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Agriculture • Food • Sustainability

Fall Semester Course: FAST.0150.
Sustainable Agri-Food Production and Supply Chain
Management

Agri-Food Industry in the EU

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“By 2050, global food systems will need to feed and nourish more than **9** billion people in a **safe, responsible** and **sustainable** way.”

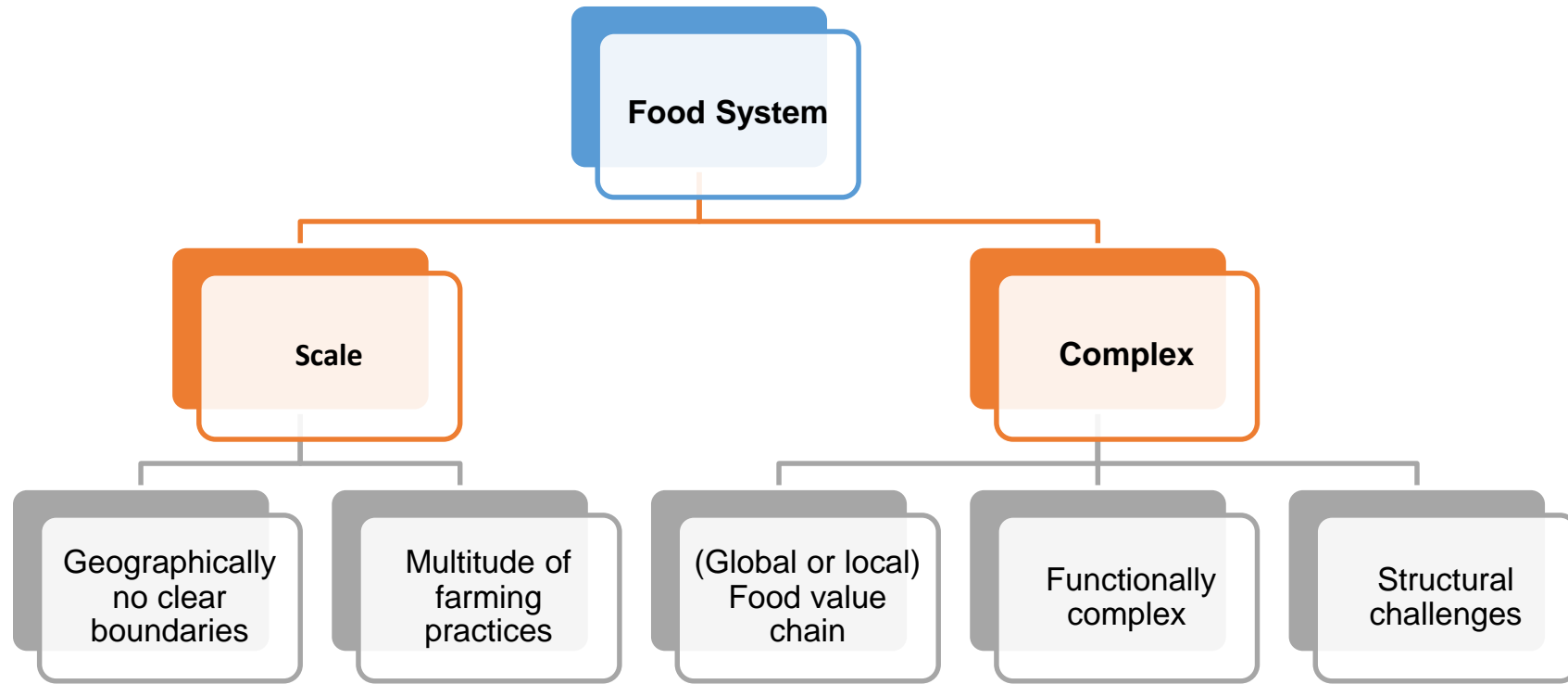


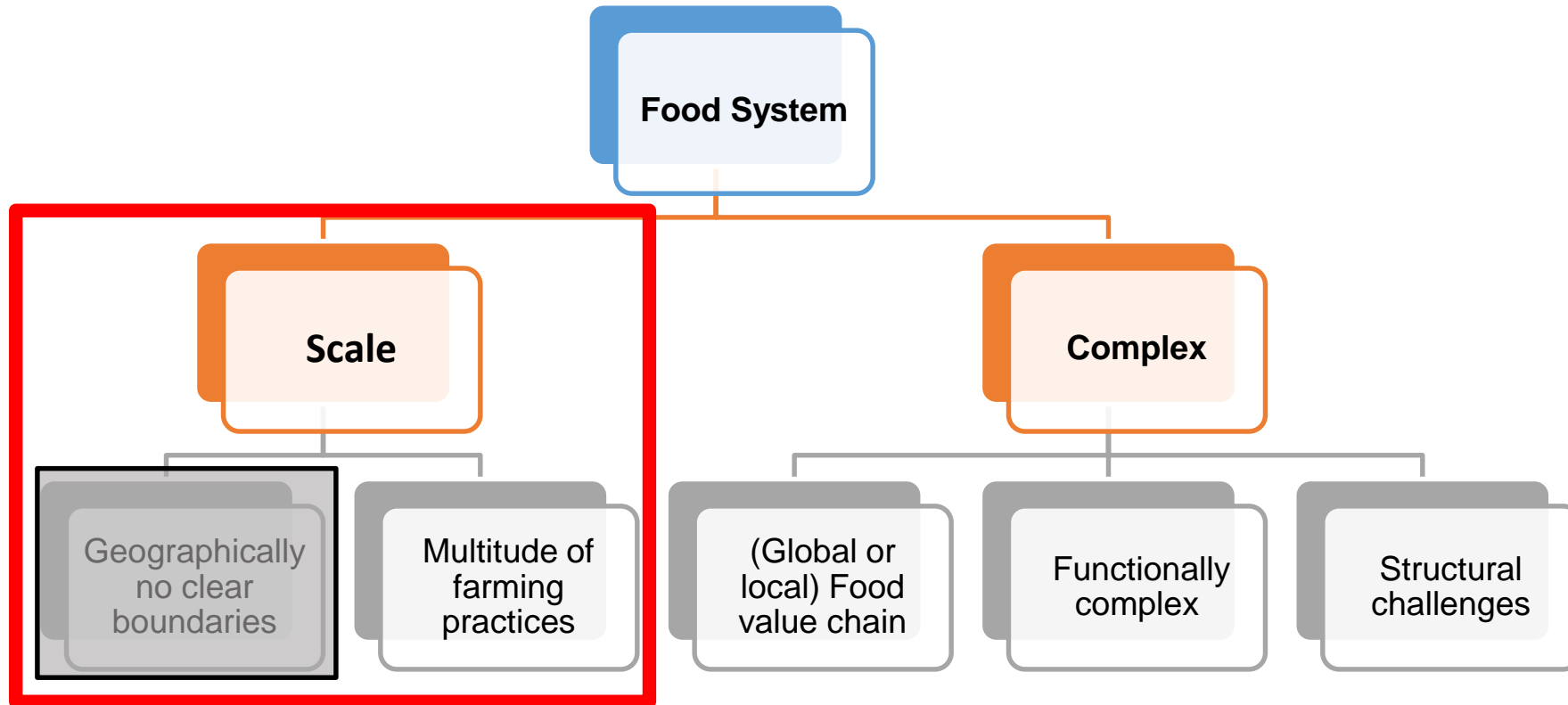
The **Food System** should work within the **planet's biophysical boundaries** [i.e., complexity of the global system]

Food Production needs to meet the anticipated **demands** of a much larger and diverse human population [i.e., food security]

What is the (Global) Food System?

“The food system is a **web of activities** that involves **people** and **food activities** like production, processing, transport , consumption of food, and waste . This web of activities also involves decisions like food choices and resource investment.”





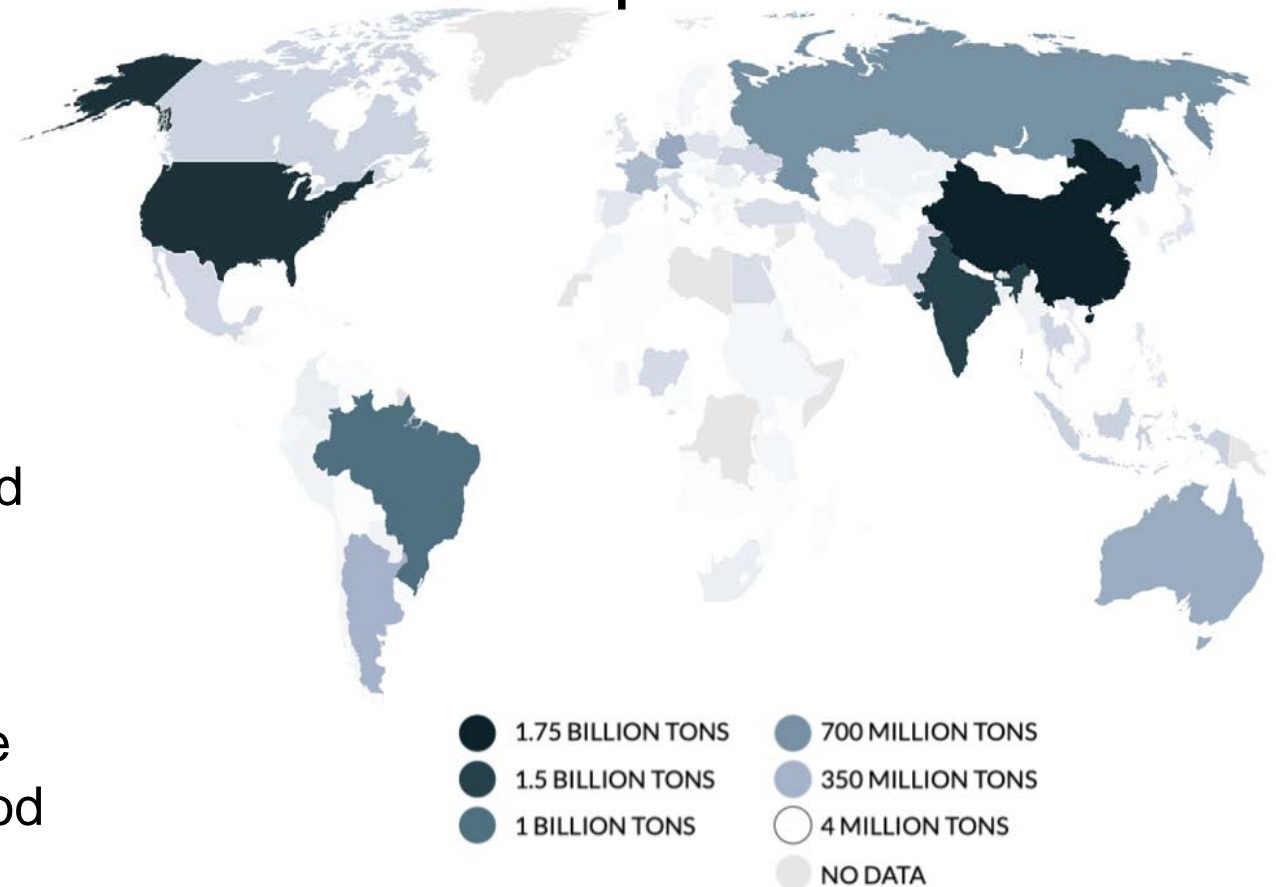
Geographical Distribution

Global food production relies on vast, continuous supplies of agricultural inputs specially **land, water, fertiliser, pesticides, labour, and capital.**

