The Economics of Ecosystems and Biodiversity for Agriculture and Food

TEEBAgriFOOD

Trondheim 02. June 2016

Alexander Mueller, TEEBAgFood Study Lead

teebweb.org
teeb.agfood@unep.org

The TEEBAgFood study is designed to provide

- **a *comprehensive economic evaluation of the 'eco-agri-food systems' complex*, and**
- **demonstrate that the economic environment in which farmers operate is distorted by significant externalities, both negative and positive, and**
- **a lack of awareness of dependency on natural and social capital**

teebweb.org
teeb.agfood@unep.org

‘The Good’ – some examples

+ Agriculture employs 1 in 3 people of the world’s economically active labour force, or about 1.3 billion people. For the 70 per cent of the world's poor living in rural areas, agriculture is the main source of income and employment.

+ Smallholder farms (i.e. less than 2 hectares) represent over 475 million of the world’s 570 million farms and, in much of the developing world, they produce over 80 per cent of the food consumed.

+ Food production systems produce approximately 2,800 calories per person per day which is enough to feed the world population today.

'The Bad' – some examples

- Eighty per cent of new agricultural lands have replaced tropical forests since the 1980s, a trend resulting in significant biodiversity loss and ecosystem degradation.

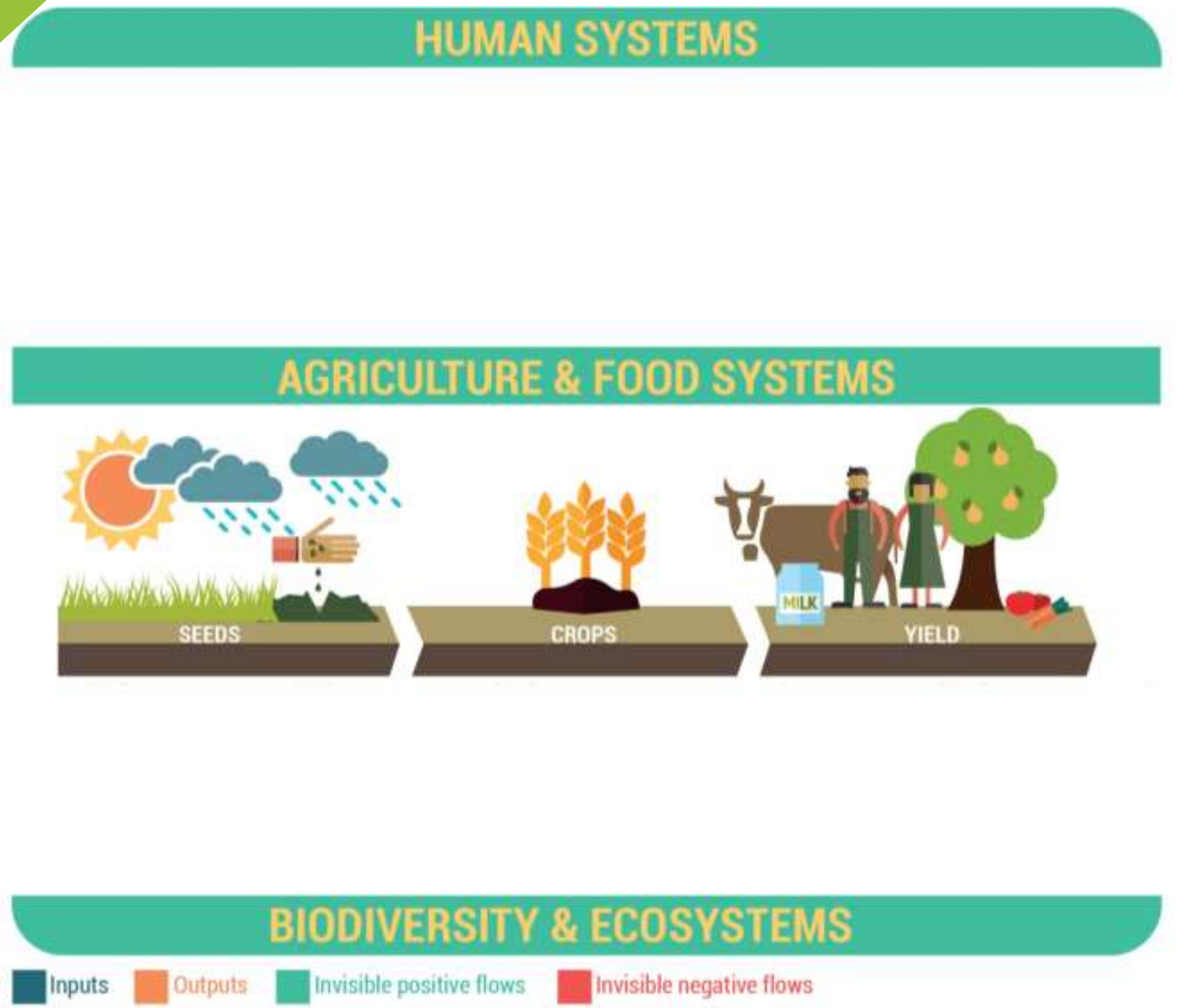
- Crop and livestock farming produce between five and six billion tons of CO_2-equivalent in greenhouse gas (GHG) emissions each year, the agricultural sector is still expanding.

