Population and food security

'End hunger, achieve food security and improved nutrition, and promote sustainable agriculture by 2030.' The world set itself a considerable challenge in the Sustainable Development Goals. Currently, one in nine of the world's population are chronically undernourished and, given that population is projected to grow significantly in upcoming years, much must change before hunger can be successfully and sustainably eradicated.

This briefing will look at food demand and food security. It will be argued that, while there are many ways in which food security can be improved in theory, these are often not viable due to conflicting challenges the world faces, including climate change, environmental degradation and water scarcity. This means that even though greater efficiency in the agricultural sector has the potential of improving food security, this will not be sufficient in the long term. It is necessary to slow down and ultimately reverse population growth to guarantee food security for all in the long term.

Food security

During the 1996 World Food summit, the United Nations (UN) defined food security as follows:

> "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."[1]

Four components can be recognised within the definition of food security:

1. **Food availability.** A country can guarantee food availability for all its citizens through domestic production or trade with other food-producing states.[2]
2. **Food access.** People need to have access to resources that are necessary to acquire foods for a nutritious diet. The UN found that malnutrition is often caused not by scarcity, but rather by an inability to access available food.[3]
3. **Food utilization.** Once people have obtained food, a number of factors influence how well the human body can ingest and metabolize that food. Food must be safe and nutritious enough to meet the physiological requirements of an individual. Education about nutrition and food preparation can improve utilization.[4]
4. **Food stability.** People must have access to food at all time. Food production and availability should thus be resistant against sudden shocks.[5]

Global food demand

Global food demand is expected to grow significantly in upcoming decades. This will be caused mostly by population growth, though rising incomes of people in developing countries will also influence demand.[6] Every day, more than 200,000 people are added to the world population. Population size is projected to increase to 9.2bn by 2050, and most population growth is expected in developing countries.[7]

Trends and challenges

The proportion of malnourished people in the world has decreased from 23.3 per cent in the early 1990s to 12.9 per cent in 2015. In spite of this, one in nine people remain chronically undernourished.[8] The vast majority of the hungry — 780 million people — live in developing regions. Latin America, Eastern and South-Eastern regions of Asia have managed to meet hunger-reduction targets, but Central and Western Africa face a higher proportion of undernourished people now than they did in 1990.[9]

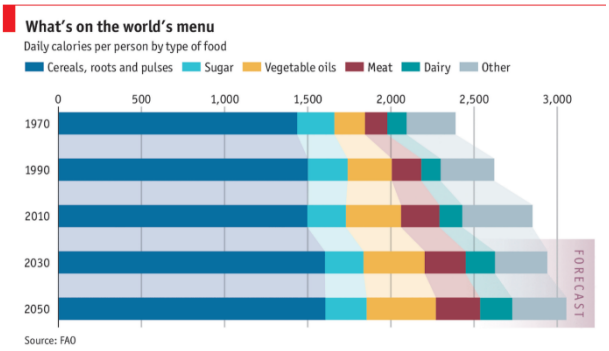
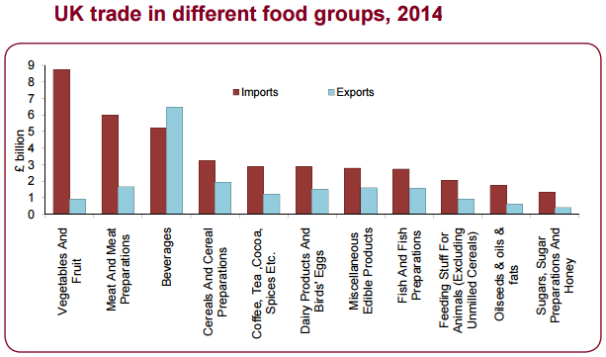


Chart: Economist

In addition to increasing food demand caused by rising population, dietary shifts also have major implications for global food demand. Per capita calorie intake has increased overall, and increasingly many people eat more animal produce.[10]

