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Unit

A report from The Economist Intelligence Unit

# Global food security index 2014

An annual measure of the  
state of global food security

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# Preface

*The Global food security index 2014: An annual measure of the state of global food security* is the third edition of an Economist Intelligence Unit (EIU) study, commissioned by DuPont. This report discusses the key findings from the research and benchmarking index. It also includes special reports on food loss and obesity—two increasingly relevant topics for food security. Lucy Hurst, associate director of custom research for the Americas, was the research director for this project. Joshua Grundleger, analyst, was the project manager. Katherine Stewart, research

associate, and Martin Vieiro, analyst, provided research and analytical support. Leo Abruzzese, global forecasting director and global director of public policy, served as senior adviser. William Shallcross designed and constructed the benchmarking model, Lolli Duvivier provided editorial support and Mike Kenny was responsible for layout and design. We would like to extend thanks to the many researchers who lent their expertise to this project. A full list of acknowledgements follows. ■

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# Acknowledgements

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## Peer panel members

The following experts on food security and agricultural policy contributed significantly to shaping the index methodology and vetting the indicators. Their diverse backgrounds and extensive experience ensured that a wide variety of views were considered. The panel met as a group in February 2012 in Washington, DC to review an initial indicator list. The panel has also provided ongoing support, as needed, throughout all three editions of the index, as well as advised on the selection of weights.

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We would also like to acknowledge the contribution of Piero Conforti of the Food and Agriculture Organisation (FAO) of the United Nations. ■

# Executive summary

Food security has slowly, but markedly, improved during the past year. Approximately 842m people today are estimated to be experiencing chronic hunger, down from 868m a year ago—an almost 3% decline. This caps a quarter of a century of progress, with the number of undernourished individuals falling by 17% since 1990.<sup>1</sup>

Improvement is evident across the globe, but particularly in developing countries, which generally started with more food-insecure environments. The 2014 Global Food Security Index (GFSI) displays these developments, revealing improvements within every region. Low- and lower-middle-income countries—particularly in Sub-Saharan Africa, which recorded the largest gains despite facing the weakest food security environment—led the way.

Notwithstanding such progress, global food insecurity remains a challenge. In particular, food price inflation and political stability appear to be negatively impacting food security in many regions. And while economic growth has helped the situation in parts of the globe, including Africa and East Asia, structural limitations, such as inadequate infrastructure, have limited the gains.

The challenges for developed and developing countries differ considerably. Developing countries often struggle with basic infrastructure and low incomes that make affordability of, and access to,

nutritious food difficult. Political risk and corruption frequently compound structural difficulties in these countries.

Although advanced countries generally outperform their developing neighbours, they experience their own challenges. Lower economic growth rates have eroded affordability and created complexities in adapting to urbanisation; at the same time, fiscal woes have limited spending on infrastructure and social programmes as many developed countries prioritise debt repayment. Additionally, changing diets in these countries commonly lead to low consumption of vegetal iron—a key micronutrient—and may contribute to the growing prevalence of obesity.

Food insecurity is a complex phenomenon that interacts with many other determinants of wellbeing. Its drivers are often inter-related, and its relationship with poverty, malnutrition and obesity is nuanced. The following report discusses the results of the 2014 GFSI and draws two new topics—food loss and obesity—into the discussion to further the dialogue on the intricacies of food security.

## New additions to the 2014 GFSI

Two new indicators, food loss and obesity, have been added to the GFSI model for 2014. Food loss, which appears in the Availability category, captures post-harvest and pre-consumer wastage and measures inefficiencies in the food supply chain, an important component of food security that had

<sup>1</sup> *The State of Food Insecurity in the World 2013: The multiple dimensions of food security*. Food and Agriculture Organisation (FAO) of the United Nations, International Fund for Agricultural Development (IFAD) and World Food Programme (WFP), Rome, 2013.

previously not been considered in the GFSI. In general, higher levels of food loss reveal difficulties in processing, transporting and storing food along the supply chain, deficiencies that can contribute to food insecurity.

The obesity indicator has been included as a background variable in the Output section. Although it does not contribute to the overall score or ranking of countries in the GFSI, obesity is a significant and complex issue that is worthy of study alongside food security. The obesity indicator, which measures the percentage of the adult population that has a body mass index (BMI) greater than or equal to 30, is provided with other output indicators, including the prevalence of undernourishment and the percentages of children who are underweight or stunted. Given the complexity of both food loss and obesity, two special articles exploring these issues have been included in the report.

Two new countries have been added to this year's index. The incorporation of Kuwait and the United Arab Emirates was driven by an increased need to explore food security in the Middle East & North Africa and the importance of these two countries to the global energy economy. Given the expansion of the model over the past two years—two new indicators and two new countries were also introduced in the 2013 GFSI—the model has been fully backscored. This facilitates more accurate year-on-year comparisons and provides more complete insight into trends over the first three years of the index.

Finally, the 2014 GFSI offers a refined regional classification. The 109 countries in the index have been re-categorised into six regions, from seven previously. A reorganised Asia & Pacific region now includes the countries of Australasia, while the European region has been narrowed to include mainly the more developed countries in the area. The full regional classification can be found in the Appendix.

## The origins of the index

The Economist Intelligence Unit (EIU) created the Global Food Security Index in 2012 to provide a robust and consistent analytical framework for measuring and deepening the understanding of food insecurity around the globe. Commissioned by DuPont, the GFSI is a benchmarking tool that assesses the state of food security in 109 countries, measured across three internationally recognised dimensions: Accessibility, Affordability, and Quality & Safety. The index builds on existing food security research and frameworks, including the annual *State of Food Insecurity in the World* report of the Food and Agriculture Organisation (FAO), the *Global Hunger Index* of the International Food Policy Research Institute (IFPRI), and the *Maplecroft Food Security Risk Index*, among others. Complementing these tools, the GFSI analyses the inputs—the drivers—of food security in a way that fosters discussion of practical solutions and policy reforms. The index also incorporates nutritional quality and food safety in its rankings—elements not considered elsewhere—alongside the traditional measures of food availability and affordability. Lastly, the GFSI includes a quarterly food price adjustment factor that updates the index and rankings as global food prices and other macroeconomic indicators, including income levels and exchange rates, change over time. This allows the GFSI to serve as an early warning mechanism for potential price shocks that may threaten or worsen a country's food security.

## Building the index

The GFSI uses the following definition of food security: "When people at all times have physical, social and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life." This definition was developed by our research team, but is adapted from a formulation established at the World Food Summit in 1996. Each of the three categories in the GFSI—Affordability, Availability, and Quality & Safety—contain a subset of indicators which evaluate programmes, policies or practices that

influence food security.

In 2013 the EIU updated the model to include two new indicators, corruption and urban absorption capacity, and two new countries, Ireland and Singapore. This year, we have added two more countries, the United Arab Emirates and Kuwait, as well as a new indicator, food loss. We are also including a new output variable this year, prevalence of obesity, to measure and understand its relationship with food security. The 2014 index is comprised of 28 unique indicators and 109 countries and uses data from a wide range of trusted international organisations, including the UN, the IMF, the FAO, the World Health Organisation (WHO) and the World Bank, among others, in addition to the EIU's own internal databases. Where data are limited or do not exist for critical assessment areas, such as the presence of food safety nets, access to financing for farmers or protein quality in the average diet, we called on our global team of economists and country experts to construct qualitative measures. The end product is a comprehensive assessment of food security across 109 countries.

## Topline results: Global food security improves despite gaps

Food security improved in most countries in 2014. Although developed, Western countries continued to have the highest levels of food security and Sub-Saharan African countries remained at the bottom of the rankings, the gap between the highest and lowest performers narrowed. As a region, Sub-Saharan Africa's score increased by two points, nearly double the improvement recorded in North America and Europe. In fact, scores improved in all regions relative to 2013.

Whereas overall food security and Affordability improved across the globe, some regions lost ground in the Availability and Quality & Safety categories. Weakness in sufficiency of supply, particularly in the Middle East & North Africa, and reduced public expenditure on agricultural research and development (R&D) in Europe were most important in reducing food availability. Less diverse diets and a weaker food safety environment

hurt Quality & Safety scores in some regions. Fortunately, these setbacks were mostly offset by improvements elsewhere.

## How this index can be used

The GFSI is an interactive, benchmarking model with a range of analytical tools intended to facilitate cross-country and cross-regional comparisons. Available in both Excel and web-based versions, it also provides detailed information about a specific country's score. This year's model offers a new, streamlined interface and a variety of advanced analytical functionalities. Users can, for example, explore year-on-year trends to track food security developments in a given country or region, or perform a detailed analysis of the underlying data that drive a country's score. Any two countries may be compared directly, and individual indicators can be examined in detail. The index also allows overall and category scores to be correlated with external factors that may influence food security. The model contains a number of background variables, including the prevalence of undernourishment, stunted children and underweight children, plus measures of the intensity of food deprivation and a new variable on obesity.

The Excel-based index analyses food security in four ways. An Overview module provides accessible insights into top-level results and year-on-year trends, including an interactive heat map and rankings and scores for the index and major categories. It also allows the user to compare indicators through a scatterplot tool. The Series Explorer allows users to move beyond the quick snapshot provided in the Overview by providing more detailed information on each of the indicators in the model. Results can be filtered by geographical region, level of economic development and landlocked versus coastal status. Top and bottom performers and year-on-year trends are also available for each indicator. The third module, the Country Explorer, presents underlying data for each country, highlighting strengths and weaknesses and progress over the three years of the GFSI. Finally, the Country

Comparison module allows a quick evaluation of any two countries in the model.

At a basic level, the index and the tool are a repository of more than 11,000 data points that impact food security. The GFSI moves beyond standard practice and provides access to the underlying data, sources and weights, allowing a full understanding of the index's scores and ranks.

Finally, in addition to the annual refresh of the baseline model, every quarter the EIU applies a food price adjustment factor to the index. This adjustment revises the Affordability score, and hence the overall score, based on changes in global food prices. The adjustment is intended to capture food price shocks in the scores, but it also reveals more gradual changes in Affordability over time.

An index, even a carefully constructed one, is only a tool. By analysing conditions at the national

level, it necessarily misses much local context. It cannot fully capture important cultural and political dimensions and risks, and thus may oversimplify complex issues. That said, by reducing major food security themes to their core elements, the index provides a useful approach to understanding the risks to food security. By centralising existing data and filling data gaps, it aims to further research on food security. Most important, the index is meant to spur dialogue about the drivers of food insecurity and to suggest where policymakers and other stakeholders should focus their efforts to have the greatest impact. ■

See the index website for more information on how to use the data and findings to inform your work: <http://foodsecurityindex.eiu.com/>





## Key findings

- **Overall global food security improved in the last year.** Following a small dip in the 2013 index, which was partially driven by drought in key growing regions and falling national incomes in some developed countries, the average country score rose by more than one point, to 56.1 in the 2014 GFSI. Additionally, the range of scores narrowed by half a point as the lowest-scored countries improved more than the top performers. As the FAO reported in a separate analysis, the number of people suffering from chronic hunger dropped from 868m to 842m over the past year.
- **Food security increased for 70% of the countries in the 2014 GFSI.** The most improved countries in the overall index—15 countries increased their score by three points or more—generally experienced noticeable increases in their Affordability and Availability scores. These countries experienced improved political environments and were less at risk of having urbanisation-related food shocks than in previous years. These mostly low-income nations also reported reasonable economic growth, which gave them the means to adapt to a wide range of food security challenges. Many poorer countries were also helped by a 2% decline in wheat prices in 2013 and a 14% drop in the price of rice.
- **Although political turbulence in Ukraine has begun to impact global food prices, it has yet to have a substantial impact on the structural aspects of global food security.** Ukraine itself experienced a decline in food security of 1.6 points from a year ago, driven by more limited access to financing for farmers, higher volatility of agricultural production, greater political stability risk and reduced urban absorption capacity.
- **Lower spending on food as a share of household consumption in most countries and better food safety net programmes, mainly in Sub-Saharan Africa (SSA) and the Middle East & North Africa (MENA), contributed to a notable increase in Affordability.** This category recorded the steepest rise among the GFSI categories, at 2.3 points. Food Availability and Quality & Safety also improved compared with the year before, increasing by 0.2 and 0.5 points, respectively. SSA countries led the way in Quality & Safety, comprising 12 of the 15 countries that improved by more than three points.

