

Global Agriculture & Food Systems

Dr. Torfi Jóhannesson

**SUSTAINABLE AGRICULTURE &
RURAL DEVELOPMENT**

**University of Iceland
The Agricultural University of Iceland**

Preface

This compendium is written to support teaching in the course *Sustainable Agriculture and Rural Development*, offered by the University of Iceland and the Agricultural University of Iceland. It offers a structured overview of global agriculture for MSc-level studies in food systems, drawing on data from organisations such as the FAO, World Bank, OECD, and IPCC. Its goal is to present an accessible framework covering production systems, resource use, economic structures, and key sectoral transitions.

The text is not intended to be exhaustive and does not follow the traditions of strict scientific writing. Few references are made in the text, but a reading list provides key resources for further study.

Table of Contents

| | |
|--|-----------|
| Preface | 2 |
| 1. Introduction: Why Agriculture Still Matters | 4 |
| <i>Major transitions shaping global agriculture</i> | 5 |
| <i>Key takeaways</i> | 6 |
| 2. How Food Is Produced Globally | 7 |
| <i>Key takeaways</i> | 10 |
| 3. Agriculture as an Economic Sector | 11 |
| <i>Trade and interdependence</i> | 12 |
| <i>Public policy and agricultural support</i> | 12 |
| <i>Key takeaways</i> | 13 |
| 4. Natural Resources and Environmental Constraints | 14 |
| 4.1 <i>Resource constraints</i> | 14 |
| 4.2 <i>Environmental externalities</i> | 15 |
| <i>Key takeaways</i> | 15 |
| 5. Food Security: Availability, Access, and Stability | 16 |
| <i>Availability: Is enough food supplied?</i> | 17 |
| <i>Access and utilization: Who can obtain food, and what kind?</i> | 17 |
| <i>Stability: Can food security be maintained over time?</i> | 18 |
| <i>Key takeaways</i> | 19 |
| 6. Agriculture and Rural Development | 20 |
| <i>Structural change and demographic pressure</i> | 20 |
| <i>Diversification</i> | 21 |
| <i>Key takeaways</i> | 21 |
| 7. Concluding Reflections | 22 |
| 8. Reading list | 23 |

1. Introduction: Why Agriculture Still Matters

Agriculture remains one of the most fundamental human activities in the 21st century. It provides nutrition for the global population and livelihoods for billions of people worldwide. As of 2023, roughly one quarter of the global workforce is employed in agriculture, with much higher shares in low-income regions. At the same time, agriculture accounts for only about 4% of global GDP. This contrast is a central feature of the sector: low economic weight, but strategically important by ensuring food supply, supporting rural areas, and anchoring broader food systems that include processing, transport, and retail.

Agriculture is also the dominant user of natural resources. Globally, it occupies around half of all habitable land and accounts for roughly 70% of freshwater withdrawals. No other sector comes close to this scale. As a result, agriculture has a large environmental footprint. Expansion of cropland and pasture has been the main driver of global deforestation. Agriculture is also a major contributor to biodiversity loss and ecosystem degradation. When agriculture, forestry, and land-use change are considered together, food systems account for roughly one quarter of global greenhouse gas emissions.

Livestock production is especially important through methane emissions, feed production, and land use. Depending on calculation methods, livestock supply chains are estimated to contribute around 12–20% of global anthropogenic emissions.

What makes agriculture unusually complex is that it is at the same time an economic sector, a way of life, and an ecological force. Hundreds of millions of farms worldwide—many of them small and family-run—remain closely tied to household livelihoods and local knowledge. At the same time, a large share of global output is produced in highly industrialised factory farms, including large-scale monocultures and intensive livestock operations. These systems rely on capital, technology, external inputs, and global markets, and increasingly resemble other industrial sectors.

Table 1. Global importance of agriculture (key indicators)

| Indicator | Global figure (approx.) |
|--|-------------------------|
| Employment in agriculture, forestry, and fishing | ~26% |
| Agriculture's share of global GDP | ~4% |
| Share of habitable land used by agriculture | ~50% |
| Freshwater withdrawals for agriculture | ~70% |
| Food systems (AFOLU) share of GHG emissions | ~25% |
| Livestock supply chains share of emissions | ~12–20% |

Agriculture reshapes landscapes and ecosystems—from rice terraces and pastoral rangelands to mechanised crop systems and concentrated animal feeding operations. The coexistence of smallholder farming and industrial agriculture within the same global food system—and often within the same country—is a defining feature of modern agriculture. It is also a source of tension. Strategies that raise efficiency and output in industrial systems may intensify environmental pressures or social concerns. Efforts to support small-scale farming, by contrast, often face limits related to productivity, income growth, and scalability. Managing

these trade-offs lies at the core of contemporary agricultural development. There is no single solution that resolves all objectives at once. Agriculture is therefore an area where trade-offs are persistent and unavoidable.

Major transitions shaping global agriculture

Agriculture today operates under rapidly changing conditions. While its basic functions—producing food, managing land, and supporting livelihoods—remain the same, the context in which these functions are carried out is shifting. Several broad and overlapping transitions are reshaping global agriculture and food systems.

Climate change is one of the most important of these transitions. Changing temperature patterns, precipitation, and more frequent extreme weather events already affect agricultural production. Climate change increases yield variability, alters where crops and livestock can be produced, and increases the frequency of shocks that disrupt food systems. At the same time, agriculture is under growing pressure to reduce emissions and environmental impacts. This dual role—as both affected by and contributing to climate change—places agriculture at the centre of both adaptation and mitigation efforts.

Demographic change and urbanisation form another major transition. Global population growth is slowing. We are now about 8 billion and we can expect the global population to reach around 10 billion. At the same time, a growing share of people live in cities, increasingly distant from food production. Urbanisation reshapes food demand and supply chains, increasing reliance on processing, transport, and retail systems. For farmers, this often means producing for more distant, standardised, and regulated markets rather than for local consumption.

