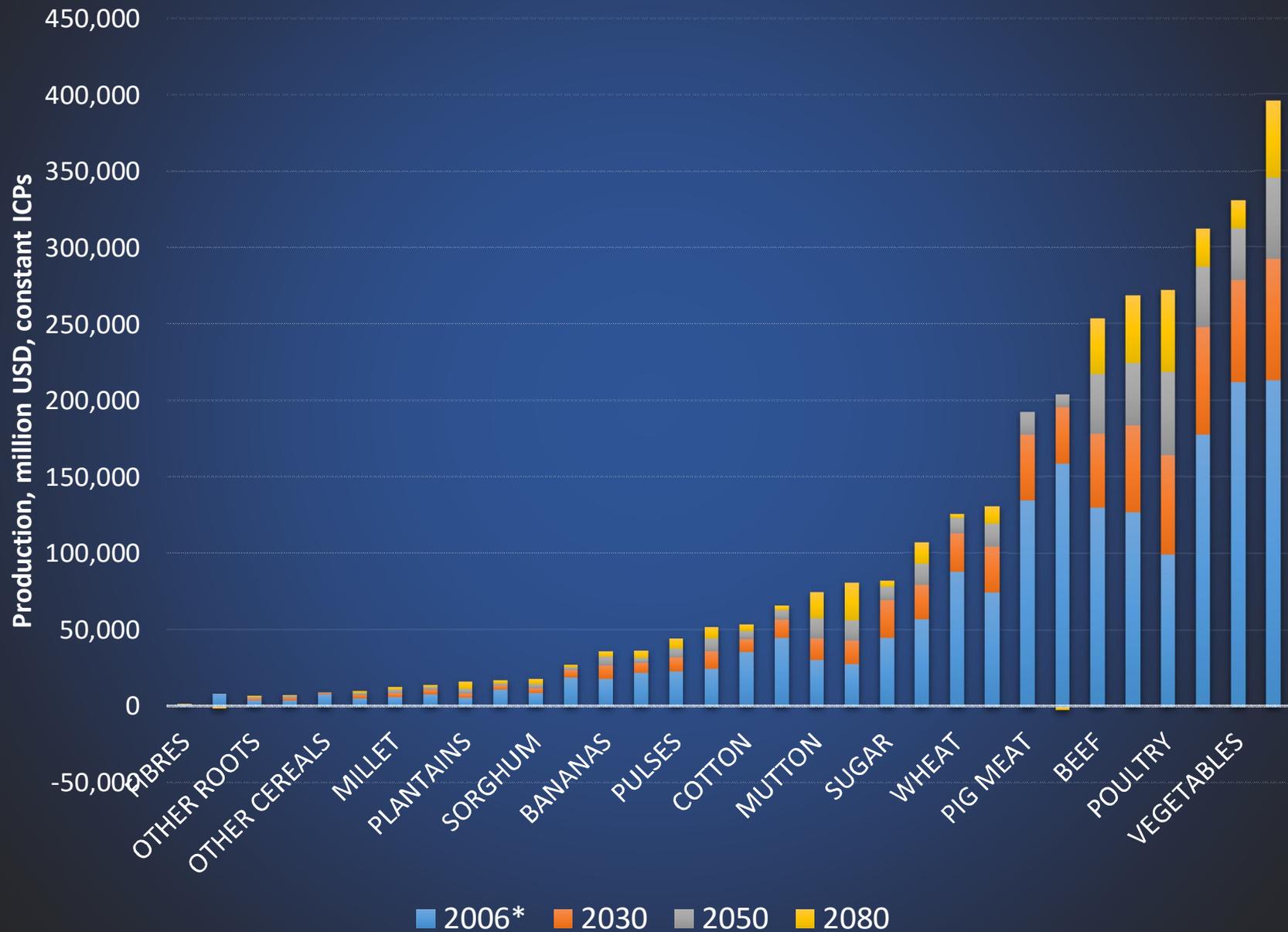


Source: United Nations, Department of Economic and Social Affairs, Population Division (2011): World Population Prospects: The 2010 Revision. New York

Note: In our definition, Europe has 48 countries, including the Russian Federation.