- **Food security rebounded in developed countries following weakness in national incomes in 2013.** The top-performing developed countries recorded an average year-on-year score increase of 1.1 points in 2014. Of the 25 highest-scoring countries, only France's (-0.6), Belgium's (-0.5), Finland's (-0.5) and Japan's (unchanged) scores declined or remained unchanged.
- **Overall scores fell for 28 countries compared with the year before, although year-on-year declines were generally quite small,** averaging only 1.1 points. Only five countries—Myanmar (-4.1), Madagascar (-3.1), Romania (-3.0), Egypt (-2.9) and Tunisia (-2.9)—recorded a decline of more than two points. Scores were unchanged for five other countries.
- **Although the bottom tier of the index includes many SSA countries, food security improved more in this region than any other.** Uganda had the biggest score improvement from 2013, moving up by 5.8 points to 45.6. Of the 11 countries in the index that showed a year-on-year improvement of four points or more, only three—Serbia (+5), Azerbaijan (+4.6) and Slovakia (+4.4)—were not from SSA.
- **Food security improved in every region in the index, but each had its own weaknesses.** For example, reduced Quality & Safety pulled down scores in Central & South America and in Asia & Pacific, both of which were hurt by reduced diet diversification. By contrast, Europe and MENA experienced declines in their Availability scores, owing to more limited food supplies in both regions, tightening public expenditure on agricultural research and development (R&D) in Europe, and higher volatility of agricultural production in MENA. Food Affordability increased across all regions, following improving global economic prospects.
- **Whereas lower-income regions, including SSA and Asia & Pacific, scored well in some areas of the index, including nutritional standards and volatility of agricultural production respectively,** they tended to perform poorly in areas that are highly correlated with overall food security, such as GDP per capita and food consumption as a share of household expenditure.
- **Eight out of 12 countries in MENA improved their scores from a year ago,** but the gains were restrained by lower real GDP per head. Only Israel and Saudi Arabia reported an increase in income per person. Economic performance in MENA countries, as a group, was held back by war, revolution and continued weakness in the euro zone (a key market for North African and Turkish exporters).
- **While Central & South America did not perform particularly well in most indicators, it recorded the best regional score for agricultural import tariffs and nutritional standards, and the second-highest score for volatility of agricultural production.** Low tariffs reflect the socio-political imperative of ensuring sufficient food supply for as much of the population as possible, compared with other regions that favour protectionist policies. ■

## New additions to the 2014 GFSI

The underlying structure of the Global Food Security Index (GFSI) does not change significantly from year to year. This is by design. Minimal changes—particularly in data series and sources—allow for consistent comparisons and analyses. However, this year's GFSI does contain a few new features. Following the inclusion of two new countries and indicators in last year's GFSI, two more countries and indicators have been added this year. Given these changes and the need to track developments carefully over time, the model has been backscored for the past two years. The scores for the 2012 and 2013 GFSIs, therefore, are now fully comparable with this year's scores. Accordingly, scores and ranks for these two years may no longer match what appeared in past reports and discussions. Finally, in the interest of fostering greater discussion around food security issues, the regional classifications have been refined. These additions are discussed below.

### Two new countries: Kuwait and United Arab Emirates

Two new countries, Kuwait and the United Arab Emirates (UAE), have been added to the GFSI. This expands coverage of the Middle East & North Africa (MENA), which had previously been under-represented. Both countries are important energy producers and, given their moderately strong performances in the index, provide an additional perspective into how MENA countries may be able to improve their food security.

Kuwait and the UAE enter the index with strong scores of 72.2 and 70.9 respectively, ranking them 28th and 30th overall. Within MENA, they rank second and third, behind Israel. Their high scores were driven by stellar performances in Affordability, where both countries scored above 80. As relatively small and wealthy countries, nearly all Affordability indicators—aside from food consumption as a share of household expenditure and, for Kuwait only, GDP per capita—were strengths for both countries, demonstrating the advantages of their oil endowments.

The countries shared weaknesses as well as strengths. In contrast to their high scores in other aspects of the index, Kuwait and the UAE had moderate scores of 61.2 (ranked 41st overall) and 55.2 (51st) for Availability. Poor performance in corruption and political stability risk hindered food security, as it did throughout the region. Their scores were also diminished by high volatility of agricultural production, which occurred alongside low production, and low urban absorption capacity. Low public expenditure on agricultural research and development (R&D) was a weakness for both countries.

Kuwait and the UAE were also quite similar in the Quality & Safety category, receiving scores of 75.3 (ranked 29th) and 73.2 (32nd), respectively. They had moderate scores in nearly all indicators here, except for food safety, which was a strength for both countries, and protein quality, which was also a strength for Kuwait.

## Two new indicators: food loss and the prevalence of obesity

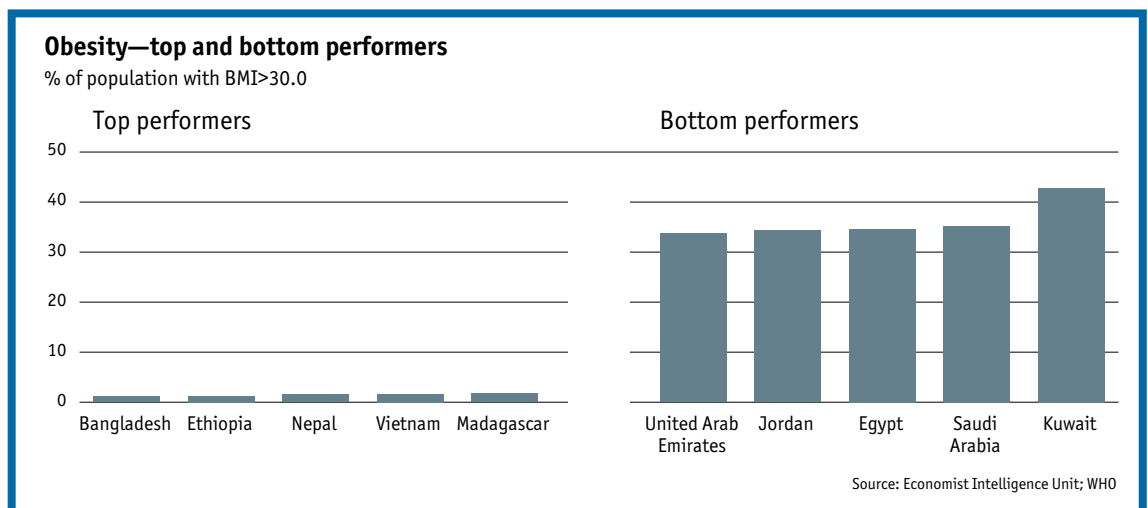
The 2014 GFSI adds two new indicators—food loss and the prevalence of obesity. The former, which is included in the Availability category, explores the effects of supply-chain food loss on food security. The indicator examines post-harvest and pre-consumer food loss—wastage that occurs in various stages of production, processing, transport and storage along the supply chain. Higher levels of such food loss often indicate problems in the supply chain that can contribute to greater levels of food insecurity. For instance, wastage or spoilage during transport can needlessly reduce available supplies of food in the marketplace. Food loss may also indirectly impact the affordability of food, since reduced supply has the potential to drive up prices.

This indicator has been narrowly focused on post-harvest and pre-consumer waste because those measures are most widely available across all 109 countries (food loss is often difficult to assess, particularly in developing countries). At the same time, understanding the implications of post-consumer waste on food security is particularly challenging. Indeed, the relationship between post-consumer food loss (generally referred to as food waste) and food security is unclear at best. Whereas food loss during the supply chain is clearly a detriment to food security, post-consumer food

waste might actually be an indicator of a high level of food security. Consumers who have access to sufficient quantities of affordable food may be less inclined to avoid wastage when preparing or consuming meals. In this sense, post-consumer food wastage might be more of symptom than a driver of food security, and accordingly has been excluded from the indicator in the model. However, given the increasing volume and importance of post-consumer food waste, it has been discussed in depth in a special article, *Food loss: From farm to fork*, that appears later in this report.

High-income countries generally have the best scores in the food loss indicator; Finland, Singapore, Norway, the US and the UK lead the rankings, with 1% or less of their domestic food supply lost during the supply chain. Given the difficulties and costs in efficiently managing such a complex logistical process, this result is unsurprising. Interestingly, a number of former Soviet countries, including Uzbekistan, Tajikistan, Belarus, Azerbaijan and Ukraine, scored as well as many developed, high-income countries. These five are all ranked in the top 25 and had less than 2.5% food loss.

Sub-Saharan countries, which generally have difficulty managing efficient supply chains, had the worst scores for this indicator, accounting for eight of the bottom ten countries (Nepal and Haiti were the other two). Supply-chain food losses ranged from a high 9.5% in Malawi to a crushing 18.9% in Ghana.



In addition to the food loss indicator, a new output measure covering the prevalence of obesity was added to the Background variables section of the GFSI. This section, which does not contribute to the overall scores of countries in the index, provides a set of variables that may be related—sometimes in complex ways—to food security. The variables can be correlated against the overall index, as well as against categories and indicators, to discern relationships.

The obesity variable has been added to capture the growing number of obese people across developed and developing countries and the increased media attention the issue attracts. The linkages between food security and obesity are addressed in a special section of this report, *The burden of obesity: Its relationship with food security*. Research has not yet definitively identified a direct connection between the two issues, and other factors, including income levels, culture and biology, undoubtedly play an important role.

Such ambiguity is revealed in the model results. Correlations between the prevalence of obesity and other indicators tend to be relatively low. The correlations between obesity and the overall index and categories fall at around 0.60 (in a range of 0 to 1), with the correlation with Availability, at 0.50, the lowest. The strongest relationship was with the proportion of the population under the global poverty line, at -0.74. Countries that have a larger percentage of extremely poor people tend to have a lower prevalence of obesity.

Interestingly, there was little or no correlation between obesity and nutritional standards (0.20) and micronutrient availability (0.42), although protein quality (0.62) had a moderate relationship. While a higher-quality diet was moderately correlated with increased prevalence of obesity, government guidelines and monitoring appear to have little direct impact on obesity.

Obesity rates vary tremendously across countries, from just 1.1% of the population in Bangladesh and 1.2% in Ethiopia to 42.8% in Kuwait. Low- and lower-middle-income countries had the lowest levels of obesity—Japan, the only high-income country among the top 25, was the

exception. Income appears to be less of a factor in more obese countries, with an array of high-income, upper-middle-income and lower-middle-income countries filling out the bottom of the list. Very low levels of income discourage obesity; in countries with higher incomes, other factors tend to be more important.

## New regional definitions

The regional groupings have been reclassified in this year's index. The seven regions from the 2012 and 2013 indices have been reorganised to create six new regions. The biggest change was the creation of a more comprehensive Asia & Pacific region, which combines South Asia, East Asia & the Pacific and Central Asian countries from the old Europe & Central Asia region. This change makes for a more intuitive comparison among developing countries, which are now more easily analysed in comparison with their regional peers.