- The agricultural sector utilizes 70 per cent of the water resources we withdraw from rivers, lakes and aquifers, raising serious concerns in terms of sustainability and security.

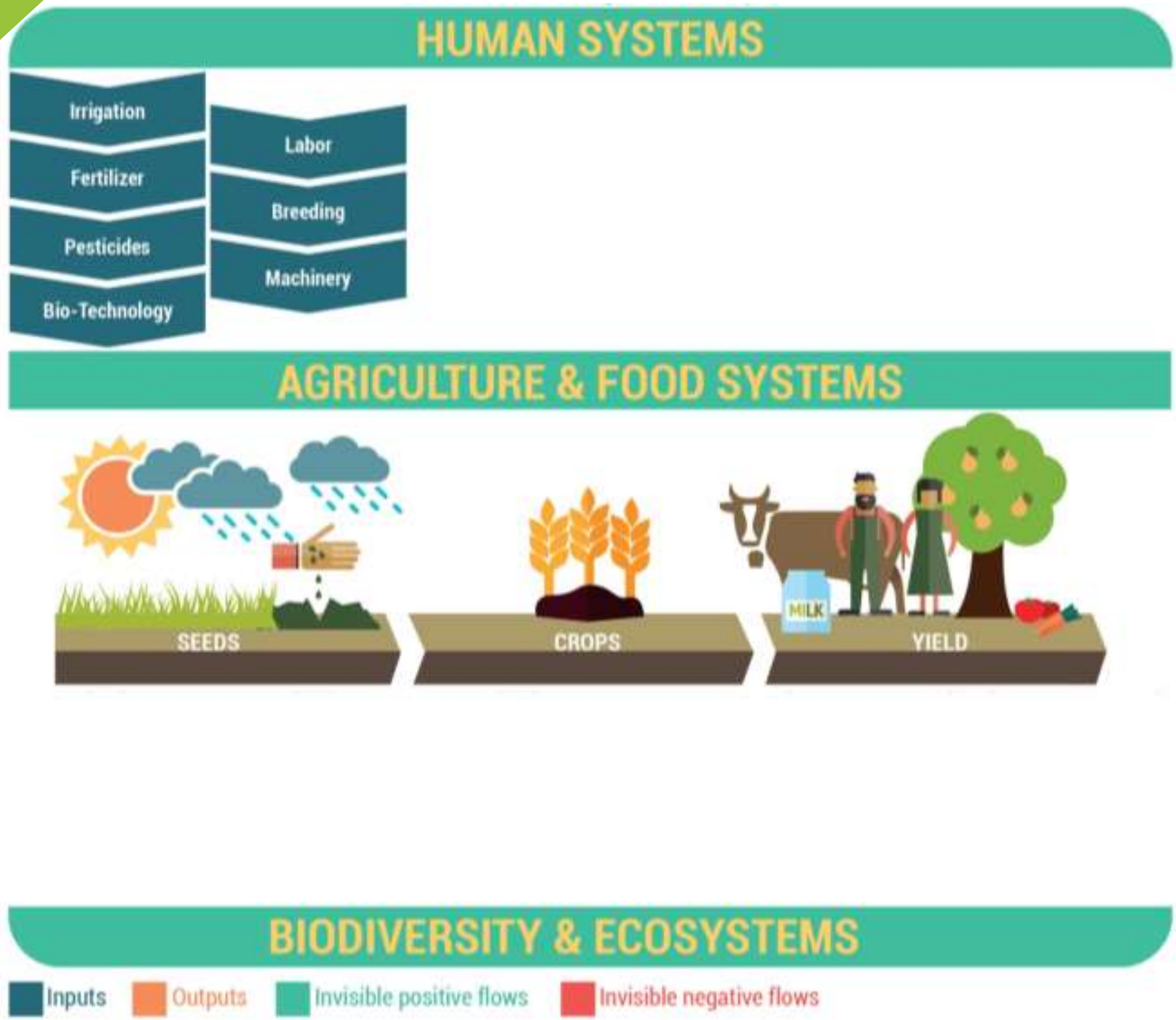
- **Still 825 Mill. people are hungry.**

