



Barilla
Center
FOR FOOD
& NUTRITION

FIXING FOOD

TOWARDS A MORE SUSTAINABLE FOOD SYSTEM



Written by

The
Economist

Intelligence
Unit



ABOUT THIS REPORT

Fixing Food is an Economist Intelligence Unit (EIU) report on food system sustainability globally, spanning agriculture, nutrition, and food loss and waste. It draws on an interview programme with experts from the academic, public and private sectors and is published alongside the Food Sustainability Index (FSI). The project was developed with the Barilla Center for Food and Nutrition (BCFN).

FIXING FOOD

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The Economist Intelligence Unit bears sole responsibility for the content of this report. The findings and views expressed in the report do not necessarily reflect the views of Barilla Center for Food and Nutrition (BCFN).

ABOUT THE FOOD SUSTAINABILITY INDEX

The Food Sustainability Index (FSI), which ranks 25 countries according to their food system sustainability, is a quantitative and qualitative benchmarking model. It is based on 58 indicators that measure the sustainability of food systems across three pillars: food loss and waste; sustainable agriculture; and nutritional challenges. The index has three key performance indicators—environmental, societal and economic—which are in turn based on 35 indicators and eight categories selected on the basis of expert analysis by The Economist Intelligence Unit (EIU) in consultation with an advisory board. The scores for the three main pillars are calculated from the weighted mean of underlying indicators and are scaled from 0 to 100, where 100 equals most sustainable. The overall score for the FSI (also on a scale of 0 to 100) is calculated from a weighted average of the category scores.

For the purposes of this study, sustainability refers to the ability of the food system to be maintained without depletion and exhaustion of its natural resources or compromises to its health and integrity.

The following 25 countries were assessed. They form the Group of 20 (G20) largest economies, which account for 85% of global GDP and two-thirds of the global population, plus five nations from regions otherwise unrepresented (Nigeria, Ethiopia, Colombia, the UAE and Israel).

The Economist Intelligence Unit, with the BCFN Foundation, has also initiated a pilot project on urban food systems. This indicator-level analysis is called City Monitor. It is intended to be a first step in assembling a set of indicators to understand the dynamics of urban food systems through data and policy assessments. In this pilot phase the 16 cities were selected on the basis of geographic representation, data availability and their efforts towards implementing sustainable urban food policies.

RANK	COUNTRY	SCORE (OUT OF 100)
1	France	67.53
2	Japan	66.66
3	Canada	64.86
4	Germany	64.67
5	United Kingdom	63.87
6	Italy	63.67
7	South Korea	62.82
8	Australia	62.36
9	Israel	60.03
10	Colombia	60.02
11	United States of America	58.86
12	Ethiopia	58.66
13	China	57.50
14	Argentina	55.22
15	Mexico	54.90
16	South Africa	54.67
17	Nigeria	54.25
18	Russia	53.74
19	Turkey	52.96
20	Brazil	51.86
21	Indonesia	50.77
22	United Arab Emirates	49.29
23	Egypt	48.85
24	Saudi Arabia	47.43
25	India	43.17

The full index, including data sources, methodologies and interactive tools to explore results, can be accessed on www.foodsustainability.eiu.com

The Barilla Center for Food and Nutrition (BCFN) Foundation is a private non-profit institution. The multidisciplinary research team includes researchers and professionals from different fields, such as economics, nutrition, and environmental and social sciences. The mission of the BCFN, through research, dissemination, and public engagement, is to contribute to the shift towards more sustainable food systems. The global challenges that relate to food and nutrition, health, and sustainability are at the core of BCFN activities.

The rationale behind the development of the Food Sustainability Index (FSI) with The Economist Intelligence Unit (EIU) can be found in the continuous effort of the BCFN to prompt the engagement of civil society, policy makers, and businesses on the food challenges that the world is now facing. This white paper is the outcome of an iterative process of collaboration between the BCFN and EIU research teams. The FSI is a means to analyse the progress of 25 countries in the world vis-à-vis three main challenges with which the global food system is currently confronted: sustainable agriculture, nutrition, and food waste. The objective of the FSI is fourfold:

- to highlight the performance of countries
- to establish a comparable benchmark
- to offer examples of best practices at the national and city levels
- to measure progress over time.

The FSI is a tool for policymakers and experts to orient their action, for students to be educated, and for the public to conscientiously adjust their behaviour for the good of our health and our planet. The BCFN's efforts in contributing to the tackling

of the three 'paradoxes' that affect the global food system began in 2014 with the development of the Milan Protocol, and were further strengthened after the United Nations identified the 17 Sustainable Development Goals (SDGs), officially known as Transforming Our World: the 2030 Agenda for Sustainable Development. The SDGs set the targets that all countries in the world are called upon to achieve by 2030. Food, nutrition, and sustainability are integral components of the SDGs that represent the framework upon which the BCFN bases its actions. Immediate action is needed to tackle climate change and ensure sustainable agriculture, to improve nutrition and well-being in developing and developed countries, and to address food loss and waste. For each of these challenges the BCFN is committed to raising public awareness and informing policy-making by providing scientifically sound analyses and data.

Over the past few years a number of publications have been released and are available for free download at the BCFN website. The annual report on the Nutritional and Environmental Double Pyramid can be considered as the flagship of the foundation, showing a direct correlation between the nutritional value of food and its impact on the environment. The message conveyed is simple and straightforward: a diet that is healthy for people is also healthy for the planet. The database on which the Double Pyramid is based contains more than 1,300 entries. Relevant BCFN publications include the position papers on food and well-being, food and health, sustainable agriculture, genetically modified organisms and biotechnologies in agriculture, sustainable diets, and water resources. Find out more at www.barillacfn.com.

The Milan Protocol is a proposal for a policy document on food, nutrition, and sustainability, developed by the BCFN Foundation in 2014. It encourages the commitment of all stakeholders on three challenges that the food system is currently facing at the global level. These three challenges are:

- 1. Current trends in food waste.** Every year one-third of the global food production is wasted. Food waste corresponds to four times the amount needed to feed the people suffering from undernutrition worldwide;
- 2. Challenges for sustainable agriculture.** A large portion of crop and food production is funnelled into animal feed or biofuels, despite widespread hunger and undernutrition;
- 3. The coexistence of hunger and obesity.** For every person suffering from undernutrition there are two who are overweight or obese.

The Milan Protocol is the result of a bottom-up approach, carried out by first identifying the latest scientific evidence and the most representative case studies. It drew upon the opinions of 500 international experts, and its supporters and endorsers contributed to our call to action with original research papers, as well as quotes and endorsements. Simultaneously, an online platform was created (www.milanprotocol.com) that received the support and comments of more than ninety organisations, institutions, and experts, and achieved more than 14,000 signatures through the online petition. The final wording of the Milan Protocol was produced after a stakeholder workshop held in Milan in October 2014. By allowing the involvement of all sectors of society, the published document was the product of a holistic approach to the paradoxes

presented. With the development of the Milan Protocol, the BCFN Foundation has pioneered a new way of creating a dialogue in the food and nutrition sector, between academia, public and private institutions, farmers, food companies, and consumers. Such an approach has the potential to become an accepted best practice in the field of food sustainability.

For each of the above-mentioned paradoxes the BCFN has formulated a specific call to action for all stakeholders in society. In 2015 the Milan Protocol inspired the Milan Charter, a proposed global agreement to guarantee healthy, safe, and sufficient food for everyone, which was sought by the Italian government as a legacy of Milan Expo 2015 and handed over to Ban Ki-moon, the Secretary-General of the United Nations, in October 2015 on World Food Day. The purpose of the Milan Protocol is not only to generate awareness in current and future generations on the state of our food system, but also to play a major role in the public agendas of countries all over the world by inspiring concrete actions that lead to the formulation of new policies and solutions for a more sustainable future.

On 1 January 2016, the 17 SDGs of the 2030 Agenda for Sustainable Development—adopted by world leaders in September 2015 at the UN Sustainable Development Summit—officially came into force. Over the next 14 years these new goals, which apply to all countries, will mobilize efforts to end all forms of poverty, fight inequalities, and tackle climate change, while ensuring that no one is left behind.¹

The BCFN is an active stakeholder in this global mobilisation, by taking the Milan Protocol a step forward and becoming a leading and reliable voice on issues of food sustainability and nutrition.



EXECUTIVE SUMMARY AND KEY FINDINGS

The world's food system is facing unprecedented challenges. The global population is set to reach 8.1 billion in 2025, with 95% of population growth driven by developing countries. The food system must ensure this growing population has access to the nutrition it needs to flourish, especially as climate change re-shapes agricultural production. This means tackling the twin nutritional challenges facing the world: hunger and nutrient deficiencies, along with unhealthy diets and obesity.

The international community must also reduce the environmental damage caused by agriculture, in terms of emissions, ground pollution and deforestation, and tackle the scourge of food loss and food waste. Millions of tonnes of food are lost or wasted every year at the farm, retailer and consumer level.

Collectively these problems were reflected in the 17 Sustainable Development Goals (SDGs) of the 2013 Agenda for Sustainable Development, which build on the success of the Millennium Development Goals (MDGs) and aim to go further to end all forms of poverty. Six of these SDGs clearly highlight the central role of food and nutrition to many of the key development indicators from health and wellbeing through to inequality, sustainability and environmental protections.

To attain the SDGs related to food and nutrition, wide-ranging reforms, investments and innovations will be needed. This includes fighting food waste and food loss, promoting knowledge and technology-sharing practices for agricultural producers, investing in farm-to-market infrastructures in developing countries, and advancing research and development (R&D) into new techniques and technologies to improve yield and lower environmental impact.



FOOD, NUTRITION, AND THE SDGS

SDG	FOOD SYSTEM CHALLENGES
SDG 2: To end hunger and all forms of malnutrition by 2030	<ul style="list-style-type: none"> • Access to affordable and nutritious food • Food fortification and vitamin supplementation programmes to needy populations
SDG 3: To ensure health and well-being for all, at every stage of life	<ul style="list-style-type: none"> • Early years' nutrition education for mothers • Encouraging exclusive breastfeeding • Regulating marketing and sale of obesogenic foods • Public education campaigns on optimal diets
SDG 10: Reduced inequalities	<ul style="list-style-type: none"> • Nutritional deficits in the early years of life can cause lifelong deficits such as stunting and impaired cognitive development, deepening inequality cycles as malnourished children are unable to participate in the labour force
SDG 12: To ensure sustainable consumption and production patterns	<ul style="list-style-type: none"> • Sustainable use of arable land • Sustainable water management practices • Limiting agriculture-related pollution and emissions
SDG 13: Take urgent action to combat climate change and its impacts	<ul style="list-style-type: none"> • Agriculture is both a cause of climate change, through the emissions it produces, and a victim as changes in temperature and rainfall impact crop growth and agricultural productivity
SDG 15: To protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss	<ul style="list-style-type: none"> • Managing deforestation related to food and non-food activities, including livestock, soy, and biofuels • Lower use of harmful chemicals and related substances in agriculture

INDEX HIGHLIGHTS: COUNTRY & REGIONAL ANALYSIS

NORTH AMERICA

The US scores poorly for food waste and the prevalence of people who are overweight, but there are policy responses to both. The two most worrying scores in the US are food waste per person and the prevalence of overweight; it ranks third-worst for both. Policy momentum is building, though, with the US scoring positively for its policy responses to food loss (joint top) and unhealthy diets (joint top), and some cities, notably San Francisco, are leading the way for their responses to food waste.

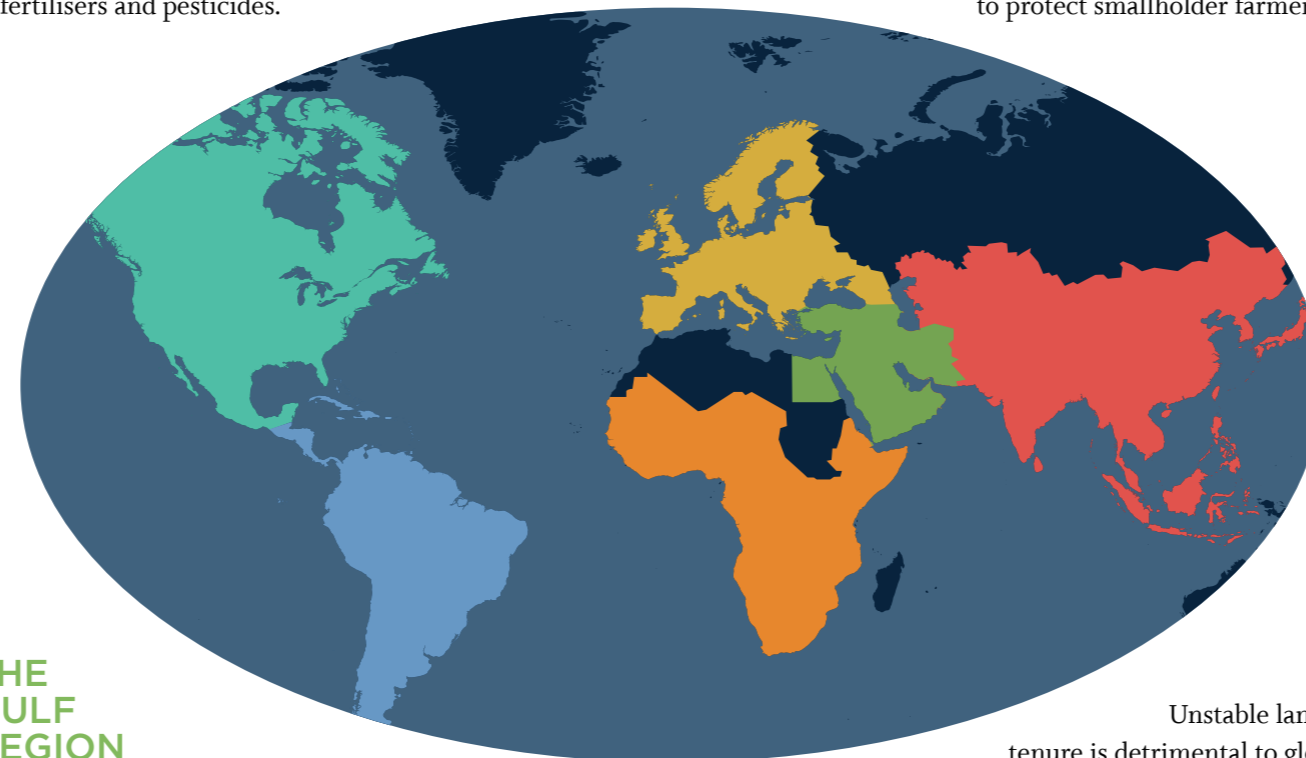
LATIN AMERICA

Colombia scores highly (9th) for sustainable agriculture. Colombia scores in the top ten for sustainable agriculture, reflecting strong performance on water management and environmental biodiversity, among other indicators. Mexico also scores well for environmental biodiversity and water management, for the quality of its agricultural subsidies, and for lower environmental impact of agriculture on land. Brazil scores low (22nd) for environmental impact of agriculture on water, in contrast, due to the heavy water footprint of its main crops and livestock, although it scores better (fifth) for agricultural water withdrawal as a percentage of total renewable water.