The European region is further reduced in size by the removal of Turkey, which was added to the Middle East & North Africa (MENA) group. This circumscribed Europe provides a more homogenous basis of comparison for these generally more developed countries. The addition of Turkey to MENA, in addition to the inclusion of the two new countries, Kuwait and the UAE, substantially increases the size of the region. These three countries tend to be more developed and perform better in the index, affording additional insights into what may drive improved food security in this region.

Finally, Mexico has been removed from the Latin America & Caribbean region (which has been renamed Central & South America) and included in North America. Given the close ties among the three North American countries—for example through the North American Free-Trade Agreement (NAFTA)—this approach may provide new insights. Additionally, by including a developing country, North America becomes more balanced and more comparable in cross-regional analyses. Sub-Saharan Africa remains unchanged. The complete classification of all 109 countries can be found in the Appendix. ■



# Overall 2014 GFSI rankings table

Weighted total of all category scores (0-100 where 100=most favourable)

Rank		Score /100	Rank		Score /100	Rank		Score /100
1	United States	89.3	38	Uruguay	65.0	=74	Uganda	45.6
2	Austria	85.5	39	Turkey	63.8	76	Côte d'Ivoire	44.7
=3	Netherlands	84.4	40	Russia	62.7	77	Pakistan	43.6
=3	Norway	84.4	41	Venezuela	62.5	78	Ghana	43.1
5	Singapore	84.3	42	China	62.2	79	Syria	40.3
6	Switzerland	84.2	43	Serbia	61.6	80	Kenya	40.1
7	Ireland	84.0	44	Romania	61.3	81	Tajikistan	38.7
=8	Canada	83.7	45	Panama	61.2	=82	Benin	38.4
=8	Germany	83.7	46	South Africa	61.1	=82	Senegal	38.4
10	France	83.4	47	Belarus	60.8	84	Cameroon	38.1
11	Denmark	83.3	48	Botswana	60.7	85	Nepal	37.7
12	Sweden	82.4	49	Thailand	59.9	86	Myanmar	37.6
13	New Zealand	82.2	50	Bulgaria	59.6	87	Nigeria	36.5
14	Belgium	82.0	51	Colombia	58.0	88	Bangladesh	36.3
15	Australia	81.9	52	Ukraine	56.4	=89	Ethiopia	35.8
16	United Kingdom	81.6	53	Peru	56.3	=89	Sierra Leone	35.8
17	Israel	80.6	54	Tunisia	55.7	91	Yemen	35.2
18	Portugal	80.3	55	Dominican Republic	54.5	92	Angola	34.4
19	Finland	79.9	56	Ecuador	54.2	93	Rwanda	34.2
20	Spain	79.8	57	Kazakhstan	53.3	94	Malawi	33.9
21	Japan	77.8	58	Paraguay	53.1	95	Mali	33.4
22	Italy	77.6	59	Jordan	53.0	96	Cambodia	33.1
23	Czech Republic	74.6	60	Sri Lanka	51.7	97	Sudan	32.7
24	Greece	74.3	61	Bolivia	50.6	98	Zambia	32.6
25	South Korea	73.2	62	Azerbaijan	50.3	99	Guinea	32.5
26	Poland	72.7	=63	Honduras	50.1	100	Burkina Faso	31.6
27	Chile	72.5	=63	Morocco	50.1	101	Mozambique	31.0
28	Kuwait	72.2	65	Philippines	49.4	102	Niger	30.5
29	Hungary	71.2	66	Egypt	49.3	103	Haiti	30.2
30	United Arab Emirates	70.9	67	Vietnam	49.1	104	Tanzania	29.9
31	Slovakia	69.8	68	El Salvador	48.8	105	Burundi	28.8
32	Saudi Arabia	69.6	69	India	48.3	106	Togo	28.4
33	Brazil	68.1	70	Algeria	47.5	107	Madagascar	27.7
34	Malaysia	68.0	71	Guatemala	46.9	108	Chad	25.5
35	Mexico	67.1	72	Indonesia	46.5	109	Congo (Dem. Rep.)	24.8
36	Costa Rica	65.8	73	Uzbekistan	46.0			
37	Argentina	65.4	=74	Nicaragua	45.6			

# Year-on-year score changes

(Net change in overall score, 2014 vs. 2013)

## Score improved

	Score change		Score change		Score change
Uganda	+5.8	United States	+1.7	Netherlands	+0.4
Togo	+5.2	Zambia	+1.7	Uruguay	+0.4
Serbia	+5.0	Algeria	+1.6	New Zealand	+0.3
Malawi	+4.9	Chile	+1.6	Philippines	+0.3
Benin	+4.8	Germany	+1.5	Switzerland	+0.2
Mali	+4.7	Nicaragua	+1.5	United Arab Emirates	+0.2
Sierra Leone	+4.7	Pakistan	+1.5	Belarus	+0.1
Sudan	+4.7	South Korea	+1.5	Peru	+0.1
Azerbaijan	+4.6	Spain	+1.5		
Slovakia	+4.4	Turkey	+1.5		
Côte d'Ivoire	+4.3	Ireland	+1.4		
Rwanda	+3.5	Kenya	+1.4		
Nepal	+3.4	Colombia	+1.3		
Nigeria	+3.4	Sri Lanka	+1.3		
Portugal	+3.4	Syria	+1.3		
Greece	+2.9	Tajikistan	+1.3		
United Kingdom	+2.9	Cameroon	+1.2		
Bulgaria	+2.8	China	+1.2		
Ethiopia	+2.7	Costa Rica	+1.2		
Singapore	+2.7	Israel	+1.2		
Congo (Dem. Rep.)	+2.6	Canada	+1.0		
Saudi Arabia	+2.5	Denmark	+1.0		
Uzbekistan	+2.5	Australia	+0.8		
Angola	+2.4	Ghana	+0.8		
India	+2.4	Kuwait	+0.8		
Yemen	+2.4	Norway	+0.8		
Senegal	+2.3	Czech Republic	+0.7		
Malaysia	+2.0	Sweden	+0.7		
Austria	+1.9	Dominican Republic	+0.6		
Bolivia	+1.9	Ecuador	+0.6		
Haiti	+1.8	Hungary	+0.5		
Poland	+1.8	Thailand	+0.5		
Chad	+1.7	Guinea	+0.4		
Italy	+1.7	Mexico	+0.4		

## Score declined

	Score change
Myanmar	-4.1
Madagascar	-3.1
Romania	-3.0
Egypt	-2.9
Tunisia	-2.9
Niger	-1.6
Ukraine	-1.6
El Salvador	-1.4
Bangladesh	-1.0
Mozambique	-1.0
South Africa	-1.0
Tanzania	-0.9
Paraguay	-0.7
Russia	-0.7
France	-0.6
Honduras	-0.6
Belgium	-0.5
Brazil	-0.5
Finland	-0.5
Burkina Faso	-0.4
Morocco	-0.4
Guatemala	-0.3
Argentina	-0.2
Burundi	-0.2
Jordan	-0.2
Vietnam	-0.2
Botswana	-0.1
Panama	-0.1

## No change

Cambodia
Indonesia
Japan
Kazakhstan
Venezuela

# Rankings by income classification

(Income groups are World Bank classifications, as of July 1st 2013)

Rank		Score /100	Rank		Score /100	Rank		Score /100	Rank		Score /100
<b>High income</b> (US\$12,616 per capita or more)			<b>Upper middle income</b> (US\$4,086-12,615 per capita)			<b>Lower middle income</b> (US\$1,036-4,085 per capita)			<b>Low income</b> (US\$1,035 per capita or less)		
1	United States	89.3	1	Hungary	71.2	1	Ukraine	56.4	1	Uganda	45.6
2	Austria	85.5	2	Brazil	68.1	2	Paraguay	53.1	2	Kenya	40.1
=3	Netherlands	84.4	3	Malaysia	68.0	3	Sri Lanka	51.7	3	Tajikistan	38.7
=3	Norway	84.4	4	Mexico	67.1	4	Bolivia	50.6	4	Benin	38.4
5	Singapore	84.3	5	Costa Rica	65.8	=5	Honduras	50.1	5	Nepal	37.7
6	Switzerland	84.2	6	Argentina	65.4	=5	Morocco	50.1	6	Myanmar	37.6
7	Ireland	84.0	7	Turkey	63.8	7	Philippines	49.4	7	Bangladesh	36.3
=8	Canada	83.7	8	Venezuela	62.5	8	Egypt	49.3	=8	Ethiopia	35.8
=8	Germany	83.7	9	China	62.2	9	Vietnam	49.1	=8	Sierra Leone	35.8
10	France	83.4	10	Serbia	61.6	10	El Salvador	48.8	10	Rwanda	34.2
11	Denmark	83.3	11	Romania	61.3	11	India	48.3	11	Malawi	33.9
12	Sweden	82.4	12	Panama	61.2	12	Guatemala	46.9	12	Mali	33.4
13	New Zealand	82.2	13	South Africa	61.1	13	Indonesia	46.5	13	Cambodia	33.1
14	Belgium	82.0	14	Belarus	60.8	14	Uzbekistan	46.0	14	Guinea	32.5
15	Australia	81.9	15	Botswana	60.7	15	Nicaragua	45.6	15	Burkina Faso	31.6
16	United Kingdom	81.6	16	Thailand	59.9	16	Côte d'Ivoire	44.7	16	Mozambique	31.0
17	Israel	80.6	17	Bulgaria	59.6	17	Pakistan	43.6	17	Niger	30.5
18	Portugal	80.3	18	Colombia	58.0	18	Ghana	43.1	18	Haiti	30.2
19	Finland	79.9	19	Peru	56.3	19	Syria	40.3	19	Tanzania	29.9
20	Spain	79.8	20	Tunisia	55.7	20	Senegal	38.4	20	Burundi	28.8
21	Japan	77.8	21	Dominican Republic	54.5	21	Cameroon	38.1	21	Togo	28.4
22	Italy	77.6	22	Ecuador	54.2	22	Nigeria	36.5	22	Madagascar	27.7
23	Czech Republic	74.6	23	Kazakhstan	53.3	23	Yemen	35.2	23	Chad	25.5
24	Greece	74.3	24	Jordan	53.0	24	Sudan	32.7	24	Congo (Dem. Rep.)	24.8
25	South Korea	73.2	25	Azerbaijan	50.3	25	Zambia	32.6			
26	Poland	72.7	26	Algeria	47.5						
27	Chile	72.5	27	Angola	34.4						
28	Kuwait	72.2									
29	United Arab Emirates	70.9									
30	Slovakia	69.8									
31	Saudi Arabia	69.6									
32	Uruguay	65.0									
33	Russia	62.7									

## Rankings by regional classification

Rank		Score /100
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### North America

1	United States	89.3
2	Canada	83.7
3	Mexico	67.1

### Central & South America

1	Chile	72.5
2	Brazil	68.1
3	Costa Rica	65.8
4	Argentina	65.4
5	Uruguay	65.0
6	Venezuela	62.5
7	Panama	61.2
8	Colombia	58.0
9	Peru	56.3
10	Dominican Republic	54.5
11	Ecuador	54.2
12	Paraguay	53.1
13	Bolivia	50.6
14	Honduras	50.1
15	El Salvador	48.8
16	Guatemala	46.9
17	Nicaragua	45.6
18	Haiti	30.2