(Updated: 19 October 2011)

Volume and growth of world agricultural markets, 2006*-2080



AT2050/80: **provisional** nutritional outcomes (global averages/aggregates)

	undernourished		% of population with kcal/person/day		obese	
	%	million	>2700	>3000	%	million
2005/07	13	844	57	28	9	570
2050	4	330	91	52	15	1400
2080	2	150	98	66	21	2000

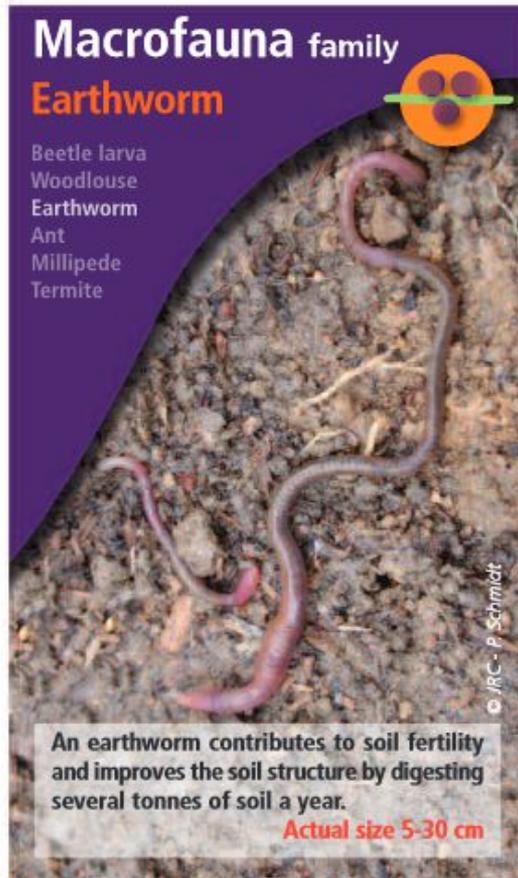
45 t/ha living material in temperate grassland soil



Macrofauna family

Earthworm

- Beetle larva
- Woodlouse
- Earthworm
- Ant
- Millipede
- Termite



© JRC - P. Schmidt

An earthworm contributes to soil fertility and improves the soil structure by digesting several tonnes of soil a year.