The visible and invisible flows of agricultural production

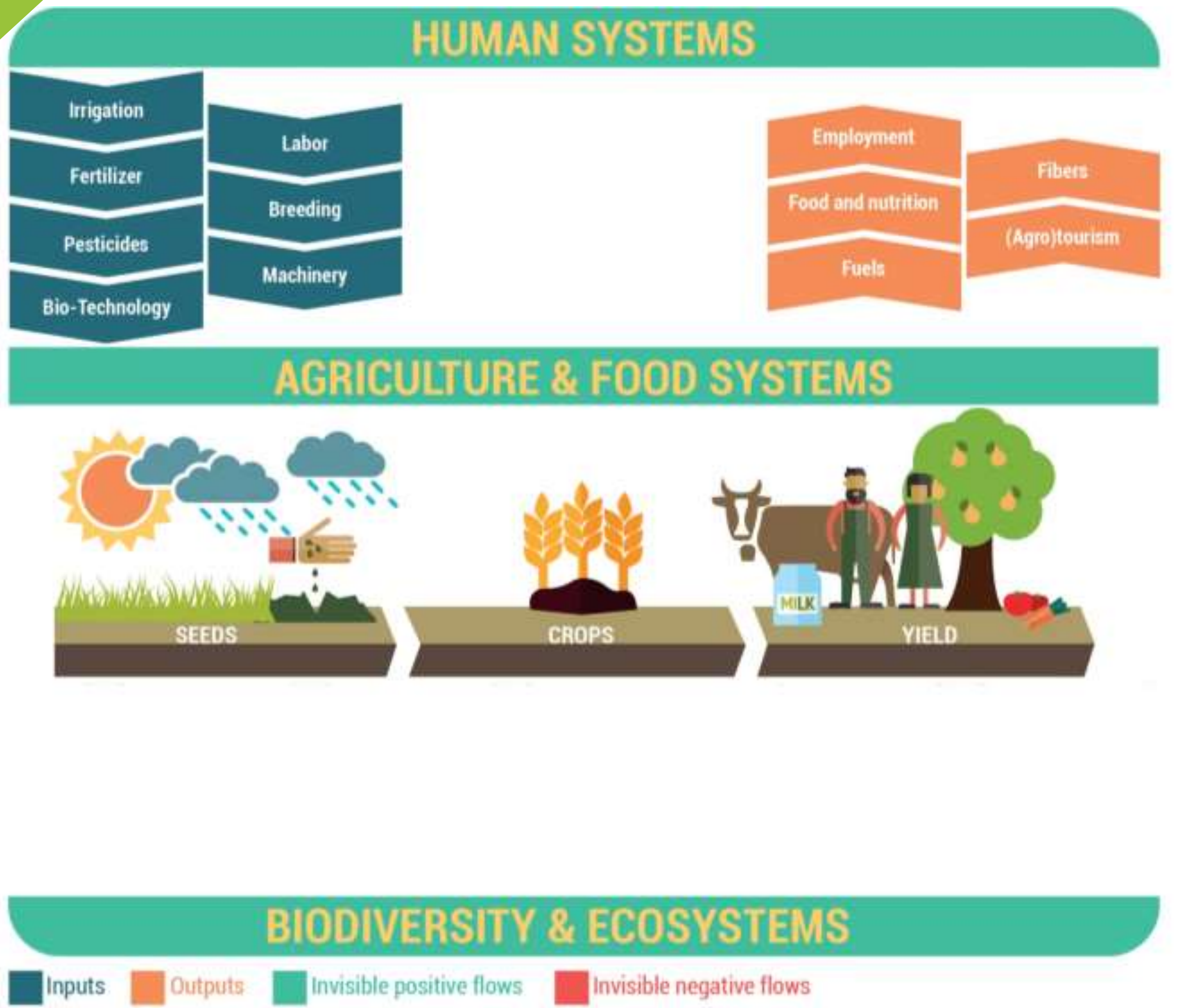
The visible and invisible flows of agricultural production