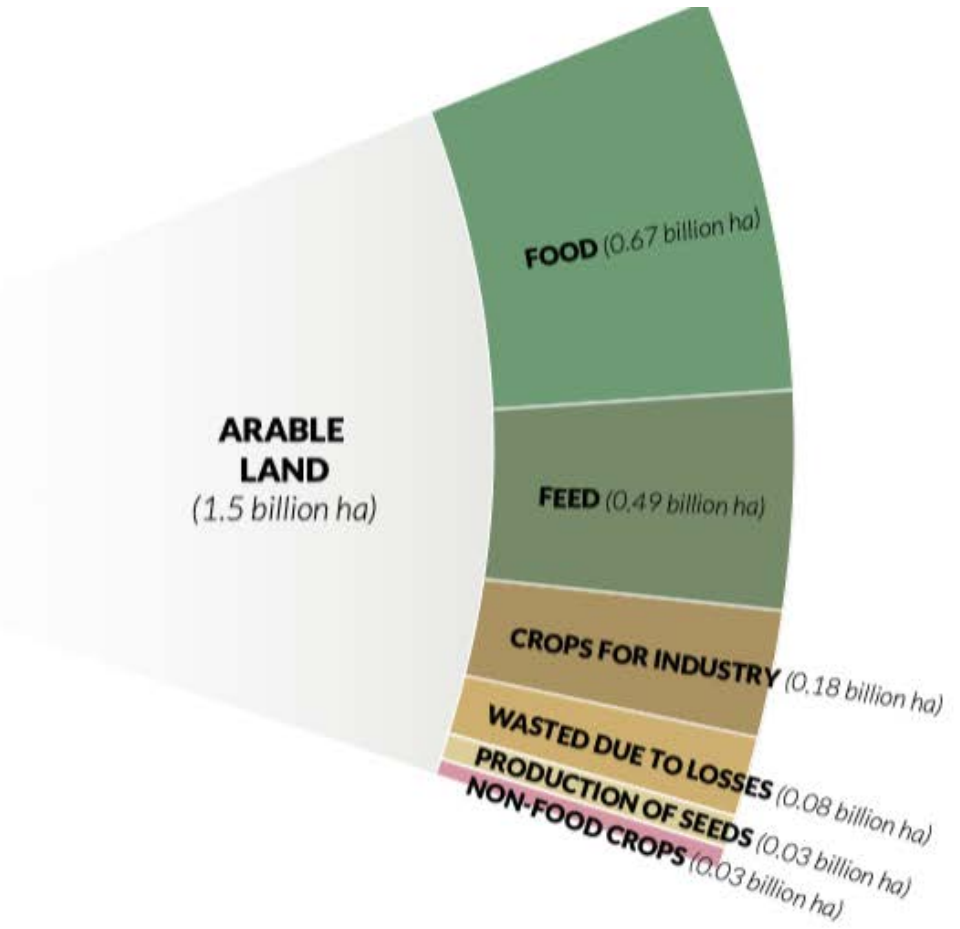
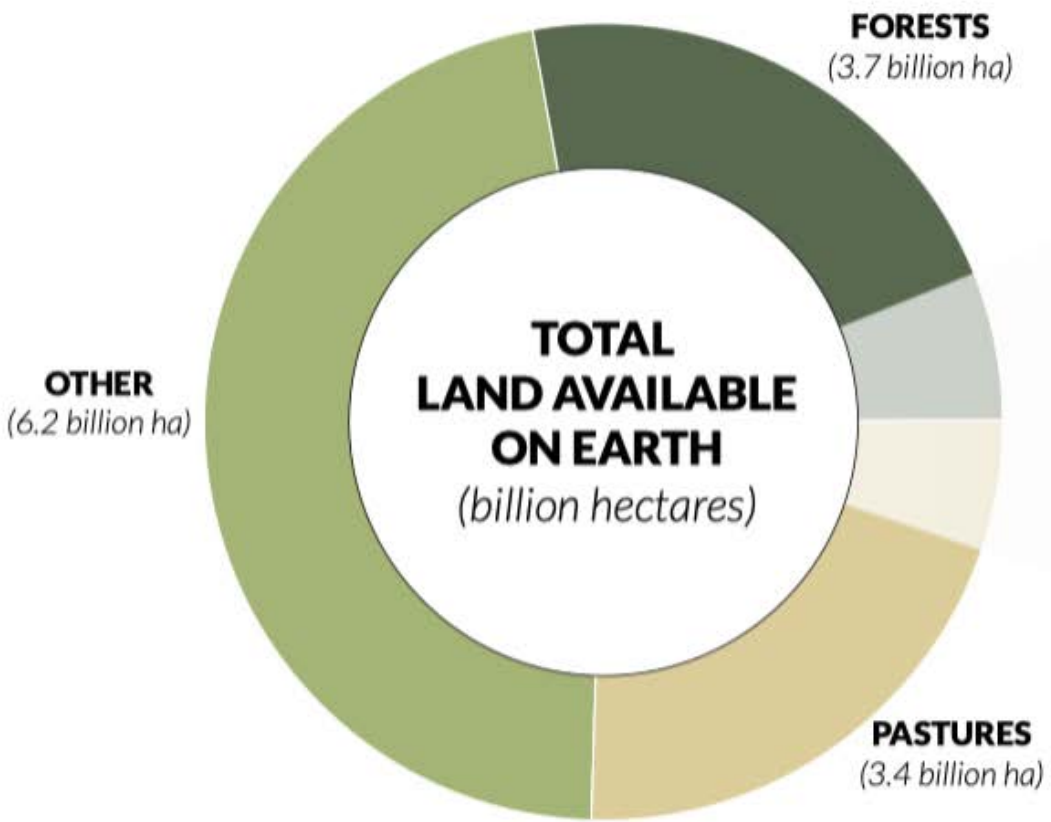
Large differences between geographical regions because of quantity and the type of food produced.

- United States, China, India, Brazil, and Russia are the world's most significant food-producing countries in terms of quantity
- Countries in Africa, the Middle East, and Oceania only produce about 10% of global production
- East Asia is the world's most productive region, accounting for 20% of global food production

Distribution of crops, livestock, and seafood production

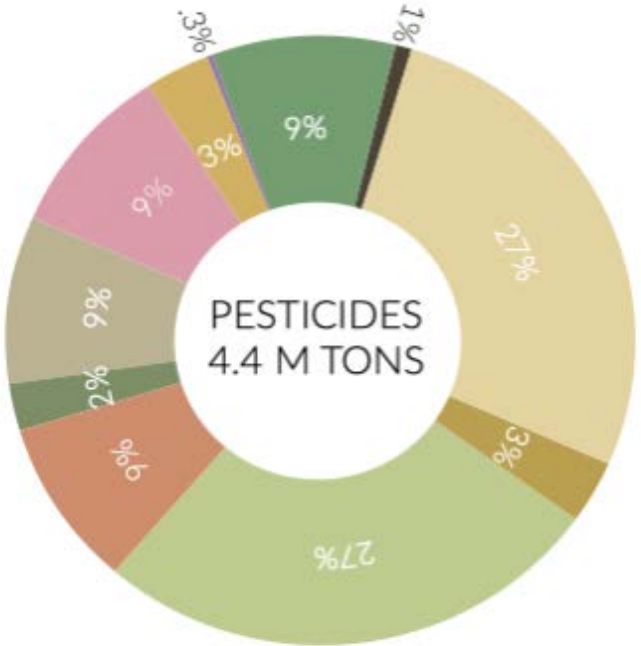
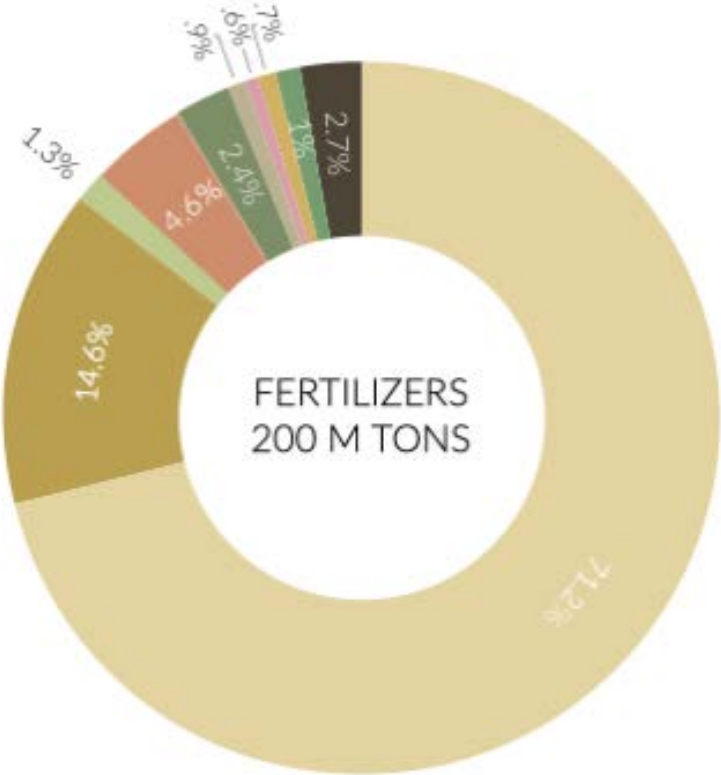
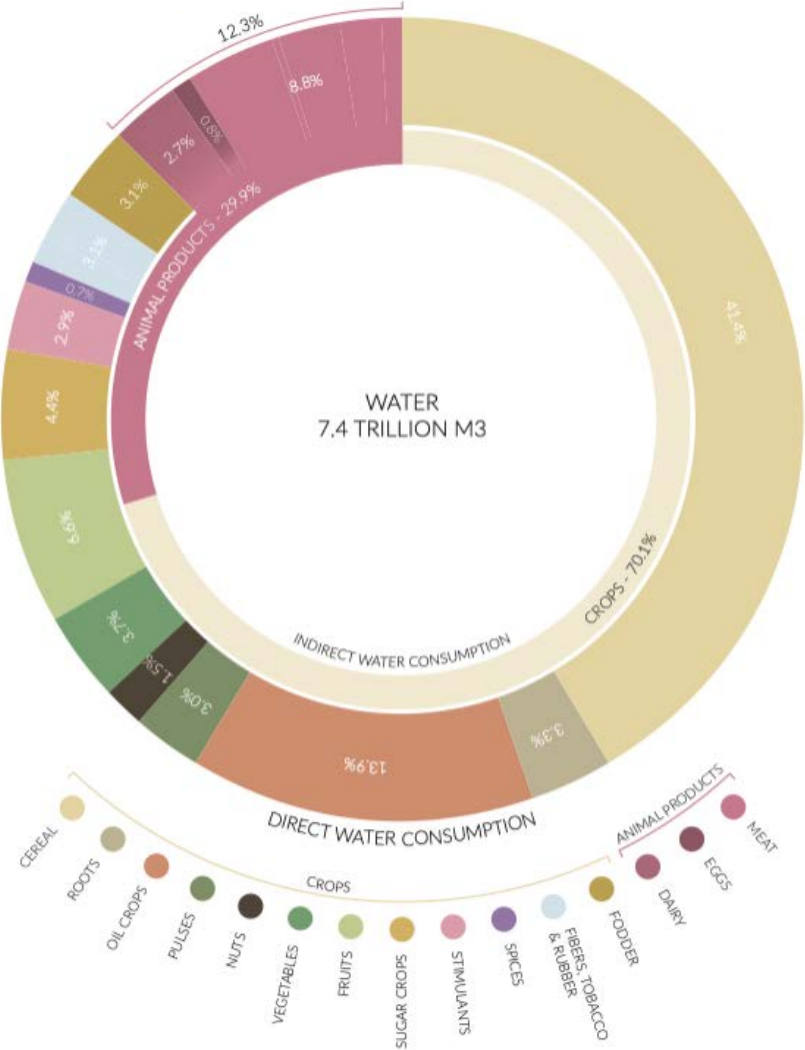