UK food demand

Although the UK has a successful agricultural industry — it contributes around eight per cent to the national GDP — it is not self-sufficient in food production.[11] It currently imports approximately 40 per cent of all its consumed food, and this proportion is on the rise. Around two-thirds of imports come from elsewhere in the European Union (EU).[12] The UK also exports food and drink — around £18.8Bn was exported in 2014.[13] Beverages are the largest export category, largely due to Scotch Whisky.[14]



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Trends and challenges

In the past two decades, the demand for better-quality produce and exotic foods has risen. More recently, larger numbers of people have started caring more about healthy food and about the impact of food on the environment. It is expected that both these trends will continue. At the same time, affordability and convenience are important, and people choose to eat outside their homes more frequently.[15]

In spite of increased interest in healthy diets, obesity is a serious problem in the UK. One in ten children and nearly a quarter of all adults are

obese. It has been estimated that around 70,000 premature deaths in the UK could be prevented each year if diets are improved, and such an improvement would save the Treasury around £20 billion each year.[16]

Origins of food consumed in the UK, 2013

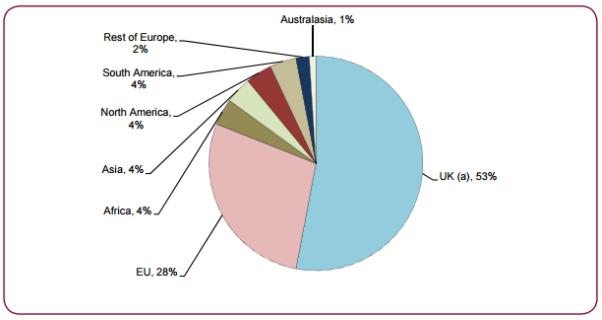


Chart: GOV

The Government sees climate change as the biggest challenge for food security, at both the global and domestic level. Extreme weather patterns have already caused significant financial losses — £1.2 billion in 2012, for example. In the winter of 2013-14, more than 50,000 ha of farm land were flooded and, while the damage of that has not yet been assessed, it is clear that such events will occur more frequently. [17]

Improving food security

There are multiple facets to improving food security. These can be roughly categorised in the following three groups:

1. Reduction of food production demand
2. Increasing food production
3. Avoiding losses in food production

All three aspects must be considered to guarantee long-term food security, yet it becomes clear that not every part of the solution is equally viable, due to global competitive challenges.

Reduction of food production demand

Food demand is driven predominantly by the total number of consumers, and the expectations of each consumer.

Reducing population growth

The most obvious measure that would slow down food production demand is slowing down population growth. Even if it were possible to optimise food consumption per capita, each additional person has nutritional needs and would, thus, cause total food demand to increase.

Reducing overconsumption

Whilst many people in the developing world face malnutrition, overconsumption is an increasingly important problem globally. The World Health Organisation (WHO) estimated that 1.9 billion adults were overweight in 2014. Of these, more than 600 million were obese.[18] Although obesity was once called a high-income country challenge, the problem is on the rise in middle-income countries, too. Currently, overweight and obesity are more prevalent than underweight. Both dietary changes — an increased intake of energy-dense foods — and physical inactivity are seen as the main causes for this trend. Awareness and attitudinal change could reduce this problem.

Reducing waste

Currently, much food waste occurs throughout the food value chain. It has been estimated that between 20 and 40 per cent of all produce is wasted. In the developing world, much food is lost before it reaches consumers. Inadequate storage systems, poor harvesting practices and pests are largely to blame for this. It was estimated that

between 10 and 25 per cent of all rice in Vietnam is lost due to poor storage, for example. [19]