Brazil, Argentina and Mexico score low for micronutrient deficiencies. The continent's performance was somewhat negative overall for nutrition, with Mexico, Argentina, and Brazil scoring in the bottom half of the group overall. Mexico came 21st for micronutrient deficiencies and 20th for over-weight, indicating highly unequal nutritional pathways. Food loss was a further area of concern, with Brazil ranking 24th overall.

EUROPE

France tops the FSI ranking overall, largely supported by its holistic policy response to food waste and the high nutrition levels enjoyed by its population. Italy scores in the top tier for its policy response to food loss and is the best-performing European country for the low environmental impact of agriculture on the atmosphere. Germany leads the index for agricultural sustainability, in particular due to its water-withdrawal sustainability and relatively low usage of fertilisers and pesticides.



THE GULF REGION

Saudi Arabia and United Arab Emirates (UAE) rank worst for food waste, overweight, and obesity. Saudi Arabia (25th) and the UAE (22nd) scores among the lowest nations globally for food waste per person per year. Quantities of food wasted per person are highest in Saudi Arabia, at 427 kg, while the UAE averages 196 kg. These two countries also have the highest prevalence of overweight people with a body mass index (BMI) above 25, with the UAE ranking 25th and Saudi Arabia 24th.

SUB-SAHARAN AFRICA

African nations have the least transparent property-rights systems and the weakest protections for smallholders regarding land acquisitions. Smallholders dominate agricultural production in Sub-Saharan Africa, but in the three FSI countries they face challenges related to security of land tenure. Nigeria, South Africa and Ethiopia are the three lowest performers on quality of land ownership, which includes the degree of property rights protection and the existence of laws to protect smallholder farmers.

nutrition despite a decade of solid economic growth, and improved life expectancy across most countries, Ethiopia, Nigeria, Egypt and South Africa score in the bottom six for prevalence of under and malnourishment, and Ethiopia has the highest undernourishment as a percentage of the population of the FSI index. South Africa, despite being the most advanced economy in Sub-Saharan Africa, scores 21st out of 25 for prevalence of stunting among children, and prevalence of underweight among children.

ASIA

India's food system faces the most severe challenges of the group. India scores bottom of the ranking, with serious problems across all three pillars of the index. The most notable deficits are its unsustainable water usage trends, low-quality agricultural subsidies, and very poor nutritional outcomes, with high levels of stunting, underweight, and micronutrient deficiency, among children especially.

Japan tops the Asia group for nutrition and sustainable agriculture. Japan has the second strongest nutrition score, and ranks third for sustainable agriculture.

Japan has particularly high scores for the quality of its land ownership laws, the fifth lowest greenhouse gas emissions from agriculture, the fifth lowest fertiliser emissions from agriculture as a percentage of total emissions, the third lowest prevalence of overweight, and the lowest micronutrient deficiencies globally. Its main challenge is demographic: it has the oldest average age of farmers of the group, reflecting the country's older age profile.

Unstable land tenure is detrimental to global food security in several ways. By driving farmers away from their land, it prevents them from practicing agriculture and contributes to unsustainable levels of rural to urban migration, causing high levels of poverty amongst former farmers. It also deters farmers from long-term investments in land or from investing in costly yet productivity-boosting inputs. Transparent approaches to land deals and acquisitions, with clear benefits for affected communities, would help. Africa continues to struggle with under-

FINDINGS BY PILLAR

SUSTAINABLE AGRICULTURE

The world is running out of cultivable arable land: meeting the world's nutritional needs means reducing food waste, developing more sustainable techniques and technologies, improving the efficiency of the food system, and making careful choices about the use of land for food versus non-food crops.

The world has a finite amount of cultivable agricultural land. Much is already under cultivation or use, or suffering erosion or over-use, and the quest for 'new' land is leading to deforestation and displacement.

To feed a growing population we must reduce food loss and food waste and develop more innovative technologies and techniques. Countries and stakeholders must also make careful choices about the allocation of agricultural land for direct human foods as opposed to non-food crops, notably biofuels. In developing regions, institutional and infrastructure reforms can also help strengthen efficiency, including more transparent land rights, greater access to finance for the agricultural sector, and stronger infrastructure for storage, transport, and logistics, can help promote greater efficiency. Traditional forms of agroecological knowledge and practices among indigenous agricultural communities, especially on-farm/in-situ conservation and resource management strategies, can also play a role in the transition to more sustainable agriculture.

The agricultural sector must reduce logging and deforestation. Rates of deforestation are falling globally thanks to initiatives to regulate the logging sector. But increasing agricultural commodities output for food and non-food production is threatening this progress, with deforestation advancing to clear land to cultivate a range of crops and foods. Palm oil, soybeans, and beef, as well as non-food crops for biofuels, are particularly prominent drivers.

NUTRITIONAL CHALLENGES

Developing countries are experiencing “premature” obesity. Obesity rates are increasing in low and middle income countries, especially among children, even as these nations continue to experience hunger. They are therefore facing a double burden of hunger and obesity, with increases in obesity-linked diseases, including type 2 diabetes, cardiovascular disease and cancer. These countries do not currently have the public-health resources to tackle such diseases in conjunction with communicable diseases and their other developmental challenges. Policy options to tackle obesity include public education campaigns, tax measures on obesogenic foods and beverages, and restrictions on advertising of high-fat, high-sugar or high-salt food to children.

Micronutrient deficiencies are underestimated in many developing countries. While levels of hunger are declining globally, micronutrient deficiencies are very prevalent in developing countries and cause a range of diseases and disorders, including anaemia, stunting, and night-blindness. Public awareness campaigns—including those directed at government and public-sector stakeholders to ensure they understand the social and economic costs of micronutrient deficiencies—can help tackle the problem.

The “megacities” of developing nations are contributing to obesity. Urbanisation in developing countries is negatively influencing obesity rates. These megacities, with their congestion, pollution, poor road safety and lack of open spaces, are un conducive to physical exercise and increase people's exposure to unhealthy food marketing and processed foods. Urban planners need to take into account how the urban environment shapes lifestyle choices over food consumption and diet.

FOOD LOSS AND WASTE

Food loss and waste are ascending the policy agenda; holistic legislation can help strengthen efforts. Food waste has risen up the policy agenda globally and was included in the SDGs. One country, France, has a truly holistic policy framework for eliminating food waste. Its legislation includes legal obligations for supermarkets to donate excess food to charities, bans on expiration dates for certain categories of goods such as wine and vinegar, education at the primary school level, and tax incentives. Italy also scores highly in the index for its laws that incentivise food donation. Other countries can look to these for ideas and best practices on tackling food waste.

Food retailers are stepping up to the plate. The food retail industry is rising to the challenge of food waste through several measures: clearer expiration dates on produce, partnerships with charities to donate excess foods, and use of food waste as fuel are among the measures used by the leading food system stakeholders. But legislation, following France's lead, will help ensure these are not disparate and one-off initiatives but part of a comprehensive strategy to slash waste.

Food loss in emerging markets comes from a range of sources, including infrastructure deficits and vulnerability to environmental shocks. Poor road and transport systems, inadequate access to cool-chain technologies, inadequate storage facilities, and vulnerability to shocks such as pests and droughts are the drivers of food loss in developing countries.

CHAPTER 1: SUSTAINABLE AGRICULTURE

INDEX HIGHLIGHTS

Germany tops the FSI for sustainable agriculture performance, with high rankings for its water withdrawal sustainability and a relatively low usage of fertilisers and pesticides. Canada scored second, with high scores for the quality of agricultural subsidies, diversification of the agricultural system, and agricultural productivity.

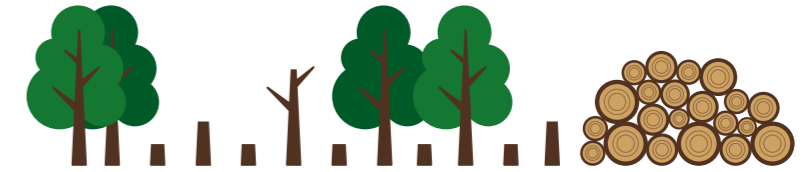
The lowest performers were, from bottom, India, the UAE and Egypt. For the UAE, water scarcity and limited biodiversity, along with a heavy environmental impact of agriculture on land, contributed to a low score. India's biggest agriculture challenges include unsustainable water management, and the negative environmental impact of agriculture on water. Quality of agricultural subsidies also scored low.

INDEX SCORE

RANK	COUNTRY	SCORE (OUT OF 100)
1	Germany	65.50
2	Canada	62.35
3	Japan	60.56
4	Australia	60.40
5	Russia	60.16
6	South Korea	60.02
7	Italy	59.81
8	United Kingdom	59.04
9	Colombia	59.01
10	Mexico	57.40
11	France	56.67
12	Brazil	56.15
13	Israel	56.02
14	Turkey	55.18
15	Argentina	55.00
16	Indonesia	53.87
17	China	51.97
18	Ethiopia	50.96
19	United States of America	50.73
20	Nigeria	49.34
21	Saudi Arabia	45.83
22	South Africa	45.60
23	Egypt	44.83
24	United Arab Emirates	41.39
25	India	40.51

Sustainable Agriculture

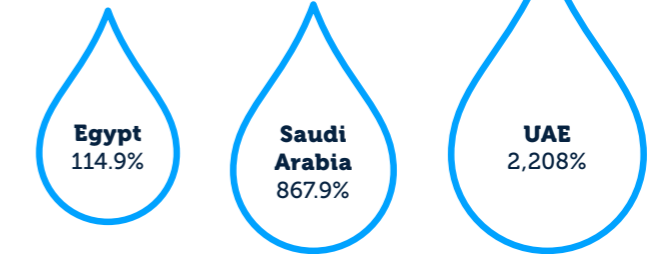
Competition for land
...for human food,
animal food and biofuels



Agriculture water withdrawal
(as a % of total renewable water resources)

Water Stress

3.9 billion people
in river basins face severe
water stress by 2050



Top 3 / Lowest 3 Performers
Sustainable agriculture

TOP PERFORMERS

1. Germany
2. Canada
3. Japan

LOWEST PERFORMERS

23. Egypt
24. United Arab Emirates
25. India

Responses



Conservation
of arable land



Reduced use of
fertilisers & pesticides



Efficiency
in water use



Investments in
agricultural knowledge,
science & technology

Technology Frontiers



Satellites



Big data



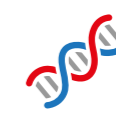
GPS-enabled
tractors



Sensors



Robots



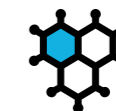
Genetic
modification



Drones



Vertical
farming



Synthetic
biology

Data from the Food Sustainability Index and index sources

PROMOTING SUSTAINABLE AGRICULTURE



Sustainable agriculture is understood to be the efficient production of safe, healthy, and high-quality agricultural products, in a way that is environmentally, economically, and socially sustainable. Such targets can be achieved by protecting the natural environment and its resources, and mitigating climate change; by improving the social and economic conditions of farmers, employees, and local communities; and by safeguarding animal welfare for all farm species. Productive and resource-efficient farming that is adapting to climate change needs to be implemented by parties through the following actions:

- Making biodiversity a priority, with special attention to diversity within and between habitats for its contribution in providing alternative food sources for beneficial insects and natural enemies of crop pests;
- Using 'green accounting' and 'virtual water' and other effective multi-criteria tools to estimate the value (monetary and non-monetary) of ecosystem services;
- Implementing agricultural practices that benefit decarbonisation and adapt to the constraints of climate change, such as carbon sequestration;
- Reforming agricultural subsidies, to consider the production capacity of farms and the degree to which their agricultural methods and local materials are sustainable, to preserve and enhance the multiple services provided by agriculture;
- Considering animal welfare issues, by implementing more sustainable husbandry practices that respect the five freedoms of animals;

- Encouraging the development of global indicators measuring the economic, environmental, and social performance of different farming systems and their impact on global sustainability targets;
- Investing in the human capital of farmers as stewards of the land, educating them about the economic and environmental benefits of sustainable agriculture;
- Striving to end land grabbing and to ensure land property rights, especially in middle- and low-income countries;
- Increasing the transparency of the food market, working on a regulatory framework for financial speculation on food commodities.

In relation to these actions, the Milan Protocol proposal also suggests:

- a) Limiting the portion of first generation biofuels from food crops in national renewable energy targets to 5%;
- b) Investigating the merits of relaxing or suspending biofuel mandates, especially at times of agricultural price pressures;
- c) Considering more sustainable ways to feed animals, such as pasture, grazing crops, agro-by-products (even from biofuel crops), or food waste;
- d) Reducing the use of antibiotics to a minimum to avoid resistance to antibiotics and/or threats to human health.



MEETING THE WORLD'S FOOD NEEDS

The global population is set to reach 8.1bn in 2025, with 95% of this growth occurring in developing countries. The population of Sub-Saharan Africa is expected to increase from 960m to 1.2bn, accounting for around 50% of global population growth, while Asia will contribute 40%.¹

This population growth will occur alongside growing wealth. Between 1970 and 2014 global GDP grew from US\$3.4trn to US\$76trn, led by Asia and the Pacific region (mainly China) with 6% growth.² GDP per capita grew by 83% in Asia and 30% in Africa over the same period.³

Economic growth has not only translated into longer and healthier lives for millions of people around the world, it has also created new challenges for the food system. Millions of people are undergoing a "nutrition transition", shifting their diets from cereals, fruits and vegetables, to more meat, sugar, fats and processed foods.⁴ This places pressure on the foundations of the food system because land, energy and water are inextricably linked in competition for space and resources.

"A growing number of people in the developing world are eating more calorie-intense and protein-intense diets, which is a substantial issue that the world is going to need to deal with," says Dr Jason Hill, associate professor at the University of Minnesota.

The expansion of the global middle classes is driving the conversion of forests to agriculture, says Duncan Brack, environmental policy analyst and associate fellow at Chatham House, a London-based think-tank. Livestock, to provide protein, is one driver of deforestation. "The richer you are, the more likely you are to eat meat," says Mr Brack. Livestock accounts for 17% of the world's calorie intake, but total land dedicated to animal feed, including pastures, permanent meadows and crops, accounts for 80% of the agricultural land.⁵ The Food and Agriculture Organisation (FAO), a United Nations agency, estimates that a 60% increase in global agricultural land will be needed to meet growing protein demand. Other estimates put that figure at over 100%.⁶ Dr Hill believes that protein production must double over the next 40 years to keep pace. Pasture expansion to enable production of beef is now responsible for more than three-quarters of land deforestation in Brazil, for instance.⁷

This robs the world of vital "carbon sinks" and increases methane emissions from the growing numbers of livestock—they emit between 8% and 18% of the world's total greenhouse gases. In the FSI, China and India receive the lowest scores for overall greenhouse gas emissions, with sources including machinery, fertiliser, pesticides, enteric fermentation, soil erosion and their burgeoning livestock sectors, which can create methane emissions and emissions related to the processes involved in growing animal feed crops.