Rank		Score /100
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### Europe

1	Austria	85.5
=2	Netherlands	84.4
=2	Norway	84.4
4	Switzerland	84.2
5	Ireland	84.0
6	Germany	83.7
7	France	83.4
8	Denmark	83.3
9	Sweden	82.4
10	Belgium	82.0
11	United Kingdom	81.6
12	Portugal	80.3
13	Finland	79.9
14	Spain	79.8
15	Italy	77.6
16	Czech Republic	74.6
17	Greece	74.3
18	Poland	72.7
19	Hungary	71.2
20	Slovakia	69.8
21	Russia	62.7
22	Serbia	61.6
23	Romania	61.3
24	Belarus	60.8
25	Bulgaria	59.6
26	Ukraine	56.4

Rank		Score /100
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### Middle East & North Africa

1	Israel	80.6
2	Kuwait	72.2
3	United Arab Emirates	70.9
4	Saudi Arabia	69.6
5	Turkey	63.8
6	Tunisia	55.7
7	Jordan	53.0
8	Morocco	50.1
9	Egypt	49.3
10	Algeria	47.5
11	Syria	40.3
12	Yemen	35.2

### Asia & Pacific

1	Singapore	84.3
2	New Zealand	82.2
3	Australia	81.9
4	Japan	77.8
5	South Korea	73.2
6	Malaysia	68.0
7	China	62.2
8	Thailand	59.9
9	Kazakhstan	53.3
10	Sri Lanka	51.7
11	Azerbaijan	50.3
12	Philippines	49.4
13	Vietnam	49.1
14	India	48.3
15	Indonesia	46.5
16	Uzbekistan	46.0
17	Pakistan	43.6
18	Tajikistan	38.7
19	Nepal	37.7
20	Myanmar	37.6
21	Bangladesh	36.3
22	Cambodia	33.1

Rank		Score /100
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### Sub-Saharan Africa

1	South Africa	61.1
2	Botswana	60.7
3	Uganda	45.6
4	Côte d'Ivoire	44.7
5	Ghana	43.1
6	Kenya	40.1
=7	Benin	38.4
=7	Senegal	38.4
9	Cameroon	38.1
10	Nigeria	36.5
=11	Ethiopia	35.8
=11	Sierra Leone	35.8
13	Angola	34.4
14	Rwanda	34.2
15	Malawi	33.9
16	Mali	33.4
17	Sudan	32.7
18	Zambia	32.6
19	Guinea	32.5
20	Burkina Faso	31.6
21	Mozambique	31.0
22	Niger	30.5
23	Tanzania	29.9
24	Burundi	28.8
25	Togo	28.4
26	Madagascar	27.7
27	Chad	25.5
28	Congo (Dem. Rep.)	24.8

## Affordability

The Affordability category explores the capacity of individuals within a country to pay for food and the relative costs they may face under both normal circumstances and food-related shocks. In addition to the annual baseline score, a quarterly adjustment accounts for changes in global food prices, incomes and exchange rates.

Affordability is measured across six indicators:

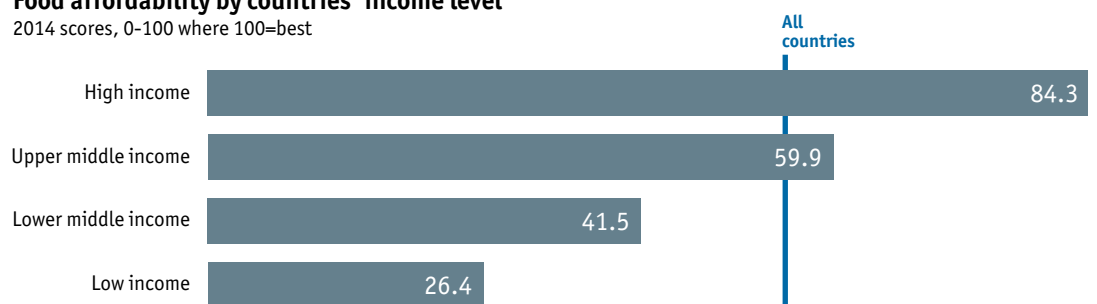
- Food consumption as a share of household expenditure
- Proportion of population under global poverty line
- Gross domestic product per capita (at purchasing power parity, or PPP, exchange rates)
- Agricultural import tariffs
- Presence of food safety net programmes
- Access to financing for farmers

The capacity to afford quality food without undue stress is a crucial aspect of food security. The GFSI looks at affordability through two primary lenses—whether an average individual in a country has sufficient means to purchase food, and the public structures that have been established to respond to personal or societal shocks. Together these provide a holistic treatment of affordability, exploring elements of ability to pay and cost under a broad array of environmental conditions.

In the 2014 GFSI, most countries showed meaningful improvement within the Affordability category. Benin had the largest score increase (11.2), despite a relatively low reading of 36.2. In general, Sub-Saharan African (SSA) countries were among the most improved from the previous year. Of the top 15 most improved countries (all with gains of 5 points or more), eight were in SSA, four in Europe and three in Asia & Pacific. Of all 109 countries, only 14 showed a decline in their 2014

### Food affordability by countries' income level

2014 scores, 0-100 where 100=best



Source: Economist Intelligence Unit



Affordability score. Myanmar recorded the largest fall (6.9), followed by Egypt (5.3), Niger (4.8) and Madagascar (4.3).

With a score of 94.8, the US passed Singapore (94) to take the first position in Affordability, maintaining a pattern where high-income countries (there were 32 in the GFSI) occupied nearly all of the top ranks. Of the first 34 positions, only two (Hungary at 26th and Brazil tied for 33rd) were not held by high-income countries. In fact, the Affordability category was highly correlated with income levels. Low-income countries accounted for the majority of the lowest-ranked, with Madagascar receiving the worst score (15.1). It was only narrowly bettered by the Democratic Republic of Congo (16), which held the lowest score last year.

The GFSI uses three indicators to assess directly the capacity of the average individual to afford food. The first is **food consumption as a share of household expenditure**, which attempts to capture the relative importance of food in household budgets. The lower the relative household expenditure on food, the easier it is for a household to respond to price increases and shocks. Accordingly, the best performers devoted less than 15% of total household expenditure to food, with the lowest rates in the US and Singapore (both 6.7%). By contrast, countries that received the lowest scores had figures of over 50%. Rwanda (71.7%) and Madagascar (71.8%) had the highest percentage of household expenditure on food. Unsurprisingly, the highest-ranked countries were generally in North America and Europe, while the lowest-ranked countries were in Sub-Saharan Africa and Asia & Pacific.

The second indicator examines the **proportion of the population under the global poverty line**, defined as those living on less than US\$2 per day (measured at PPP exchange rates). Those below the poverty line have very limited resources and considerable difficulty purchasing food. Fifty-six countries, all high-income, were tied for first with 0% of the population under the global poverty line. This is in marked contrast to the bottom 20 countries, which had an average of 81% of their

populations under the poverty line. These economies were largely in Sub-Saharan Africa, although India, Bangladesh, Uzbekistan and Haiti were in the bottom group. There was little year-on-year change in these figures; most countries either remained the same or improved by less than 2 percentage points. Most of these gains occurred among countries with the weakest scores. Only four countries experienced a decline in score, including the Democratic Republic of Congo, which fell to last place with 95.2% of its population in poverty.

**Gross domestic product (GDP) per capita (at PPP exchange rates)** provides insight into the relative wealth of a country and the ability of the average citizen to consume. Understandably, countries with higher GDP tend to have higher food security. Most countries experienced slight improvements in their GDP figures over the past year. Nonetheless, these gains could not prevent score declines in countries that were unable to keep up with the higher pace of growth in better-performing countries. Australia had the largest score improvement (2.8), followed by the US (2.0), while the United Arab Emirates (3.0) and Spain (2.8) saw their scores decline the most.

The index also includes two indicators that add perspective on the cost of food within each country. **The agricultural import tariff** is measured as the average applied most-favoured nation (MFN) rate on all agricultural imports. Higher tariff rates can hurt food security by raising the price of both domestically sourced and imported food. Top-performing countries have rates below 6%, while the highest rates of protection, such as in South Korea (52.7%), Norway (53.2%) and Egypt (66.7%), are eight to ten times higher. Scores have tended to improve since the 2013 GFSI. Japan's score increased by 11.4 points following a fall in its tariff rate from 23.3% to 16.6%. Switzerland fared even better: its score increased by 16.2 points after it cut its tariff rate to 33.5%. South Korea and India, however, increased their MFN rates, causing their scores to drop by 5.4 points and 2.1 points, respectively.

**Access to financing for farmers**, a qualitatively scored indicator that examines the breadth and

depth of farmer financing, provides another perspective on food costs. Better access to financing allows farmers, particularly smallholders, to respond appropriately to price shocks and provides the means for a more vibrant agricultural sector. High-income countries, plus Hungary, performed the strongest in this category, while lower-middle-income and low-income countries—again often from Sub-Saharan Africa—had the lowest scores.

The remaining indicator in the Affordability category is the **presence of food safety net programmes**. This qualitatively scored indicator measures the presence and depth and of

programmes that protect individuals from food-related shocks and considers the nature of the organising entity, for example, the government or non-governmental organisations (NGOs). The more robust these programmes are—which include in-kind food transfers, food vouchers and school feeding programmes—the higher the score a country will receive. If individuals have a safety net to fall back on during a crisis, their food security will improve meaningfully. As with most of the indicators in this category, this one follows a pattern in which highly developed, high-income countries score well, while low-income countries in Sub-Saharan African receive the weakest scores. ■

## Availability

This category assesses factors that influence the supply of food and the ease of access within a country. It examines how structural aspects determine the capacity within a country to produce and distribute food, and explores elements that might create bottlenecks or risks to robust availability.

Availability is measured across eight indicators:

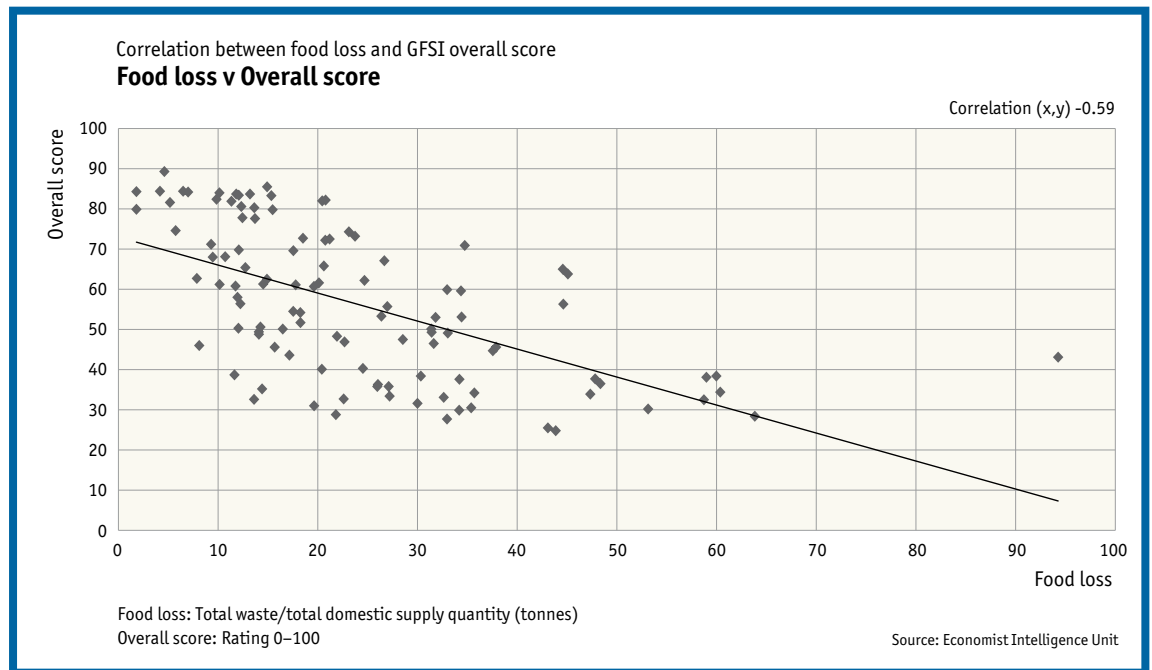
- Sufficiency of supply
- Public expenditure on agricultural research and development (R&D)
- Agricultural infrastructure
- Volatility of agricultural production
- Political stability risk
- Corruption
- Urban absorption capacity
- Food loss

Affordable food has minimal value if access is difficult, volatile or uncertain. Accordingly, the GFSI examines eight crucial aspects of food availability to determine the ease of access within each country. Economies with fewer structural restrictions on food availability—from both markets and governments—and more advanced agricultural markets—in terms of both infrastructure and support for the sector—tend to have environments more conducive to food security. Such operating environments are often less at risk of food supply shocks and can handle shocks better when they arise.