Actual size 5-30 cm



Photo credit Roger Klidd
modified by Alan Belward
stats Karl Ritz

45 tons living material = 900 sheep –
all in the first meter



Photo credit Roger Klidd
modified by Alan Belward
stats Karl Ritz

5 t/ha living material in arable soil



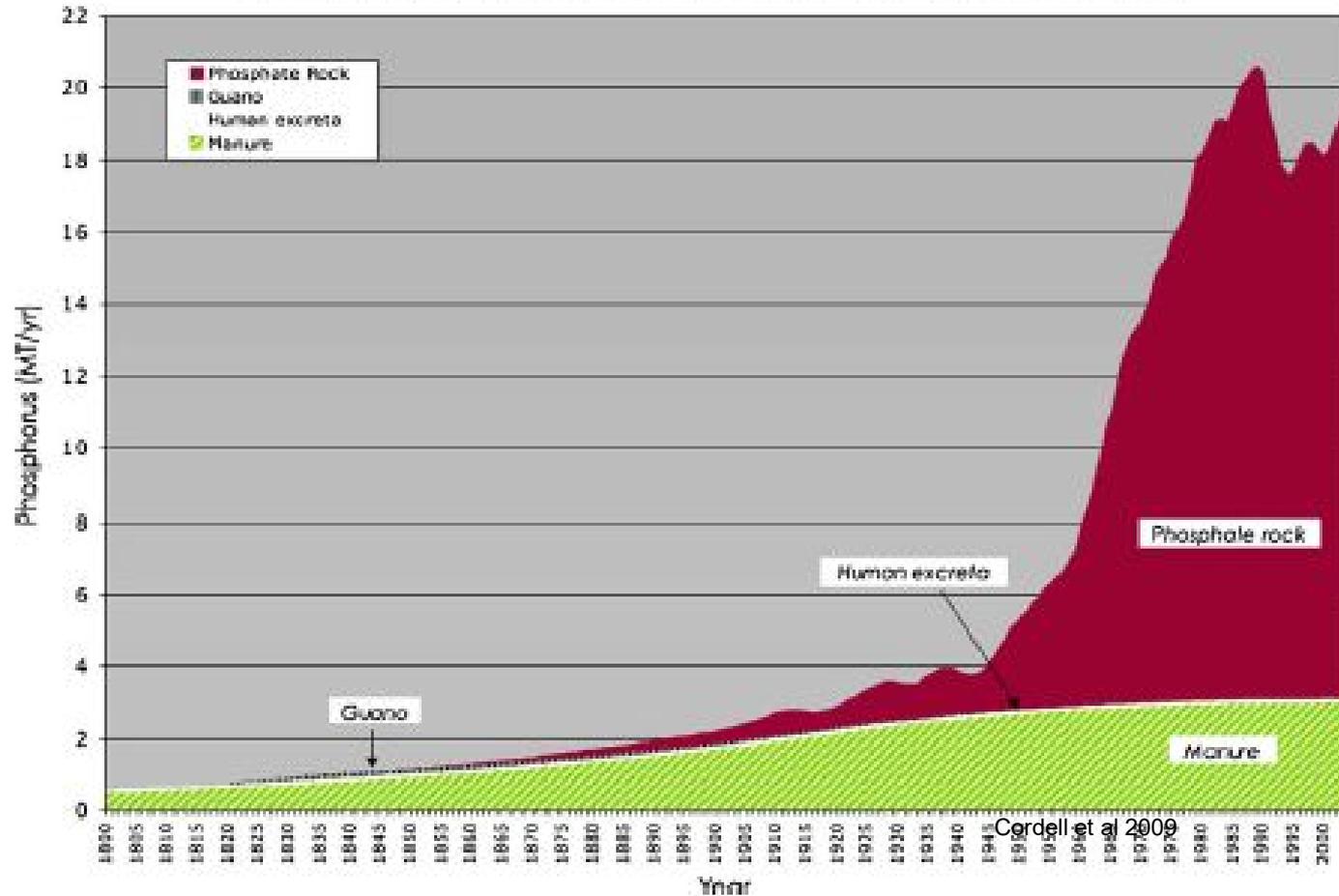
Photo credit Roger Kidd
modified by Alan Belward
stats Karl Ritz