¹ OECD. "Global Food Security: Challenges for the Food and Agricultural System". OECD Publishing, Paris. 2013. Available at: <http://dx.doi.org/10.1787/9789264195363-en>

² Food and Agriculture Organisation of the United Nations, "Global Trends in GDP and Agriculture Value Added (1970–2014)". August 2016. Accessed 2 September 2016. Available at: <http://www.fao.org/economic/ess/ess-economic/gdpagriculture/en/>

³ Food and Agriculture Organisation of the United Nations, "Global Trends in GDP and Agriculture Value Added (1970–2014)". August 2016. Accessed 2 September 2016. Available at: <http://www.fao.org/economic/ess/ess-economic/gdpagriculture/en/>

⁴ J Pretty. "Agricultural Sustainability: Concepts, Principles and Evidence". Philosophical Transactions of the Royal Society B: Biological Sciences 363.1491 (2008): 447.

⁵ HLPE. "Sustainable agricultural development for food security and nutrition: what roles for livestock?". HLPE, Rome. 2016.

⁶ OECD. "Global Food Security: Challenges for the Food and Agricultural System". OECD Publishing, Paris. 2013. Available at: <http://dx.doi.org/10.1787/9789264195363-en>; D Tilman, et al. "Global Food Demand and the Sustainable Intensification of Agriculture". Proceedings of the National Academy of Sciences 108.50 (2011): 20260–20264.

Meat is not the only food that has a high environmental impact. Palm oil and soy are also replacing some forested land, says Chatham House's Mr Brack. Palm oil is one of the most utilised ingredients in the food system, found in around half of all packaged products sold in supermarkets and a major crop in Malaysia, Indonesia, and increasingly also in West Africa, while soybeans and beef are drivers of deforestation in South America.⁸





Along with land, growing food production also puts pressure on available water. "Agriculture is the main user of freshwater on the planet," says Dr Tom Tomich, director of the US-based Agricultural Sustainability Institute. "Water demand from non-irrigation uses, such as domestic, industrial, and livestock, is projected to more than double

by 2050, with high demand coming from developing countries," notes Dr Shenggen Fan, president of the International Food Policy Research Institute in Washington, DC.





By 2030 the water demand from farmers is expected to increase by 45% as more shift from rain-fed to modern irrigation methods.⁹ Livestock places more strain on the world's water resources: a kilogram of beef takes 15,000 litres to produce.^{10,11} Meanwhile, some arid nations face particularly acute water stress when agricultural water withdrawal is measured as a percentage of their total renewable water, notably Egypt, Saudi Arabia and the UAE, whose agricultural sectors use over 100% of their available renewable water resources.

AGRICULTURAL WATER WITHDRAWAL AS A PERCENTAGE OF TOTAL RENEWABLE WATER RESOURCES

TOP PERFORMERS

	GERMANY	0.14%
	CANADA	0.16%
	COLOMBIA	0.27%
	RUSSIA	0.29%

LOWEST PERFORMERS

	ISRAEL	57%
	EGYPT	114.9%
	SAUDI ARABIA	867.9%
	UAE	2,208%

⁷ D Boucher, et al. "The root of the problem: what's driving tropical deforestation today?". The Union of Concerned Scientists publishing. 2011. http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/UCS_RootoftheProblem_DriversofDeforestation_FullReport.pdf

⁸ World Wildlife Fund, Retrieved from: <http://www.worldwildlife.org/pages/which-everyday-products-contain-palm-oil>

⁹ The Economist, "No Easy Fix", 24 February 2011. Accessed on 2 September 2016. <http://www.economist.com/node/18200678>

¹⁰ The Economist, "No Easy Fix", 24 February 2011. Accessed on 2 September 2016. <http://www.economist.com/node/18200678>

¹¹ M Herrer and P Thorton. "Livestock and global change: emerging issues for sustainable food systems" Proceedings of the National Academy of Sciences 110.52 (2013): 20878-20881.

LAND ACQUISITIONS

A further land-related challenge relates to land acquisition, especially overseas land acquisitions, which increased after the food price spikes of 2006–08. A number of countries, notably in the Gulf region, acquired land overseas to produce food for their home markets. The UAE, Israel and Saudi Arabia have the largest quantities of overseas arable land as a percentage of domestic arable land, according to the FSI.

In the process of acquiring overseas land, human rights organisations claim some populations are being displaced and dispossessed, or else the acquisitions lead to productive enclaves which export food while domestic populations go hungry. Such allegations were pronounced in Ethiopia, Sudan, Cambodia, and elsewhere.¹²

The issue was sufficiently grave as to incite 150 representatives of social movements, international organisations and governments to launch, back in 2011, the "Tirana Declaration". The signatories pledged to place "small-scale producers, agricultural labourers, indigenous peoples and landless rural and urban poor at the centre of efforts to overcome structural food and environmental crises".

"Whether these acquisitions help or harm rural populations depends on how the land is acquired, what it is being used for, and whether there is strong governance and policies to ensure that vulnerable members of society—particularly women and indigenous people—are not marginalised," says Kanayo Nwanze, president of the International Fund for Agricultural Development (IFAD). "We have seen that land acquisition associated with inclusive agricultural investments can result in significant and lasting benefits for small-scale producers and rural communities. Large-scale investors can offer developing countries much-needed capital, expertise, market access and employment. This, in turn, can contribute to lasting social and economic benefits for poor rural communities."

In the FSI, African nations have the least transparent property-rights systems and the weakest protections for smallholders on the matter of land acquisitions. Nigeria, South Africa and Ethiopia are three of the bottom five countries for property rights protection, and the bottom three in terms of policies to protect smallholders against land grabbing.

¹² European Parliament. "Addressing the Human Rights Impact of Land-grabbing", Directorate General for External Policies. 2014. [http://www.europarl.europa.eu/RegData/etudes/STUD/2014/534984/EXPO_STU\(2014\)534984_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2014/534984/EXPO_STU(2014)534984_EN.pdf)

TIME FOR “AGRI-TECH”?

It is clear that finding new land will not solve the food production problem but, thankfully, this was never the biggest driver of increased output. Production increases have tended to come from innovation rather than land expansion: 77% of the growth in crop production between 1961 and 2005 came from yield growth, and only 14% from the expansion of arable land.¹³

In rich countries, yield growth can come from technologies such as the emerging field of precision agriculture.^{14,15} Some developing nations can greatly increase agricultural growth through institutional reforms and infrastructure development. Consolidating smallholders' access to land, in particular, will incentivise producers to invest more in their plots. Improved infrastructure—covering transport and information infrastructures—can also bring large gains. Poor transport infrastructure limits the access of farmers to markets (local and international), which in turn makes them less likely to seek major yield growth.

While transport and information infrastructures are more serious challenges for smallholders than for larger agricultural players, experts agree that smallholder agriculture will remain critical for food output in developing regions, especially Africa and Asia. “In many emerging countries smallholder farmers play a big role in agricultural production—they provide up to 80% of the food supply in Asia, for example,” says Dr Fan. “However, smallholders are faced with several challenges, such as limited access to productivity-enhancing technologies and infrastructure and distorted land tenure systems, which impair agricultural productivity.” There are many technologies deployed in the agricultural sector today (see table).

¹³ J Bruinsma. “The Resource Outlook to 2050: By how much do land, water and crop yields need to increase by 2050?” In Expert Meeting on How to Feed the World in 2050. June 2009. pp. 1–33. <ftp://ftp.fao.org/docrep/fao/012/ak542e/ak542e06.pdf>

¹⁴ A Channing, et al, “Malawi’s farm subsidy benefits the poor but doesn’t come cheap”, The Conversation. 11 September 2015. Accessed 2 September 2016. <http://theconversation.com/malawis-farm-subsidy-benefits-the-poor-but-doesnt-come-cheap-46561>;

TECHNOLOGY FRONTIERS

GPS-enabled tractors
Sensors
Multispectral analysis
Drones
Satellites
Robots
Big data
Decision-support systems
Vertical farming

Precision agriculture (PA) is coming into greater focus. It incorporates remote sensors, GPS-enabled machinery and big data to record soil fertility disparities and growth rates, examine plants for problems and locate disease outbreaks. Based on this information farmers can more accurately and efficiently provide the necessary pesticide or nutrient to each plant, reducing the total amount used and thereby simultaneously saving money and minimising environmental harm.

Satellite imaging and data technologies are being applied to a growing range of agricultural sustainability problems, says Jill Kolling, senior director of sustainability at Cargill. “Satellite imaging technology helps monitor deforestation rates in the Brazilian Amazon and drones are being used on farms for crop imaging. We have also been testing the use of drones on our palm oil plantations in Indonesia to help monitor land use and aid yield intensification efforts.”

Farmers using PA are beginning to enjoy tangible results. German agriculturalists have reduced fertiliser application by 10-15% without reducing yield.¹⁶ Almost a quarter of British farms now use PA.¹⁷ Nesta, a think-tank, estimates that smart (GPS-enabled) tractors alone save British farmers

K Deininger and D Byerlee, “The rise of large farms in land abundant countries: do they have a future?”. World Bank Policy Research Working Papers. March 2011. <http://dx.doi.org/10.1596/1813-9450-5588>

¹⁵ W Klümper, M Qaim. A Meta-Analysis of the Impacts of Genetically Modified Crops. PLOS ONE. 2014. 9(11). <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111629>

£854 annually (about US\$1,000).¹⁸ American farm productivity has grown by almost two-thirds since the mid-1980s, when GPS first became available to farmers.¹⁹ GPS-enabled tractor use increased from 4% in 2004 to 83% in 2015, while aerial imagery (likely through drone use) has increased from 16% to 51%.²⁰ “Precision agriculture, including the use of satellites and sensors, helps farmers optimise their use of fertiliser and other inputs to maximise yields and reduce nutrient runoff,” says Jill Kolling.

In conclusion, land expansion alone will not suffice to feed a growing population. Much of the world’s fertile land is already under cultivation or usage, and the quest for “new” land is leading to deforestation and displacement. Technology will deliver the greatest gains. Precision agriculture, new seed varieties, synthetic biology and novel techniques such as aeroponic agriculture are among the many promising production innovations. In developing regions output can also be raised through institutional reforms, including clearer land rights, greater access to finance and stronger logistics infrastructures.

Increasing yields and productivity will have to reconcile with environmental sustainability and the preservation of farming communities, particularly in the global South. Investments in agricultural knowledge, science and technology (AKST) would respond to environmental concerns and at the same time ensure producers’ income, responding to growing pressures on natural resources, degraded soils and ecosystems, loss of biodiversity. Simple technology transfer, in fact, will not suffice if producers will not participate in selecting approaches that are appropriate to their specific circumstances and tailored to sustainability and development, further to productivity.

¹⁶ Directorate-General for Internal Policies “Precision agriculture: an opportunity for EU farmers – potential support with the CAP 2014–2020”. June 2014.

¹⁷ Directorate-General for Internal Policies “Precision agriculture: an opportunity for EU farmers – potential support with the CAP 2014–2020”. June 2014.

¹⁸ Nesta, “Precision agriculture: almost 20% increase in income possible from smart farming”. 9 October 2015. Accessed 2 September 2016.

¹⁹ L Whipker, J Akridge. “2006 Precision Agricultural Services Dealership Survey Results”. Staff Paper. 2006. pp 3–10.

GET VERTICAL: AEROFARMS

Perhaps the most advanced form of precision agriculture is a branch of production called aeroponics or vertical farming, where crops are grown in vertical stacks of plant beds using artificial sunlight, water, and soil. Sensors take in large amounts of data, allowing growth to be monitored and tweaked precisely.

AeroFarms, based in New Jersey, US, grows more than 20 types of leafy greens in rigidly controlled settings. LED lights mimic certain types of sunlight wavelengths, nutrient-rich mist is sprayed directly onto the roots of the plants, and sensors send over 30,000 data points to a central computer to be analysed and tweaked by algorithms. The firm believes that it will increase crop yields by as much as 70 times compared with traditional fields.

CEO David Rosenberg says: “AeroFarms grown crops are using 95% less water, 50% less fertiliser and zero pesticides, herbicides and fungicides,” while also “producing up to 30 annual harvests, compared to a traditional farm that may produce three harvests in a good year.” Other costs may be higher, however. LED lights are left on 24/7, which could generate up to ten times the carbon footprint of traditional farms.²¹ However, LED lighting is becoming more efficient: between 2012 and 2014 efficiency increased by 50% and is expected to increase another 50% by 2020.²²

²⁰ J Lowenberg-DeBoer. “The precision agriculture revolution”. Foreign Affairs. May/June 2015.

²¹ L Garfield. “Inside the world’s largest vertical farm, where plants stack 30 feet high”. Tech Insider. 15 March 2016. Accessed 2 September 2016.

²² US Energy Information administration. “LED light bulbs keep improving in efficiency and quality”. 4 November 2014. Accessed 2 September 2016.; US Energy Information Administration. “LED bulb efficiency expected to continue improving as cost declines”. 19 March 2016. Accessed 2 September 2016.

CHAPTER 2: NUTRITIONAL CHALLENGES

INDEX RESULTS

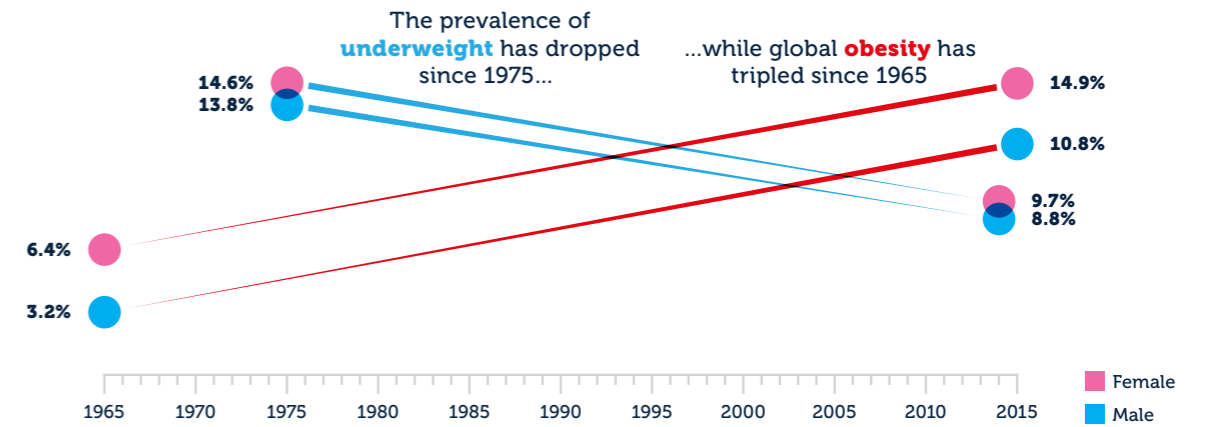
France, Japan and South Korea scores top in the index for nutrition. France's leadership position is driven by high rates of nutritional adequacy among its population and low rates of nutritional deficiency, including micronutrient deficiency. Japan's score partly reflects its low levels of micronutrient deficiency and low rates of obesity.