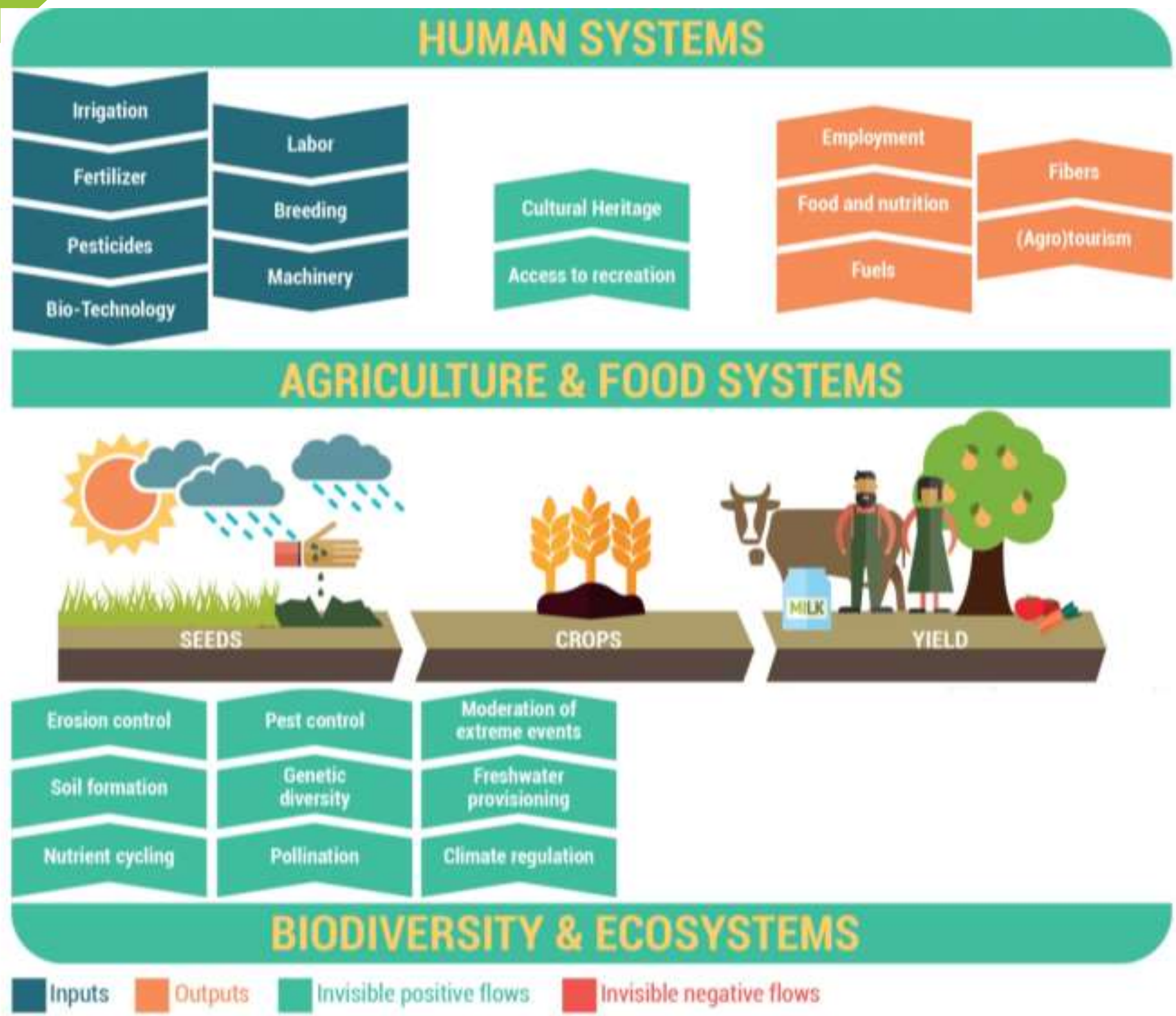
The visible and invisible flows of agricultural production



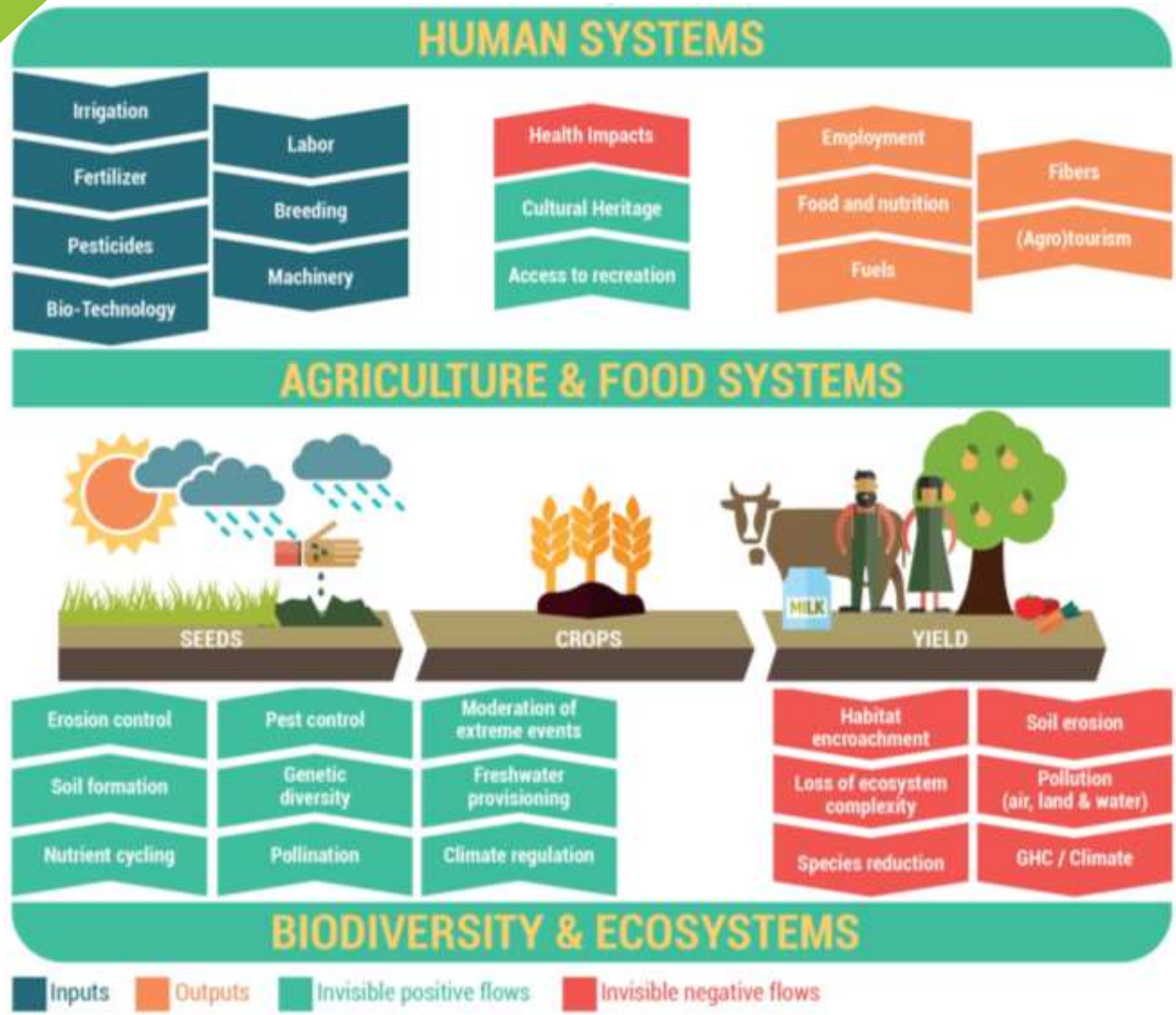
The visible and invisible flows of agricultural production