Global Food Production Activities [Land Use]

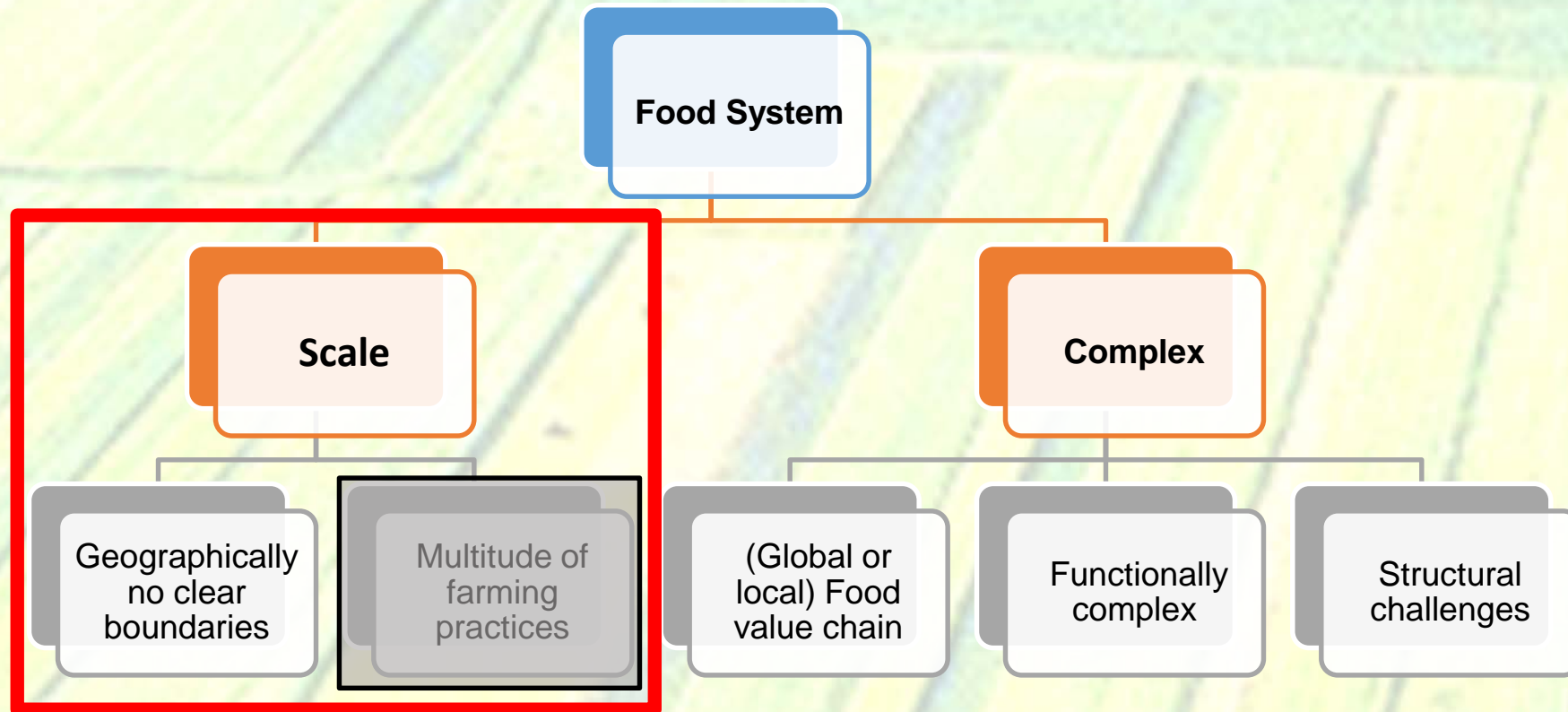


(Metabolic, 2017 ; FAOSTAT, 2015)

Resource Inputs in Food Production Activities



(Metabolic, 2017 ; FAOSTAT, 2015)

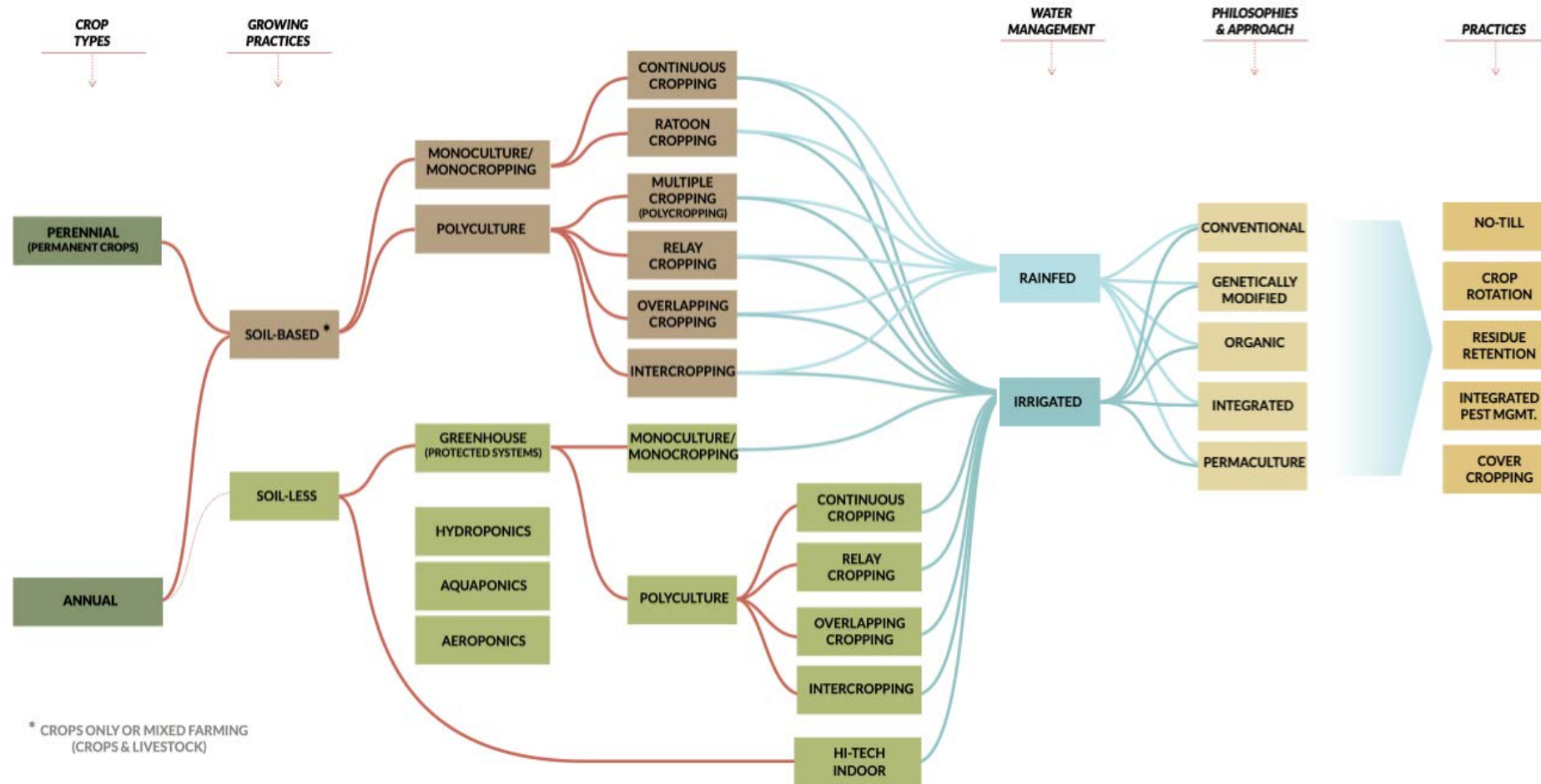


Agricultural Production Practices

- Enormous variability in agricultural production practices across the globe
- Type of agricultural production practices determines the resource demand and overall impacts
- A few examples of commonly used production practices are:
 - Crop cultivation,
 - Livestock production, and
 - Fisheries and aquaculture production.