Countries with the biggest nutritional challenges are India, Nigeria and South Africa. India has a high rate of nutritional deficiency, and high prevalence of under- and malnourishment, while South Africa has a high adoption of fast foods, and limited purchasing power for buying healthy foods.

INDEX SCORE

RANK	COUNTRY	SCORE (OUT OF 100)
1	France	72.05
2	Japan	70.27
3	South Korea	69.60
4	Israel	66.98
5	Colombia	65.64
6	United Arab Emirates	65.55
7	United Kingdom	64.86
8	Italy	64.37
9	China	64.19
10	Canada	63.52
11	Germany	63.06
12	United States of America	60.44
13	Saudi Arabia	58.96
14	Ethiopia	58.60
15	Argentina	57.95
16	Australia	57.34
17	Brazil	57.03
18	Indonesia	56.79
19	Turkey	55.39
20	Russia	54.84
21	Egypt	54.57
22	Mexico	53.33
23	South Africa	53.22
24	Nigeria	52.91
25	India	45.04

Nutritional Challenges



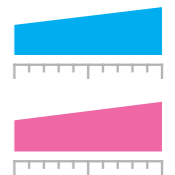
Undernutrition

Nutrition-related factors contribute to **45% of deaths** in children under 5.



Obesity & Overweight

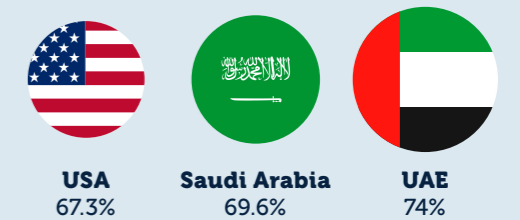
In developing countries, child and adolescent overweight has increased **8.1% to 12.9% in boys**, and **8.4% to 13.4% in girls**.



Prevalence of Undernourishment (% of population)



Prevalence of Overweight (BMI>25)



Top 3 / Lowest 3 Performers Nutritional challenges

- TOP PERFORMERS**
1. France
 2. Japan
 3. South Korea

- LOWEST PERFORMERS**
23. South Africa
 24. Nigeria
 25. India

Responses



UNDERNUTRITION



OBESITY & OVERWEIGHT

Data from the Food Sustainability Index and index sources

ERADICATING HUNGER AND FIGHTING OBESITY



Today 795 million people suffer from under nutrition globally,²³ while over 2.1 billion people²⁴ are obese or overweight, and the numbers continue to rise in epidemic proportions. The Milan Protocol recognised that it is necessary to account for differences and to develop more specific national targets.²⁵ Parties call for the eradication of hunger and undernutrition. The actions identified are:

- a) Following the new global paradigm for development, laid out in the SDGs, to:
 - Provide all populations with year-round access to adequate, safe, and nutritious food;
 - End undernutrition;
 - Make food production systems more productive, efficient, sustainable, and resilient; secure access for small food producers and youth.
- b) Endeavour to make equity intrinsic to economic development;
- c) End cyclical and chronic undernutrition through direct and indirect actions;
- d) Make undernutrition visible as a preventable crisis.

Parties also call for the implementation of actions to halt the rise in obesity, ensuring that there is no increase in childhood overweightness and no increase in adolescent and adult obesity by 2025. The SDG 3—to ensure healthy lives and promote well-being for everyone at all ages—and SDG 12—to ensure sustainable consumption and production patterns²⁶—affirm once again how human diet and nutrition, by their very nature, affect the well-being of people, and that eating well is a key factor to improved health. The actions identified have anticipated and are perfectly in line with the SDG targets to be completed by 2030, and include:

- a) To promote a culture of prevention on the role of nutrition for health, including among vulnerable populations, and encouraging responsible and healthy diets and lifestyles;
- b) To encourage physical activity as a crucial component to a healthy lifestyle;
- c) To improve food system governance.

The rise in overweight and obesity and their effect as risk factors for non-communicable diseases is an extremely urgent and serious issue that requires immediate intervention. The growing necessity for a balanced relationship with food calls for strategies to pursue food security goals and envision a new concept of well-being. It is a complex challenge that cannot be addressed in isolation. The BCFN encourages inter-ministerial collaboration for a holistic approach to nutrition and to deal effectively with the challenges on a regulatory level. Creating a common language is the first step in this platform of collaboration.

Food production is one of the three pillars explored in the FSI. Nutrition is equally important. Today two very different nutritional challenges face the world: continued hunger and malnourishment, and growing obesity and overweightness. Both have long-term consequences for public health systems, mortality, life chances and economic productivity. Sustainable Development Goal 2 pledges to end hunger and all forms of malnutrition by 2030. It also commits to universal access to safe, nutritious and sufficient food at all times of the year.

As Hannah Brinsden and Tim Lang reflect in their review of the Second International Conference on Nutrition in November 2014: “The societal awareness of the enormity of the food and health challenge is spreading... Even poor countries now acknowledge rising obesity. Concern about the tsunami of ‘non-food’ foods washing over the world and distorting diets also grows, fuelled by experience of the wiles of marketing.”²⁷

Hunger is thankfully a diminishing problem. Between 1975 and 2014 the prevalence of underweightness dropped from 13.8% in men and 14.6% in women to 8.8% and 9.7% respectively.²⁸ But undernutrition still contributes annually to the

deaths of more than 3m children under the age of five.²⁹ In 2010, 104m children across the world were underweight.³⁰ Countries like Indonesia (36.4%) and India (38.7%) suffer from especially high rates of “stunting”, or physical underdevelopment, even as they post impressive economic growth figures.³¹ In absolute terms, the number of hungry people in the world has dropped to 795m—a reduction of 216m compared with 1990-92.³²

However, it should be noted that these figures mask important nuances. Firstly, much of the reduction is the result of gains in specific, large countries (notably China). Secondly, while the number of individuals whose annual calories are inadequate may have fallen, some of those individuals may face periods of inadequate nutrition, for instance between harvests.

The FSI highlights India and Ethiopia as the lowest-performing nations for undernourishment (see table), and several fast-growing countries, or nations with a higher income level, are also affected. The scores for Sub-Saharan African nations are particularly low for stunting of children under five, with three of the bottom five countries hailing from the continent.

²³ World Food Programme data: Available at: <http://www.wfp.org/hunger>

²⁴ The Lancet. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet, Volume 384, Issue 9945, August 2014. Pp. 766–781.

²⁵ Massari, S. and Allievi F. (2016). The Milan Protocol: Challenges and Promises for a Better Future. Food Studies: An Interdisciplinary Journal, 6 (2), 1-13.

²⁶ Sustainable Development Goals. Available at: <http://www.un.org/sustainabledevelopment/development-agenda/>

²⁷ H Brinsden, T Lang. “Reflecting on ICN2: was it a game changer?”. Archives of Public Health. 2015. <https://archpublichealth.biomedcentral.com/articles/10.1186/s13690-015-0091-y>

²⁸ “Trends in adult body-mass index in 200 countries”. The Lancet. April 2016. [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(16\)30054-X/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)30054-X/abstract)

²⁹ “Nutrition: A quintessential sustainable development goal”. The Lancet. June 6, 2013. [http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(13\)61100-9.pdf](http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(13)61100-9.pdf), p. 371





³⁰ “Nutrition Challenges”. World Health Organization. 2016. <http://www.who.int/nutrition/challenges/en/>

³¹ “From Promise to Impact: Ending Malnutrition by 2030”. Global Nutrition Report. 2016. <http://eibrary.ifpri.org/utills/getfile/collection/p15738coll2/id/130354/filename/130565.pdf>, p. 120





³² “World hunger falls to under 800 million, eradication is next”, FAO media notice > Retrieved from: goal <http://www.fao.org/news/story/en/item/288229/icode/>







PERCENTAGE OF STUNTED CHILDREN UNDER 5: LOWEST PERFORMERS

	NIGERIA	32.9%
	INDONESIA	36.4%
	ETHIOPIA	40.4%
	INDIA	47.9%





PERCENTAGE OF STUNTED CHILDREN UNDER 5: TOP PERFORMERS

	GERMANY	1.30%
	AUSTRALIA	1.80%
	USA	2.10%
	S. KOREA	2.50%

PREVALENCE OF UNDERNOURISHMENT, % OF POPULATION: LOWEST PERFORMERS

	COLOMBIA	8.80%
	CHINA	9.3%
	INDIA	15.20%
	ETHIOPIA	32.00%

VITAMIN A DEFICIENCY, % OF POPULATION: LOWEST PERFORMERS

	MEXICO	29%
	NIGERIA	29.5%
	ETHIOPIA	46%
	INDIA	62%

China, one of the world's largest economies, receives the third-lowest score for undernourishment when taken as a percentage of the total population, and a number of middle-income countries are experiencing micronutrient deficiencies. Turkey, South Africa, Brazil, Mexico and Argentina all score in the bottom ten for vitamin A deficiencies, for example.

"Micronutrient deficiencies are definitely a misunderstood part of malnutrition and easily fixable," says Alison Cairns, external affairs director at Unilever. "Think about prevalence of night-blindness, which can be easily resolved by vitamins which can be added to mass market products, or anaemia and its link with girls' inability to be healthy enough to carry babies full term, or to go to school and get an education."

According to the World Health Organisation (WHO), 2bn people—around 30% of the world's population—suffer from anaemia, often due to iron deficiencies. In low-income areas this is worsened by infectious diseases. Among the lowest performers in the FSI are India, Ethiopia and Nigeria, but also middle-income countries such as Turkey and Mexico.

In the FSI, several middle-income or faster-growing emerging markets exhibited low performance on micronutrient deficiency. Turkey, Mexico, Argentina, Russia and Brazil all score in the bottom eight for micronutrient deficiencies, while the scores for lower-income nations, such as South Africa, Indonesia, China and Colombia, are higher, meaning they have lower levels of micronutrient deficiencies.

Undernutrition, and especially micronutrient deficiencies, is not just a challenge in developing countries. So-called "hidden hunger" manifests in the inadequate consumption of key micronutrients, including folic acid, vitamin D, vitamin E, iron and iodine, which can lead to impaired cognitive development, reduced immunity and increased childbirth risks, and poses health risks in developed economy settings as well as in middle-income ones.³³

To galvanise government departments, it may also be necessary to show the hard costs involved if the problem is not addressed. Research conducted in Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and the Dominican Republic estimated that child undernutrition had led to losses of US\$6.6m (total for the group) in 2004, driven largely by losses in productivity through the increased incidence of child mortality and lower educational attainment.³⁴

In Africa, similar research is taking place across 12 countries: Botswana, Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Malawi, Mauritania, Rwanda, Swaziland and Uganda. It shows that the annual cost of child undernutrition ranges from 1.9% to 16.5% of GDP.³⁵ "It was resulting in low productivity, low performance at school, low performance in terms of health indicators, and high medical bills," says Boitshepo Bibi Giyose, senior nutrition officer for policy and programmes in the nutrition division of the FAO. In the FSI group, healthy (disability-adjusted) life years due to nutritional deficiencies are highest in India, followed by Nigeria, China, and Ethiopia.

³³ S Muthayya, et al. "The Global Hidden Hunger Indices and Maps: An Advocacy Tool for Action". PLOS ONE. 2013. <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0067860>

³⁴ "The Cost of Hunger". ECLAC/WFP. http://documents.wfp.org/stellent/groups/public/documents/liaison_offices/wfp193127.pdf

³⁵ "The Cost of Hunger in Africa". World Food Programme. <http://www.costofhungerafrica.com/10-findings-of-coha/>

Inter-ministerial collaboration is critical to raise the profile of nutrition issues across government. Some experts recommend creating “free-standing” nutritional divisions, independent from the department of health. This autonomy would be important, Dr Giyose notes, because nutrition policymakers need to connect with so many different divisions. “You need someone at a higher level to be able to hold these different ministries and sectors accountable,” he says. “By pulling nutrition out of sector coordination it makes it much better. It can sit in the Ministry of Finance and Economic Development Planning, it can sit in the Prime Minister’s office.” This can help to bring together stakeholders, which remains a problem. “I think that the greatest challenge is alignment of multiple stakeholders: government, donors, NGOs, and civil society,” notes Stefanus Indrayana, head of corporate communications at Indonesia-based Indofoods.

DISABILITY-ADJUSTED LIFE YEARS DUE TO NUTRITIONAL DEFICIENCIES: LOWEST PERFORMERS

	ETHIOPIA:	2,799
	CHINA:	3,673
	NIGERIA:	7,099
	INDIA:	19,731

Public awareness campaigns are also needed, as the problem of micronutrient deficiency is not well understood. Catchy slogans and phrases could help. “In the West we talk about the importance of breakfast and five a day,” says Unilever’s Alison Cairns. “In other parts of the world there is a lack of understanding about the importance of good nutrition.” Education programmes focused on women and girls are especially critical. Maternal education has a large and direct impact on the nutritional status of children, offering a way to tackle problems of undernutrition early. “Education is a form of empowerment for women,” says Dr Anna Lartey, director of the nutrition and food systems division at the FAO. “It doesn’t only benefit themselves, it trickles down to the whole family for generations to come.”

Finally, there are apparently indirect issues that can also help improve nutritional outcomes. Most prominent among them is sanitation, where progress has stalled or even reversed, notably in parts of Sub-Saharan Africa. Poor sanitation causes malnourishment or undernutrition even in the absence of poverty as a result of diarrhea and other illnesses. “Child growth is also affected by infections,” says Bonnie McClafferty of the Global Alliance for Improved Nutrition. “You could have a very sufficient household from a food perspective, but yet there’s stunting because of inadequate hygiene practices or other complicated factors that come with poverty.”

³⁶ “Obesity Update”. OECD. June 2014. p.2. <http://www.oecd.org/els/health-systems/Obesity-Update-2014.pdf>

³⁷ “From Promise to Impact: Ending Malnutrition by 2030”. Global Nutrition Report. 2016. p.19. <http://ebrary.ifpri.org/utills/getfile/collection/p15738coll2/id/130354/filename/130565.pdf>

³⁸ “Report of the commission on ending childhood obesity”. WHO. 2016. p.2. http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf

³⁹ N Fleming, et al. “Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013”. The Lancet. Aug 30 2014. 384(9945):766-81. <http://www.ncbi.nlm.nih.gov/pubmed/24880830>

FROM TOO LITTLE TO TOO MUCH

As global hunger is receding, obesity is on the rise, driven by developing countries, which as a result are facing a greater prevalence of obesity-linked, non-communicable diseases (NCDs) including cancer, stroke, cardiovascular diseases and type 2 diabetes.