Closely linked to these trends is **dietary change**. As incomes rise, especially in middle-income countries, diets tend to shift away from staple cereals toward higher consumption of animal products, oils, sugar, and processed foods. This transition has already reshaped agricultural demand in much of Asia and Latin America and is increasingly visible in Africa. Because animal-based foods typically require more land, water, and feed per calorie, dietary change has major implications for resource use and emissions. At the same time, counter-trends are emerging in high-income countries, where health, environmental, and ethical concerns are driving interest in plant-rich diets and alternative

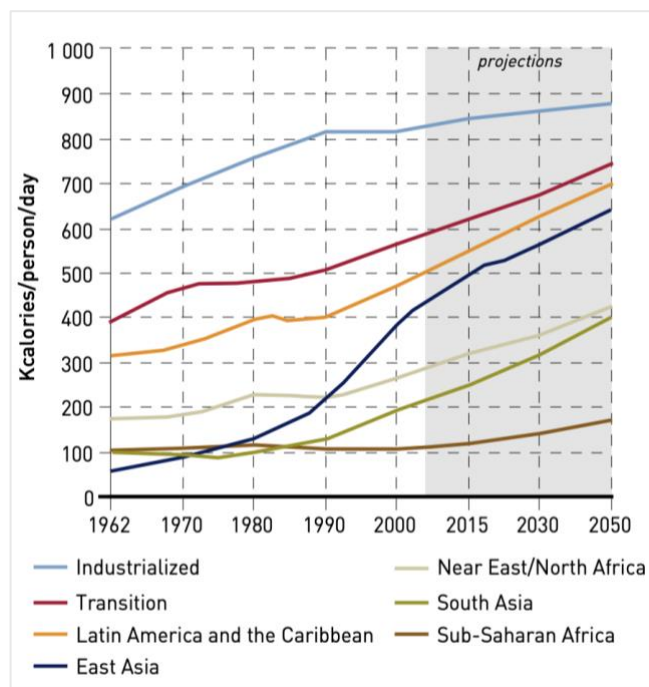


Fig. 1. Meat consumption – past and future predictions (*Livestock's Long Shadow*)

proteins. The global food system must accommodate these diverging patterns at the same time.

Technological change is another powerful driver. Advances in plant breeding, biotechnology, digital tools, mechanisation, and data-driven farm management expand the technical possibilities of agriculture. Precision farming, improved genetics, and automation offer ways to raise productivity while reducing resource use. However, access to these technologies is uneven. Differences in capital, skills, infrastructure, and institutions mean that technological progress can widen gaps between regions and between large commercial farms and smallholders if not supported by effective extension and knowledge systems.

Global economic integration is yet another important driver. International trade links regions with very different production conditions into a single food system. This improves efficiency and supports food availability, but also creates exposure to external shocks. Input markets are particularly globalised: fertilisers, energy, feed, machinery, and agrochemicals often depend on international supply chains. As a result, even food produced domestically is dependent on global markets and value chains. Recent crises have shown how disruptions can spread rapidly across borders. Food security is therefore not something individual countries can secure alone – it requires international cooperation.

Finally, agriculture is undergoing **structural change** within the sector itself. In most regions, the number of farms is declining, average farm size is increasing, and the farming population is ageing. Processing, trading, and retail are becoming more concentrated, which can lead to loss of stability.

This explains why agriculture remains politically, economically, and socially sensitive and is a central theme of this compendium: **agriculture cannot be understood in isolation**. It must be analysed as part of a broader food system shaped by natural constraints, markets, institutions, and long-term structural change.

Key takeaways

- Agriculture employs a large share of the global workforce despite contributing a modest share of global GDP.
- The sector is central to rural livelihoods and poverty reduction, especially in low-income countries.
- Agriculture dominates global land use and freshwater withdrawals.
- Food systems are a major source of greenhouse gas emissions and biodiversity loss, with livestock playing a key role.
- Agriculture is shaped by persistent trade-offs between productivity, environmental sustainability, and social outcomes.
- Climate change, demographic shifts, dietary change, technology, and global integration are reshaping how food systems function.

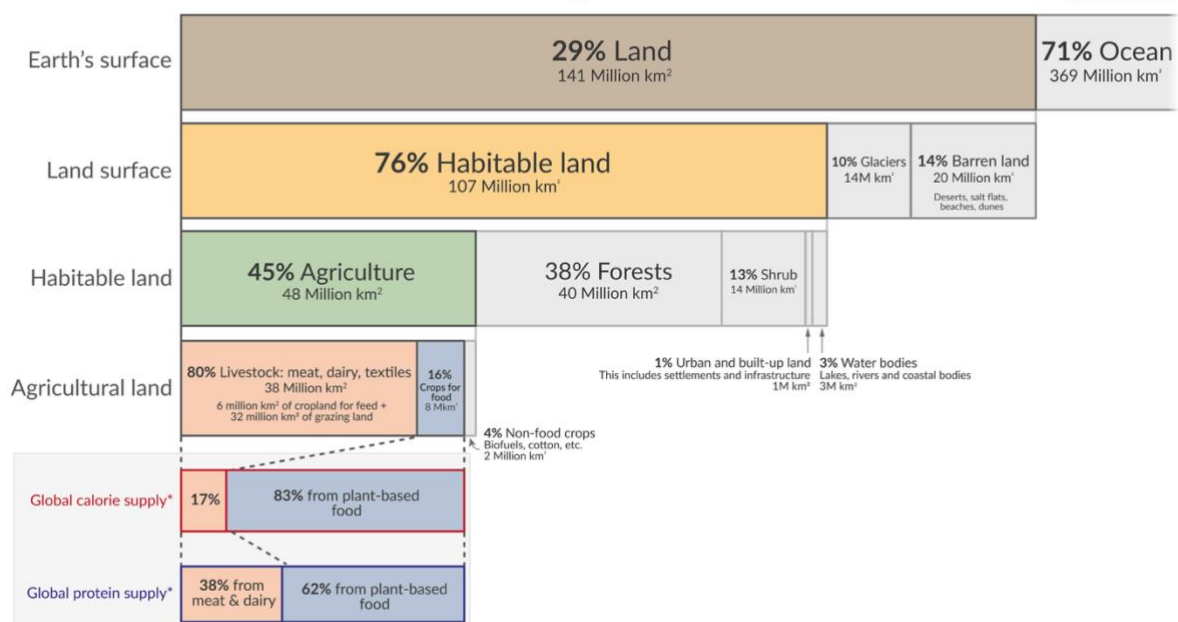
2. How Food Is Produced Globally

Global food production relies heavily on a small group of crops. Three cereals—wheat, rice, and maize—provide around half of the world’s food calories, making them central to food security in most countries. Beyond these staples, only a limited number of crops play a major role globally, including sugar cane, oilseeds such as soybeans and oil palm, and root crops such as potatoes and cassava, which are particularly important in specific regions.

Livestock production occupies a particularly important position in global agriculture and resource use. Livestock systems often make use of resources that are otherwise difficult to use for direct human food production, including permanent grasslands, marginal lands unsuitable for cropping, and by-products from crop production and the food and bio-industry. Ruminant livestock, in particular, can convert grasses, crop residues, and processing by-products into edible food.