5 tonnes = 100 sheep



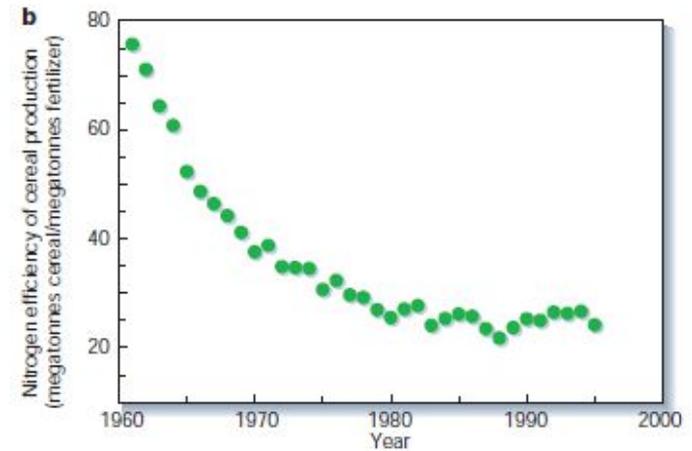
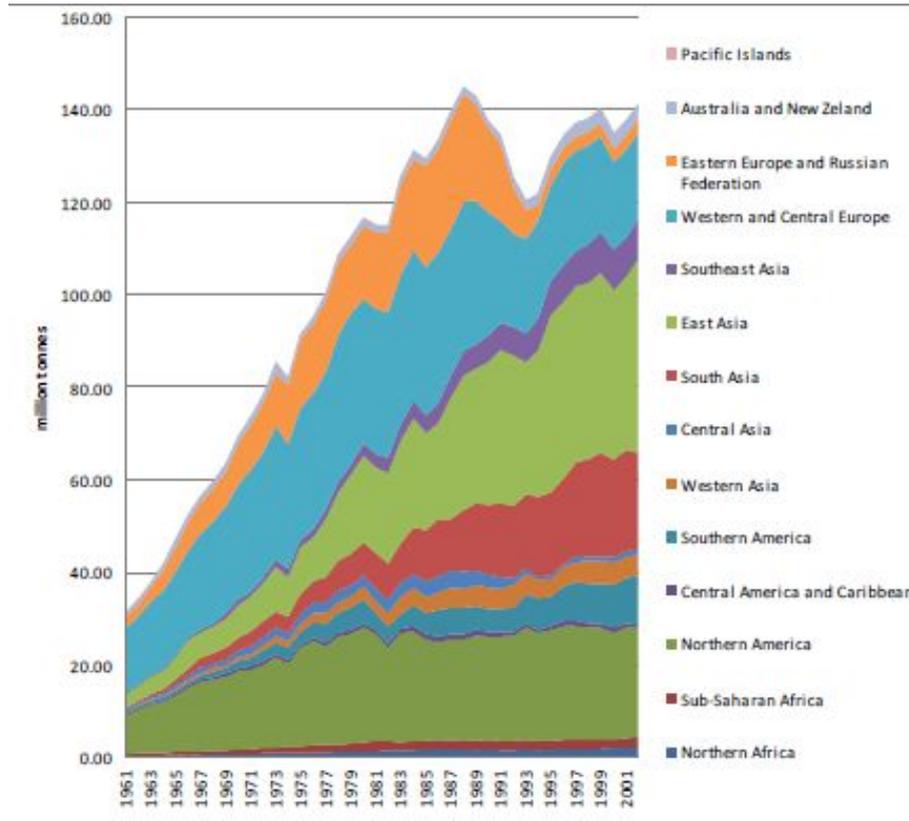
Increased use of Phosphorus

Historical global sources of phosphorus fertilizers (1800-2000)



Is Efficiency the Solution?

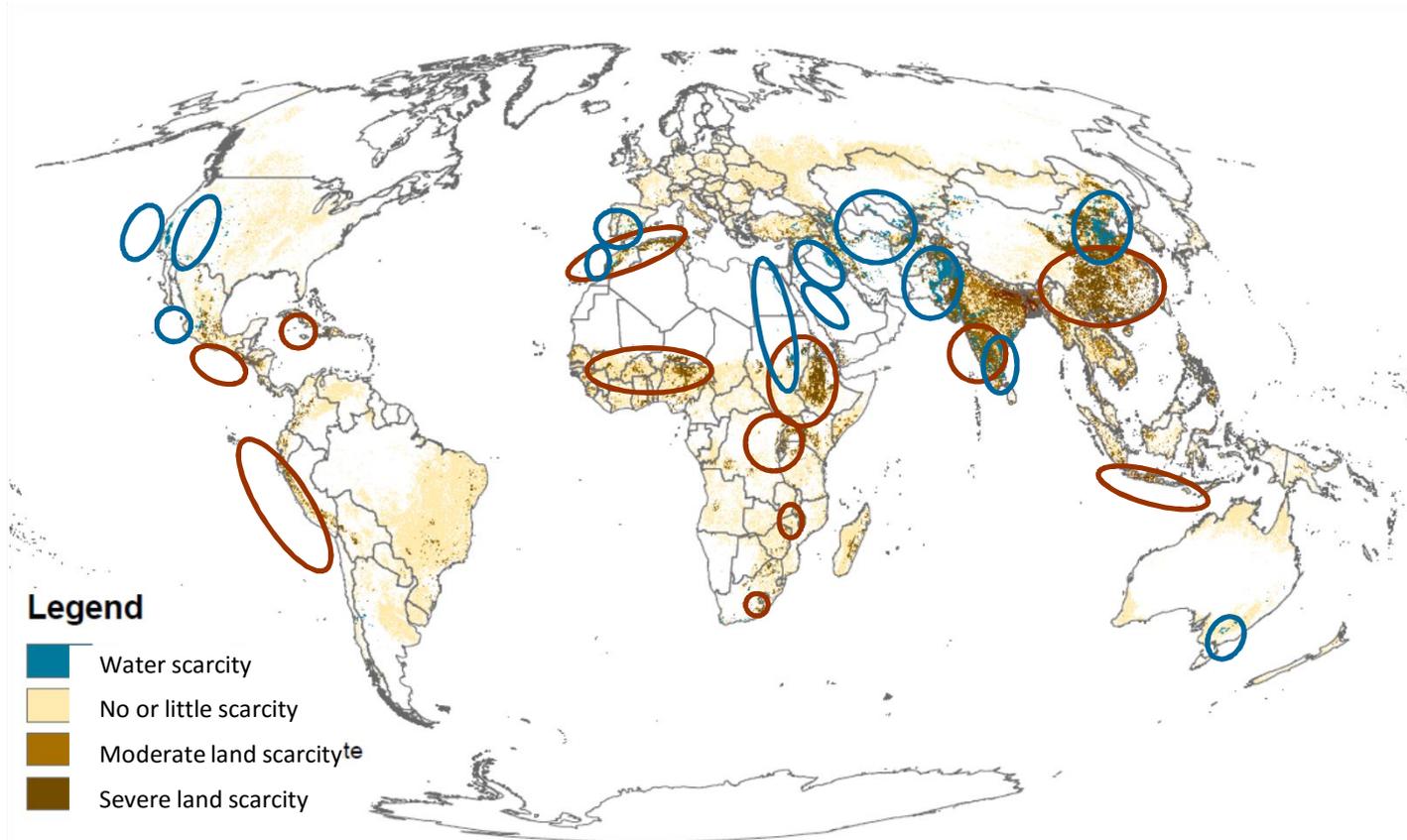
Trends in Fertilizer use and nitrogen efficiency