Globally, the prevalence of obesity has tripled since 1965, from 3.2% in men and 6.4% in women to 10.8% and 14.9% respectively. Just over 2% of men and 5% of women are now severely obese, and more than half of all adults in the 35 (mostly developed) OECD member states are overweight. In the US, 36.6% of women and 33.9% of men were obese by 2012.³⁶

Although obesity rates are higher in rich countries, the number of overweight children under five is now growing fastest in Asia,³⁷ while in Africa the number of overweight or obese children has doubled since 1990.³⁸ Oman, Saudi Arabia, Bahrain and Egypt are

experiencing a rapid increase in obesity levels, and the situation on the Pacific Islands is an emergency, experts say. Yet obesity can be tackled through reducing food intake and increasing physical activity levels. A global review of obesity trends from 1980 to 2013 came to a sobering conclusion: “No national success stories have been reported in the past 33 years.”³⁹

To the casual observer the rise in obesity in developing countries could be considered a sign that people are growing wealthier. But the picture is more complex. Obesity seems to be increasing at earlier stages in the “developmental cycle” of these countries than is the case in their rich-world counterparts. As a result, low- and middle-income countries are facing a dual healthcare load of non-communicable and communicable illnesses. This comes with a huge economic cost.



FOOD INEQUALITY: MEXICO, SOUTH AFRICA AND INDIA

A cluster of emerging markets in the FSI group stand out for stark “food inequality” dynamics: the simultaneous existence of high rates of undernourishment and obesity/overweightness.



India has shot up the global obesity rankings but also suffers a significant prevalence of underweight in women and men.⁴⁰ India is now home to more than one-third of the world’s stunted children, but obesity is on the rise in the middle and affluent classes.⁴¹ As early as 2002 researchers observed a “parallel rise in malnutrition and obesity”, in which neither the rich nor the poor were eating well.⁴² Studies found that between 1996 and 2006 the prevalence of underweight remained high, while overweight and obesity among women of reproductive age rose.⁴³ According to the International Diabetes Federation,

more than 65.1m people live with diabetes in India,⁴⁴ surpassing the World Health Organisation’s 2002 projected estimate.⁴⁵ In 2014 it was placed second among the world’s countries with the largest number of adults with diabetes, at 64.5m (or 15.3% of global diabetes sufferers).⁴⁶ In the FSI, India has the lowest score for the prevalence of undernourishment and malnourishment and the second-lowest score for micronutrient deficiency, yet its score is higher than those of several affluent countries (Japan, the UAE, and France) for prevalence of overweight among children.

Mexico leads an OECD ranking for obesity in women (37.5%).⁴⁷ However, a recent study on Mexico found that among children under the age of five there is a 13.6% occurrence of stunting, and 23.3% are anaemic. The researchers found an alarming rise in overweight and obesity across all ages and socioeconomic groups.⁴⁸ Among school-age children 34.4% were overweight or obese and 7% were stunted, with obesity/overweightness and stunting co-existing in 1% of children. The Mexican government has launched a strategy to tackle the problem by raising awareness, providing better medical care for chronic illnesses, and through regulatory and fiscal measures. In 2014 Mexico introduced a 10% tax on high-sugar drinks and an 8% tax on categories of unhealthy foods.⁴⁹ When

the Mexican government launched its Crusade against Hunger programme, it emphasised the need to tackle food insecurity. But the policy overlooked the fact that seven out of ten adults and one out of three children in Mexico were overweight or obese, including in the impoverished populations the programme targeted. Researchers say the programme is slowly evolving to take overweightness and obesity into account.⁵⁰ In the FSI, Mexico is 18th out of 25 for prevalence of overweight in children, scoring worse than affluent economies, including Saudi Arabia, Canada, and Germany. Yet for undernourishment the country also scores weakly, at 19th out of 25 for prevalence of stunting and 22nd out of 25 for vitamin A deficiencies.

In **South Africa** one-third of child deaths are caused by undernutrition, and stunting is present in more than one-quarter (27%) of children under five.⁵¹ In the FSI, South Africa scores very low for nutrition overall, at 23rd. It scores low for vitamin A deficiencies. Yet most South African adults (53.9%) are overweight or obese. South Africa is “at a crossroads”, according to Boitshepo Bibi Giyose, senior nutrition officer for policy and programmes in the nutrition division

of the Food and Agriculture Organisation. “On the one hand the country is grappling with serious stunting, serious wasting, serious underweight, but we are also struggling with adults and even children who are overweight and sometimes morbidly obese. The question is: How does such a country balance its budget to make sure that it addresses the under-side and the over-side?”

⁴⁰ S Bhattacharya. “India has a growing obesity problem, study shows,” Wall Street Journal, April 16, 2016, <http://blogs.wsj.com/indiarealtime/2016/04/04/india-has-a-growing-obesity-problem-study-shows/>

⁴¹ “From Promise to Impact: Ending Malnutrition by 2030”. Global Nutrition Report. 2016. p.3. <http://ebrary.ifpri.org/utills/getfile/collection/p15738coll2/id/130354/filename/130565.pdf>

⁴² “India sees parallel rise in malnutrition and obesity,” The Lancet, December 2002, p. 1948 [http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(02\)11943-X.pdf](http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(02)11943-X.pdf)

⁴³ Y Balarajan, E Villamor. “Nationally Representative Surveys Show Recent Increases in the Prevalence of Overweight and Obesity among Women of Reproductive Age in Bangladesh, Nepal, and India”. The Journal of Nutrition. 2009. <https://www.ncbi.nlm.nih.gov/pubmed/19776182>

⁴⁴ “India: Did you know?” International Diabetes Federation. 2015. <http://www.idf.org/BRIDGES/map/india>

⁴⁵ “WHO has warned India that the number of people with diabetes could increase from 19 m today to 60 m by 2025”. P Chatterjee. “India sees parallel rise in malnutrition and obesity”. The Lancet. 2002. <https://www.ncbi.nlm.nih.gov/pubmed/12493270>

⁴⁶ “Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants,” The Lancet. April 2016. [http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(16\)00618-8.pdf](http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(16)00618-8.pdf)

⁴⁷ “Obesity Update 2014” OECD. <http://www.oecd.org/health/Obesity-Update-2014.pdf>

⁴⁸ M Kroker, et al. “The double burden of undernutrition and excess body weight in Mexico”. American Journal of Clinical Nutrition. 2014. <http://ajcn.nutrition.org/content/100/6/1652S.long>

⁴⁹ “The Mexicans dying for a fizzy drink”. BBC. 2 February 2016. http://www.bbc.com/news/magazine-35461270?ocid=socialflow_facebook&n_s_mchannel=social&n_s_campaign=bbcnews&n_s_source=facebook

⁵⁰ M Kroker, et al. “The double burden of undernutrition and excess body weight in Mexico”. American Journal of Clinical Nutrition. 2014. <http://ajcn.nutrition.org/content/100/6/1652S>.

⁵¹ “Nutrition at a glance: South Africa”. World Bank. <http://siteresources.worldbank.org/NUTRITION/Resources/281846-1271963823772/southafrica.pdf>

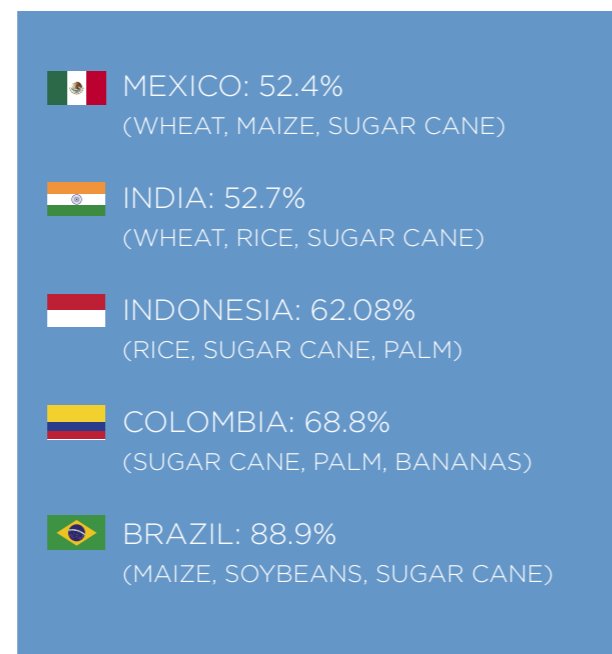
This troubling coexistence of overweight and underweight people is not just happening within countries, but also within individuals over the life cycle, says Barbara Burlingame, professor of public health and nutrition at Massey University, New Zealand. “For example, in children we have examples of concurrent stunting, which is low height for age, and obesity,” she says, raising an issue that has been noted by various studies.⁵²

“They’re connected; it’s not just a coincidence of two separate phenomena,” says Francesco Branca, director of nutrition for health and development at the WHO. “A child who is born with low weight for gestational age, or has poor growth in the first months of life, is also more susceptible to develop obesity, hypertension and diabetes later in life. Malnourished fetuses or children are primed to cope with a shortage of nutrients but are later exposed to an environment which has foods high in fats, salt and sugar, and therefore they are more prone to develop obesity.”

Obesity is profoundly shaped by the individual’s environment. Availability, convenience and affordability of unhealthy foods are all powerful factors. The food system is currently better organised for producing and distributing processed foods than perishable fresh foods. Modern agricultural production favours large-scale mono-agricultural crops such as sugar or maize, and in 2013 the top five foodstuffs produced globally were sugar cane, maize, rice, wheat and potatoes.⁵³ In the FSI group, Latin America stands out as having the largest number of countries with a high dependence on a small number of crops.

The emergence of increasingly complex “capillary” global distribution systems favours highly processed foods with a long shelf-life, which are more profitable to store and sell than fresh food products. Growing wealth leads to an increase in the amount of processed foods consumed, according to Mr Brack at Chatham House, partly because processed foods are combined with urbanisation. “So people are less likely to grow their own food, and they buy it from somewhere. If it’s processed, that means it lasts longer in the supply chain, so it’s easier to transport and store than fresh food.”

SHARE OF TOP THREE CROPS IN TOTAL AGRICULTURAL PRODUCTION



“In several high-income countries, such as the UK or the US, more than 60% of the foods we consume are high in salt, sugar and fat, what the Brazilian scientist Carlos Monteiro calls ‘ultra-processed foods,’” explains Dr Branca at the WHO. “Changes in food systems are now driving a rapid increase in the consumption of such foods in developing lower- and middle-income countries.” High-sugar drinks have been on the rise in many middle-income developing countries and are considered a high-risk product for obesity. In developing countries, where food contamination and pollution is a continual fear, there may also be a preference for processed over naturally occurring foods.

A second environmental factor is reduced physical activity levels due to changing working and living patterns. As the middle classes expand in developing countries more people work in office-based jobs, and technology has replaced many manual tasks. The growing prevalence of mobiles, computers, and tablets across all income groups is resulting in increased hours of sedentary ‘screen time’.

Emerging market major cities, especially ‘mega-cities’—defined as metropolitan areas with a population of over ten million—are particularly uncondusive to exercise. Characterised by crowded urban ‘sprawl’ effects, they rarely have public spaces for physical recreation, and climate in developing countries tends to be far hotter and more humid than developed countries. Other factors limiting physical activity in these locations include crime and road safety for those wishing to cycle, walk, or run. Traffic accidents are a major cause of mortality in developing countries. “A lot of structures are being built whose designers don’t consider the possibility of putting parks or physical activities into the lifestyles of people,” Dr Lartey says.

Cities are hotbeds of advertising for unhealthy products, with a growing prevalence of fast food restaurants. In developing countries fast food brands are often viewed as status-symbols. “In the past we had the dogma in nutrition that it is very difficult to change people’s eating behaviours and dietary habits. It is not,” Professor Burlingame says. “You bring a fast-food restaurant into a community that has never seen fast food before, and instantly there is a brand new dietary pattern.”



⁵² Concurrent stunting and obesity in children has been documented in Mexico, and other developing countries (e.g. European Journal of Clinical Nutrition. 2007. 61, 623–632. doi:10.1038/sj.ejcn.1602558. <http://www.nature.com/ejcn/journal/v61/n5/full/1602558a.html>)

⁵³ “Statistical Pocketbook, World food and agriculture 2015”. FAO. 2015. <http://www.fao.org/3/a-i4691e.pdf>

FIGHTING THE FAT

While some people have a strong genetic predisposition to obesity, it is most commonly caused by personal choices and environmental factors. As such, it is complex for governments, policy makers, or health organisations to combat. Even benign efforts to ‘nudge’ people to make better choices have led to vocal debates over the ‘nanny state’. But it’s also true that, without regulation, people are simply being influenced by the marketing environment they are immersed in.

What options do governments and health organisations have at their disposal? “We need to have interventions that address both the supply side and the demand side,” says Dr Branca. “We need to reduce the availability of highly processed foods, high in salt, sugar, and fat, and improve the availability of fresh products, particularly wholemeal cereals, fruit and vegetables, and water. At the same time, we have to act on the demand side by introducing measures on marketing, labelling of products, and price policies, as well as information for consumers.”

Soft measures include awareness-raising campaigns through the media, which are sometimes led by governments but also by companies wishing to align themselves with the health agenda. Harder measures include taxing sugary drinks, banning child-focused food advertising, regulating food contents (notably sugar and salt), and mandating food labelling to guide consumer choices.

While companies are pressed to abide by regulations on a country-by-country basis, others are beginning to think globally about healthier product development. “In a new market, whether or not there is regulation that requires us to have a certain percentage reduction in salt in our products, for instance, we want to be practicing that regardless,” says Unilever’s Ms Cairns. “That means there is a role to play in bringing the rest of industry with us to create a fair playing field.”



FOOD LABELLING

Governments and regulators have multiple options to choose from, each with strengths and weaknesses, when it comes to labelling foods for nutritional content. These include:

Guideline Daily Amount (GDA) notifications inform consumers about the percentages of recommended daily nutritional intake of a product, varying across gender and sometimes age group.

Traffic lights alert readers to fat, sugar, and salt contents through red, amber, and green colours.

Health stars and badges (Australia, Singapore) reward healthy foods without penalising less healthy ones.

Activity-equivalent calorie labelling⁵⁴ indicates how much exercise is required to burn off the calories of the product, and are a more recent innovation.