Global land use for food production

Our World in Data



*Includes fish and seafood from aquaculture production, which uses land for feed. If wild fish catch is also included, animal products would provide 18% of calories and 40% of protein.

Data sources: UN Food and Agriculture Organization (FAO) and Poore and Nemecek (2018).

OurWorldinData.org - Research and data to make progress against the world's largest problems.

Licensed under CC-BY by the authors Hannah Ritchie and Max Roser (September 2023).

Figure 2. Global land use for food production (Our World in Data)

At the same time, a substantial share of cropland is devoted to producing animal feed rather than food consumed directly by humans. Globally, only about half of cropland is used to produce crops eaten directly by people, while roughly 35–40% is used for animal feed and around 10–15% for biofuels and other non-food uses. When extensive grazing pasture is included, livestock production accounts for close to 80% of total agricultural land use worldwide.

Despite this large land footprint, meat and dairy products contribute less than one fifth of global calorie supply, while providing around 35–40% of global dietary protein. Animal-based foods generally require more land, feed, and water per calorie than plant-based foods

produced for direct human consumption. This difference is also reflected in feed conversion rates, which vary widely across livestock species. Producing one kilogram of beef typically requires 6–10 kg of feed input, while pork requires roughly 3–5 kg, and poultry around 1.5–2 kg.

Expansion of pasture and feed crop production has been a major driver of deforestation and land conversion over time—historically in Europe and North America, and more recently in parts of South America and other frontier regions.

Production systems vary widely across countries and regions. In many middle- and high-income, export-oriented agricultural regions, food is produced in large-scale, capital-intensive systems using advanced machinery, genetically improved crop varieties, irrigation, and substantial inputs of fertilisers and pesticides. This model is common in North America, Europe, parts of South America, and Australasia, where average farm sizes can reach hundreds or thousands of hectares.

In contrast, large parts of the world’s food supply still come from small-scale farming systems, often operating on one to two hectares and relying primarily on household labour. This pattern is especially common in Sub-Saharan Africa and South Asia. Africa alone is home to tens of millions of small farms, many producing mainly for local markets or household consumption. These farms generally have lower output per worker and per hectare than large mechanised systems, but they remain central to rural livelihoods and local food supply.

Globally, around 90% of farms are owned by individuals or families, but this tells us little about how farming is organised in practice. Family-owned farms range from very small subsistence plots to large, highly industrialised operations. Family ownership does not imply that a farm is small, low-input, or traditional. Many large and technologically advanced farms in Europe and elsewhere are family-owned but operate much like corporate enterprises. In other cases, farms are organised as companies or cooperatives for legal, financial, or succession reasons, without changing how production is carried out. Recent research shows that very small farms (below 2 hectares) produce around one third of global food, while most remaining output comes from medium- and large-scale farms.

In many countries, different production models exist side by side. Large, export-oriented farms producing crops such as soybeans, sugar, or bananas often operate alongside large numbers of small subsistence or semi-commercial farms. This pattern is clearly visible in the European Union, where there are close to nine million farms, but farm sizes are very unevenly distributed. While the average EU farm size is close to 20 hectares, relatively few farms fall into this size category. Most farms are very small, especially in countries such as Romania, Poland, and Greece, where small and semi-subsistence holdings remain common.

At the same time, a small number of very large farms control most agricultural land. Roughly two thirds of EU agricultural land is farmed by holdings larger than 50 hectares. As a result, most agricultural output comes from medium- and large-scale farms, even though most farms by number are small. This means that references to “the average European farm” are often misleading, as they hide a highly uneven distribution of farm sizes.

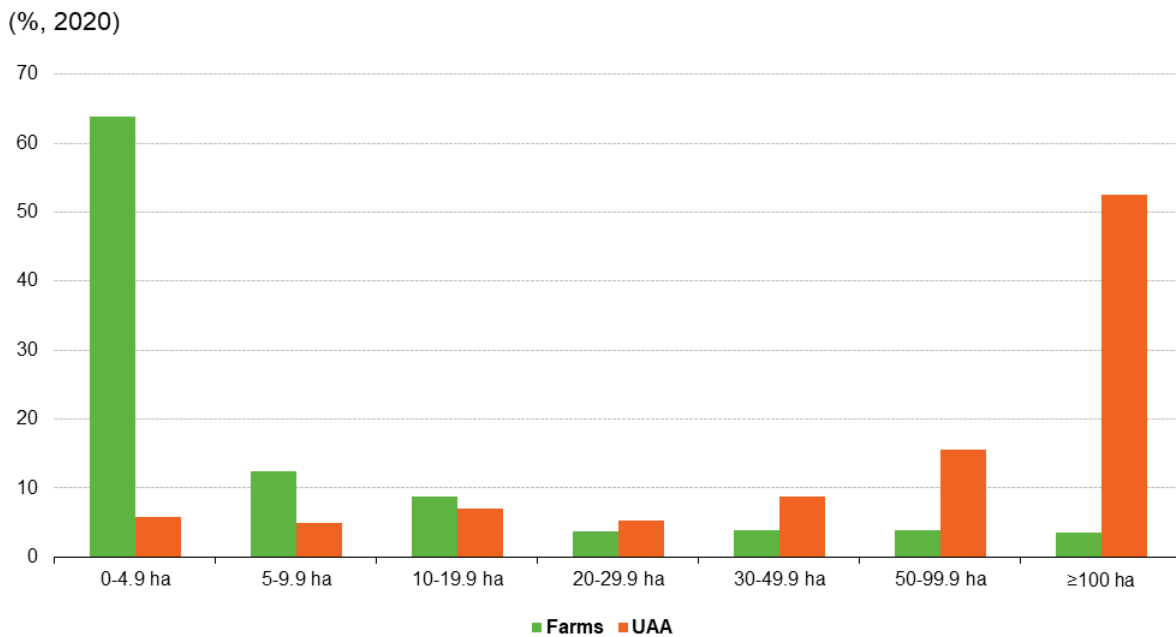


Figure 3. Distribution of EU farm and utilised agricultural area according to farm size (Eurostat).

Geography and agro-ecological conditions shape global food production. Climate, soils, water availability, and terrain largely determine what can be produced where. Major grain belts have developed in regions with fertile soils and temperate climates, such as the U.S. Midwest, the Ukrainian steppe, and the Argentine Pampas. Tropical regions support year-round cultivation of crops such as rice, oil palm, coffee, and cocoa, but often face constraints related to soils, pests, or rainfall variability. Water availability is a key limiting factor: irrigated regions such as the Indus–Ganges plains or California’s Central Valley sustain very high yields of cereals, fruits, and vegetables, while arid areas without irrigation are often limited to grazing or low-yield cropping.