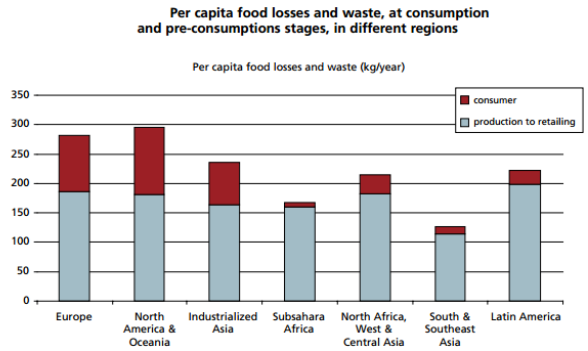
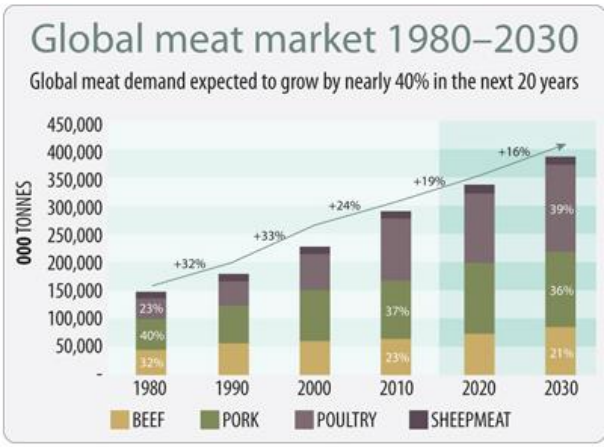


Chart: FAO

In the developed world, most food is wasted in supermarkets, restaurants and households because people either buy too much or let food expire.[20] It was estimated that approximately 43bn kg of food was lost in the US from retailing onwards — around a quarter of all available food.[21] In the UK, 15bn kg of food — around a third of what is purchased —is wasted throughout the food chain.[22] WRAP estimates that the UK's wasteful behaviour costs over £19 billion a year, and that 75 per cent of all waste is avoidable. [23]

Consumption of animal products typically grows as living conditions improve. Animal products in diets have nutritional value, but the projected increase of average global meat consumption from 37.4 kg per person per year in 2000 to over 52 kg per person per year by 2050 is problematic.[24] Meat production requires many resources. It was estimated that approximately one third of the world's cereal grain supply was used to feed livestock in 2014.[25] If projections are correct, this could increase to over 50 per cent by 2050. [26] Consequently, the more people rely on animal products for their nutrition, the more food demand will increase, as animals must be fed too.



Graph: Rabobank

Biofuel policies

Due to an increased demand for biofuel, much land that was previously used for food production has been sacrificed to produce biofuels. It is probable that demand for biofuel will continue to grow as the world runs out of fossil fuels. That would reduce the amount of space available for food production and, thus, increase the amount of crops that need to be yielded from each acre. Advancements in biofuel technology, improved alternative sustainable energy sources and restrictive policies could reduce the necessity to increase output per acre.[27]

Improving food distribution

Food is not distributed equally over regions and households. Not every crop can be grown in every region. Consequently, most countries rely heavily on food imports. Long-distance redistribution of food through trade has a lot of potential, but in practice it has adverse implications. Too much dependence on trade places a country in a vulnerable position, and the shipping of food across the globe is damaging for the climate.[28]

Increasing food production

Historically, agricultural yields have improved considerably as technological knowledge has expanded. Industrialisation of the food system made agriculture more efficient, meaning that fewer people had to work as farmers, that farming became increasingly mechanised and that production volumes increased strongly.[29]

Expanding net land footprint

It was estimated that 4895 million ha of land were used for agriculture in 2010. It would be possible to increase food production by cultivating land that has not previously been used for those ends.[30] Doing this will, however, likely have adverse implications for biodiversity and for climate change. In Scotland, for example, much heather-covered moorland has been transformed into less nutrient-rich and biodiverse grassland since the 1940s to allow farmers to keep greater numbers of livestock. [31,32]

Another problem that comes with the suggestion of expanding agricultural acreage is that urbanisation and industrialisation have, throughout the decades, claimed increasingly more land. It has been observed that 2600 ha of agricultural land are converted to urban area in Accra (Ghana) every year, and a similar pattern has been spotted in China and Indonesia. This not only means that less farming land is available, but also often means that farms have to shift to other areas which are less productive.[33] Moreover, urban areas are in direct competition with the agricultural sector when it comes to the use of resources such as fresh water. [34]