Given the structural nature of the Availability category, more advanced economies in North America, Europe and Asia perform the best. The US (85.5) improved its score by 1.3 points over the past year, remaining at the top of the rankings. It was followed by three European countries—Austria (82.8), the Netherlands (81.3) and Germany (80.9)—all of which saw their scores improve since last year. However, many European countries experienced score declines, with six of the ten largest reductions in that region. Ukraine, for instance, recorded the second-largest decline (6.8), which was driven by the worsening political environment.

Low-income countries, particularly in Sub-Saharan Africa, have the lowest scores for Availability. However, the lowest scores in this category were substantially higher than for both Affordability and Quality & Safety. Twenty countries in the Affordability category and nine in Quality & Safety received lower scores than the 30 recorded by Chad—the worst-performing country in Availability. This narrower range of scores suggests that countries have generally been more successful in addressing questions of food Availability than either Affordability or Quality & Safety.

The primary indicator in the 2014 GFSI measures the **sufficiency of supply**. This composite indicator examines the **average food supply** and the **dependency on chronic food aid** to assess the core question of availability: Is there enough food? The latter indicator is particularly important because,



while more food is generally preferable, reliance on external donors for regular food supplies reflects weaknesses in the system. Overall, there was little year-on-year change in the sufficiency of supply, although a handful of low-income and lower-middle-income countries experienced declines driven by increased dependency on food aid.

The domestic food supply is partially determined by the **volatility of agricultural production**. Highly volatile output can have detrimental effects on food security by making it difficult to manage food supply. Higher volatility can potentially create unneeded surpluses or shortages that severely impact food availability. Asia & Pacific and Sub-Saharan Africa comprise the majority of countries with the lowest volatilities. The best-scoring countries, led by Guinea (100) and China (98.8), had agricultural volatilities lower than 0.03. This contrasts with many MENA countries, including Morocco (0.33), Tunisia (0.32), the UAE (0.31) and Algeria (0.26), where agricultural volatility was nearly ten times higher.

While volatility of agricultural production reflects potential problems at the beginning of the food supply chain, **food loss** examines the share of food that is lost post-harvest and before it gets to the consumer. A higher share of food that is lost

during processing, production, transport and storage often indicates meaningful structural problems within the supply chain. High-income economies performed well in this category, constituting nine of the top ten countries—all of which lost 1.6% or less of their total domestic supply during these stages. Interestingly, Uzbekistan, a lower-middle-income country, was ranked 10th, with a score of 93.2. It was followed by Hungary (91.9) and Malaysia (91.7). The highest levels of food loss were in Sub-Saharan Africa, with the bottom six countries from this region. Ghana had the highest percentage of food loss (18.9%) of all the countries in the index.

**Public expenditure on agricultural R&D** serves as a proxy to assess the level of innovation that can increase market efficiency and access. Greater expenditure on R&D can improve agricultural yields and advance the capacity of a country to produce sufficient food supplies. Expenditure on agricultural R&D differed tremendously across regions. Botswana and the US were tied for first, while six countries tied for fifth place, including three in Europe (France, Germany and Spain), two in the Middle East (Israel and Jordan) and one in Sub-Saharan Africa (South Africa). However, public expenditure is generally low across the

globe—only 21 countries spent more than 1.5% of their agricultural GDP on R&D.

**Agricultural infrastructure** examines three vital infrastructure components—the **existence of adequate crop storage facilities** and the **extent and quality of both port and road infrastructure**. Crop storage facilities are necessary to minimise food loss, facilitate the movement of goods and provide buffers in case of shocks to the food supply. Robust port and road infrastructures assist in the distribution of food supplies. Without such networks, countries may find it difficult to import and distribute products, particularly to rural or remote parts of the country. Scores largely remained constant from the 2013 GFSI, although four countries in Asia & Pacific (Myanmar, Thailand, Australia and Sri Lanka), three in Central & South America (Haiti, Chile and the Dominican Republic) and two in Sub-Saharan Africa (Angola and Togo) experienced considerable score improvements (greater than 9 points).

Good infrastructure, however, can be threatened by both corruption and political instability. High **political stability** risk can limit access to food through such avenues as transport blockages or reduced international food aid commitments. It can also create interruptions in the supply chain, as uncertainty or outright conflict diminish the ability and willingness of individuals to supply food products. Countries such as Syria (0.0) and Ukraine (16.7), which are experiencing serious domestic political conflict, score extremely poorly in this indicator. Ukraine recorded the largest decline in this category (16.6 points), followed by Brazil, France, Sri Lanka and Venezuela, whose scores all fell by 11.1 points. By contrast, Mali, which has

begun to recover from its political crisis, experienced the largest score increase (16.7).

**Corruption** poses similar difficulties for Availability by creating distortions and other inefficiencies in both the use of natural resources and in food distribution. Corruption can divert food supplies, thus limiting availability in certain areas or creating undesirable bottlenecks. Corruption scores improved by 25 points in some Asia & Pacific countries in 2014, including China, Malaysia, Nepal and Pakistan, although, with the exception of Malaysia, overall scores still remained weak. Jordan, Kenya and Saudi Arabia also recorded score improvements in this indicator, while only three countries (Australia, Malawi and Paraguay) experienced a decline.

Another potential vulnerability is captured by **urban absorption capacity**, which compares a country's real GDP growth rate with its urban growth rate. This metric suggests whether a country has sufficient resources to accommodate the costs of urbanisation. Rapid urbanisation can place strains on infrastructure and lead to difficulties in feeding a growing urban population, particularly if a country's economy is not growing rapidly enough to accommodate the changes. Asia & Pacific tends to perform well in this indicator (claiming seven of the top ten positions) because relatively fast-growing economies can more easily accommodate high levels of urbanisation. Highly developed countries, particularly those in Europe that are still affected by weak economies, generally have lower scores. Italy (50.3), Portugal (50.1) and Greece (43.1) share the bottom five ranks with Sudan (49.8) and Syria (0.0). ■



## Quality and safety

The third category in the GFSI explores the nutritional quality of average diets and the food safety environment within each country. This category is sometimes referred to by other commentators as “utilisation”.

Food quality and safety is measured across five indicators:

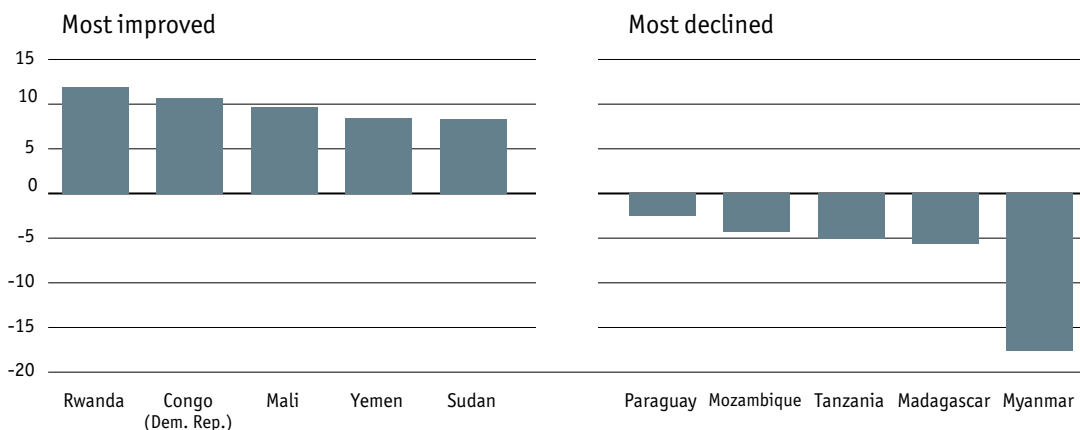
- Diet diversification
- Nutritional standards
- Micronutrient availability
- Protein quality
- Food safety

The Quality & Safety category separates the concept of food security from more traditional welfare metrics, such as poverty, which are often linked to considerations of access. This category moves beyond such a focus to explore the overall quality of food supplies, based on the understanding that food security requires access to “nutritious food that meets [individuals’] dietary needs”.

Overall, more countries experienced a decline rather than an improvement in their Quality & Safety score between the 2013 and 2014 GFSIs. However, the majority of score declines were small, with only Madagascar (17.6) falling by more than 6

### Quality and safety—most improved and most declined

Score change, 2014 v 2013



Source: Economist Intelligence Unit

points. The average score decline was half of the average score increase, contributing to an average improvement across the globe.

The most improved countries, led by Rwanda (11.9 points), the Democratic Republic of Congo (10.7) and Mali (9.7) were largely from Sub-Saharan Africa, although most of these countries remained at the bottom of the rankings. By contrast, the top-performing countries were highly developed economies that experienced only minor adjustments in score over the past year.

In the GFSI, Quality & Safety are explored by examining the composition of the average diet and the structural and regulatory environment within each country. Although differences certainly exist within a given country, understanding the average diet provides important insights into whether individuals within a country are receiving sufficient nutrients in their diets. Three indicators are employed to develop this understanding.

The first, **diet diversification**, measures the share of non-starchy foods in total dietary energy consumption. Diets that consist of higher percentages of non-starchy foods, which include all but cereals, roots and tubers, tend to be more nutritious, given the prevalence of vegetables, dairy and meat products. Unsurprisingly, there are tremendous differences in diets across countries. Those with the highest levels of diversification tend to be well-developed European countries, led by Switzerland, where 76% of the diet comes from non-starchy foods. By contrast, low-income, Sub-Saharan African and Asian countries dominate the bottom ranks. Bangladesh has the lowest share of non-starchy foods, at just 20%.

The second indicator that focuses on average diets explores **micronutrient availability**. This composite indicator considers three distinct micronutrients—**vitamin A**, **animal iron** and **vegetal iron**. Advanced Asia & Pacific countries performed well in this indicator, with South Korea (80.9), Japan (75.5) and Singapore (71.1) claiming three of the top four positions. European countries also scored highly—France (72) ranked third. However, the relationship between level of development and micronutrient availability was

not as strong as with other indicators. Factors other than income, such as culture, may play a significant role in determining national diets and thus influence access to key micronutrients. For instance, the US received a score of 58.5, which places it narrowly ahead of low-income Chad (58.4) in 20th position.

**Protein quality** is the final nutrition-focused indicator. It measures the grams of quality protein consumed, based on the presence of nine essential amino acids. Israel had the largest amount of quality protein (126 g) in the average diet, more than five times that of bottom-ranked Mozambique (23.6 g). As with diet diversification, there was a strong relationship between income level and protein quality. Central & South American countries are positioned in the middle of the index alongside countries from the Middle East & North Africa and Asia & Pacific.