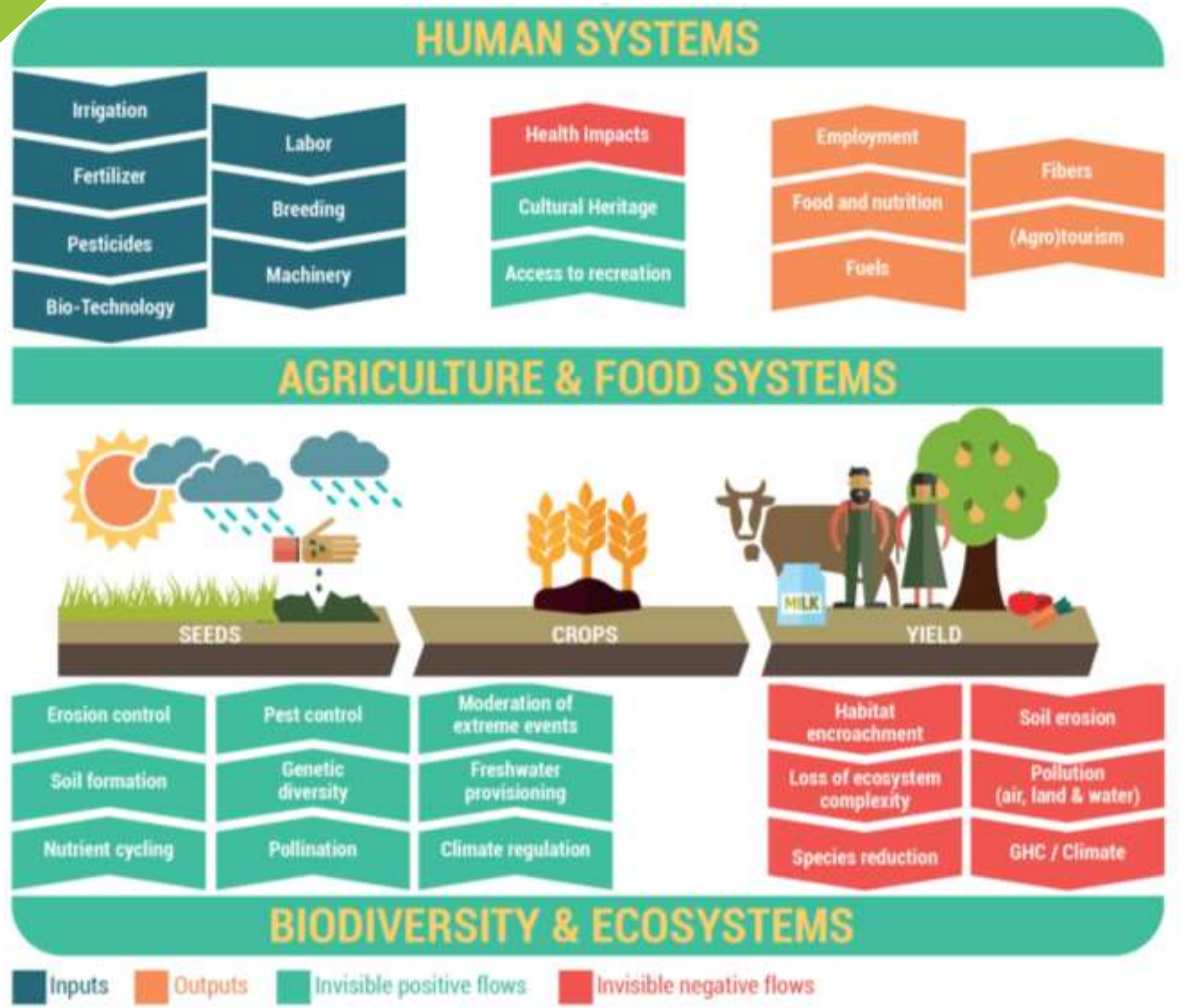
The visible and invisible flows of agricultural production