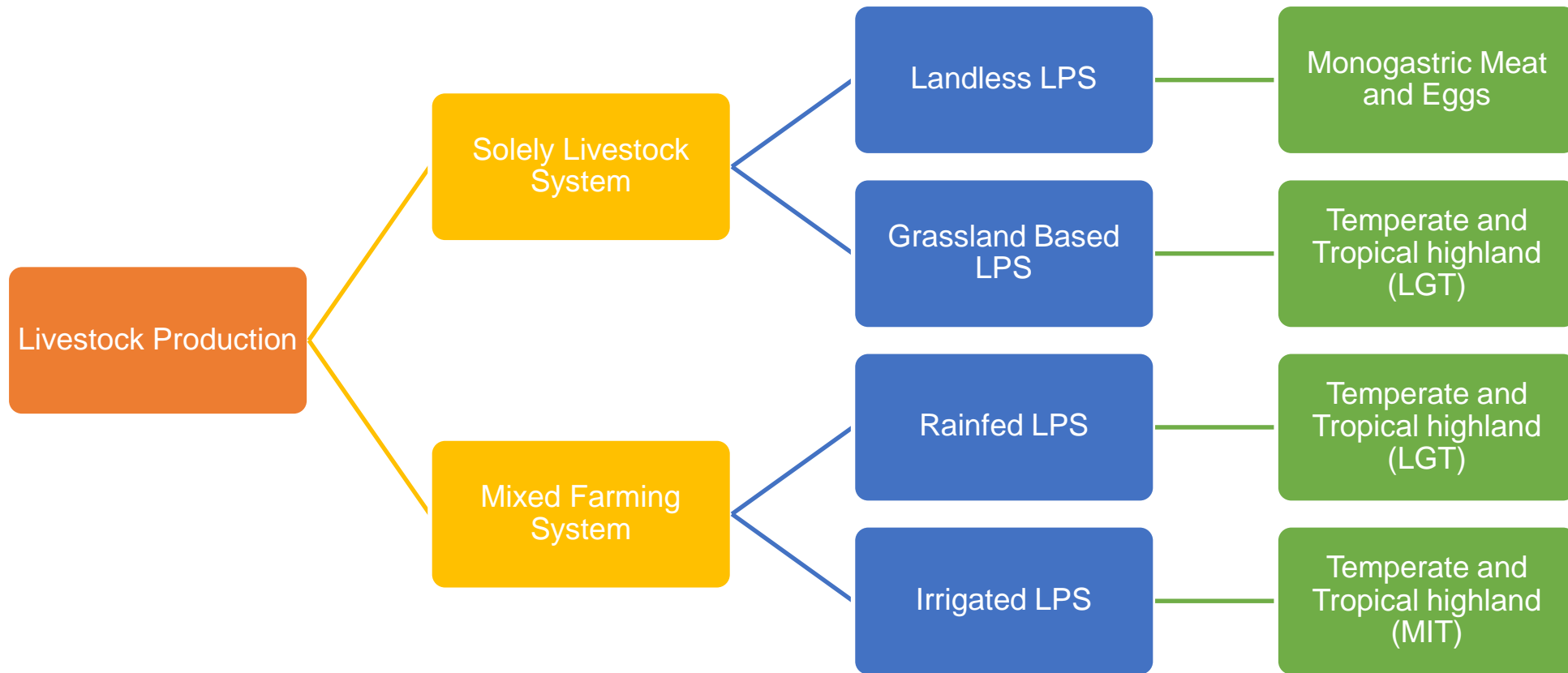


Crop Cultivation Practices



- Crop classification system based on farming system broadly to collect data or mapping of agricultural areas.
- Farm classifications have often focused on geographic or economic parameters like local climate zones, presence or absence of irrigation, or degree of farm commercialization

Livestock production practices



- Livestock production uses almost 80% of the global agricultural land.
- Livestock are produced in either mixed, grassland-based, or industrial (landless) systems.
- Meat production for the wealthier part of the population has begun to compete directly with food availability for the global poor.

Fisheries and Aquaculture Practices

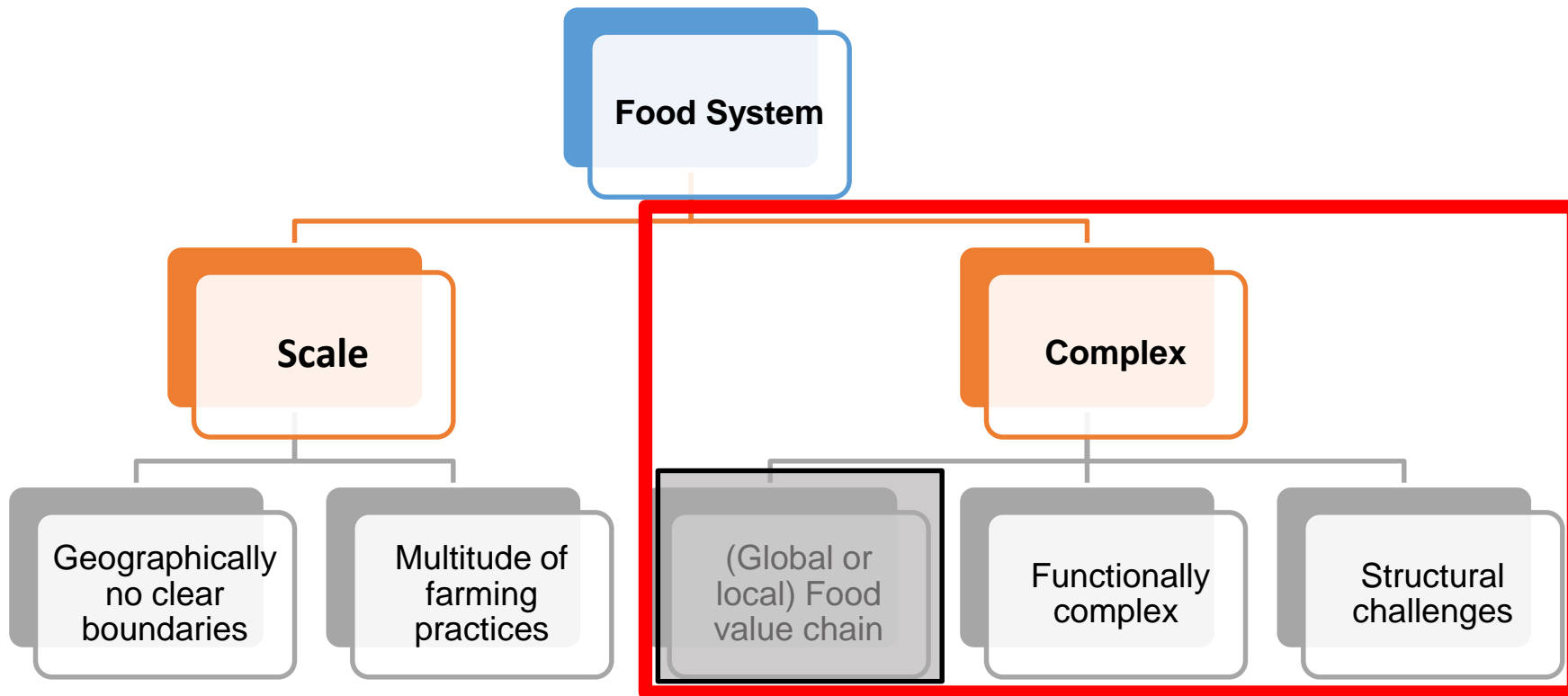
Fishing Method

- Bottom Trawl
- Dredge
- Gillnetting
- Jigging
- //
- Trolling

Aquaculture Method

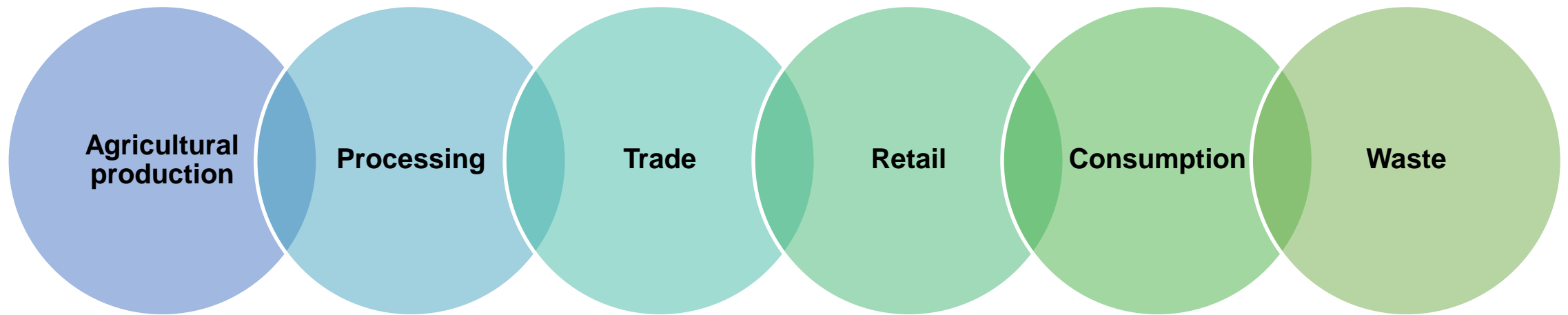
- Bag/Rack
- Hatcheries
- Open net pens
- Ponds
- //
- Tuna ranching

- Over 90% of fishers involved in global capture fisheries operate in either small-scale and about 50% of fish supply for human consumption
- around 63% of the aquaculture production of fish, crustaceans, and other species, occurred inland, while 37% of the production was marine aquaculture, and
- Freshwater aquaculture often comes at the expense of other ecosystems.



Food Value Chain

A food value chain (FVC) consists of all the **stakeholders** who **participate** in the coordinated **production** and **value-adding** activities that are needed to make **food products**.



(Kaplinsky and Morris, 2000; FAO.2014)

Food Value Chain [Processing]

Food processing is defined as the ***“transformation of agricultural crops, livestock, and seafood into secondary products. Processing could be simple cleaning to high end product like cereals, soft drinks, and meat product, etc.”***

- 1/5 of all primary crops are processed before consumption
- Sugar and oil crops make up the largest share of primary crops going into processing – i.e., 1,940 million tonnes [=92%]and rest of the share come from cereals, fruits and roots
- Processing adds value to the product – e.g.,
 - Complying with food security standards,
 - Extending product life,
 - Developing special products,
 - Legal standards on health and hygiene, and
 - Technological innovations



Food Value Chain [Trade]

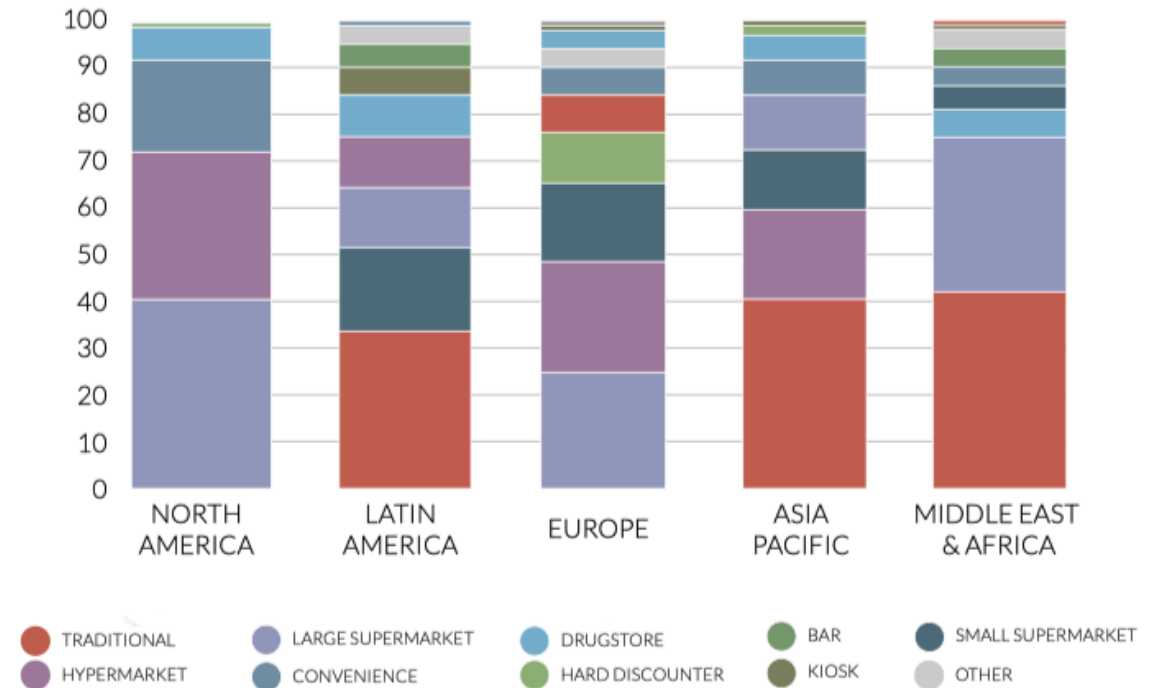
Every year, about **15%** of world food supply [raw and processed food] traded internationally and about **60%** within regions.