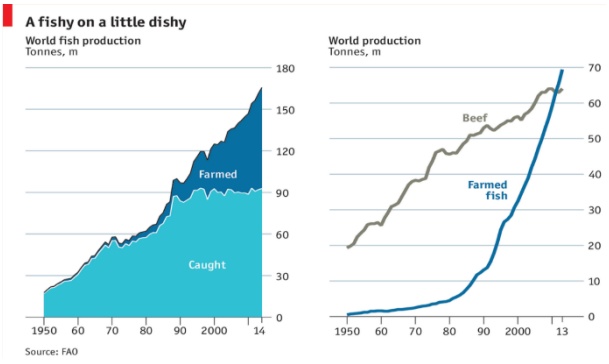
Irrigation

Globally, around 70 per cent of all fresh water is used for agriculture. There are regions, such as Sub-Saharan Africa, where irrigation systems are, as yet, barely developed. Introduction of irrigation techniques in these areas would increase food production. Yet, given that the world faces increasing water scarcity, it is especially important to ensure that every drop of freshwater is used efficiently. The majority of farmers currently rely on irrigation canals that lose much of their water to evaporation or seepage before it reaches the crops.[35] Technology that reduces losses of water in irrigation systems and allows farmers to use water to its fullest potential would be beneficial.[36] Only when that is achieved will it be potentially viable to expand irrigation to other areas.

Aquaculture production

The expansion of aquaculture production is seen as a good alternative to conventional livestock production. It can make use of land and water that cannot be used for food production otherwise. [37] Fish farming would alleviate the strain on the marine species: an astonishing 63 per cent of global fish 'stocks' are considered overfished. Remaining fish are endangered: 99 per cent of European eels, and 95 per cent of

Southern bluefin and Pacific bluefin tunas, are now lost.[38]



Graphs: Economist

Existing aquaculture production, however, is known to pollute water with excess nutrients, chemicals and antibiotics. This leads to an increase in algae that reduce oxygen levels in the water and block sunlight. This in turn can cause the extinction of various marine species.[39] Moreover, disease and parasite outbreaks are more common in fish farms. To combat this, drugs have been used, but it is not healthy for humans to consume traces of these drugs. Finally, farmed fish need to be fed — which means that fish farming increases food demand. Aquaculture production also relies heavily on the availability of fresh water and energy.[40]

Closing yield gaps and improved technology

Currently, 'yield gaps' — the gap between what is achieved and what is attainable - vary from 10 to 20 per cent in developed countries and from 60 to 80 per cent in some developing nations. Yield gaps exist for various reasons. Farmers may not have the means or willingness to use certain technologies or practices, for example. Closing yield gaps by introducing existing technologies globally could improve yields dramatically. It has been estimated that increasing the yields of 16 important crops up to 95 per cent could increase production by around 60 per cent.[41] Developing new, more efficient farming systems that allow us to use land and water in the most optimal way would increase this result further.

Studying genetics

Studying the genetics of our crops allows us to understand our crops better. It has the potential for making farming more precise. We want crops for certain characteristics they have. Often these appear before a plant is fully matured. Thus, precision could help reduce the length of a growth cycle. Growing Underground, a London firm that uses this knowledge, has successfully reduced the growth cycle for coriander from 21 to 14 days, and is now doing the same with carrots, radishes and other vegetables.[42]

Genetically modified (GM) food also has the potential to produce higher crop yields and to extend the shelf-life of foods. Additionally, it may enable crops to withstand weather extremes and increase the nutritional content of food groups. Yet, GM foods are controversial, because they are known to trigger allergic reactions in humans and to harm other organisms in the ecosystem, thus threatening biodiversity.[43]

Fertilisers

Mankind has used fertiliser to improve crop yields for at least 8000 years.[44] Although farmers relied on natural fertiliser for a long time, the development of chemically-synthesized fertiliser transformed farming, as crops grew better than before. Yet, the use of fertiliser and the expansion of such use is not, per definition, viable. Many mineral resources are increasingly exhausted. Phosphorus, a mineral that is used as a fertiliser, will run out by 2149 at its current usage rate.[45] This means organic fertilisers are not limitless.