The visible and invisible flows of agricultural production



The visible and invisible flows of agricultural production



Production and Consumption of MAIZE

Interim results of a maize study by CONABIO/Mexico – connected with research on human health

TEEBAgriFood – Production of Maize Global and Regional

Agricultural ecosystems have expanded now cover half of the non-frozen land on earth.

Maize has become one of the most important crops in agriculture, mostly because of its great environmental adaptability and high productivity.

Maize production has increased twice as much as its harvested area since the year 1990.

Area of maize grain cultivation increased by 41% between 1990 and 2013. Production increased by 111% in this same period.

The average current maize yield is 5.5 tons/ha, expected to reach 6.5 ton/ha by the year 2025 and 8.6 ton/ha by 2050.

Yields per hectare increased from 1.5 to 2 ton/ha in Africa; and from 7.4 to 9.95 ton/ha in North America from 1990 to 2013

Three Types of Maize Production Systems

Maize production systems have a high heterogeneity of producers and of management practices. Three systems with two subsystems (differential dependency and impact on ecosystem services)**:**

a. intensive (irrigated and rainfed),

Profit-oriented enterprises that rely on expert knowledge, hired workforce, full mechanization and high agricultural inputs

b. smallholders (shifting and stable),

Predominantly rainfed, formed by a highly heterogeneous group of farmers with a wide variety of management practices. Mainly (semi-) subsistence farmers who depend on traditional ecological knowledge to manage ecosystem services underlying farm productivity

c. organic (small and large-scale)

Organic systems are small and large-scale production units, essentially market oriented.

Global Maize Production

The vast majority of maize in the world is produced as raw material for livestock, sweetener and oil industries, for the production of ethanol and other non-edible products.

- **Globally 14% of Maize directly used as food** (US only 1 % as direct-food)
- Production of maize grain for **animal feed** is **55%**
- Maize produced for **industrial purposes** is **21% (**incl. ethanol, sweetener and oil industries,...)
- Seeds, waste and other uses

- Maize's supply chain is heterogeneous and defined by its ultimate use

Historically maize has had multiple uses (linked to cultural practises), for thousands of years and up to the beginning of the 20th century its was mainly used for food.

Direct Food-Maize

Direct food-maize is geographically restricted in terms of its consumption, production and commerce, in contrast with maize that has industrial purposes.

With exceptions (Mexico and Central America) production and consumption of **direct food-maize** is concentrated in societies with high poverty rates that depend on this cereal as a staple food.

Consume of maize mainly for food is located almost entirely in the sub-Saharan Africa, Latin America and the south of Asia. For 900 million poor people this cereal constitutes their main food source.

White maize represents only 4% of the internationally traded maize; the other 96% **is yellow maize**, which is mainly destined for the livestock, ethanol, and edible oil industries.

Small-Scale Maize Production

Agrobiodiversity that is managed in small-scale maize production systems has a strategic value for the producers and consumers.
Its evolving (on-farm) conservation represents an irreplaceable natural insurance.
And it offers farmers (globally) a wide array of adaptation options for unpredictable future conditions.

Agrobiodiversity stewards are the most vulnerable to biotic and abiotic stress, being the poorest and having the highest levels of food insecurity.
This will persist as long as the local and global value of agrobiodiversity stewardship remains invisible to the markets and to society overall, and therefore is not duly compensated

Despite the global expansion of modern maize varieties, landraces are still grown in several regions of the world. This is partly due to economic drivers such as a lower market value of modern varieties and high technological transaction costs, but also to the close relationship between cultural and crop diversity, particularly in Latin America.