- Cereals are the most traded commodities on earth (accounting for 30% of trade by mass)
- There are five main international food trade networks : U.S. and Canada, Latin America, Europe, East Asia, and Southeast Asia and about 80% of world's food trade take place on these network.
 - Intra-European trade movements, which are mostly self-contained
 - East Asia is the largest food importer region in the world i.e., that is 8% of its food supply
 - The Middle East and North Africa are the most dependent for its food supply
 - Latin America is the largest importer of non-food crops like flowers and live plants.

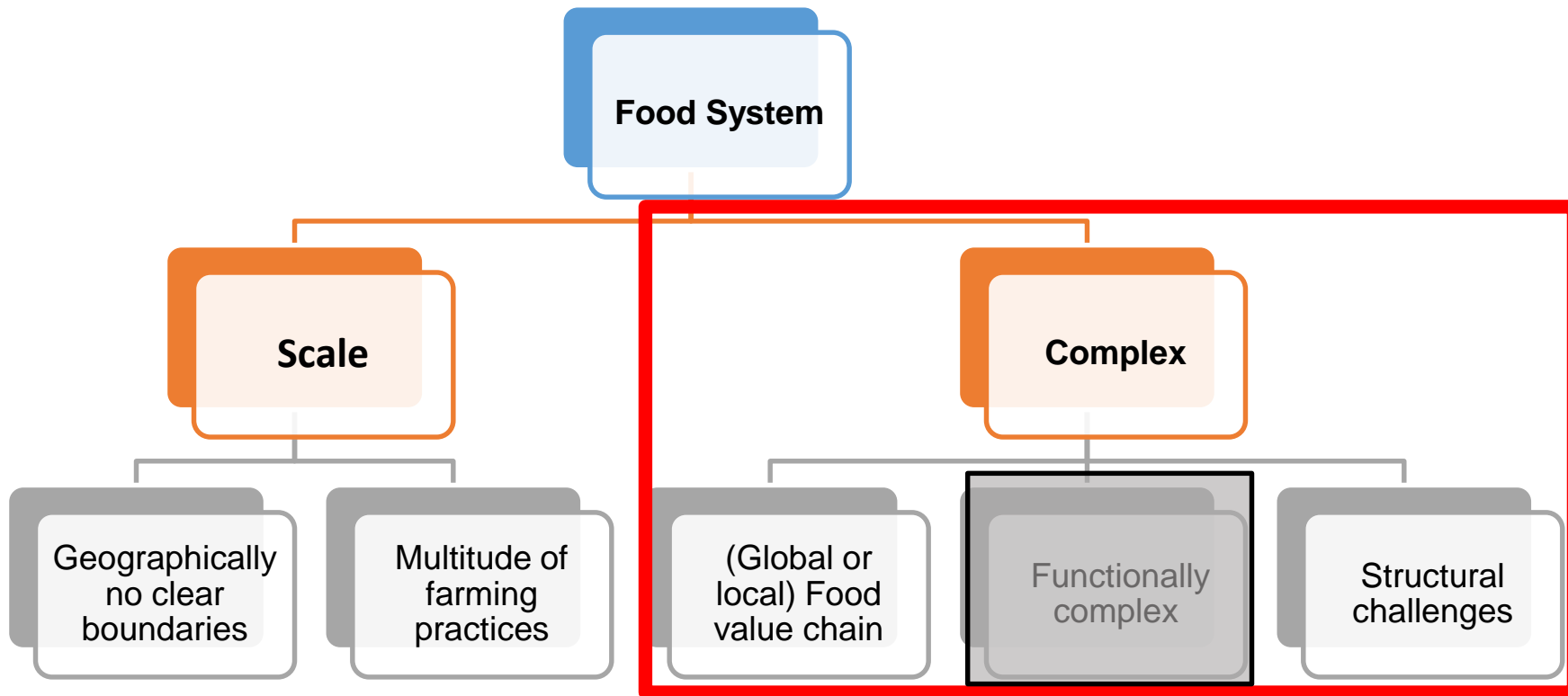
Food Value Chain [Retail]

Globalisation has created space for large retailers in the food distribution and main players in developed and developing nations for food sale.

- 51% of global food sales are purchased through supermarkets and they are growing at a rate of 2% annually.
- 90% of supermarkets are based in U.S. and Europe.
- Big retail players are using their globalised networks and their resource to control the majority of food distribution system-e.g., Walmart, General Mills, Nestlé, Con-Agra.
- Roughly, 80% of supermarkets goods are processed and made by a limited number of manufacturing companies.



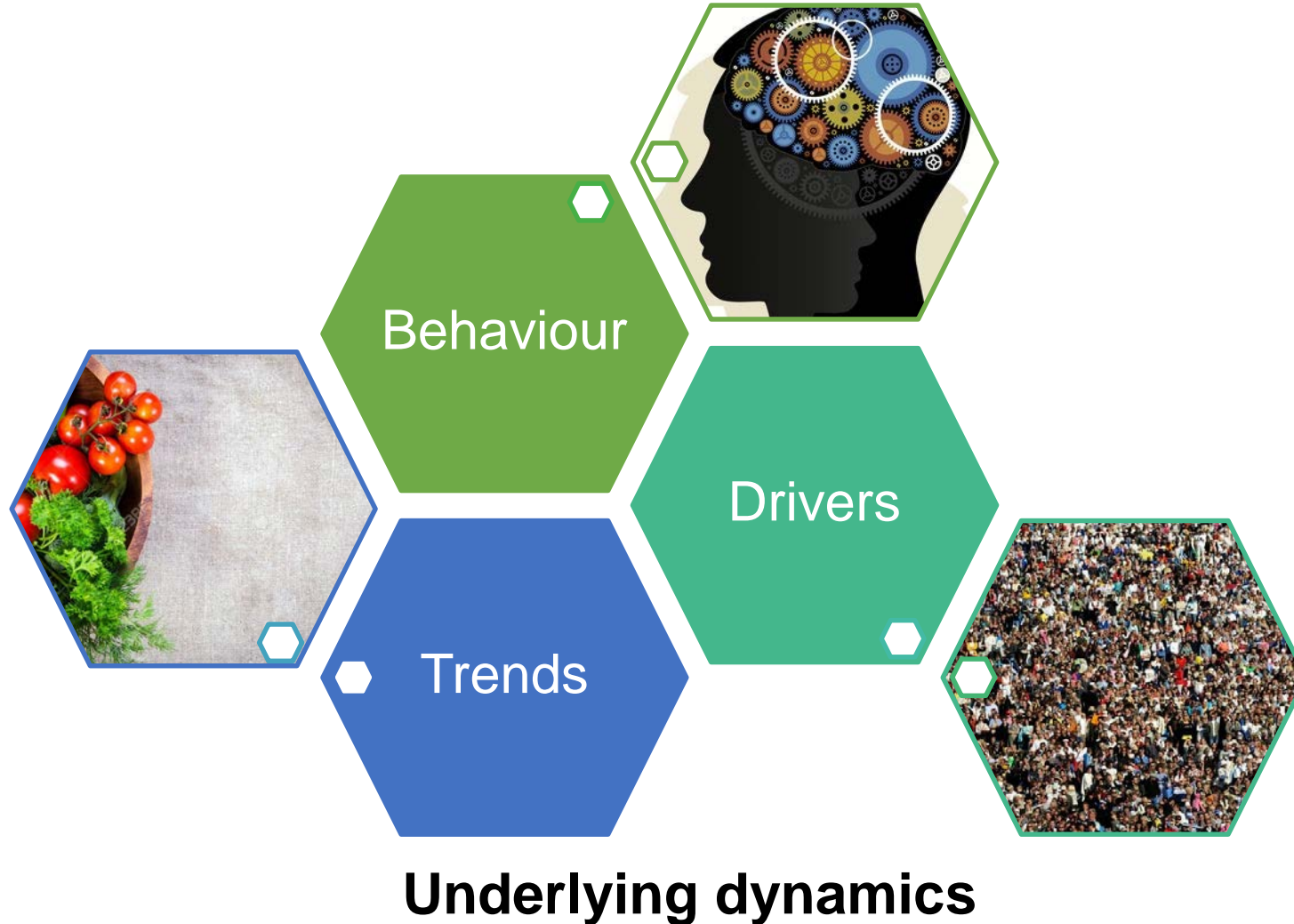
Food retail channels by region



Functional Complexity

Since WW-II, the world food system has tripled its output across many areas of food production to feed the growing population with changing food patterns.

(FAO, 2015)



Functional Complexity [Trends]

Green Revolution [1930-1970]: “Intensive agricultural production methods that centred around aggressive use of technologies”

Food Production

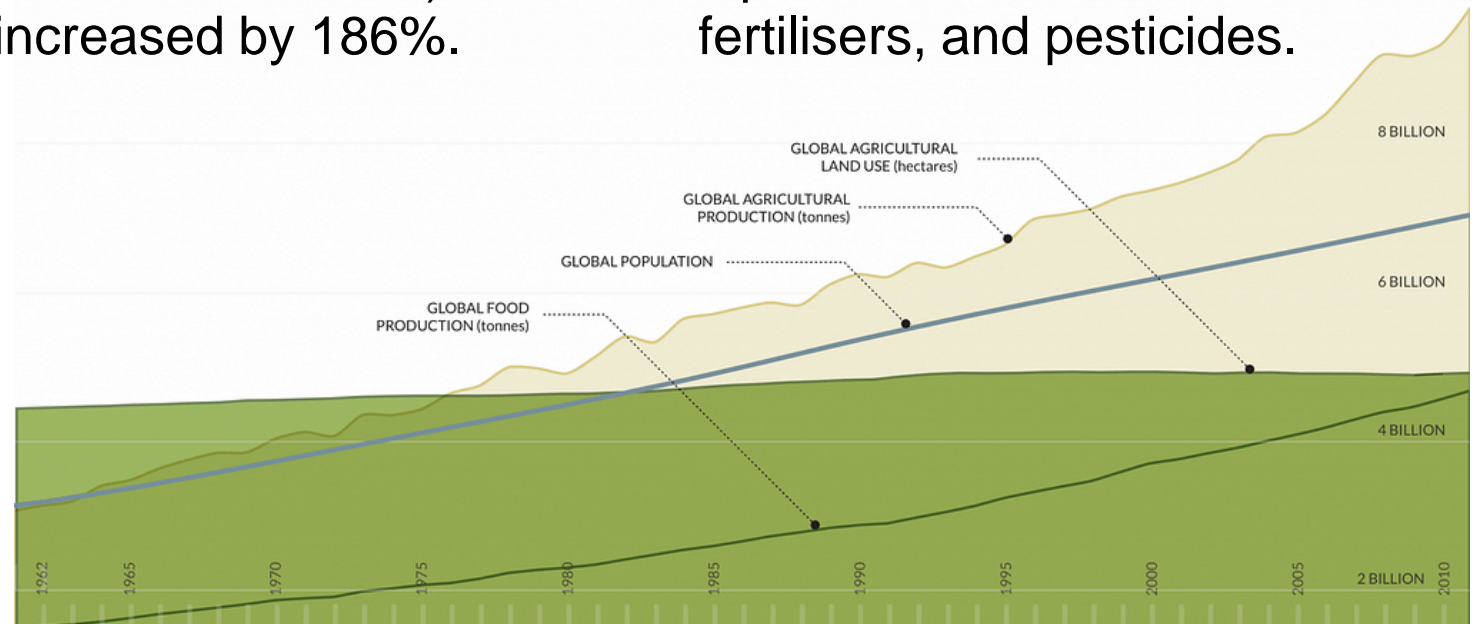
- The amount of food produced globally more than tripled from 1961 – 2011 (like, 5.54 B tonnes in 2011).
- Global meat, crop and fisheries production tripled since 1961 and growing to 205%, 209% and 416% above 1961 respectively.