The other two indicators within the Quality & Safety category assess the structural and regulatory environment for each country. These indicators attempt to address the safety portion of the category by examining the presence of government oversight of the food sector and national nutrition. Both of these indicators are composites, incorporating multiple sub-indicators into their analyses.

**Nutritional standards** examines the presence of **national dietary guidelines** and a **national nutrition plan or strategy**. It also considers whether there is **nutritional monitoring or surveillance** within a country. These three components provide insight into whether a government is committed to increasing nutritional standards. Together, they determine whether a government is providing information on nutrition, implementing a policy to address nutrition, and tracking progress. Most countries score well in this area, possessing all three components of nutritional standards. However, gaps do remain in nearly 30% of the countries, many of which are in Sub-Saharan Africa or are low-income.

**Food safety** is the final indicator in the Quality & Safety category. It examines whether a country has an **agency to ensure the safety and health of**

**food**, a baseline regulatory function that helps to ensure food security. It also explores two structural elements of food safety: the **percentage of the population with access to potable water** and the **presence of a formal grocery sector**. Both of these indicators assess whether a country has reached a level of development necessary to provide safe food. Access to potable water is clearly a key component of food safety, while a formal grocery sector provides consistent and

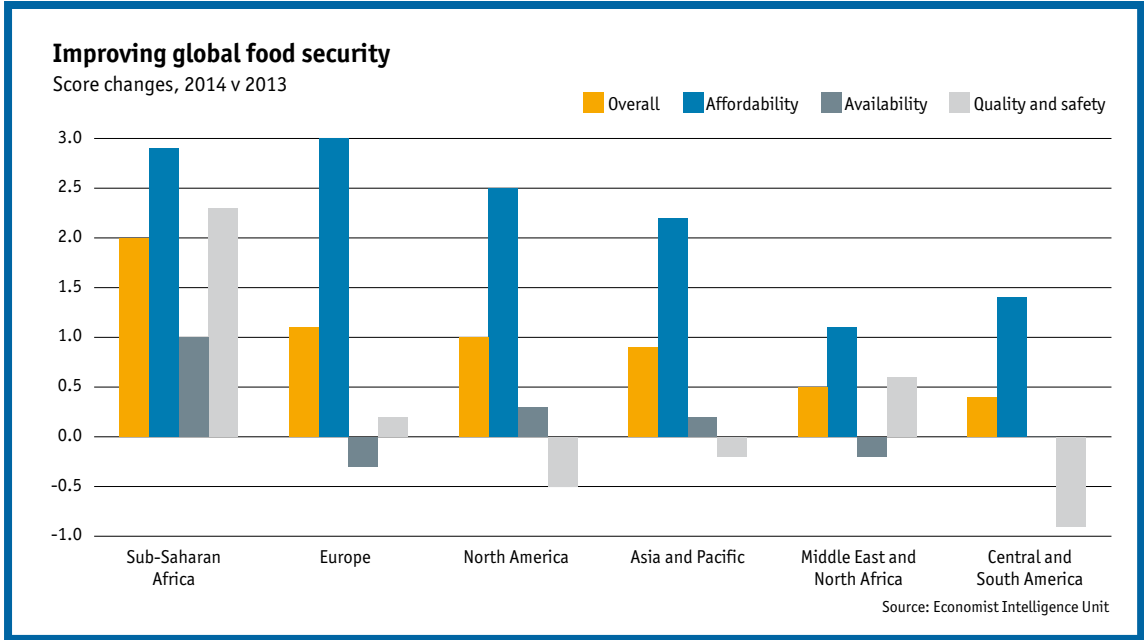
accessible food products that generally have some level of public or private oversight. Twenty-two highly developed countries have perfect scores in food safety, in sharp contrast to those in Sub-Saharan Africa, which constitute the majority of the lowest-ranked countries. The bottom ten economies—all from Sub-Saharan Africa except Haiti—have an average score of 26.8, reflecting the lack of resources and development necessary to ensure basic food safety. ■

# Regional findings

Food security is a complex and nuanced issue, which can be analysed through many viewpoints and from many geographical perspectives—national, regional and global. The regional perspective is beneficial because of the commonalities that are often present across regions and because it creates an additional basis for comparing countries beyond a global framework. This approach can offer greater insight into the GFSI’s measures and provide points of comparison among the regions to understand the dynamics of food security and the mechanisms that may be employed to address the unique issues that

are experienced within a region and its constituent countries.

On a regional level, structural elements, which are generally more similar within regions than across the globe, tend to play an extremely important role in determining food security. In regions that include countries with different economic systems, policy environments, agricultural infrastructures and nutritional standards, the gap in food security between best and worst performers is wider. These structural elements tend to change little year on year; however, when changes do occur, they have a



greater impact on food security than other factors explored in the index.

Highlights of the regional results are provided below. More detailed discussions of regional food security and the 2014 GFSI results can be found in the *Food loss and its intersection with food security* regional reports, which identify similarities as well as differences between countries in each region, highlight regional areas of strength and weakness, and offer insight into the economic, political and social context of the results of the 2014 GFSI.

## Cross-regional comparison

**North America and Europe**, which collectively encompass 29 of the 109 countries in the index, recorded the strongest performances in the 2014 GFSI, driven by the developed countries' dominance of those regions. As two regions comprised primarily of rich countries, Europe and North America have high levels of GDP per capita, with an average share of only 17.7% of household expenditure spent on food—just under half the global average (34.5%). Wealth corresponds with developed agricultural infrastructure, high sufficiency of supply, relatively low political stability risk and low corruption levels, factors that contribute to North America's and Europe's first and second ranking, respectively, in the overall index and in each category.

The next three highest-ranked regions—the **Middle East & North Africa (MENA)**, **Central & South America (CSA)** and **Asia & Pacific**—account for 52 countries in the index, and all fall within a range of 2.4 points. These regions are comprised of a mix of developed and developing countries that have varied economic and political structures. MENA performs the best of the three regions owing to its strong Affordability score—2.3 points ahead of CSA—and its third-place tie with CSA in Quality & Safety. Asia & Pacific's comparatively high percentage of the population under the global poverty line and low diet diversification explain its lower scores in the Affordability and Quality & Safety categories, although Asia & Pacific outperforms MENA and CSA in Availability.

**Sub-Saharan Africa (SSA)** has the lowest regional score in the 2014 GFSI, with an overall score that is just two-thirds that of the Asia & Pacific region. It also scores the lowest in each of the index categories owing to the large number of low-income countries in the region: of the 28 countries in SSA, 18 are low-income according to World Bank income classifications. Commitments to agricultural research and development (R&D), while still weak, are an area of relative strength in comparison to select other region, but underdeveloped agricultural infrastructure, low income levels and poor diet diversification drive the region's poor results.

## Regional overviews

### Asia & Pacific

Asia & Pacific's low overall food security score disguises acute differences between wealthy nations and underdeveloped ones. If the top five countries in the region—Singapore, New Zealand, Australia, Japan and South Korea—were considered separately, Asia & Pacific would rank second globally. By contrast, poor countries such as Bangladesh, Nepal, Myanmar and Cambodia have some of the highest levels of food insecurity seen around the world.

Those countries that saw increases in the share of household expenditure spent on food experienced a deterioration in score, highlighting the strong correlation between shifts in food affordability and overall food security. Robust governance, which affects volatility of agricultural production, urban absorption capacity, national dietary guidelines and nutritional monitoring systems, in addition to relatively low agricultural import tariff rates, bolstered food security scores across the region. Low levels of economic development in most countries in the region, which impacted micronutrient availability and agricultural innovation and development, hampered regional food security.

## Central & South America

Central & South America can be divided into three broad economic regions in terms of their development and placing in the 2014 GFSI. Since income levels are closely linked to food security outcomes, it is not surprising that the more developed southern countries—Chile, Argentina, Brazil and Uruguay—score better than poorer countries, while less developed economies—such as Paraguay, Bolivia, Peru and to some extent Colombia—lie behind the leaders. Most of the Central American and Caribbean countries are placed further behind, largely reflecting lower income levels.

CSA experienced the smallest regional improvement in food security, owing primarily to high urbanisation rates coupled with stunted GDP growth over the past year and the prevalence of corruption in the region, which continues to impair food availability through distortions and inefficiencies in resource allocation and distribution systems.

Nonetheless, the region has areas of strength. Despite localised problems of harvest failure that are affecting some crops used for both domestic consumption and cash crop exports, CSA scores very well on volatility of agricultural production. This reflects the region's large arable land mass and fairly good level of agricultural development. Additionally, the more comprehensive regional presence of food safety net programmes, together with a decrease in the share of household expenditure spent on food and improved agricultural infrastructure—including port development in Chile and the Dominican Republic—drove CSA's 0.4 increase between the 2013 and 2014 indices.

## Europe

The countries in Europe are differentiated by economic and social conditions. Long-time EU member countries and non-EU countries with high per capita incomes, such as Norway and Switzerland, tend to do very well in the GFSI, while east European countries that are either EU newcomers or non-members score relatively poorly. Despite these disparities, Europe has a very stable overall food security environment. Eighteen of the 26 European countries in the index fall into the "best environment" quartile among the 109 countries ranked; the remaining eight countries are characterised as having a "good environment".

Comprehensive food safety net programmes, high levels of food safety and minimal food loss owing to strong and effective national regulations and infrastructure systems are regional strengths that drive Europe's high levels of food security in all three categories in the GFSI. Despite high scores across all three categories, high volatility of agricultural production—a product of low spending on agricultural R&D despite the increased focus of the EU's common agricultural policy (CAP) and Europe 2020 programme on agricultural production and R&D—and low urban absorption owing to low GDP growth as the region still recovers from the global recession are regional weaknesses.

Compared with the 2013 index results, the region's performance in the Affordability category improved, supported primarily by a better score in food consumption as a share of household expenditure and, to a lesser extent, a reduction in agricultural import tariffs. A normalisation of food prices following a spike caused by severe drought conditions has supported food affordability; however, there remains significant heterogeneity in the share of household expenditure on food among European countries.



## Middle East & North Africa

The countries that comprise the Middle East & North Africa region for the GFSI are extremely diversified both in terms of food supply and consumption. Several states, including Turkey, Morocco and Israel, are major food exporters and self-sufficient in most, albeit not all, agricultural products. Conversely, the arid Gulf Arab states are, unsurprisingly, heavily dependent on food imports and their governments are focused on ring-fencing supplies from abroad while expanding food storage capacities domestically. Broad trends are difficult to discern given the widely differing economic and political situations of the countries in the region, but the biggest net gains were evident in the Affordability category.

Improved Availability scores reflect a decline in the share of household expenditure spent on food—a key measure of vulnerability—which, assisted by the trend of reduced agricultural tariffs across the region, helped bring down food costs. However, the improvement was restrained to a degree by lower levels of real GDP per head compared with the year earlier—only Israel and Saudi Arabia saw an increase—as war, revolution and continued weakness in the euro zone (a key market for North African and Turkish exporters) continued to hinder overall economic performance.

The most consistent declines across MENA were in Quality & Safety scores, where the majority of the countries saw a worsening of their score. Although Yemen was an exception—its score improved markedly as the easing of the country's political crisis allowed food safety nets to be rebuilt and nutritional standards to improve—in general the Gulf peninsula states continue to suffer from undiversified diets and low protein quality.