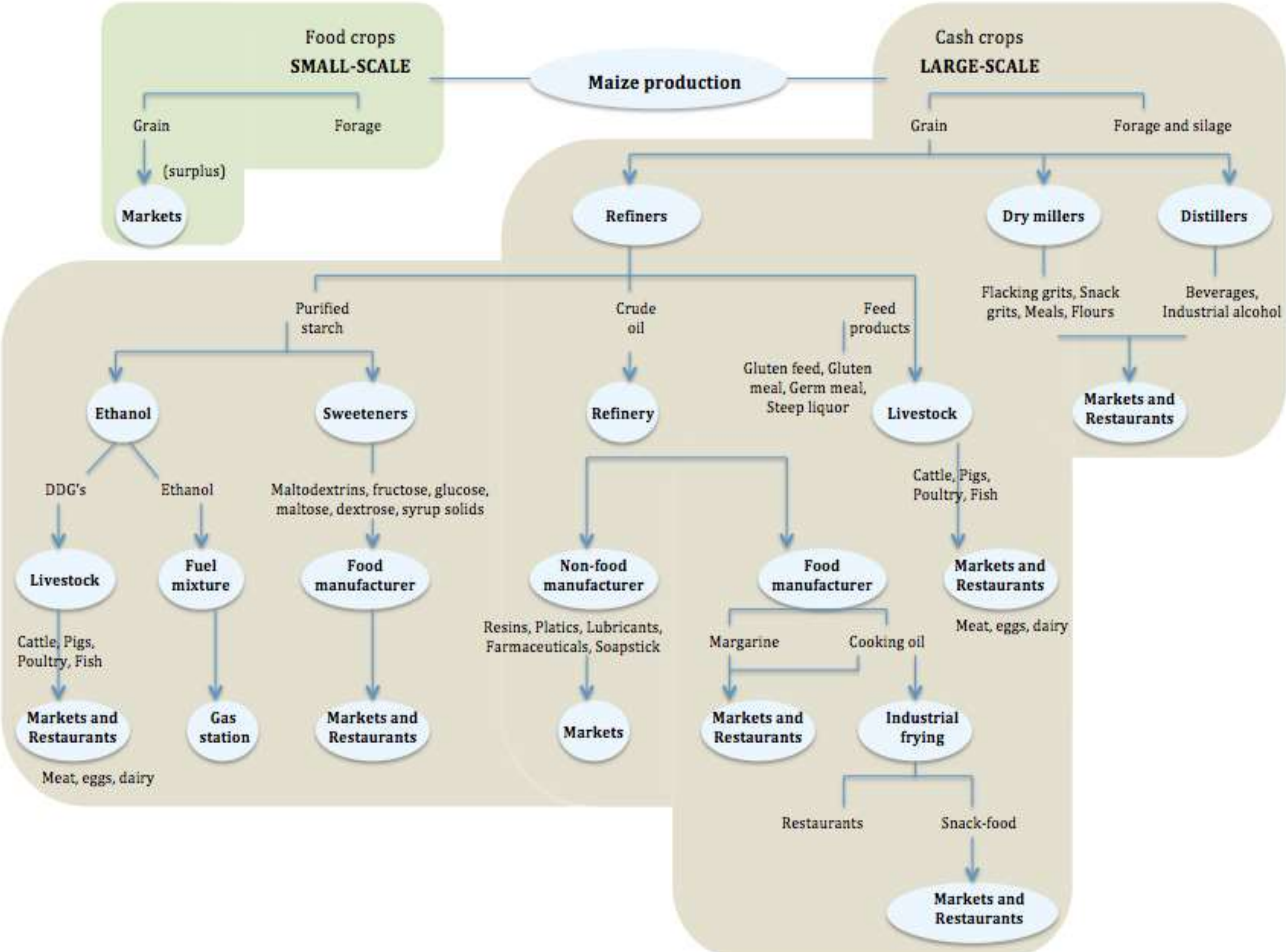
Maize and diverse diets

Smallholders provide most of the world direct food-maize and are the stewards of the genetic, agricultural and landscape diversity of this crop.

Numerous **different production** systems growing maize, most of them rotating or mixing this cereal with legumes, tubers, vegetables, fruits, trees, nuts, non-edible crops or with other cereals, mainly for food or forage production.
No other species is grown together with such a variety of species as maize.

In Sub-Saharan Africa there are eight different systems where maize is mixed with other crops, which represent 61% of the agricultural area and 58% of the farming population.

In Latin America, four different multiple cropping systems of maize are described. In this region, farmers grow between 70 and 90% of beans together with maize, potatoes and other crops, and the multiple cropping maize system covers 60% of the area devoted to the production of this cereal.