International trade links specialised agricultural regions into a global food system. Each year, well over one trillion US dollars’ worth of agricultural goods cross international borders. Trade is particularly important for grains (wheat, maize, and rice) and oilseeds and vegetable oils, which are produced in surplus in a small number of regions and can be stored and transported over long distances. Tropical products such as coffee, cocoa, bananas, palm oil, and sugar are also heavily traded, as they can only be produced in specific climatic zones but are consumed worldwide.

By contrast, most meat production is still consumed close to where it is produced. Only about 10–15% of global meat production crosses national borders. Even when traded, it often moves within integrated markets, such as within the EU or between the USA and Mexico, or between Brazil and China. Meat trade is shaped by animal health regulations, cold-chain infrastructure, and cultural preferences.

Overall, global food production today is marked by strong concentration in a limited number of crops and regions, a dominant land footprint of livestock production, and the coexistence of highly industrialised farming systems alongside millions of smallholder farms.

Key takeaways

- Global diets rely heavily on a small number of staple crops.
- Livestock production uses most agricultural land but provides a minority of food calories.
- Food is produced through very different systems, from industrial farming to smallholder agriculture.
- Farm size, productivity, and organisation vary widely, even within the same countries.
- Geography, climate, and trade remain decisive in shaping where and how food is produced.



3. Agriculture as an Economic Sector

Agriculture is economically different from most other sectors. Food is essential, and demand is therefore highly inelastic. People can delay buying a car or a new phone when prices rise, but they cannot delay eating. At the same time, farmers must make production decisions months or even years in advance, long before prices or weather outcomes are known. As a result, agricultural markets are structurally prone to volatility.

On the supply side, agricultural production is highly exposed to shocks. Weather extremes, pests, diseases, and shortages of key inputs can reduce output suddenly and at large scale. Because production cycles are long and storage options are limited for many products, supply cannot respond quickly to price changes. On the demand side, consumption—especially of staple foods—changes little when prices rise or fall. Small supply shocks can therefore lead to large price movements, particularly when exports are concentrated in a limited number of regions.

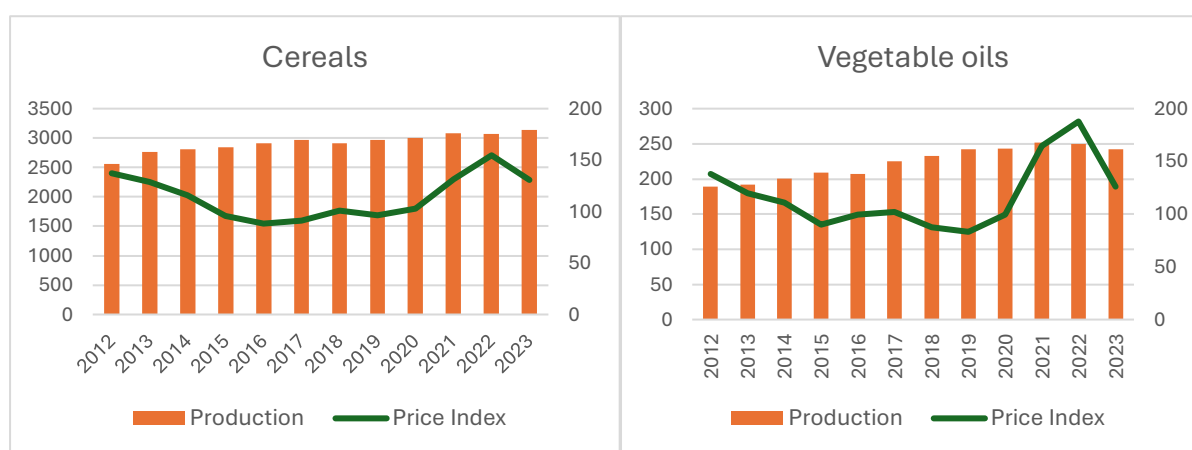


Figure 4. Stable production vs. volatile prices. Examples for cereals and oils. (FAO)

Recent events illustrate how these mechanisms interact. Russia’s invasion of Ukraine in 2022 disrupted grain exports from one of the world’s most important cereal-producing regions. At the same time, the war pushed up energy prices, which increased the cost of nitrogen fertilisers, a key input in crop production. Higher fertiliser costs reduced profitability and, in some regions, application rates, contributing to higher cereal prices. Rising feed costs then fed through into higher prices for meat and dairy products, resulting in broad food inflation. This sequence shows how shocks can move through input markets, production, trade, and consumer prices.

These dynamics create vulnerability on both sides of the food system. Producers face volatile prices and uncertain incomes, where a single bad year can threaten farm viability. Consumers, especially low-income households and import-dependent countries, are vulnerable to sudden price increases that undermine food access and social stability. Left entirely to market forces, agriculture would tend to experience cycles of farm bankruptcies during price downturns and food shortages or unaffordable prices during price spikes.

This is why agriculture has long been subject to policy intervention. Governments intervene, not to replace markets, but to limit the social costs of instability. Agricultural policies have therefore aimed to stabilise production and prices, protect farm incomes, and ensure reliable food supplies. While the specific instruments vary across countries and over time, the underlying objective is the same: to manage risk in a sector where volatility is structural and food security is critical.

Trade and interdependence

Agricultural production is spread across millions of farms worldwide, but many other parts of the food system are far more concentrated. Processing, trading, retailing, and input supply are often dominated by a small number of large firms operating at national or global scale.

This imbalance in market power helps explain why farmers' share of the final consumer price is often small, even when food prices rise. While concentration can improve efficiency, it also increases the economic vulnerability of primary producers and strengthens the case for collective action and public policy.

International trade plays a central role in modern agriculture. Most countries are both importers and exporters of food and agricultural inputs, and global markets allow production to be concentrated in regions with favourable natural conditions. This improves efficiency and helps smooth supply across seasons and regions.

At the same time, trade creates strong interdependence. Many countries rely on imports for staple foods, animal feed, or fertilisers. Because exports of key commodities are concentrated in a small number of regions, disruptions—such as poor harvests, export restrictions, or geopolitical conflicts—can quickly affect global prices.