The exact approach to labelling is the outcome of a country-specific negotiation between the interests of industry, government, and health organisations, and different approaches have benefits and drawbacks. Ultimately, the key is to make sure labels are clear, concise, and understandable for consumers at all literacy and education levels. Too many countries have food labelling systems which consumers do not properly understand.⁵⁵

Colour-coded ‘traffic light’ systems have been positively received by health experts and perform well in comparative studies.⁵⁶ In August 2014 Ecuador introduced traffic light food labelling, with the support of Unicef and the Pan-American Health Organisation, aiming to target child obesity.⁵⁷ The UK also launched a colour-coded traffic light system in 2013,⁵⁸ drawing attention to how much fat, salt, sugar, and calories each product contained. Although big supermarkets embraced the colour code, it is not a legal requirement.⁵⁹ The traffic light system has, though, been criticised in terms of the science underpinning its methodology and a perceived unfair penalisation of some foods.⁶⁰

Similarly, earlier this year Chile introduced a law requiring that products containing more than 275 calories, 500 mg of salt, 10g of sugar, or 4g of saturated fat per 100g⁶¹ should carry a black label with a warning. However, there have been complaints that such systems unfairly stigmatise particular food types and overlook important questions about context and overall diet. Italian scientists and politicians noted that products common in the fabled Mediterranean diet, including salami, prosciutto and cheeses, fare poorly under the UK system.⁶²

⁵⁴ “Introducing ‘activity equivalent’ calorie labelling to tackle obesity”. RSPH. January 2016. <https://www.rsph.org.uk/asset/AF749523-C2E0-4871-90EC35AF4D159160/>

⁵⁵ J Yodtheun, et al. “National survey in use of GDA nutrition labeling 2012”. The 7th Thailand Congress of Nutrition BITEC Bangkok. 2013. Cited in: <http://www.sciencedirect.com/science/article/pii/S0306919215000998#b0395>

⁵⁶ “‘Traffic-light’ nutrition labelling and ‘junk-food’ tax: a modelled comparison of cost-effectiveness for obesity prevention”. International Journal of Obesity. 2011. 35.7. <https://www.ncbi.nlm.nih.gov/pubmed/21079620>

⁵⁷ “UNICEF Annual Report 2014: Ecuador”. UNICEF. http://www.unicef.org/about/annualreport/files/Ecuador_Annual_Report_2014.pdf

⁵⁸ “New colour-coded food nutrition labels launched”. NHS Choices. 2013. <http://www.nhs.uk/news/2013/06/June/Pages/universal-colour-coded-food-nutrition-labels.aspx>

⁵⁹ “Food ‘traffic light’ labelling should be mandatory, councils say,” BBC News. September 17 2016, <http://www.bbc.com/news/health-37389804>

⁶⁰ L Davies. “Italy claims ‘traffic-light’ labelling unfair on Mediterranean food”. The Guardian. October 21 2013. <https://www.theguardian.com/world/2013/oct/21/italy-traffic-light-food-labels-unfair>

⁶¹ “Chile seeks to fight obesity with new food labeling law”. Voice of America. June 28 2016. <http://www.voanews.com/a/chile-seeks-to-fight-obesity-with-new-food-labeling-law/3395681.html>

⁶² L Davies. “Italy claims ‘traffic-light’ labelling unfair on Mediterranean food”. The Guardian. October 21 2013. <https://www.theguardian.com/world/2013/oct/21/italy-traffic-light-food-labels-unfair>

As the world becomes ‘smaller’, countries have greater access to information about, and data on, policy approaches to fighting obesity. Governments can look to the experience of their peers to benchmark themselves and gain ideas, lessons, and best practices for obesity interventions. “Countries are looking to other countries in terms

of what products are available, what formulations are available, and what is going on in the broader regulatory environment,” Ms Cairns says. “Latin America is an example, where demand for certain types of food labelling began in Colombia and started spreading like wildfire.”

CHILD NUTRITION: FOCUS ON THE FIRST 1,000 DAYS

From hunger to obesity, one principle is clear: the first thousand days of life—from conception until a child is almost three—are the most critical, from a nutrition standpoint, to a long-term healthy weight. Thus, nutritional questions into underweightness and obesity need to focus on this window.

Battling nutritional deprivation in the womb and promoting exclusive breastfeeding are essential. Babies born to nutrition-deprived mothers are not only born underweight but develop a survival mechanism that enables them to preserve energy. If a foetus is malnourished in the womb, Dr Lartey explains, “it may either die or, to survive, that foetus must go through some compromises so that essential nutrients can be diverted to critical areas of the body.” Typically, a foetus sends essential nutrients to the brain, protecting that critical organ at the expense of other tissues or muscles. Its response to undernutrition may also lead to changes in metabolism and in the placental hormones, which regulate growth.⁶³ These changes increase the child’s susceptibility to non-communicable diseases as an adult—what is known as the foetal origins of adult diseases, Dr Lartey says. Malnourished children will thus face potentially lifelong physical development deficits.

Once born, a further key nutritional phase, which is most notably for obesity and overweight prevention, is exclusive breastfeeding for the first six months. Breast milk transmits a mother’s immune response to the infant, along with prebiotics that encourage

the growth of beneficial bacteria—a sort of unique, personalised medicine.⁶⁴ Breastfeeding also instils behaviours that fend off obesity because children who are breastfed have to suck, an effort that leaves them better able to control their appetites, says Dr Branca. “The child drinking of infant formula with a bottle is less able to do that. The longer a child is breastfed, the lower the risk of obesity. Eventually children who are formula-fed have a higher energy intake and grow bigger than children who are breastfed.”

Breastfeeding is one of the few positive health behaviours more prevalent in poor than in rich countries, with 37% of children younger than six months of age exclusively breastfed⁶⁵ (in most wealthy countries the figure is less than 20%). But exclusive breastfeeding is declining. This could have knock-on effects on obesity due to the weight implications of formula-based products.⁶⁶ A number of health bodies, including UNICEF,⁶⁷ the UN’s children’s fund, have raised concern about the apparent fall in exclusive breastfeeding in developing countries over recent years, and implementation of the WHO’s code on the marketing of breast milk substitutes is unevenly observed.⁶⁸ “It’s also a cultural issue,” Dr Branca explains. “Improving the culture about breastfeeding in the public is something we need to do. There are a lot of prohibitions and taboos about breastfeeding in a restaurant or public space and we need to see breastfeeding becoming a cultural norm.”

SCHOOL FEEDING PROGRAMMES

While the first 1,000 days are the most critical nutritional window for long-term child health, the rest of childhood continues to be a time in which healthy practices can be laid down and poor nutrition, providing either too little energy or too much, can still have deleterious consequences. While children cannot be forced to eat a given diet, there are more opportunities to positively influence a child’s diet compared to when they reach adolescence and school-leaving age. Schools are one of the few places where government and health organisations can directly influence eating and physical activity. Several countries have used school meals as a platform to achieve major gains in improved nutrition. For example, Thailand deployed a highly successful free school-lunch programme which offered free lunches to the most in-need students in 30,000 public primary schools. Thailand’s child malnutrition rate fell from 18% in 1992, the start of the programme, to 8.42% in 2005.

In Brazil, school feeding programmes have also won plaudits for the nutritional gains and the wider benefits of the procurement systems set up, with quality foods procured from family farms.⁶⁹ They sought to provide nutritious meals to vulnerable children, but the model can also include school gardens and nutrition education, to form lifelong healthy eating habits. Dr Giyose notes the programme’s range: “They invested quite heavily in child undernutrition, in malnutrition overall.”



⁶³ D Barker. “The malnourished baby and infant”. British Medical Bulletin. 2001. <http://bmb.oxfordjournals.org/content/60/1/69.full>

⁶⁴ “Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect”. The Lancet. January 2016. p.486. [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)01024-7/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)01024-7/fulltext)

⁶⁵ “Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect”. The Lancet. January 2016. p. 487. [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)01024-7/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)01024-7/fulltext)

⁶⁶ J Zheng, et al. “Exclusive breastfeeding is inversely associated with risk of childhood overweight in a large Chinese cohort”. The Journal of Nutrition. 2014. 144(9). p.1454-9.

⁶⁷ “UNICEF Rings Alarm bells as Breastfeeding Rates Plummet in East Asia”. UNICEF, Thailand. 2012. http://www.unicef.org/thailand/media_18626.html

⁶⁸ “Report of the commission on ending childhood obesity.” WHO. 2016. p. 27. http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf; J Brady. “Marketing breast milk substitutes; problems and perils throughout the world”. Archives of Disease in Childhood. 2012. 97: pp. 529–532. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3371222/>

⁶⁹ “Strengthening School Feeding Programmes in the Framework of the Zero Hunger Initiative in Latin America and the Caribbean 2025”. Food and Agriculture Organisation of the United Nations. <http://www.fao.org/in-action/program-brazil-fao/projects/school-feeding/en/>

CHAPTER 3: FOOD LOSS AND WASTE

INDEX FINDINGS

France leads the index on food loss and waste, driven by its holistic approach which includes mandates for education and new business practices. On a per capita basis, Saudi Arabia, Indonesia, the US and the UAE have the highest food waste per person.

Food waste in developed countries largely occurs at the retailer and consumer level, while in developing countries it primarily results from losses at the farm and pre-market stage, due to droughts, natural shocks, poor road infrastructure and lack of storage and refrigeration facilities.

INDEX SCORE

RANK	COUNTRY	SCORE (OUT OF 100)
1	France	80.25
2	Australia	76.30
3	South Africa	75.70
4	Ethiopia	74.19
5	Canada	72.57
6	United States of America	71.97
7	Japan	71.64
8	United Kingdom	71.56
9	Italy	69.96
10	Nigeria	66.75
11	Germany	66.19
12	China	55.15
13	South Korea	54.85
14	Israel	54.17
15	Mexico	53.05
16	Colombia	50.81
17	Argentina	50.21
18	Egypt	45.46
19	India	44.76
20	Turkey	43.68
21	Russia	38.71
22	Brazil	32.94
23	United Arab Emirates	32.55
24	Indonesia	32.53
25	Saudi Arabia	27.56

Food Loss and Waste



Largest food wasters
(per person per year)



Saudi Arabia
427kg



Indonesia
300kg



US
277kg



UAE
196kg

Methane from food in landfills is
21 times more damaging
than CO₂

Reducing US food waste by 20% over 10 years would cut
18 million tons
of greenhouse gases annually

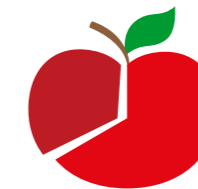
In **rich countries**, consumers waste most food



In **developing countries**, food losses occur before reaching the consumer



One third of the world's food,
1.3 billion tonnes
is lost or wasted at a cost of
\$750 billion
every year



Meanwhile,
795 million people
are going hungry



The carbon footprint of food waste accounts for about
3.3 giga-tonnes
of greenhouse gas emissions,
which is equivalent to one third of
annual emissions from fossil fuels



If **one quarter** of the food currently lost or wasted were saved, it would be enough to feed the world's hungry

Top 3 / Lowest 3 Performers
in reducing food loss & waste

TOP PERFORMERS
1. France
2. Australia
3. South Africa

LOWEST PERFORMERS
23. United Arab Emirates
24. Indonesia
25. Saudi Arabia

Responses

BEST BEFORE
-- / -- / --

Clearer expiration
date labels



Donations from
food retailers



Consumer
education



Reduction of
food losses

Data from the Food Sustainability Index and index sources

HALVING FOOD WASTE



Every year, 1.3 billion tonnes of edible food are wasted, an amount that represents one-third of global food production, or four times the amount needed to feed the 795 million³ people suffering from undernutrition worldwide.

Food waste is growing globally at alarming rates.

There is enough food on this planet: it is a matter of redistributing it to guarantee equal access, and of reconsidering the sustainability of our production.

Awareness of the problem is rising, as well as the number of organizations and community groups working toward its prevention. The focus should be primarily on avoiding food waste, and secondly on how to best dispose of it. A hierarchy based on the use of food, privileging policies, and initiatives that prevent waste and promote the reuse of food for human nutrition, should guide combined efforts.

The time is now ripe for a global change, and the Milan Protocol has put forward a call to all stakeholders of the food system, from producers to consumers, recognizing that everyone has the responsibility and the opportunity to reduce food loss and waste.

The SDG 12—responsible production and consumption—calls for halving the amount of food wasted at the consumer and retail level by 2030. The Milan Protocol called for a reduction in food waste by implementing the following actions:

- a) Agree on a common definition of food loss and food waste;
- b) Give priority to policies that aim to reduce food waste by addressing the causes of the phenomenon and follow a hierarchy for the use of food, since keeping track of the nature of food loss and waste is essential to eliminating hunger globally;

- c) Recognize the positive contribution of cooperation and long-term food chain agreements (between farmers, producers, and distributors) to allow for better planning and projections of consumer demand;
- d) Provide support to generate awareness-raising initiatives, including those from professionals in the food sector.

For several years the BCFN has been committed to better understanding food loss and waste issues at every level of the food supply chain. In 2012, involving academics and experts, BCFN released its first position paper providing an exhaustive appraisal of the phenomenon. Thanks to its updated data on the underlying food loss and waste causes, and by analysing the environmental, economic, and social impacts, the report provided some recommendations:

- to analyse the phenomenon there should be a clear definition of the terms ‘food loss’ and ‘waste’ and a harmonization of statistical data;
- to understand its causes along the entire food supply chain;
- the priority should be to reduce food waste before thinking of its possible re-use;
- the importance of cooperation and long-term food chain agreements between farmers, producers, and distributors should allow for better planning and projections of consumer demand;
- awareness-raising campaigns and educational initiatives should be encouraged, to make people more aware of the phenomenon and its impacts.

Efforts to promote sustainable agriculture and balanced nutrition also require attention to the full food cycle, which means tackling food waste (by retailers and consumers) and food loss (from harvest to market, including farmers and retailers).

According to the World Wildlife Fund, one third of all food produced goes to waste—1.3 billion tonnes perish on the farm, are lost or become inedible during distribution, or are thrown away in food retail stores, restaurants, and kitchens.⁷⁰ This is about four times the amount of food needed to feed nearly 800m people on the planet who are undernourished. The carbon footprint of food produced and not eaten accounts for about 3.3 giga-tonnes of greenhouse gas emissions, and food consumes vast quantities of water during maturation which, when the food is not eaten, is entirely wasted.⁷¹ Food waste also creates emissions—when thrown into a landfill it decomposes anaerobically, releasing methane, a greenhouse gas 21 times more damaging than CO₂. Producing more food than we eat thus undermines the world’s greenhouse-gas reduction goals. ReFED, a US coalition to reduce food waste, estimates that a 20% reduction in food waste in the US over ten years would avoid nearly 18 million tonnes of greenhouse gases annually.⁷²

Waste is highest in developed countries, where food is comparatively cheap. The US sends 46m tonnes of food to the landfill annually, with consumer waste at home accounting for 40%. In 2012 an average family

of four was leaving more than two million calories, worth nearly \$1,500, uneaten each year.⁷³ According to a 2016 study,⁷⁴ almost 80% of US citizens said they feel guilty when throwing away food, but almost half (42%) said they don’t have enough time to worry about it. Europe fares little better: according to FAO data, the food currently wasted on the continent could feed 200 million people. Other causes include the ubiquitous phenomena of supermarket offers such as two-for-one deals, which can encourage greater quantities of food shopping which, when of perishable items, might not be cooked and eaten.