## North America

North America, which is comprised of Canada, Mexico and the United States, contains two high-income countries and one upper-middle-income country, all with relatively large personal income levels, developed agricultural infrastructures, high diet diversification and comprehensive access to both safe and nutritious food. Higher disposable incomes, as all three countries gradually recovered from the effects of the global financial crisis, have reduced the share of household expenditure spent on food and resulted in increased food affordability and improved food security across the region. North America maintained its top score in the 2014 GFSI, with each country showing overall score improvements. The US and Canada drove the strong year-on-year performance across the board. Political stability throughout the region, as the global economy emerged from the financial crisis and recession, helped to support these scores.

Improvement was greatest in the Affordability category. This was driven by a decline in food consumption as a share of household expenditure, reflecting both the fall in global food prices and the region's improved agricultural tariff environment. However, it was slightly constrained by regional GDP per capita remaining flat from the previous year, with only the US showing improvement. High volatility of agricultural production, low urban absorption capacity owing to subdued real GDP growth (despite coinciding low urbanisation rates) and limited dietary availability of vegetal iron are the region's main food security challenges.

## Sub-Saharan Africa

Food security, particularly food affordability, in most countries in Sub-Saharan Africa is undermined by low average incomes, widespread poverty and a heavy reliance on costly food imports. Although SSA has experienced high economic growth rates over the past five years, it remains by far the poorest region of the world. Food security is further undermined by the fact that national populations across much of SSA are spread over large geographical areas and are poorly served by weak transport infrastructures, logistics services and distribution channels. Finally, political unrest and armed conflict continue to affect food security in countries such as the Democratic Republic of Congo (DRC), Mali, Somalia and Nigeria, resulting in restricted access to agricultural land and food distribution, internally displaced local populations and an influx

of refugees to neighbouring countries.

Nonetheless, SSA has seen a strengthening of its food security position over the past year, with 20 (71%) of the countries in the region recording an overall improvement. This largely reflects the continued rapid pace of economic growth across the region—SSA has accounted for eight of the world's 20 fastest-growing economies over the past five years (2009-13). SSA also has an abundance of agricultural resources (land and water) and policy is increasingly focusing on the agricultural sector, which somewhat bolsters food affordability and availability. Market reforms in SSA have renewed the interest of private-sector investors in agriculture, which supports rural incomes and encourages agricultural production and productivity gains. But regardless of these improvements, the gap between Sub-Saharan Africa and the other regions is wide, and the region continues to lag. ■

## SPECIAL REPORT:

# Food loss and its intersection with food security

- **Food loss occurs mainly during the early phases of the food supply chain—at the production, post-harvest and processing stages—when food intended for human consumption is destroyed, degraded or otherwise unused. It can negatively impact food security because it is often the result of inefficient uses of supply chain resources and deficient national infrastructure.**
- **Food loss is more of an issue in developing countries given weaknesses in their food supply chains. It constrains food security by reducing the availability of nutritious food.**
- **Food waste differs from food loss and occurs during the final stages of the supply chain—distribution and consumption—when food is discarded.**
- **Food waste is more common in high-income, developed countries and does not cause food insecurity, but rather is the result of higher food availability and greater food security.**

In an annual assessment of global hunger in 2013, the Food and Agriculture Organisation (FAO) of the United Nations reported that “the world produces enough food to feed everyone”, yet at the same time an estimated one in eight people, or some 870m, suffer from chronic undernourishment.<sup>1</sup> At the centre of this gap between production and consumption are food loss and waste, which occur throughout the globe’s countless food supply chains.

Food loss poses tremendous problems for national food systems. At a minimum it represents the wastage of resources, including the land, water, labour and power used to generate food. It also reveals deficiencies within a country’s food supply chain (FSC), which create areas that may be restricting access to food.

Reduced access to food is one of the negative factors for food security. When food supply chains break down and food supplies become less physically or economically accessible, it is often the most vulnerable who are affected. Supply-chain wastage is a pernicious problem, and whether from insufficient storage for wheat or lack of efficient

transfer from field to market, food loss indicates structural problems in the agricultural infrastructure necessary for food security.

The many consequences of food loss—whether to food security, the economy or the environment—and its causes vary significantly among regions, stages of the FSC and types of food products that are lost. To better comprehend the impact of food loss on food security, this special report by The Economist Intelligence Unit (EIU) explores how to measure the costs of food loss; it assesses where and when losses occur and examines the relationship between food loss and the Global Food Security Index (GFSI).

## Measuring food loss and its costs

Measuring food loss is complicated, owing both to poor data availability and to the many ways in which the magnitude and costs of food loss can be assessed. Various measurement approaches focus on different aspects of loss, and accordingly reveal different costs of—and concomitantly different solutions to—food loss. Three main approaches consider loss in terms of weight, caloric level and

“the world produces enough food to feed everyone”, yet at the same time an estimated one in eight people, or some 870m, suffer from chronic undernourishment.

<sup>1</sup> 2013 World Hunger and Poverty Facts and Statistics, World Hunger Education Service.

## What is food loss?

The concept of food loss is seemingly straightforward, yet it is underpinned by considerable complexity and there is little consensus regarding its definition. In general, food loss occurs when edible food products are lost (left in the field or through spillage, for example), destroyed or discarded (processing, quality control), degraded (contamination, improper packaging) or consumed by pests at some stage during the food supply chain.<sup>1</sup> Most definitions of food loss consider reductions in quality, such as wilting or bruising, in addition to reductions of quantity.

However, some organisations, including the FAO, go beyond this basic definition and include the diversion of food originally meant for human consumption to other uses, such as bio-energy or animal feed. This diversion of food represents a reduction in the planned food supply and may indicate poor planning or inefficiencies in the agricultural system.<sup>2</sup> Likewise, while most

definitions only consider edible food loss, non-edible food loss—the loss of parts of food that are generally not consumed, such as bones, eggshells and apple cores—is sometimes considered. Even if non-edible food loss is excluded in principle, the physical difficulty of separating it from the edible portions of food loss often means that data sources are unable to distinguish the two issues in practice.<sup>3</sup>

There is also a meaningful difference between the concepts of **food loss** and **food waste**. Whereas the former captures losses in the food supply chain that occur from harvesting through processing, food waste addresses losses that occur during distribution and consumption. Thus food waste explores consumer behaviour (including retail and wholesale distribution) and addresses different problems than food loss, which examines infrastructure and other structural aspects of the food supply chain. Each concept has a very different relationship with food security. This distinction is used throughout this report.<sup>4</sup> ■

1 Julian Parfitt, Mark Barthel and Sarah Macnaughton, "Food waste within food supply chains: quantification and potential for change to 2050", *Philosophical Transactions of the Royal Society: Biological Sciences*, 365 (2010): 3065.

2 Jenny Gustavsson et al., "Global Food Losses and Food Waste: Extent, Causes and Prevention", Food and Agriculture Organisation of the United Nations, Rome, 2011.

3 *BIO Intelligence Service (2013) Modelling of Milestone for achieving Resource Efficiency, Turning Milestones into Quantified Objectives: Food waste*. Prepared for the European Commission, DG Environment.

4 The term "wastage" is sometimes used to refer to the combination of food loss and food waste.

economic cost. By quantifying food loss from these dissimilar perspectives, the nature of food loss can appear to be starkly different.

The most direct, and most commonly used, measure of food loss is weight. The total tonnes of food lost provide a sense of the magnitude of the problem. For instance, the most widely cited estimate of global food loss, as published by the FAO in 2011, indicates that "roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tonnes per year".<sup>2</sup>

However, considering food loss in terms of

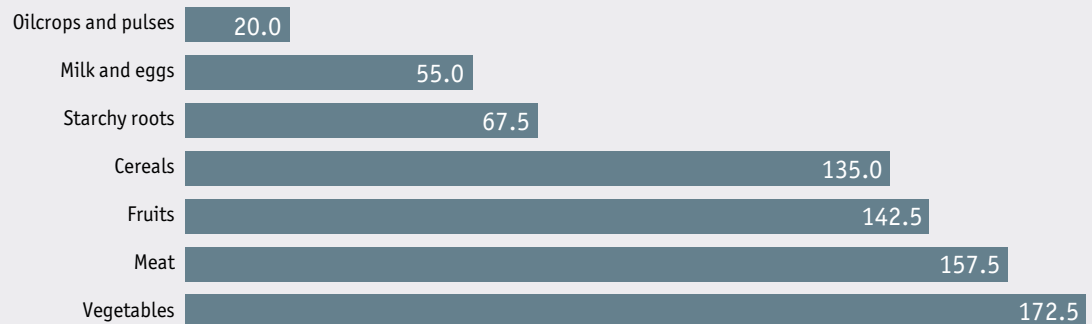
tonnes of food is difficult to assess—even the FAO figures rely on significant assumptions given the lack of global data—and is blunt and imperfect; it does not distinguish between types of food. Under this measure, a tonne of celery is equivalent to a tonne of beef. Weight-based measures do not account for water, which constitutes a large component of many foods' weights. Nutritional content also fails to be captured by such an approach: in terms of food security, the loss of more nutrient-rich food products is arguably of greater concern than the loss of less nutritious ones.

Accordingly, caloric-based measures have sometimes been employed. Aggregate weights, by food type, can be converted into caloric estimates.

2 Jenny Gustavsson et al., "Global Food Losses and Food Waste: Extent, Causes and Prevention", Food and Agriculture Organisation of the United Nations, Rome, 2011.

**Global economic costs of food wastage, by commodity, 2007**

US\$ bn



Source: Economist Intelligence Unit; Food and Agriculture Organisation

The US is particularly wasteful, losing or wasting an estimated 1,520 calories per person per day. Europe and developed Asia lose or waste less than half that amount, or fewer than 750 calories per person per day.

In 2013, for example, the World Resources Institute (WRI), a US-based global research organisation, found that “cereals comprise the largest share of global food loss and waste by caloric content—53%”. When considering calories, the US is particularly wasteful, losing or wasting an estimated 1,520 calories per person per day. Europe and developed Asia lose or waste less than half that amount, or fewer than 750 calories per person per day.<sup>3</sup> Despite inevitable data limitations, a calorie-based approach provides a better measure of the potential impact of food loss on individuals’ health. Nevertheless, a calorie-based approach only measures food loss in terms of the caloric energy lost, and not the nutritional quality of food lost, thus missing an estimation of a key aspect of food security.

While these approaches can be used to assess the direct costs of food loss, they do not fully capture some broader costs. More expansive approaches attempt to quantify food loss in economic terms. Overall, the economic costs of food loss are generally thought to be massive. The FAO estimates that food worth over US\$750bn—based on 2009 producer prices—is lost or wasted annually. The economic cost approach also reveals different problems than other measures of food loss. Meat, for example, only accounts for a small share of wastage by weight, but has considerable

economic costs owing to its high production costs.<sup>4</sup>

Similarly, environmental measures provide a perspective to understanding the problems of food loss. Brian Lipinski of WRI’s Food, Forests and Water Programme, states that “even calories are not the best measure” because of the ways in which food loss impacts other issues.<sup>5</sup> WRI cited several significant costs to the environment, including the drain on natural resources, such as water and cropland, indicating that “food loss and waste are associated with approximately 173 billion cubic meters of water consumption per year... [and] 198 million hectares [of cropland] per year”.<sup>6</sup> The inefficient use of resources can hurt food security, particularly in poorer countries that, for instance, have limited access to potable water or volatile agricultural production.

Measuring food loss through multiple lenses provides a more nuanced understanding of the drivers and wider implications of this issue. While cereals, for example, have significant nutritional costs, their environmental costs are lower than those of meat. This may imply that when dealing with the nutritional-quality aspects of food security, stakeholders should focus on cereal loss, whereas environment-related aspects may be better understood by analysing the FSCs of meat. By using such a multifaceted approach,

3 Brian Lipinski et al., “Reducing Food Loss and Waste”, Working Paper, Instalment 2 of *Creating a Sustainable Food Future*, World Resources Institute, 2013.