Trade therefore plays a dual role. In good years, it spreads surplus production and supports market stability. In bad years, it can transmit scarcity and volatility across borders. This helps explain why many countries combine open trade with domestic production support, strategic reserves, or trade restrictions.

Public policy and agricultural support

Given these structural features, public policy has long played a central role in agriculture. In broad terms, agricultural policies pursue three main objectives: stable farm incomes, stable and affordable food prices for consumers, and manageable environmental impacts.

In high-income countries, policy has focused mainly on stabilising farm incomes and maintaining domestic production capacity, using tools such as direct payments, insurance schemes, and income-stabilisation instruments. In many low- and middle-income countries, policy has focused more on consumer price stability and food security, often through public procurement, input subsidies, administered prices, or trade measures.

A third and increasingly important objective is to limit the environmental impacts of agriculture. As concerns about climate change, biodiversity loss, and water scarcity have grown, policies have increasingly sought to reduce negative environmental effects while

maintaining production. This objective interacts directly with the others, sometimes reinforcing them and sometimes creating new trade-offs.

Key takeaways

- Agricultural markets are structurally volatile due to biological production, long production cycles, and inelastic demand.
- Regional concentration of production and trade amplifies price movements and transmits shocks internationally.
- Value chains beyond the farm are increasingly concentrated, affecting how risk and value are distributed.
- Trade improves efficiency and availability but also creates interdependence and exposure to external shocks.
- Public policy plays a central role in stabilising farm incomes, food prices, and food supplies.
- The core challenge is not whether to intervene, but how to design interventions that manage risk without creating new vulnerabilities.



4. Natural Resources and Environmental Constraints

Agriculture is land-based. This means that everything agriculture does affects—and is affected by—land, soils, water, and climate. As discussed in Chapter 1, agriculture already uses a very large share of the planet’s productive resources. This means that future gains in food production must come from better use of existing resources, rather than from further expansion of land use.

To clarify the challenges involved, this chapter distinguishes between **resource constraints** and **environmental externalities**. Resource constraints limit what agriculture can do. Environmental externalities describe the impacts agriculture imposes on wider ecosystems and society.

4.1 Resource constraints

Land is the most basic constraint. Agriculture uses close to half of the world’s habitable land, including most land suitable for cropping and grazing. Further expansion is still possible in some regions, but it would often require converting forests or other natural ecosystems, with significant environmental costs. While land conversion historically supported agricultural growth in many parts of the world, it increasingly conflicts with biodiversity conservation and climate goals.

Water availability is another major constraint. Agriculture accounts for around 70% of global freshwater withdrawals, far more than any other sector. Irrigation plays a key role in global food production: irrigated land represents about 20% of cultivated area, yet produces around 40% of global crop output due to higher and more stable yields. At the same time, water use in agriculture is often inefficient and, in some regions, unsustainable. Groundwater is being depleted in major farming areas, including parts of the U.S. Great Plains, northern India, and northern China. Several major river basins, such as the Indus and the Colorado, are heavily over-allocated.

Importantly, water scarcity is not only a physical problem but also an economic and institutional one. In many regions, irrigation water is underpriced or unpriced, which leads to wasteful use. A relatively small number of crops—such as rice, sugarcane, and cotton—account for a disproportionate share of global irrigation water use. More efficient irrigation systems, better timing of water use, pricing reforms, and crop choices better aligned with local conditions can substantially reduce water stress without necessarily reducing output.

Soil quality is another critical constraint. Long-term intensive cultivation without adequate soil management has led to erosion, nutrient depletion, and loss of organic matter in many regions. A significant share of global cropland is estimated to be moderately to severely degraded. In rainfed systems, erosion removes fertile topsoil faster than it can be replaced. In irrigated systems, poor water management has led to salinisation, affecting roughly one fifth of irrigated land worldwide. These processes reduce yields over time and increase dependence on external inputs.

Soil degradation is not irreversible. Improved soil management—such as maintaining ground cover, returning organic matter, reducing tillage, and better nutrient management—can restore soil fertility and improve water retention. Many of these practices are well known, but adoption remains uneven due to costs, knowledge gaps, and short planning horizons.

4.2 Environmental externalities

Beyond being constrained by natural resources, agriculture also generates significant environmental impacts on land, soils, water, and climate.

As discussed in Chapter 1, agriculture, including land-use change, contributes around one quarter of global greenhouse gas emissions. These emissions come mainly from methane released by ruminant livestock, rice cultivation, nitrous oxide from fertilisers and manure, and carbon dioxide from land-use change. Ruminant livestock alone account for a substantial share of agricultural emissions, primarily due to methane.

Agriculture is also a major source of water pollution. Excess nutrients from fertilisers and manure run off into rivers, lakes, and coastal waters, causing eutrophication and “dead zones.” Nitrogen and phosphorus losses reduce water quality and impose costs on downstream users and ecosystems. Agriculture is also a major source of ammonia emissions, contributing to air pollution and ecosystem acidification.

Biodiversity loss is another major externality. Simplified landscapes, monocultures, pesticide use, and habitat conversion have reduced populations of insects, birds, and other species in many farming regions.

These externalities do not mean that agriculture is incompatible with environmental protection. But we need better alignment between production practices and environmental limits. As with resource constraints, many mitigation options already exist: more precise input use, improved manure management, diversified cropping systems, agroforestry, and changes in livestock feeding and breeding. The main challenge lies less in technical feasibility than in incentives, coordination, and implementation.

Key takeaways

- Agriculture operates within hard constraints set by land, water, soils, and climate.
- Expansion of agricultural land increasingly conflicts with biodiversity and climate objectives.
- Water scarcity reflects institutional and economic factors as much as physical limits.
- Soil degradation reduces long-term productivity but can often be reversed with improved management.
- Agriculture generates significant environmental externalities, including greenhouse gas emissions, water pollution, and biodiversity loss.
- Many solutions already exist; the key challenge is scaling up adoption and aligning incentives.

5. Food Security: Availability, Access, and Stability

Food security is commonly defined using the framework developed by the Food and Agriculture Organization of the United Nations. According to this definition, food security exists *when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life*. The definition is widely accepted and is structured around four dimensions: *availability, access, utilization, and stability*.

These four dimensions describe outcomes of food systems. They indicate whether people are food secure at a given point in time. However, they say less about how food security is produced, maintained, and protected over time, especially under stress. In practice, food security depends on the resilience of the food system—its capacity to absorb shocks, adapt to change, and sustain supply over time.