Food crops
SMALL-SCALE
Maize production
Cash crops
LARGE-SCALE
Grain
Forage
(surplus)
Markets
Grain
Forage and silage
Refiners
Dry millers
Distillers
Purified starch
Crude oil
Feed products
Flacking grits, Snack grits, Meals, Flours
Beverages, Industrial alcohol
Gluten feed, Gluten meal, Germ meal, Steep liquor
Ethanol
Sweeteners
Refinery
Livestock
Markets and Restaurants
DDG's
Ethanol
Maltodextrins, fructose, glucose, maltose, dextrose, syrup solids
Cattle, Pigs, Poultry, Fish
Livestock
Fuel mixture
Food manufacturer
Non-food manufacturer
Food manufacturer
Markets and Restaurants
Meat, eggs, dairy
Cattle, Pigs, Poultry, Fish
Resins, Platics, Lubricants, Farmaceuticals, Soapstick
Margarine
Cooking oil
Markets and Restaurants
Gas station
Markets and Restaurants
Markets
Markets and Restaurants
Industrial frying
Meat, eggs, dairy
Restaurants
Snack-food
Markets and Restaurants

High Fructose Corn Syrup (HFCS)

After ethanol, the most important industrial is **High Fructose Corn Syrup (HFCS).**

HFCS has gained ground over sucrose because of its easier storage and transportation handling; also because the price of HFCS is more stable, due to governmental subsidies for the production of maize (US); finally, because maize has a wider base production than sugarcane in the world.

HFCS has become the main sweetener of soft drinks and is used in fruit juices, breads, confectionery, marmalades, cereals, yoghurts and other dairy products, condiments, and canned and packed products.

Its consumption is still nine times smaller than sucrose, but in the US it already covers 40% of all sweeteners. Its nutritional value and its possible contribution to an increase of diabetes and hypertension in countries that use more HFCS than sucrose have been debated

High Fructose Corn Syrup (HFCS)

Over the last half century, the average annual consumption per-capita of high-calorie sweeteners increased in the US by 18 kilos approximately and HCFS accounts for over 80% of the additional calories consumed every day in the form of sweeteners.

HCFS producers have benefited from an implicit subsidy of approximately USD $243 million per year, and over USD $4 billion since 1986.

Thus, soda producers, the main consumers of HFCS have saved nearly USD $100 million annually and about USD $1.7 billion since the mid 80s when the soda industry started to use HFCS in their products.

Between 1985 and 2000 “the real cost of (unsubsidized) fresh fruits and vegetables increased

HFCS and Diabetes?

Economic impact of diabetes

- Catastrophic medical expenditure significantly higher in people with diabetes.
- Direct annual cost of diabetes globally > US$ 827 billion.
- Losses in GDP worldwide estimated to be US$ 1.7 trillion from 2010 to 2030

Maize and Livestock

The increased production of cheap maize in the US has also benefited the **industry of concentrated animal feeding operations (CAFOs)** where animals are fed with subsidized maize instead of grass.

CAFOs have thousands of animals in small areas, creating large **concentrations of excrement**, which often spill in local rivers and are responsible for large methane emissions, contributing to climate change

Moreover, the widespread use of **antibiotics** in CAFOs has increased the risk for more virulent and resistant microorganisms, reducing the effectiveness of antibiotics to treat infections in livestock and humans.

Antibiotic Resitance

The inappropriate use of antimicrobial drugs, including in animal husbandry, favours the emergence and selection of **resistant strains**, and poor infection prevention and control practices contribute to further emergence and spread of antimicrobial resistance.

Antibiotic resistance is one of the biggest threats to global health today. It can affect anyone, of any age, in any country

In the European Union alone, drug-resistant bacteria are estimated to cause 25,000 deaths and cost more than US$1.5 billion every year in healthcare expenses and productivity losses.

Antibiotic Resistance

Drug-resistant infections currently kill an estimated 700,000 people worldwide/a.

If efforts to curb antibiotic resistance fail, this number could increase to 10 million by 2050, surpassing the 8.2 million deaths a year caused by cancer, (report to the UK government).
The economic impact would also be devastating: the report estimates a cost of $100tn of global GDP over the next 35 years.

The food sector, primarily livestock production, is already grappling with a post-antibiotic reality. The meat industry is facing increased pressure, from both the public and the private sector, to phase out the routine use of these drugs.

"Human resistance to antibiotics could bring 'the end of modern medicine as we know it',"

http://www.nhs.uk/news/2012/03march/Pages/antibiotic-resistance-who-strategy.aspx

Intensive Maize Production and the Environment

The dead zone in the Gulf of Mexico is to a great extent the result of maize and soybean production in the so called Corn Belt, located in the states of Iowa, Illinois, Indiana, Nebraska, Kansas Minnesota and Missouri.

The United States cultivates 62% of GM maize in the world, and almost all maize that is produced within its territory is GM: 96% of its cultivated area.

Only 1% of US maize production is used as direct food, and 8% for industrially manufactured food (mostly high fructose corn syrup).
The rest is produced for the ethanol (49%) and livestock (42%) industries.

is supported by

UNEP

GLOBAL ALLIANCE FOR THE FUTURE OF FOOD

Norad

teebweb.org

teeb.agfood@unep.org