Many fertilisers dissolve in water, and are therefore often washed away by rain. This pollutes water bodies, and can cause algae and other water plants to grow excessively. Such growth can cause the extinction of life in the water source.[46]

Artificial fertilisers have adverse implications for the environment. They can cause the build-up of salt in soil, which dries out plants. Over-application also damages crops. [47] Finally, inorganic fertilisers are mostly made from non-renewable sources, including fossil fuels. This means production will be more expensive as scarcity grows, and that renewable alternatives must be found at some point.[48]

Avoiding losses in food production

Large quantities of food are lost in the food production chain. This is problematic for multiple reasons: when food is lost, it is not just potential nutrition that is wasted but also the land, water, fertiliser, seed, pesticide and labour that was required to produce it in the first place. This means that food losses also have a financial and an environmental dimension.

Maintaining disease resistance

Crops are vulnerable to pests, weeds and diseases. Pests can consume crops once they are grown, or prevent them from growing at all. FAO has estimated that approximately 25 per cent of crops are lost to pests and diseases.[49] The outbreak of a new pest has serious consequences. A state of emergency was declared when Liberia was invaded by African armyworms in 2009, for example.[50]

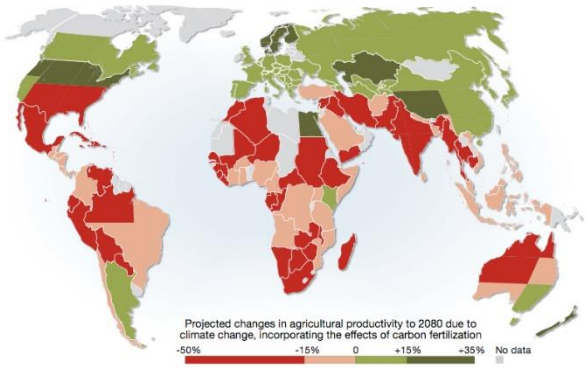
Avoiding land and water degradation

Soil degradation, desertification, erosion and acidification are all threats to the agricultural sector. Desertification — the process where a landscape dries out completely and becomes arid, losing its former vegetation and wildlife — is seen as one of the greatest environmental challenges of our time.[51] It is an issue of global significance that has troubled humanity throughout the ages. Not only has it caused the displacement of populations, it has also contributed to the collapse of great civilisations in the Mediterranean, the Mesopotamian Valley and the Loess Plateau of China.[52] To avoid a similar fate, it is necessary that we manage water and consider reforestation, even if that would reduce available farmland.[53] Currently, however, 75bn

tonnes of soil are lost every year, costing the world around US$400bn per year.[54]

Minimising climate change

Climate change can restrict food production severely. Therefore, it is necessary to commit to reducing gas emissions across all sectors, including the agricultural sector itself. Animal agriculture produces enormous amounts of methane, a gas with a higher greenhouse effect per unit than $C0^2$, and fertilisers contain much $N0^2$. It will be crucial to find a balance between optimising yields through the use of fertilisers and minimising climate change.



Map: GRIDA

Adapting to unavoidable climate change

Some implications of climate change are unavoidable. They will affect crop and livestock yields. On the one hand, droughts will require farmers to use more water for irrigation, thereby increasing the total water demand of the agricultural sector.[55] It is expected that maize, a staple crop, will cease to grow well in Sub-Saharan African countries as result of insufficient rainfall.[56] On the other hand, flooding causes harvest failure and damages farmland severely, as happened on a large scale in Java and Sumatra.[57] Rising sea levels are a problem as well. A one metre sea-level rise could render 12 to 15 per cent of Egypt's farmland useless, and thus affect over 6 million people, and a similar fate could harm 13 million Bangladeshis.[58]

Conclusion

Although the UK is affluent enough to guarantee food security for its population for now, it will not be able to do this indefinitely. Due to its reliance on other countries for much of its food, the UK will find that the problem of food security is, per definition, a global problem. Global challenges, including climate change, environmental degradation and water scarcity, will affect the UK.

Though there are, in theory, many opportunities to improve food security across the globe, not all of these are viable in practice. Many opportunities, such as the expansion of crop land, intensify other challenges, such as climate change or environmental degradation. Moreover, it may be impossible to realise such opportunities in densely populated areas, due to a lack of space and competition with the building sector. Population growth will make these conflicts more prevalent, and consequently, it is necessary that governments across the globe consider population stabilisation as a key component of improving food security.

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