We can regard food security as a system emerging from the interaction between structural conditions, adaptive capacities, and the core functions of the food system. **Structural factors** include geography, infrastructure, demographics, and access to resources. **Adaptive factors** include skills and learning, social and business networks, governance arrangements, and food cultures. Together, these factors shape how well food systems perform across production, processing, distribution, and external supply.

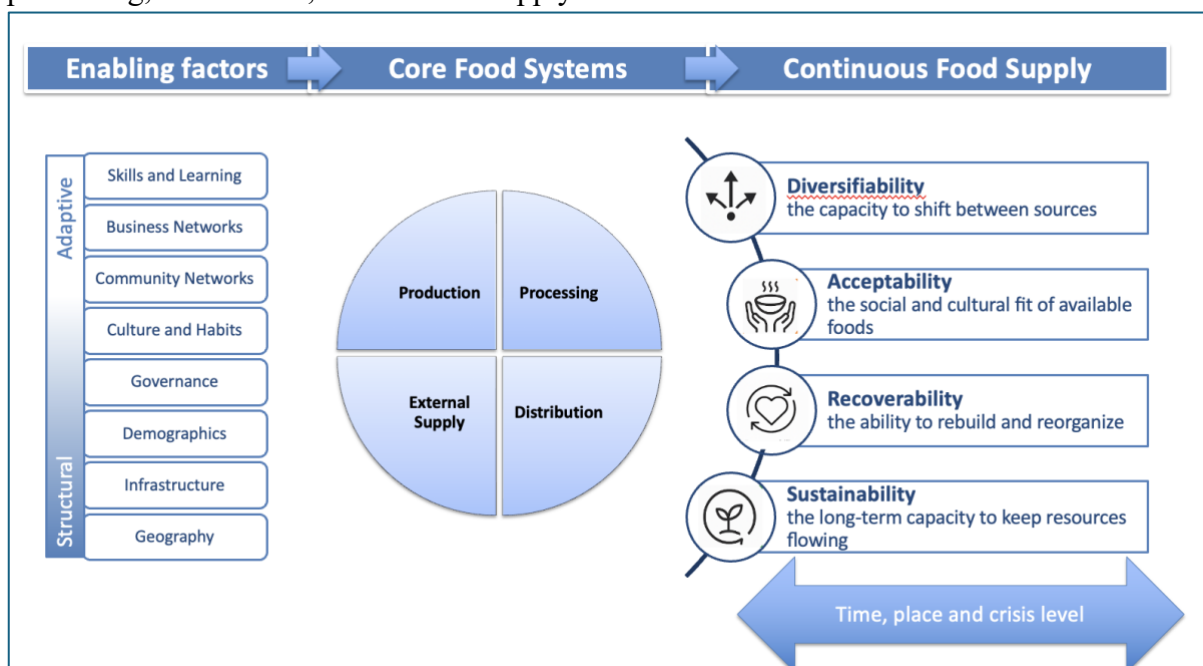


Figure 5. Graphical illustration of the elements of resilient food systems (T. Joh.)

What ultimately matters is whether food systems can deliver a continuous and acceptable food supply under changing conditions. This involves several closely related properties: diversification of supply sources, social and cultural acceptability of available foods, the ability to recover after disruptions, and the long-term sustainability of resource use.

Availability: Is enough food supplied?

Availability refers to the physical presence of food in sufficient quantities, whether from domestic production, imports, or food stocks. At the global level, food availability has improved markedly over time. Average food supply now exceeds 2,800 kilocalories per person per day, compared to around 2,200 kilocalories in the early 1960s. Global production of staple foods has generally kept pace with, and often exceeded, population growth.

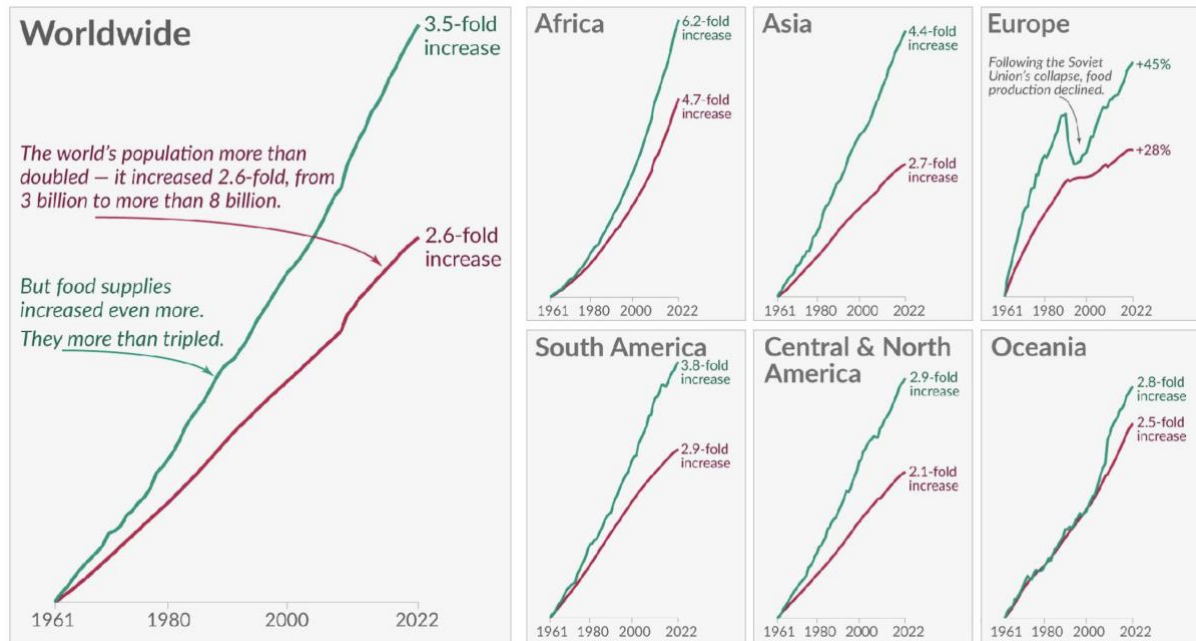


Figure 6. Food production increases faster than population growth everywhere in the world (*Our world in data*).

This increase reflects long-term gains in agricultural productivity. Higher-yielding crop varieties, expanded irrigation, fertiliser use, mechanisation, and improvements in storage and transport have all contributed. For cereals in particular, global output has more than doubled since the 1970s, while world population increased by roughly two thirds. Over long periods, this has been accompanied by a decline in real prices of staple foods, which has supported food access for large parts of the global population.