Agricultural Yield

From 1961, the global agricultural yield (both food and non-food) increased by 186%.

Resource Use

Green revolution highly relied on an intensification of resource inputs such as land, water, fuel, fertilisers, and pesticides.



(Metabolic, 2017)

Functional Complexity [Drivers]

Population

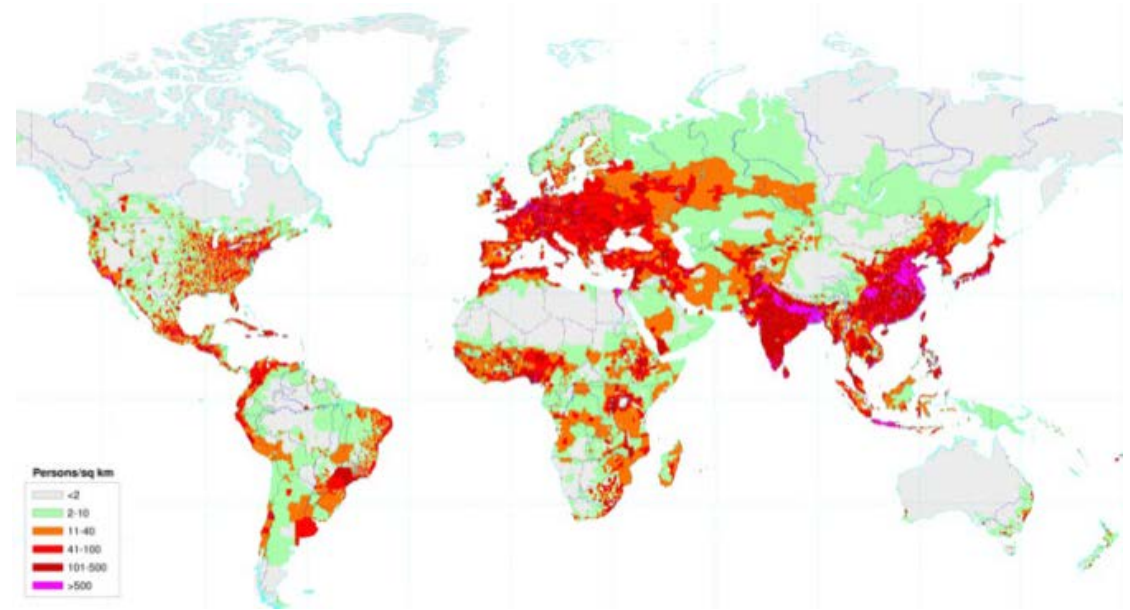
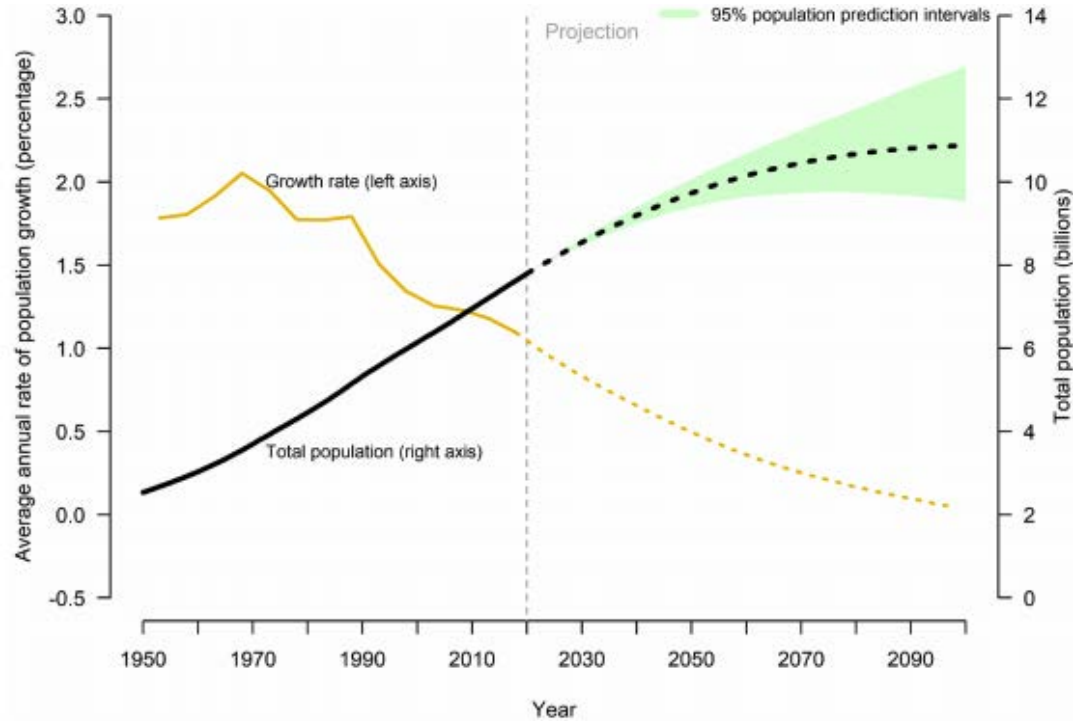
Gross Domestic Product

Biofuels

Changing Diets



Drivers: Population Trend

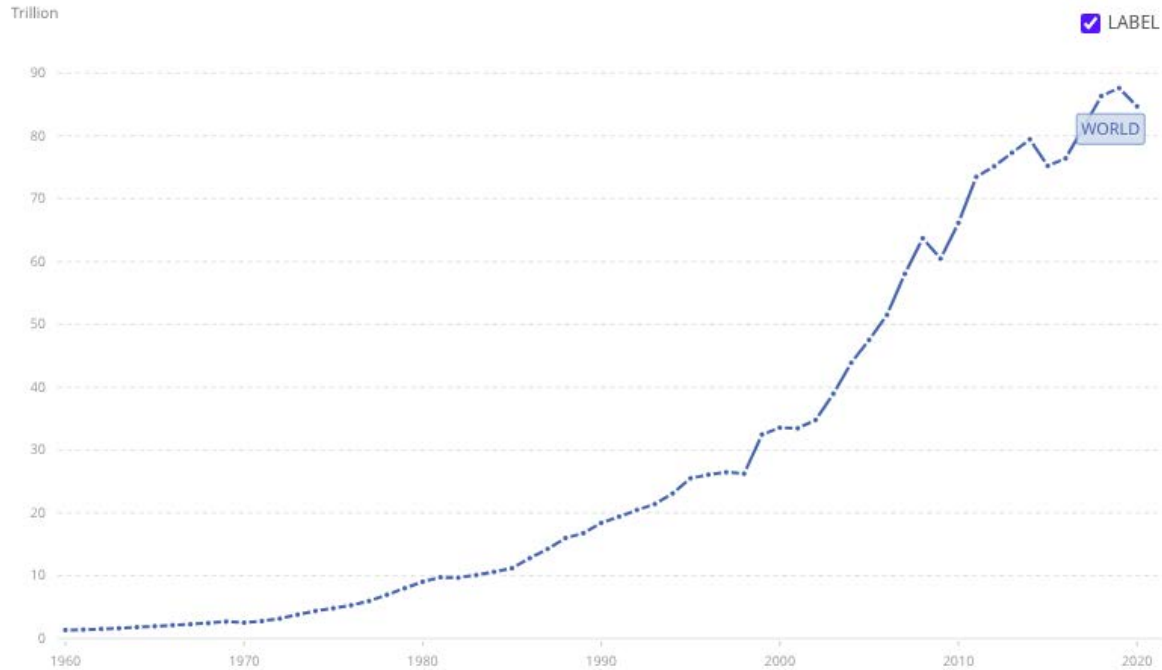


Population size & annual growth (1950-2020)

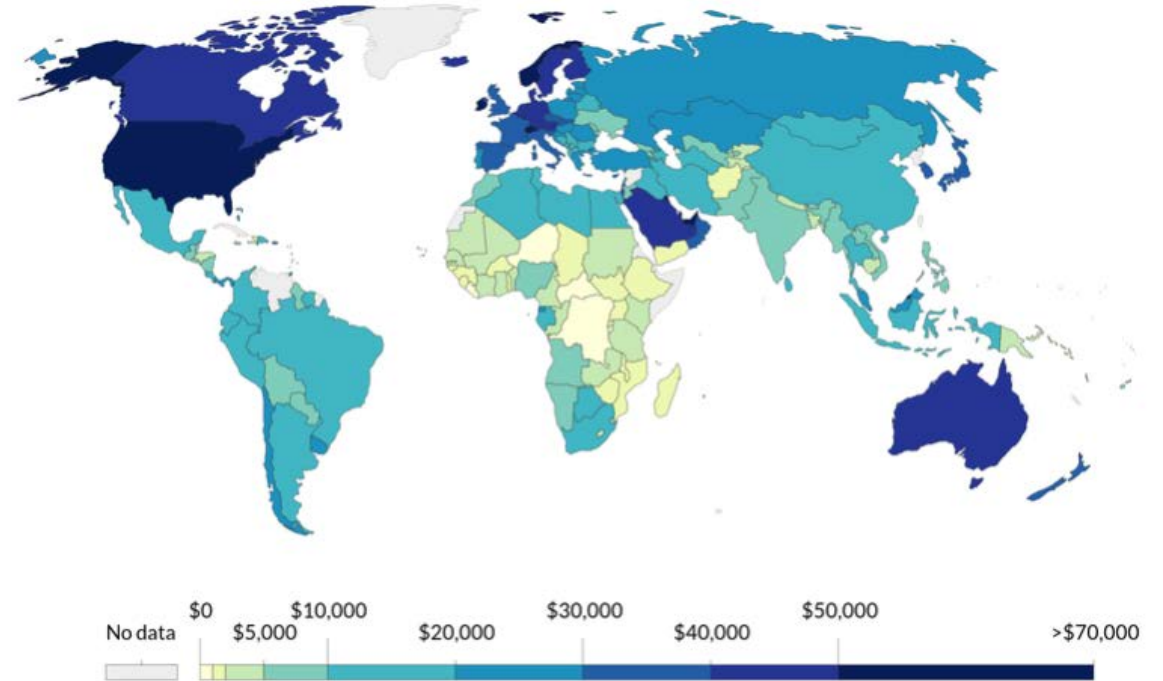
Current population density

- Global population more than doubled between 1950 - 2011, with an annual growth rate of 1.65% .