China, according to its own Xinhua news agency,⁷⁵ throws away enough food every year to feed 200m people—about one-sixth of the country’s population. But, generally, developing nations have a very different dynamic. As food constitutes a higher proportion of average spending, food waste at the consumer level is very low. Therefore, it is no surprise that in the FSI group the top four countries in terms of low end-user food waste were, in descending order, Ethiopia, Nigeria, South Africa, and India. However, developing countries do lose food earlier in the cycle, often as a result of losses on the farm or during farm-to-market. Developing countries generally struggle to harvest, process, and transport food efficiently due to poor roads and a lack of supportive logistics infrastructure, such as cold-chain facilities. Meanwhile low usage of technologies means their crops are more susceptible to drought and disease.

⁷⁰ “Fight climate change by preventing food waste”. World Wildlife Fund. 2016. <http://www.worldwildlife.org/stories/fight-climate-change-by-preventing-food-waste>

⁷¹ “Food Wastage Footprint: Impacts on Natural Resources”. Food and Agriculture Organisation of the United Nations. 2013. <http://www.fao.org/docrep/018/i3347e/i3347e.pdf>

⁷² “A Roadmap to Reduce U.S. Food Waste by 20 Percent.” Rethink Food Waste Through Economics and Data (ReFED), <http://www.refed.com/?sort=economic-value-per-ton>

⁷³ D Gunders. “Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill”. Natural Resources Defense Council, 2012. <https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf>

⁷⁴ D Qi, B Roe. “Household Food Waste: Multivariate Regression and Principal Components Analyses of Awareness and Attitudes among U.S. Consumers”. PLOS ONE 11(7). 2016

⁷⁵ W Zhou. “Food Waste and Recycling in China: A Growing Trend?”. Worldwatch Institute. 2013. <http://www.worldwatch.org/food-waste-and-recycling-china-growing-trend-1>



POLICY MOMENTUM

This issue has moved up the policy agenda. In September 2015 the United Nations adopted a set of Sustainable Development Goals, one of which, Target 12.3, calls for members to cut per-capita food waste in half by 2030.⁷⁶ The EU and the US have committed to meeting the deadline, while 30 CEOs, government ministers, and NGO leaders launched a coalition called the Champions 12.3 to “inspire ambition and mobilise action”.

The public are also taking up the cause. In Portugal, Isabel Soares founded Fruta Feia (Ugly Fruit), a co-op that has rescued 300 tonnes of blemished produce that would otherwise be thrown away. At the summer Olympics the Italian chef Massimo Bottura set up a soup kitchen in Rio’s downtrodden neighbourhood of Lapa to feed hungry people, using castoffs and leftovers from the Olympic Village. Alain Ducasse, Francis Mallmann, and Rodolfo Guzman were among the 50 guest chefs who joined the cause. These initiatives capture and gain the public imagination and gained media coverage. Other such campaigns have been waged in the UK, where consumer-education campaigns have contributed to a 21% cut in food waste over five years.

Reducing food loss and waste also requires efforts by retailers and food processors, some of whom are responding. Walmart donates its excess produce to charity or turns it into animal feed or compost. It sells imperfect fruits through its Beautiful on the Inside programme at Asda (which it owns)

in the UK, or through the Walmart Spuglies scheme to market potatoes damaged by bad weather. They are also seeking to tackle the behaviours that lead consumers to erroneously discard food due to confusion about expiration and use by dates. Walmart has replaced ‘best by’, ‘use by’, and ‘sell by’ labels with a consistent single label, ‘Best if used by’, according to Ragan Dickens, director of sustainability communications at Walmart.

Sainsbury’s, a UK supermarket, has pursued a similar donations strategy, working with charities to minimise food waste. “We want every single store across the whole of our network to be partnered with a charity donation partner so that whenever we have that situation, that surplus will be eaten by human beings,” says Paul Crewe, head of sustainability, engineering, and environment at the supermarket.

Reducing food waste is a win for both consumers and businesses. “Almost everyone benefits from solving the problem,” says Lorin Fries, the World Economic Forum’s director of global food systems. Businesses see a market in new and innovative technology and services, and governments can make good on promises to feed hungry people while furthering their emissions-reduction goals. “This is an area where it makes sense economically, not just socially and environmentally, for us to solve a problem,” says Ms Fries, “And I think that is the reason that there is so much momentum.” France has moved the most comprehensively to address the problem.

⁷⁶ United Nations Sustainable Development Goals 12.3. UN. <https://sustainabledevelopment.un.org/sdg12>



FRANCE LEADS THE WAY ON FOOD WASTE

On 3 February 2016, France passed sweeping legislation to combat food waste. The new regulations prevent supermarkets from disposing of edible food and requires them to donate it to food banks and other charities, and mandate that food waste be addressed in school curricula. This progressive law puts France at the leading edge of the international fight against food waste.

Why was France the first mover? As in many countries, there has been spirited debate about the vast quantity of food wasted—the average French person throws away 110 kilograms of food per year—and how organic waste contributes to climate change. Food-waste dinners and restaurants have sprung up: at the Freegan Pony in Paris, a rotating group of chefs serve elegant meals made from food discarded from the wholesale market. And at Simone Lemon, chefs use ‘ugly’ fruits and vegetables to cook a vegan buffet and guests pay for the food by weight to discourage waste. In 2014 French Councillor Arash Derambarash launched a Change.org petition against food waste and received more than 210,000 signatures.

One key difference is that in 2012 the French government created a ministry position for agro-food systems. Guillaume Garot, a Socialist member of the French National Assembly, took up the cause with vigour, leading a two-year study that resulted in a 2015 proposal for 36 new regulations or policy measures across the French food system. “Just the fact that this position existed made a huge difference,” says Marie Mourad, a researcher at the Paris Institute of Political Studies. “Before we had only agriculture ministers who were much more focused on production.”

The power of the French law is its holism, which includes mandates for education and new business practices. “The fight against food waste should become a major national cause like road safety that

mobilises everybody,” says MP Garot. “That implies that every authority, at every level, plays its part.” The new law includes the following provisions: A ‘food recovery’ hierarchy for businesses and institutions to be implemented by 2025, which prioritises recovery of edible food, then anaerobic digestion and composting. The measure also sets a goal of separating all organic waste (residential and commercial) by 2025.

A legal obligation for supermarkets to donate excess food to charitable organisations and recycle what is no longer edible. Retailers are also prohibited from destroying food after media articles claimed that some retailers poured bleach on discarded food to prevent people taking food from disposal containers. If retailers fail to comply with the measures they can be fined up to €3,750 (US\$4,100).

Clarification of food-expiration dates, such as ‘best before’ and ‘use by’, to reduce consumer confusion. The new law bans expiration dates entirely on products such as wine, baked goods, vinegar, salt, sugar, and sweets as these products do not pose a danger to human health even when consumed long after production. Food-waste education, beginning at the primary school level, to teach students about farming, cooking, and how to choose products to prevent waste.

Extension of tax incentives to farmers even when a product is processed. This is important because previously a farmer who donated milk, which was then pasteurised, did not receive any benefit. Instead, the milk processor got the credit. New rules, still in development, will incentivise farmers to donate excess food.

Establish community service positions focused on food waste to employ young people. The national goal is to create 1,000 civic service positions, many of which have already been filled.

Each element is important. But MP Garot is especially enthusiastic about the mandate to educate children. Local authorities will decide how that will be done, he says, but the government hopes that lessons will be presented in context, such as in a cafeteria or on a farm, places where children will learn the value of food and the work that goes into growing it. Teaching children not to waste is about more than the effects of waste itself, he said, adding that “the education about food waste should aim at promoting the cultural value of food”.

It is still too early to judge the impact of the food-waste law. But MP Garot says he is seeing an impact:

supermarkets that did not previously donate food are now partnered with charities. Many retailers are developing internal policies that adjust and improve stock management. For example, at some stores products near their expiration date are now sold at a discount, rather than automatically discarded.

The world is watching, says Craig Hanson, global director of food, forests, and water at Washington’s World Resources Institute. France has implemented a “multi-sectoral, multi-modal approach in trying to tackle a complicated issue. It is, by definition, pioneering because no other country has anything like it on the books,” he says.



CONSUMER EDUCATION

Elsewhere in the world, policy measures have tended to be more targeted—although not without some successes. South Korean households and businesses are required to pay for what they throw away, which increased the recycling rate of food waste from 2% in 1995 to 95% in 2009. In response to growing food waste by China's emerging middle class, President Xi Jinping backed a Clean Your Plate campaign in 2013. “To have something mentioned by the president,” says Dr Fan, of the International Food Policy Research Institute, “it was a pretty big deal.”

Holism can be achieved through government-formed agencies that help to mobilise stakeholders. In 2004 the UK government charged the Waste and Resources Action Programme (WRAP), a registered charity, to work with retailers to reduce the food waste. A year later WRAP announced a voluntary agreement, the Courtauld Commitment, with 40 retailers, brands, and manufacturers, to reduce and improve packaging. That agreement was followed by two more, which have produced dozens of innovative

solutions. The retailer Asda boosted the shelf life of more than 1,500 products by finding ways to more efficiently deliver products to stores; while Heinz introduced a re-closable “fridge pack” to reduce waste at home. Sainsbury's converts unused food to electricity, and powers one shop, in Cannock, UK, entirely through food waste. WRAP also works with manufacturers and retailers to clarify date labelling on food packages—and, in 2007, launched a powerful consumer-education campaign entitled Love Food, Hate Waste.

“The heart of our strategy is providing the evidence that there is an issue to tackle and being really clear about how much that is costing,” explains Richard Swannell, WRAP's director of sustainable food systems. But he notes that there are few generic lessons. The reasons for food waste vary from country to country, even from region to region within countries. “The solutions are complex, cultural, and location specific,” he said.



FOOD LOSS IN DEVELOPING COUNTRIES

Food accounts for a far higher share of the money spent by consumers in low- and middle-income countries, naturally leading to far less wastage. Food loss results more from inefficiencies in the farm-to-market infrastructure, including poor roads, inefficient production practices, and limited access to capital.

In Kenya, poor land preparation, inadequate soil management, and ineffective pest and disease control, leads to significant losses in potato production. In Nigeria one study of the cassava value chain showed most losses occurring during processing. Without mechanical peelers, the tuber is stripped by hand, a slow and arduous process that results in unnecessary rot. A study of Nigeria, Ghana, and Vietnam suggested that new machinery could lower cassava losses by about 44%.⁷⁷

Lack of refrigeration is another cause of food loss in low income regions. India loses 20–50% of its fruits and vegetables because of a lack of refrigerated trucks and storage. Improving the cold chain for bananas would lift exports from 3,000 containers to 190,000 containers annually.⁷⁸ United Technologies Corporation's Carrier unit, a leading provider of refrigeration solutions, is now marketing a stripped-down refrigerated truck in India. Called Citifresh, it retails for about one-tenth of the cost of more sophisticated versions used in the US and Europe.

More and better data about food waste will help identify losses in these countries, says Dr Fan. “We need to connect the data of where we have wasted, and how we have wasted, along the whole value chain,” he says. “Then we can prioritise the investment, to tackle the links where you [can] have the biggest gain.”

Food waste can also be reduced by agricultural companies and retailers in developing countries. “We use recovered vegetable oils and animal fats to displace fossil fuels, reducing the amount of material going to landfills,” says Jill Kolling at Cargill. “At one of our facilities in Brazil, the pomace, skins, and seeds extracted from tomatoes during processing has now been approved by the country's Ministry of Agriculture for use in animal feed, and at a texturising facility in Germany we save the lemon peels and fruit seeds for biogas and as horse and poultry litter. Previously such by-products would have been disposed of as waste, so they're great examples of how investment and innovation can yield positive results.”

⁷⁷ M Schuster, M Torero. “Toward a sustainable food system: Reducing food loss and waste”. International Food Policy Research Institute (IFPRI). In 2016 Global Food Policy Report. 3. pp. 22–31. <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130211>

⁷⁸ C. Winkworth-Smith, et al, “The Potential Value of Reducing Global Food Loss,” The University of Nottingham, Division of Food Sciences, School of Biosciences. March 2015. 17, 19.

SAN FRANCISCO: CASE STUDY

San Francisco is a leading global city in tackling food waste, with policy initiatives dating back to 1989 and a close integration with the private sector and citizens.

The menu didn't seem unusual. The fruits and vegetables—fava beans, corn, lettuce, tomatoes, and aubergines—were all in season at the peak of summer in San Francisco. But it would be hard to call the ingredients 'fresh'; before the chef had collected them, each one was headed for the dustbin. The meal, put on by the Salvage Supper Club, was held in a giant blue food waste unit.

Such food-waste dinners are increasingly common in the likes of San Francisco, Paris, and New York, where the fight against food waste has intensified. But in San Francisco slashing food waste has long been city policy. Each day the city collects 590 tonnes of compostable material, about half of which is food scraps, which would otherwise go to a landfill. Today, 80% of the city's waste is recycled or composted, compared to the national recycling rate of 34.5%.

San Francisco's focus on food waste began in 1989 when California passed a landmark piece of legislation, AB 939. Called the Integrated Waste Management Act, it set ambitious goals for cities and counties to divert solid waste from landfills: 25% by 1995 and 50% by 2000.

In many places the majority of compostable materials come from lawn trimmings and garden waste. But in San Francisco, a thicket of dense residential housing, city officials knew that wouldn't be enough. "We knew we needed to address food," says Jack Macy, San Francisco's senior coordinator for commercial waste. "But we didn't know exactly how to do it."

The city's first step was to help food banks to collect food that would otherwise be thrown out. Feeding people, says Mr Macy, is the "highest and best use" for any edible food. The process was straightforward: city agents helped raise money to hire a driver and buy a refrigerated truck that could pick up leftover

food at the city wholesale market. Two decades later, between 2,700 and 4,500 tonnes of food are donated in San Francisco every year.

Next, San Francisco began to pilot residential and commercial composting programmes. Between 1997 and 2000 it rolled out a three-bin system, dubbed the Fantastic Three: black bins for rubbish, blue bins for recyclables, and green ones for food scraps, including meat and other compostable materials. The composting programme helped the city meet its goal of 50% waste diversion by 2000—and its promise encouraged city officials to set a new one in 2002 of 75% diversion by 2010 and zero waste (i.e. nothing sent to landfills or incinerators) by 2020.

Education—showing consumers and businesses how to separate their trash and why it is important to do so—has been essential. But so was offering incentives. Residential homes pay for trash collection, but recycling and composting is free. So families who reduce the amount in their bins also lower their bills. The incentives paid off exponentially in the commercial sector. In 2006 the city established a formula that increased discounts to businesses that recycled and composted a greater percentage of their waste.

The benefits are particularly compelling to San Francisco's 5,000 restaurants and its hundreds of coffee shops, where scraps and compostables can make up as much as three-quarters of what gets thrown away. "Talking about how it's the right thing to do is fine," says Mr Macy, "but if businesses see that they can change and save money, it sets up an efficiency. It drives people to follow the rules."