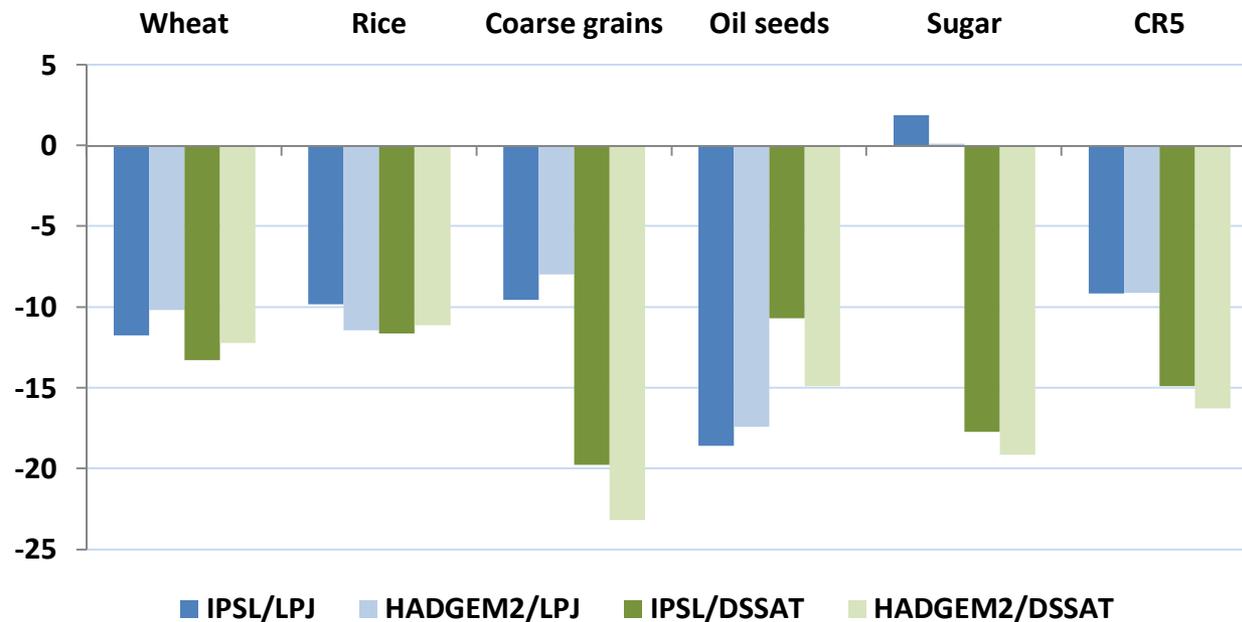
Tilman et al., 2002

FAO SOLAW 2011

Agricultural systems at risk (Source FAO, SOLAW report)