Drivers: Gross Domestic Product



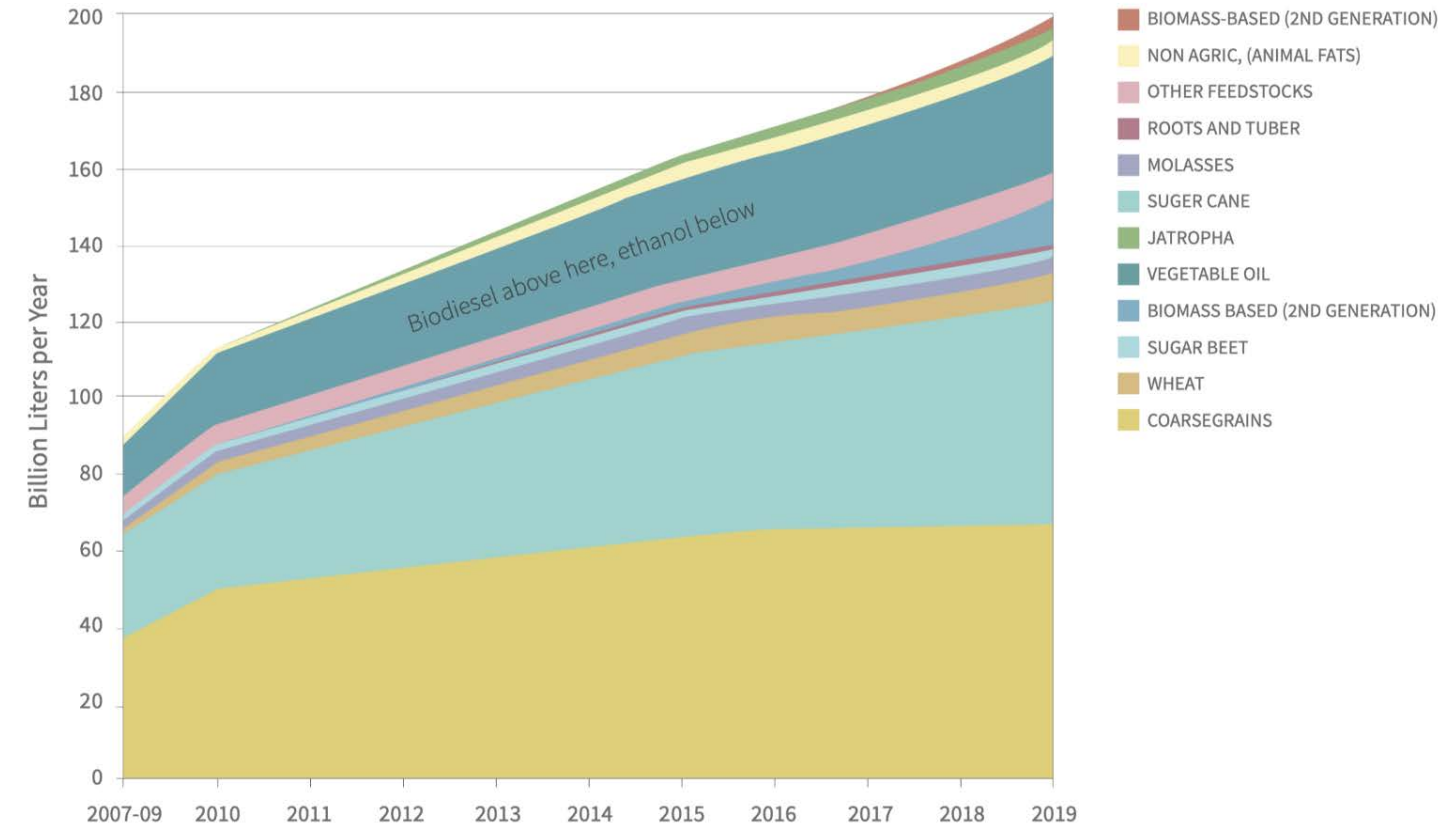
Global GDP trend



GDP per capita, 2017

- Global GDP increased by 461% between 1960-2011 and per capita GDP by 148%.

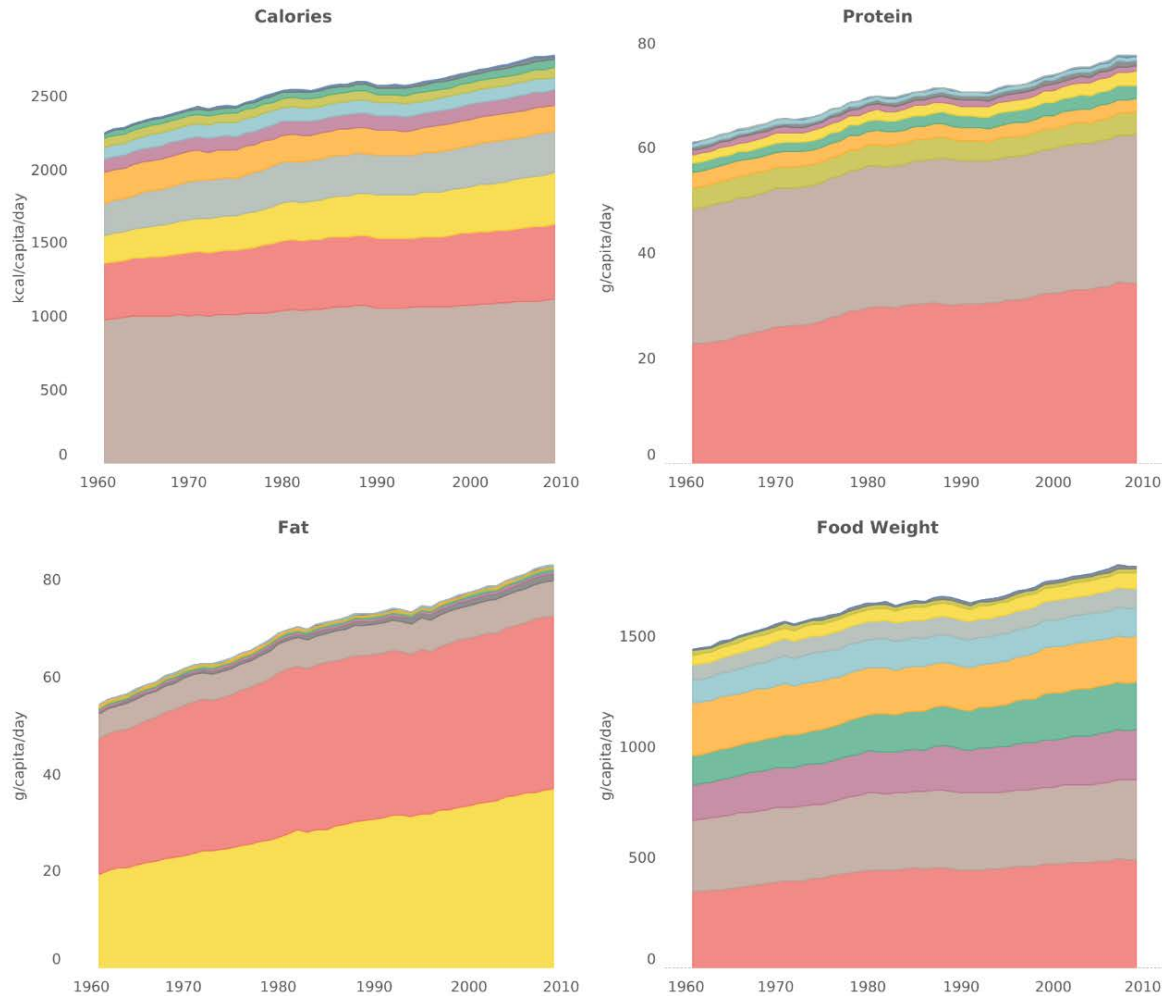
Drivers: Biofuels



Share of different crops in Biofuels

- Biofuels policies and production strategies [i.e., biobased economy] affecting food system negatively and competing with food security.
- Currently about 8% of primary crop and 15% of processed crops diverted for biofuels and biomaterials production.
- This accounts for about 12% of global arable land use.

Drivers: Changing Diets



- Globalisation and urbanisation driving more people to move to cities and cities have access to diverse, nutrient-dense, and resource intensive diet.
- Between 1950 and 2011 consumption of meat and fish has doubled roughly.

Diet trends [1970-2010]

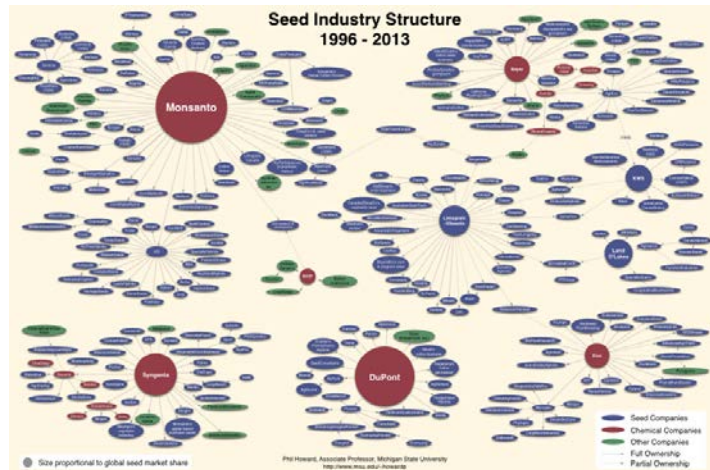
Functional Complexity [Behavior]

Behaviours are **emergent properties** like the structure of the system [in this case food system] arising from the **aggregate actions** [underline social rules] of many different actors within a system.