In 2009 San Francisco made composting and recycling mandatory. (This was followed by a requisite number of fear-mongering stories in the media about the 'garbage police'.) But city officials believed it was essential. Instead of releasing methane in landfill sites, composting food scraps transforms organic waste into a new and rich organic material that is valuable to farmers.

Recology, the private firm that collects and processes San Francisco's waste, now operates two composting facilities. The resulting compost is certified organic, and much of it goes to more than 300 wineries in five Californian counties, including Napa and Sonoma, and in recent years fruit and vegetable farms have also become reliable buyers. "We've had four years of drought, and compost is a natural sponge," said Robert Reed, Recology's public relations manager. "It attracts and retains water. For that reason, orchards are now as big a market as vineyards."



CONCLUSIONS & FINAL CONSIDERATIONS

FIGHTING FOOD WASTE: POLICY OPTIONS

The growing consensus is that the problem of food loss and waste is too obvious to ignore. “There is nowhere else in society where we tolerate 40% inefficiency in anything,” said John Mandyck, the chief sustainability officer for United Technologies Corporation, an American conglomerate. “And yet we have come to accept 40% loss in something so important: food, the thing that sustains the human race. We need to try to help people to understand the scale and that this is an issue we can solve.”

Set a mandated hierarchy of actions to fight food loss and waste: Governments should mandate that surplus food must be directed to its highest possible use. Recovered edible food should go to human consumption, animal feed, industrial uses, and anaerobic digestion and composting. Fines and incentives can spur action.

Fund critical infrastructure: Many governments have set ambitious food-waste reduction goals. However, funding is needed to help farmers, food manufacturers, and consumers. In the developing world, governments should work to improve roads, energy supply, and markets, laying a foundation for the private sector to improve cold-chain facilities

and food transport. But the same is true for the developed world: in the US there are nearly 3,100 active landfills and fewer than 300 composting facilities that accept food scraps. When the city of Battle Creek, Michigan, hometown of cereal maker Kellogg’s, looked to the US Department of Agriculture to help fund a US\$3m composting and waste-to-energy facility, no funds were available.

Create incentives for producers and retailers to donate, sell, and recycle, and to prevent food waste: It is essential to demonstrate that avoiding food loss and waste can save, even make, money for businesses. Incentives can come in the form of legislation—such as the US’s Good Samaritan laws which protect retailers from liability if they donate excess food—or tax incentives and grants. In France the government is extending tax benefits to farmers who donate products such as milk for processing.

Educate consumers on the problems of, and solutions to, food waste: Governments, non-profit groups, and retailers must work together to overcome apathy by emphasising consumers’ ability to save money and waste less. In the UK the WRAP initiative launched the Love Food, Hate Waste campaign, which successfully reduced consumer food waste by 21% in five years.

Humanity has faced its share of food challenges before. Back in the 1800s, the English cleric and scholar Thomas Malthus believed population growth would lead to episodic famines. He was wrong. We have continually found ways of producing more food, even as the population has expanded. Over the last half century the amount of food available to each person increased by 20%, even while the world’s population more than doubled.⁷⁹ Famines in the 20th century—whether in Ethiopia in the 1980s, or Maoist China—were driven by conflict and political destabilisation, not by any limits on nature’s bounties.

In the 21st century humanity will need its brightest ideas to feed and nourish tomorrow’s populations sustainably. This report, drawing from expert interviews and the findings of the Food Sustainability Index, has outlined a number of priority areas for policy makers, companies, and civilians. Four key considerations emerge from this research.

The world produces plenty of food; inefficiencies in the food system are the primary challenges to tackle, including food loss and waste. There are limited land resources left to exploit, given the challenges of deforestation and land degradation. This means that the public, companies, stakeholders and governments must work harder to reduce food loss and waste, through well-designed policies, incentives, public education programmes, and media-friendly awareness-raising initiatives. Ensuring that the food we already grow does reach people can reduce how much

new land is needed for crops and foods. The food retail industry can help through several measures: clearer expiration dates on produce, partnerships with charities to donate excess foods, and use of food waste as fuel are among the measures used by the leading companies. Legislation, following France’s lead, will help ensure these are not disparate and one-off initiatives but part of a comprehensive strategy to slash waste. Food loss in developing countries comes from different sources, including poor road and transport systems, inadequate access to cool-chain technologies, and vulnerability to shocks such as pests and droughts.

Agriculture is threatening the world’s forests and water supplies. Rates of deforestation have fallen globally, thanks to initiatives to regulate the logging sector. But increasing agricultural commodities output for food and non-food production is threatening this progress, with deforestation advancing to clear land to cultivate a range of crops and foods. Palm oil, soybeans, and beef, as well as non-food crops for biofuels, are particularly prominent drivers. Stakeholders must make careful choices about the further expansion of agricultural land, especially for non-food crops used for biofuels. Secondly, the world is facing increasing water stress, and not just in arid countries. Agricultural producers and governments must improve water management practices, including greater water recycling, and reduce the water footprint of crops and livestock.



APPENDIX

Developing countries are facing a twin challenge of obesity and undernutrition.

Obesity rates are increasing in developing countries, especially among children, even as these nations continue to experience hunger. They are facing a double burden of hunger and obesity, with increases in obesity-linked diseases including type 2 diabetes, stroke, and cancer. Without fast remedial action these countries will be battling a double burden of communicable and non-communicable diseases. Policy options include public education campaigns, tax measures on foods high in fat and salt and on sugar-sweetened beverages, along with rules on marketing and the sale of unhealthy food to children. Clear and effective food labelling to guide consumer choices can also help. Micronutrient deficiencies are also underestimated in many developing countries. While levels of hunger are declining globally, micronutrient deficiencies are prevalent in developing countries and are causing a range of diseases and disorders, including anaemia, stunting, and night-blindness. Greater public awareness is needed to ensure micronutrient deficiency, or ‘hidden hunger’ is not underestimated.

Cities can drive change across all the pillars:

While food and nutrition is often analysed at the level of national policies and data, effective approaches and strategies can be levied at the city level. Over 50% of the world’s population lives in urban areas, and this is projected to increase to 66% by 2050. Perhaps the most notable initiative to date is the Milan Urban Food Policy Pact, which aims to reduce food waste, promote health eating and encouraging the purchase of food produced in a sustainable manner. The project is led by Milan, and involves the municipalities of Turin, Barcelona, Bilbao, Utrecht, Ghent, Bruges, and Marseille, and civil society partners (People’s Expo, Equo Garantito, World Fair Trade, World Fair Trade Europe, Fair Trade Advocacy Office, Fair Trade Hellas, GRAIN and ACRA). The municipalities of London, Thessaloniki, Dakar and the departments of Antioquia and Medellin are associated partners.

⁷⁹ OECD, “Global Food Security: Challenges for the Food and Agricultural System”. OECD Publishing, Paris. 2013. <http://dx.doi.org/10.1787/9789264195363-en>

The Food Sustainability Index, which ranks 25 countries on food system sustainability, is a quantitative and qualitative benchmarking model. It is constructed from 58 indicators which measure the sustainability of food systems across three pillars: food loss and waste, sustainable agriculture and nutritional challenges. The index has three key performance indicators—environmental, societal and economic—which are in turn based on 35 indicators and eight categories selected on the basis of expert analysis by The Economist Intelligence Unit in consultation with an advisory board. Three category scores are calculated from the weighted

mean of underlying indicators and are scaled from 0 to 100, where 100 equals most sustainable. The overall score for the FSI (also on a range of 0 to 100) is calculated from a weighted average of the category scores.

The list of indicators and how to interpret the scores can be found below, and full definitions and sources of the indicators are available online and in the downloadable Excel workbook. Additional information on how the policy indicators were scored can be found online.⁸⁰

⁸⁰ www.foodsustainability.eiu.com

BUCKET	SUB-BUCKET	#	INDICATOR	#	SUB-INDICATOR	
A. Food loss and waste	1. Food loss	1.1	Food loss	1.1	Food lost as % of total food production of the country	
		1.2	Policy response to food loss	1.2	Quality of policies to address food loss	
		1.3	Causes of distribution-level loss	1.3	Quality of the road infrastructure	
		1.4	Solutions to distribution-level loss	1.4	Investment in transport infrastructure	
	2. End-user waste	2.1	Food waste at end-user level	2.1	Food waste per capita per year	
		2.2	Policy response to food waste	2.2	Quality of policies to address food waste	
B. Sustainable agriculture	3. Water	3.1	Environmental impact of agriculture on water	3.1	Water footprint of main crops and livestock in the country	
		3.2	Sustainability of water withdrawal	3.2.1	Agricultural water withdrawal as % of total renewable water resources	
		3.3	Water scarcity	3.3.1	Monthly freshwater scarcity (number of months per year that a basin faces severe water scarcity)	
		3.4	Water management	3.4.1	Initiatives to recycle water for agricultural use	
	4. Land (land use, biodiversity, human capital)	4.1	4.1.1	Environmental impact of agriculture on land	4.1.1	Fertilizers and pesticides (total use)
			4.1.2	Percentage of agricultural land lost yearly to desertification/pollution	4.1.2	Percentage of agricultural land lost yearly to desertification/pollution
			4.1.3	Average carbon content of soil as a % of weight	4.1.3	Average carbon content of soil as a % of weight
		4.2	4.2.1	Land use	4.2.1	Arable land under organic agriculture as percentage of agricultural land
			4.2.2	Percentage of utilised agricultural area of total agricultural area	4.2.2	Percentage of utilised agricultural area of total agricultural area
			4.2.3	Existence of sustainable urban farming initiatives	4.2.3	Existence of sustainable urban farming initiatives
		4.3	4.3.1	Impact on land of animal feed and biofuels	4.3.1	First and second generation biofuel production
			4.3.2	Land diverted to animal feed and biofuels	4.3.2	Land diverted to animal feed and biofuels
			4.3.3	Biodiesel imports	4.3.3	Biodiesel imports
		4.4	4.4.1	Land ownership	4.4.1	Land owned / under concession in foreign countries as a % of domestic arable land
			4.4.2	Degree of property rights protection	4.4.2	Degree of property rights protection
			4.4.3	Existence of laws to protect smallholders against land grabs	4.4.3	Existence of laws to protect smallholders against land grabs

BUCKET	SUB-BUCKET	#	INDICATOR	#	SUB-INDICATOR		
B. Sustainable agriculture	4. Land (land use, biodiversity, human capital)	4.5	Agricultural subsidies	4.5	Quality of agricultural subsidies		
		4.6	Animal welfare policies	4.6	Quality of animal welfare regulation		
		4.7	Diversification of agricultural system	4.7	Share of top 3 crops of total agriculture production		
		4.8	Environmental biodiversity	4.8	Environmental biodiversity measured by the GEF benefits index for biodiversity		
		4.9	Quality of R&D and innovation	4.9	Quality of R&D and innovation		
		4.10	Productivity	4.10.1	Total factor productivity (TFP) growth rate between 2001-2012		
		4.11	Land-users	4.11.1	Participation rate of women in farming	4.11.1	Participation rate of women in farming
				4.11.2	Participation rate of youth in farming	4.11.2	Participation rate of youth in farming
				4.11.3	Average age of farmers	4.11.3	Average age of farmers
		5. Air (GHG emissions)	5.1	Environmental impact of agriculture on the atmosphere	5.1.1	GHG emissions from agriculture	5.1.1
	5.1.2				Percent animal emissions from total emissions in agriculture	5.1.2	Percent animal emissions from total emissions in agriculture
	5.1.3				Percent fertilizer emissions from total emissions in agriculture	5.1.3	Percent fertilizer emissions from total emissions in agriculture
	5.1.4				Net emissions/removals (CO2eq) from land use total	5.1.4	Net emissions/removals (CO2eq) from land use total
	5.2	Climate change mitigation	5.2	Implementation of agricultural techniques for climate change mitigation and adaptation	5.2	Implementation of agricultural techniques for climate change mitigation and adaptation	
C. Nutritional challenges	6. Life quality	6.1	Prevalence of under- and malnourishment	6.1.1	Prevalence of undernourishment (% of population)		
				6.1.2	Prevalence of stunting, height for age (% of children under 5)		
				6.1.3	Prevalence of wasting, weight for height (% of children under 5)		
				6.1.4	Prevalence of underweight, weight for age (% of children under 5)		
		6.2	Micronutrient deficiency	6.2.1	Micronutrient deficiency - Vitamin A (% of general population)		
				6.2.2	Micronutrient deficiency - Iodine (% of general population)		
		6.3	Ecological efficiency of supporting people's well-being	6.3	NEF Happy Planet Index		
		6.4	Healthcare expenditure and costs	6.4	Public health expenditure as a % of total health expenditure		

BUCKET	SUB-BUCKET	#	INDICATOR	#	SUB-INDICATOR
C. Nutritional challenges	7. Life expectancy	7.1	Life expectancy	7.1.1	Life expectancy at birth, total (years)
				7.1.2	Healthy life expectancy (HALE)
		7.2	Prevalence of over-nourishment	7.2.1	Prevalence of overweight in children (2-18 years of age)
				7.2.2	Overweight (body mass index >= 25) (age-standardized estimate)
		7.3	Impact on health of nutritional deficiencies	7.3	Disability Adjusted Life Year (DALY) due to nutritional deficiencies
		7.4	Physical activity levels	7.4.1	Proportion of the population reaching recommended physical activity per week
				7.4.2	Hours of fixed screen time per week
		8. Diets	8.1	Prevalence of sugar in diets	8.1
	8.2		Number of people per fast food restaurant	8.2	Number of people per fast food restaurant
	8.3		Purchasing power for fresh food	8.3	Percentage of population living under the national poverty threshold
	8.4		Policy response to dietary patterns	8.4	Quality of policies to address dietary patterns

“CITY MONITOR” PILOT PROGRAMME

The Economist Intelligence Unit, with the BCFN Foundation, has initiated a pilot project on urban food systems. This indicator-level analysis is called City Monitor. It is intended to be a first step in assembling a set of indicators to understand the dynamics of urban food systems through data and policy assessments. In this pilot phase the 16 cities were selected on the basis of geographic representation, data availability and their efforts towards implementing sustainable urban food policies.

London
Milan
Paris
Toronto
Belo Horizonte
Johannesburg
Shanghai
Kyoto
Mexico City
Berlin
Moscow
Tel Aviv
Dubai
San Francisco
Lagos
Mumbai

On the index tool online, users can explore the index results with different weightings as follows:

- 1 = neutral: all weights equal
- 2 = policy: policy indicators given more weight to reflect the efforts made by governments
- 3 = status quo: indicators reflecting the current situation of countries in terms - it does not account for the policies in place to address the challenges, only at where the countries are presently performing
- 4 = environmental: more weight given to indicators focusing on environmental issues
- 5 = mixed: weights given according to priority of certain areas (e.g. water sustainability, food waste, land users) etc. which reflects a holistic view of what a sustainable food system should be (accounting for social, environmental, and economic challenges).

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