In aggregate terms, the world today produces enough food to feed its population. However, availability at the global level masks large differences across countries. Some countries rely heavily on imports to meet basic food needs, while others produce large surpluses for export. Availability is therefore closely linked to trade, infrastructure, and political stability, as discussed in earlier chapters.

Aggregate availability alone does not ensure that food reaches all people. This leads to the second dimension of food security: access.

Access and utilization: Who can obtain food, and what kind?

Access refers to people's ability to obtain food through markets, own production, or social support. For most households, economic access—income relative to food prices—is the

decisive factor. This explains why hunger can persist even when food is plentiful at the global level.

As of the early 2020s, roughly 700–800 million people are chronically undernourished. Undernourishment is highest in parts of sub-Saharan Africa, where conflict, poverty, and weak infrastructure constrain access, and lower in most of Asia and Latin America. Even within food-exporting countries, hunger can persist where income inequality is high or social protection systems are weak.

Access must also be understood in nutritional terms, not only calories. A growing share of the global population can meet basic energy needs but cannot afford a healthy, balanced diet. More than two billion people are estimated to experience moderate or severe food insecurity, meaning they are forced to reduce food quality or quantity at times. At the same time, many countries face a double burden of malnutrition, where undernutrition coexists with overweight and obesity. These patterns reflect food environments in which cheap, energy-dense foods are widely available, while fruits, vegetables, and protein-rich foods remain relatively expensive or inaccessible.

Utilization refers to how the body uses the food that is consumed. It depends on factors such as food safety, dietary practices, health status, and access to clean water and sanitation. While utilization is not the main focus of this compendium, it remains an important dimension of food security outcomes.

Stability: Can food security be maintained over time?

Stability refers to the ability to maintain food security over time without sharp interruptions caused by shocks. It cuts across both availability and access and is closely linked to resilience.

Food security is inherently fragile. Conflict, economic crises, extreme weather events, and supply-chain disruptions can rapidly undermine access to food. The COVID-19 pandemic, for example, did not cause a global food shortage, but it sharply reduced incomes and disrupted logistics, pushing millions of people into food insecurity. Repeated droughts, floods, or heatwaves can also trigger acute food crises, particularly where safety nets are weak.

Climate change is expected to increase pressure on stability by intensifying weather extremes and increasing production variability in many regions. Market shocks can further undermine stability, especially when export restrictions, currency depreciation, or sudden price spikes limit access for import-dependent countries or low-income households.

Stability depends strongly on system properties. Diversified sources of supply, functioning trade networks, food stocks, social protection systems, and early warning mechanisms all help reduce vulnerability to shocks. At the household level, stable incomes, savings, and social support play a similar role.

Stability is often the most difficult dimension to address, because it requires coordination across sectors and time horizons. Yet it is central to understanding why some food systems absorb shocks while others experience rapid breakdowns.

Food security is not a state – it's a process

Food security is often framed as a choice between domestic production and imports. In practice, this distinction is misleading. Modern food systems are deeply interconnected, and even food produced domestically depends on global value chains for inputs such as fertilisers, animal feed, energy, machinery, and veterinary medicines. Few countries could sustain food production in isolation from international markets.

Food security depends less on self-sufficiency than on diversification and resilience. Countries that combine domestic production with diversified import sources, functioning trade relations, and strategic stocks are generally better able to absorb shocks than countries that rely heavily on a single source of supply—whether domestic or foreign. Food systems that are closed, highly centralised, or rigid often struggle to adjust when harvests fail, inputs become scarce, or trade is disrupted.

Key takeaways

- Food security describes outcomes, not just production levels.
- Global food availability has improved, but access remains uneven across and within countries.
- Hunger is driven more by poverty, conflict, and inequality than by global food shortages.
- Stability and resilience are central to food security under increasing climate and market volatility.
- Food security depends less on self-sufficiency than on diversified, resilient food systems.
- Food security gains are real, but uneven and reversible.

6. Agriculture and Rural Development

Agriculture does not exist in isolation from its rural contexts. It is embedded in rural societies, many of which have changed profoundly over recent decades, especially in middle- and high-income countries. Across much of Europe and other OECD regions, rural areas have experienced long-term population decline, ageing, and job losses as agriculture has become more productive while employing far fewer people.

Rural decline, however, cannot be explained by changes in agriculture alone. Over time, many rural regions have also lost manufacturing, retail, public services, and administrative functions. Schools, healthcare, transport services, and local businesses have increasingly been centralised in towns and cities. This has reduced the attractiveness of rural living, even in places where farming itself remains productive.

Historically, rural economies were closely tied to agriculture. Farming provided jobs, income, and social structure. Today, that link is much weaker. In most Western countries, agriculture accounts for only a small share of rural employment, and many farm households depend on income from outside farming. Rural residents increasingly work in other sectors or commute to nearby urban centres. Agriculture still matters, but it no longer sustains rural economies on its own.

In 2006, the OECD proposed a new policy approach that became known as “**The New Rural Paradigm**”. Rather than focusing narrowly on agriculture, it proposes a place-based approach that looks at rural regions as a whole.

Table 2. Key differences between traditional policy and the new rural paradigm (OECD).

| | Old approach | New approach |
|-------------------|---|---|
| Objectives | Equalisation, farm income, farm competitiveness | Competitiveness of rural areas, valorisation of local assets, exploitation of unused resources |
| Key target sector | Agriculture | Various sectors of rural economies (ex. rural tourism, manufacturing, ICT industry, etc.) |
| Main tools | Subsidies | Investments |
| Key actors | National governments, farmers | All levels of government (supra-national, national, regional and local), various local stakeholders (public, private, NGOs) |

This emphasis moves away from sector-specific subsidies and toward investment in infrastructure, skills, innovation, and economic diversification. Rural development is treated as a multi-sector challenge, not an agricultural one. In practice, however, much public support to rural areas remains concentrated on a relatively small number of agricultural sectors, many of which are declining.

Structural change and demographic pressure

Changes in agriculture have taken place alongside strong demographic shifts. Across much of Europe, fewer people live in rural areas, and those who remain are often older, as younger

generations move to cities for education and employment. This makes it harder to recruit labour, transfer farms to the next generation, and maintain vibrant local communities.

These trends largely reflect broader economic forces rather than policy failure. The transition from farming-based economies to industrial and then service- and knowledge-based economies has changed where and how value is created. The challenge is therefore not to halt these shifts, but to adapt so rural areas remain viable and attractive places to live and work.

Even in labour-intensive parts of agriculture, the local impact can be limited. Sectors such as horticulture, meat processing, and intensive livestock production often rely on temporary or migrant labour. While this labour is economically essential, it is often short-term and weakly integrated into local communities. As a result, these jobs do not always support long-term population stability or broader community development.