Intensification

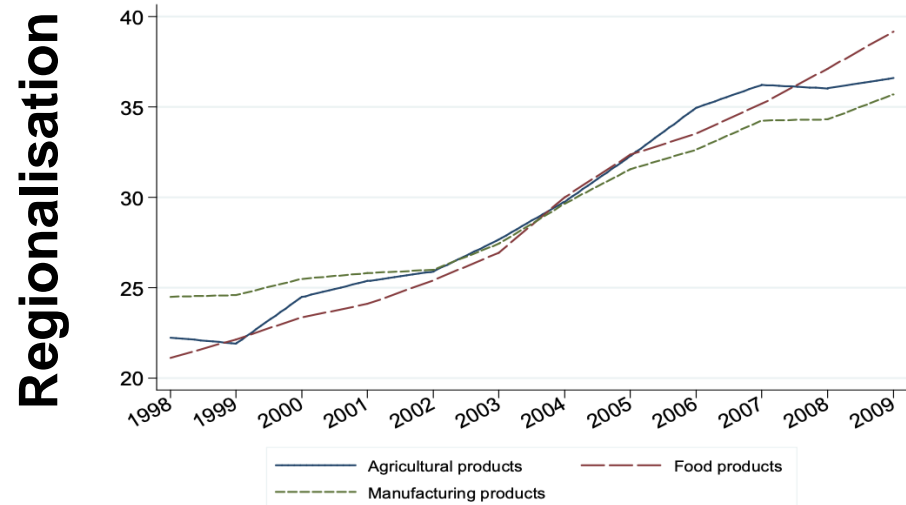


Consolidation



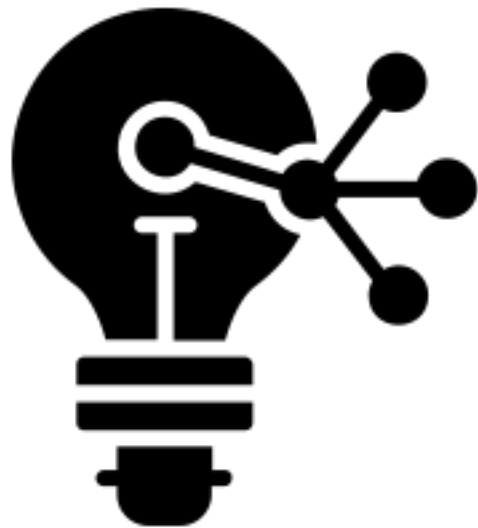
- Yield, fertiliser, and pesticide use per hectare have all increased globally since 1950.
- From 1960 to 2000, 70% of the total increase in global crop production is taking place in developing nations .
- Four agribusinesses control 90% of the global grain trade .

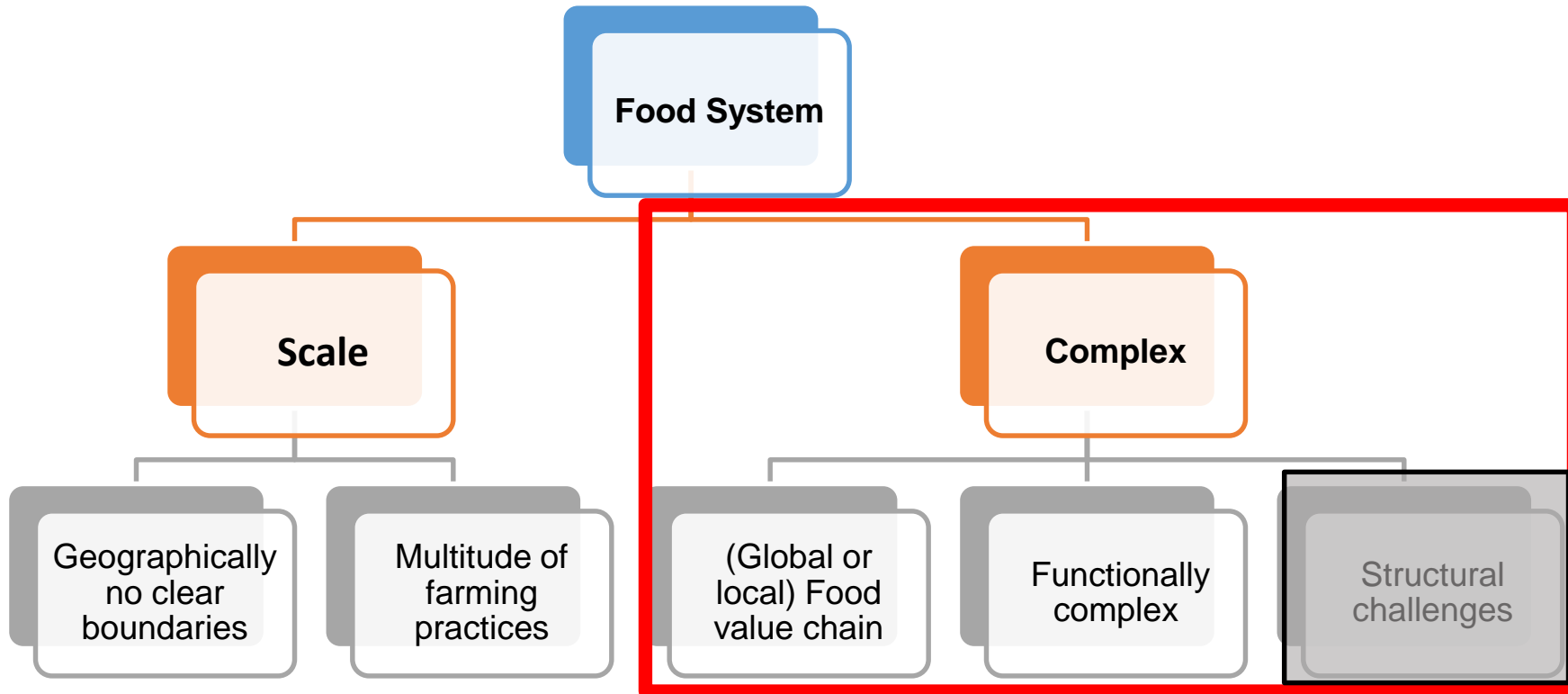
Functional Complexity [Behavior]



- From 1986 – 2011, food trade increased 2.3 times in absolute terms due to increases in both total production and trade across borders.
- Latin America, Africa, Asia, and Southeast Asia have driven much of this growth.
- Globally, agricultural research saw increased investment between 1981 and 2008, with an annual growth rate hovering around 2%. Four agribusinesses control 90% of the global grain trade .

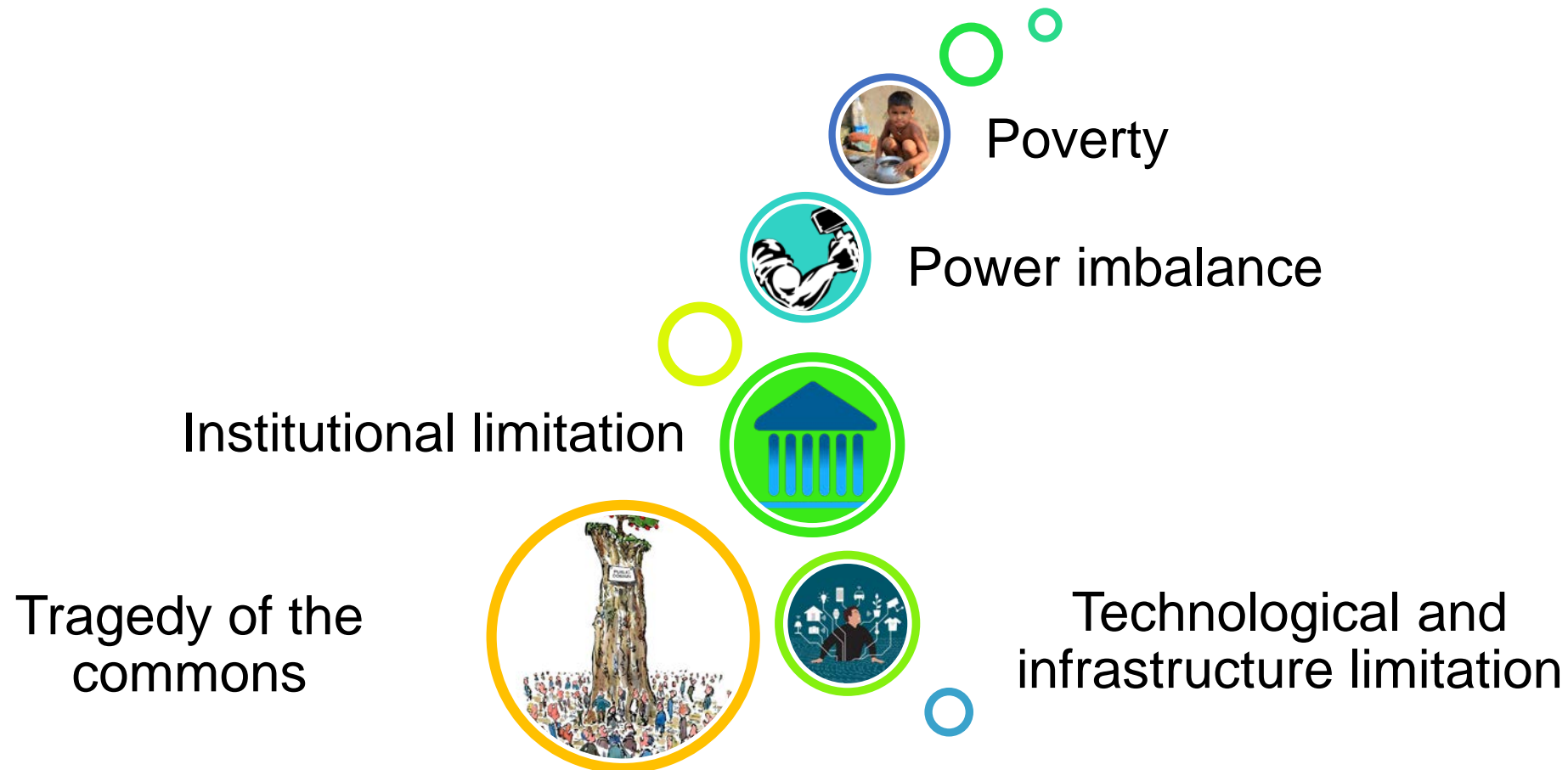
**R&D in Agri-
Food Sector**





Structural Challenges

Many underline structural elements (e.g., infrastructural elements, rules, and key relationships) of agri-food system that impacts the system's functions and influence surrounding behaviours.



Structural Challenges



Poverty

- World's poorest countries are those most dependent on agriculture
- Vulnerability to shocks, and social exclusion
- Factors like, education services, labour and employment, gender discrimination, economics and social infrastructure and power entrenchment are crucial for understanding poverty trap



Power imbalance

- Power and wealth entrenchments enables a few actors to have disproportionate influence on policy
- Deregulation has created a climate for multinationals to dominate the food and drink sector and influence policy to suit their interests
- Liberal economic policies and lobbying are key strategies for maintaining the power

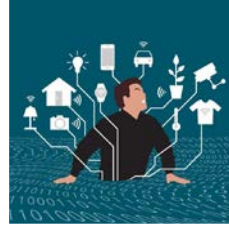
(IFAD, 2001; Alderman, 2011; Piketty, 2014; Auble, 2013)

Structural Challenges



Institutional limitation

- Institutionalized liberalization as the official discourse and status quo for international trade
- Unfair competition and eroding domestic productive capacity



Technological and infrastructure limitation

- Technological 'lock-in' excludes competing and possibly superior technologies
- Sunk costs, time for profits, and market and institutional structures



Tragedy of the commons

- Ecological over-exploitation by few for individual interests
- Social contract

Discussion Points

- The food system is in need of a significant transformation if it is to feed growing population in a sustainable, equitable, and adaptive manner.
 - Before we chart a pathways for transforming the food system to a different state, we must have a clear outlook of where we would actually like to go.
 - For the food system to become sustainable, we need to address following challenges:
 - *How to adapt and build a resilient food system?*
 - *How to provide nutritious and safe food to all ?*
 - *How to maintain the planetary boundaries while providing livelihoods and well-being?*
-



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