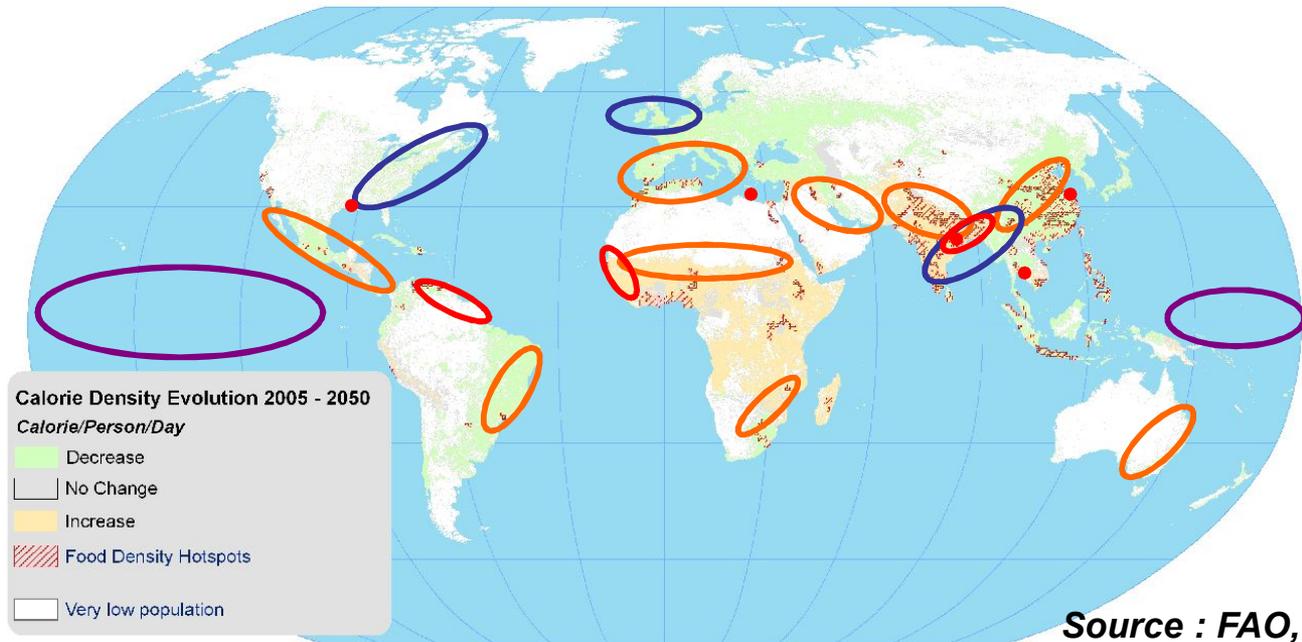


Simulated impacts for the four **climate scenarios**: global average for major crops in 2050 with respect to reference



Source: Shocks from IFPRI as interpreted for use in the ENVISAGE model, Nelson et al. (2014).

Global Calorie Density Evolution and Food Density Hotspots (2005 and projection for 2050)



Source : FAO, NR



Drought



Cyclones/Extreme events



SIDS



**Sea level rise incidence
(mangroves/deltas/SIDS)**

Why are the impacts of food systems on health important?

Global disease burden is shifting from infectious diseases to non-communicable diseases (NCDs), cardiovascular diseases, cancer, diabetes and neurodegenerative diseases, and are now the major cause of death (63%), disability and health care costs

Non-communicable diseases (NCDs) are primarily nutrition-related, and food is the result of production processes that could be either “risky” or “healthy”: opportunities exist not only to prevent many NCDs but also to cure them through healthy food



Hazards for human health from food systems occurring through three main routes I

1. unsustainable diets (over-consumption and under-consumption),

Over-consumption (individual choices)

Obesity & Type 2 Diabetes (fat and sugar)

Cardio-vascular diseases & hypertension (fat, salt)

Colorectal cancer (meat) ?