Diversification

Diversification is central to modern rural development strategies, particularly in Western and Northern Europe.

One pathway is value-added food production. This includes local processing, specialty foods, and short supply chains. Small dairies, bakeries, breweries, and meat processors cannot compete with industrial producers on price, but they can retain more value locally and contribute to local identity through quality, origin, and tradition.

A related pathway is tourism and recreation linked to farming and landscapes. Agritourism, farm stays, food tourism, and outdoor recreation have become important income sources in many rural areas. These activities depend on agricultural landscapes and cultural heritage, even when farming itself employs relatively few people.

A third area of growth is energy production and environmental services. Rural land is increasingly used for renewable energy, including wind, solar, and biogas. New income streams are also emerging around carbon storage, biodiversity management, and other ecosystem services. These activities are still developing and unevenly regulated, but they reflect a broader shift in how rural land contributes to economic value.

Key takeaways

- Agriculture remains important in rural areas, but it is no longer the main source of employment.
- Rural decline is driven by broader economic and demographic forces, not agriculture alone.
- Productivity growth reduces labour demand in farming, even where output remains high.
- Rural development increasingly depends on diversification beyond agriculture.
- Place-based approaches that combine services, infrastructure, and economic diversity are central to rural vitality.
- The future of agriculture and the future of rural society remain connected, but they are no longer the same thing.

7. Concluding Reflections

Global agriculture in the 21st century is characterised by constant trade-offs. Feeding a growing and more affluent population, protecting natural resources, supporting farm livelihoods, and ensuring food security are all necessary goals, but they often pull in different directions. There are no simple solutions, only choices that involve balancing competing objectives.

In this compendium, I have tried to show that agriculture is more than food production. It is a land-based activity with large environmental impacts, an economic sector prone to volatility, a cornerstone of food security, and a foundation for many rural societies. How agriculture performs depends not only on what happens on farms, but also on markets, policies, technologies, institutions, and the state of the natural environment.

A central lesson is that business as usual is not an option. Environmental limits, climate change, and social pressures are already forcing change. At the same time, past progress in productivity and food security shows that improvement is possible.

Agriculture will remain a sector where public policy, collective action, and long-term thinking matter. Decisions about land use, trade, technology, and support systems will shape whether future food systems are resilient, equitable, and sustainable.

In this sense, agriculture still matters—not as a relic of the past, but as a key part of our shared future. Understanding its structures, constraints, and trade-offs is a necessary starting point for anyone working with food systems, policy, or rural development.



8. Reading list

The following reading list provides selected overviews and data sources for each chapter. It is intended as guidance for further study rather than as an exhaustive list of references.

Chapter 1 – Why Agriculture Still Matters

- [*The State of Food and Agriculture \(SOFA\)*](#) – latest edition. Food and Agriculture Organization of the United Nations (FAO)
(Global overview of agriculture, resources, and productivity)
- [*World Development Indicators – Agriculture, land use, employment*](#). World Bank
(Key statistics across countries)
- [*Environmental impacts of food production*](#). Our World in Data
(Visualisations and long-run trends)
- [*Factfulness*](#) – Rosling et al. 2018
(Must read!!! Context, history, and ...fun)

Chapter 2 – How Food Is Produced Globally Today

- [*FAOSTAT – Crops, livestock, land use, yields*](#)
(Primary global agricultural database)
- [*The Future of Food and Agriculture – Alternative Pathways to 2050*](#). FAO 2018.
(Systems-level overview of production, demand, and constraints)
- [*Agricultural production, land use, and diets*](#). Our World in Data
(Accessible data on crops, livestock, and land)
- [*Solutions for a Cultivated Planet*](#). Foley J. et al. 2011. Nature
(Classic synthesis on production, land, and environmental trade-offs. Requires subscription but must university libraries have access)

Chapter 3 – Agriculture as an Economic Sector

- [*Price Volatility in Food and Agricultural Markets: Policy Responses*](#). FAO/OECD et al. 2011
(Core analysis of volatility and policy responses)
- [*Food prices, trade, and volatility*](#). Our World in Data
(Long-run price series and trade exposure)
- [*Agricultural Policy Monitoring and Evaluation*](#). OECD (latest edition)
(Comprehensive account of agricultural policy in the OECD)
- [*From Uniformity to Diversity: A Paradigm Shift from Industrial Agriculture to Diversified Agroecological Systems*](#). IPES-Food 2016.
(How the shift from uniform industrial agriculture can be made)

Chapter 4 – Natural Resources and Environmental Constraints

- [*Climate Change and Land*](#). IPCC (2019)

(Definitive assessment of land, food, and climate interactions)

- [*Livestock's Long shadow: Environmental Issues and Options*](#). FAO 2006.
(Thought provoking account of the environmental impact of livestock production)
- [*The State of the World's Land and Water Resources for Food and Agriculture*](#). FAO
(Land, soil, and water constraints)
- [*Water stress and agricultural water use*](#). World Resources Institute (WRI)
(Global water risk mapping)
- [*Planetary Boundaries: Exploring the Safe Operating Space for Humanity*](#). Rockström, J., et al. 2009. Ecology and Society.
(Agriculture and planetary boundaries)
- [*Environmental impacts of food production*](#). Our World in Data
(Emissions, land use, and biodiversity indicators)

Chapter 5 – Food Security: Availability, Access, and Stability

- [*The State of Food Security and Nutrition in the World \(SOFI\)*](#). FAO et al.
(Annual global reference on hunger and food insecurity)
- [*Food Security: The Challenge of Feeding 9 Billion People*](#). Godfrey H.C.J. et al. 2010. Science
(Influential article on food security drivers)
- [*High Level Panel of Experts on Food Security and Nutrition*](#). (HLPE)
(Up-to date – loads of good stuff.)
- [*Hunger, food supply, and diets*](#). Our World in Data
(Accessible data. Trends in availability and undernourishment)

Chapter 6 – Agriculture and Rural Development

- [*The New Rural Paradigm: Policies and Governance*](#). OECD 2006.
(Foundational framework for place-based rural development)
- [*Rural Well-being: Geography of Opportunities*](#). OECD 2020.
(Living conditions and services in rural areas)
- [*State of the Nordic Region*](#) – latest edition. Nordregio
(Nordic rural and regional dynamics – have also a look at earlier editions)
- [*Rural transformation and structural change*](#). World Bank
(Long-run transition from agriculture to diversified rural economies)