Hyper-active & ADD children (sugar)?

Under-consumption (access to food)

Hunger

Malnutrition and stunting



Hazards for human health from food systems occurring through three main routes II

2. Food production processes (less nutrients and more additives, contaminants?)

Poor quality/"empty" foods

Vitamins A, K and Iron deficiency (N-fertilized crops, refined wheat,...)

Immune system (Omega-3 and other anti-oxidants not in factory farm products)

Allergies (additives)

Pesticide risks (workers, local communities and consumers)

Cancer, Endocrine-disruptors

Neuro-degenerative

Antibiotic resistance (meat, dairy and eggs)

Food-borne infections: food safety linked to 31 infectious disease agents (e.g.BSE, avian influenza, salmonella, E. Coli, Campylobacter) causing 32 diseases according to WHO Foodborne Disease Burden Epidemiology Group



Hazards for human health from food systems occurring through three main routes III

3. Environmental conditions created by agricultural practices that affect farmers, workers, communities and consumers

Air pollution

PM respiratory diseases and human variants of animal illnesses (near intensive factory farms)

Drinking water contamination with nitrates and pesticides

Occupational hazards: injuries and workers safety and health



What is the current body of evidence? What do we know?

There is a general agreement on the threats of NCDs and the importance of healthy diets (and life styles)

Science is focusing on food safety of products. Consumers are responsible for choices

There is only limited research on food systems

For authoritative evaluations, dedicated institutions rely on accumulated scientific literature that:

is often difficult to compare

large cohort studies take decades to be available

lobbies finance research (vested interests)



NCDs in different world regions?

NCDs incidence is no longer a high-income country burden only, as low and middle-income countries experience same threats, esp. in urban areas

Big question: Is healthiness of food a result of industrial food production or linked (only) to consumption patterns and life styles? Or both?

What is the role of:

- **agricultural inputs: fertilizers, pesticides and veterinary drugs (e.g. endocrine disruptors, antimicrobial resistance)?**
- **refined products (wheat and sugar): glycemic peaks?**
- **Additives: colorants, preservatives, flavoring agents (e.g. convenience foods), sweeteners and fats**
- **Cheap fast food & soft drinks – expensive fruits & vegetables**



Cheap Food and Social Equity?

Cheap food as human right???

**Is there a direct correlation, especially in high income countries, between decreased expenditures on food and increased expenditures on health?
What are the root causes?**

Cheap price of food does not cover all production costs (natural and social capital), it also decreases farming viability, leading to abandonment of rural areas, increasing urban slums and consequent social tensions

Is cheap food increasing inequity of individual: what is saved on food is spent on lost health and wellbeing?



TEEBAgriFood and institutional system of risk assessment?

FAO/WHO Expert Committee on Food Additives evaluates safety of: food additives, processing aids, flavoring agents, residues of veterinary drugs, contaminants and natural toxins – as well as exposure assessment before proposing MRL and safety principles

However it remains reactive, subject to countries' request (e.g. endocrine-disruptors in 1999), while using conventional risk assessment procedures (e.g. Droplet Evaporation Method and vitality not considered)

While safety is privileged, is “healthiness” considered appropriately?



How to better understand impacts of food systems on human health?

As scientific evidence is hard and slow to be established on the food-health link, and that traditional preference-based valuation methods have their limitations, a better approach is required

Is the Subjective Wellbeing Approach a useful pathway for valuing health impacts of foods?

**impact of NCDs on individual wellbeing and costing them
cost of national health services and individual costs
link poor nutrition and individual wellbeing (statistical model)
translate self-reported measures of welfare (i.e. life satisfaction) in
marginal rate of substitution of income (e.g. money
compensating a health state) to cost health impacts**



**TEEBAgriFood sounds complex –
and it is!**