4 “Food Wastage Footprint: Impacts on natural resources”, *Technical Report*, Food and Agriculture Organisation Natural Resources and Management Department.

5 Interview with Brian Lipinski, associate at the World Resources Institute Food, Forests and Water Programme.

6 Brian Lipinski et al., “Reducing Food Loss and Waste”, Working Paper, Instalment 2 of *Creating a Sustainable Food Future*, World Resources Institute, 2013.

policymakers and stakeholders can develop a more robust appreciation of the causes and ramifications of food loss and its impacts on food security.

## What is happening to our food? The food supply chain

The FSC summarises the complex series of processes from the cultivation of food through consumer use. While FSCs differ across the globe, they can generally be broken down into five basic steps: production operations, post-production operations, processing operations, distribution and consumption. The amounts and causes of food loss differ depending on both the stage of the FSC and the level of development of the geographical region under consideration. WRI states that data on food loss “suggest that efforts to reduce food loss and waste should focus on stages ‘close to the farm’ in most developing regions and focus on stages ‘close to the fork’ in developed regions”.<sup>7</sup>

The first major stage of the FSC—agricultural production—encompasses the harvest of grains, vegetables and fruits and the breeding of animals. However, even before the harvesting process begins, food loss can occur owing to weather or pests. During the harvest, losses are frequently caused by mechanical damage and spillage. Food loss during the production phase also includes crops that are separated and removed post-harvest because they are unsuitable for consumption, often owing to the presence of pests or rot. While these losses technically occur during the growing phase, they are harvested and thus considered part of losses incurred during the production process. For meat, including cow, pig and poultry products, loss at the production stage generally entails animal death during breeding. Milk production loss accounts for decreased milk production owing to mastitis (dairy cow sickness), while fish production loss is associated with fishing discards.<sup>8</sup>

Globally, the largest losses occur during agricultural production, or “in the field”.

<sup>7</sup> *Ibid.*

<sup>8</sup> Jenny Gustavsson et al., “Global Food Losses and Food Waste: Extent, Causes and Prevention”, Food and Agriculture Organisation of the United Nations, Rome, 2011.

Production food loss is often caused by a combination of poor education, farming methods (including improper handling, inefficient harvesting methods and premature harvesting) and infrastructure. Pests, disease, overplanting (often motivated by the uncertainty of weather) and labour shortages also contribute to losses at this stage.

Food produced is then stored and transported until it is ready to be processed, which is broadly defined as post-harvest handling, storage and transport operations. For vegetables and milk products, losses are generally caused by degradation—the break-down of enzymes in products owing to temperature, moisture and oxygen content, which causes deterioration and spoilage<sup>9</sup>—and spillage. For animal products, including meat, losses at this stage include premature death, particularly during transport to slaughter and, in the case of fish, spillage and degradation during icing, packaging, storage and transport.<sup>10</sup>

Post-harvest handling and storage food loss is often directly correlated with production loss, and many of the same causes apply during post-harvest. Improper handling of food, underdeveloped and insufficient infrastructure and inefficient agricultural procedures play a particularly large role during post-harvest handling. Because they are highly perishable and require extremely efficient production and post-harvest systems to minimise loss, fruits, vegetables, roots and tubers have the highest proportion of loss globally during the first two stages of the FSC, especially in warm and humid climates.<sup>11</sup>

Accordingly, the primacy of vegetables, roots and tubers, such as cassava and potatoes, in developing countries’ diets results in high food

<sup>9</sup> Diane M. Barrett, “Maximizing the Nutritional Value of Fruits and Vegetables”, *Food Technology*, 61(4):40-44.

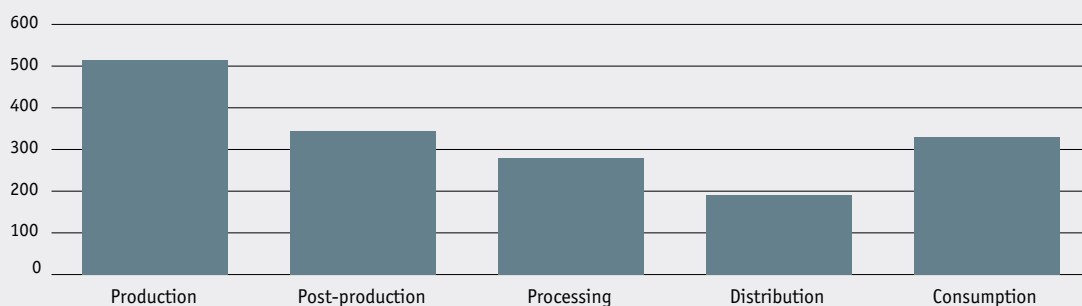
<sup>10</sup> Jenny Gustavsson et al., “Global Food Losses and Food Waste: Extent, Causes and Prevention”, Food and Agriculture Organisation of the United Nations, Rome, 2011.

<sup>11</sup> Nate Springer, Ryan Flaherty and Kai Robertson, “Losses in the Field: An Opportunity Ripe for Harvesting”, *Business for Social Responsibility*, April 2013.



**Food wastage volumes, by FSC phase, 2007**

Million tonnes



Source: Economist Intelligence Unit; Food and Agriculture Organisation

While spillage and degradation are the primary causes of food loss throughout all the earlier stages of the FSC, once food enters the market system for the fourth stage of the FSC—distribution—spoilage and excess supply become the main drivers of food loss.

losses during production.<sup>12</sup> This diet, combined with agricultural infrastructure difficulties, including poor and underdeveloped harvesting mechanisms and processes, insufficient storage facilities, deficient transport systems and inadequate processing and packaging, contribute to developing economies experiencing the highest levels of food loss during these stages of the FSC.

The third stage of the FSC—processing—encompasses both domestic and industrial processing, and includes such operations as pasteurisation, canning preparation and packaging. Processing losses are mainly caused by spillage and degradation. Loss may also occur if food—or parts of food—is not suitable for processing and is thus discarded during preparation (washing, peeling or slicing) or is improperly processed. For instance, during juice production, once the juice of a fruit or vegetable is squeezed, the pulp is typically discarded. Trimming spillage and processing spillages for processes such as smoking or canning account for the majority of animal product food losses during this stage.<sup>13</sup>

Global food loss during processing is low compared with other stages of the food supply chain. According to the FAO, there is little difference between the number of tonnes lost during processing in the countries with the highest

overall levels of loss—the developed economies of Asia—and those with the lowest overall levels of loss—North America and advanced economies in the Pacific region. Additionally, development levels have little bearing on the amount of food lost at this stage.<sup>14</sup> More efficient processing systems in advanced economies tend to minimise food loss, despite larger quantities of food being processed, while high levels of loss relative to a smaller volume of processed food drive similar loss levels in developing countries.

While spillage and degradation are the primary causes of food loss throughout all the earlier stages of the FSC, once food enters the market system for the fourth stage of the FSC—distribution—spoilage and excess supply become the main drivers of food loss.

In the final phase—consumption—food enters the household or food establishment, where it remains until either eaten or thrown away. Much of the food loss that occurs during distribution and all of the food loss that occurs during consumption is consumer loss, which is typically acknowledged as food waste rather than food loss. Given the uncertain relationship with food security, food waste is not included in the GFSI's measure of food (see box on page 39 for details).

Food waste during consumption is a product of different issues than supply-chain food loss. Food waste is mainly a phenomenon of the developed

<sup>12</sup> Jenny Gustavsson et al., "Global Food Losses and Food Waste: Extent, Causes and Prevention", Food and Agriculture Organisation of the United Nations, Rome, 2011.

<sup>13</sup> *Ibid.*

<sup>14</sup> *Ibid.*

world, although it is also present throughout some of the richer areas of the developing world, including parts of Latin America, Asia and North Africa.<sup>15</sup> Higher incomes and food availability, which make food more dispensable, drive food waste in developed countries.<sup>16</sup> Food waste often occurs because people prepare too much food or food spoils before it is consumed.

This dynamic speaks to the substantial role that income has on determining when food loss (as well as food waste) occurs in the FSC and what drives it. In food-insecure countries, where there is a dearth of food, food waste is less likely to occur because of the limited supply of food. Food is consumed when it is available or degraded food is consumed without being wasted. Food loss thus often represents failures within a country's infrastructure and within the FSC, thereby contributing to greater food insecurity. By contrast, food waste may be more appropriately understood as a symptom of a generally wealthier, food-secure environment that has surplus resources.

## Food loss in developing countries

Developing countries in Africa, Asia and Latin America experience considerable difficulties early in their FSCs, mainly owing to the lack of necessary infrastructure. Approximately 70-80% of food losses in these countries occur during early stages of the FSC,<sup>17</sup> and many low- or lower-middle-income countries lose more than 7% of their food supplies before distribution and consumption. Divine Njie of the FAO's Agro-Food Industries Group says that "perishable products such as fruits, vegetables, milk, meat and fish pose the biggest challenge" for developing countries owing to the considerable obstacles in bringing them to market.<sup>18</sup> These obstacles, which coincide with

early-stage FSC challenges, are a product of inadequate harvest techniques, poor post-harvest management, lack of necessary infrastructure (both storage and transport), inefficient processing and defective packaging, as well as public market information systems that deal inefficiently with price information and consumer preferences.<sup>19</sup>

Additionally, developing countries often have underdeveloped cold chains for food preservation during transport and storage. Sufficient cold storage capacity is essential to deliver fresh food and vegetables to market with minimal loss owing to spoilage. The Postharvest Education Foundation, a US-based non-profit public charity, explains that "fresh foods continue to metabolise and consume their nutrients throughout their shelf life, from harvest or slaughter through packing, distribution, marketing and sale".<sup>20</sup> The nutrients in both animal and vegetable products, when exposed to inappropriate temperatures, undergo degradation that results in reduced quality or quantity of food. This introduces deleterious food security risks by reducing the supply of food and diminishing its nutritional content.

The scale of agricultural production is also a factor. A non-industrialised agricultural sector generally produces small quantities of food at comparatively high prices, which exacerbates the economic impact of food losses. Small-scale farming has a higher risk of food loss during this first stage of the FSC in many developing countries. Smallholder farmers see a higher percentage of food loss during cultivation and harvest owing to the agricultural methods they employ and the small-scale nature of their crop production.<sup>21</sup> By contrast, large-scale farmers, who use more efficient production methods owing to the scale of their operations and access to better inputs, can produce larger volumes at relatively low costs. Their access to proper seeds, fertilisers and machinery minimises losses early in the FSC.

15 Regional classifications differ from those used in the Economist Intelligence Unit's *Global Food Security Index* owing to FAO data availability. The regions presented here reflect FAO classifications.

16 "Food Wastage Footprint: Impacts on natural resources", *Technical Report*, Food and Agriculture Organisation Natural Resources and Management Department.

17 *Ibid.*

18 Interview with Divine Njie, Food and Agriculture Organisation's Agro-Food Industries Group.

19 "Bringing agriculture to the market", *World Development Report 2008*, World Bank, Washington DC, 2007.

20 Lisa Kitinoja, "Use of cold chains for reducing food losses in developing countries", White Paper No. 13-03, Postharvest Education Foundation, 2013.

21 Tom Davy, "Food Wastage: The Irony of Global Gluttony", *Future Directions International*, 2013.

Advanced and high-income countries face a very different set of food loss and waste problems.

The high levels of food loss during the early stages of the FSC contribute to the inadequate food supply that plagues a large portion of the developing world. According to the GFSI, nearly 70% of the lowest-performing countries in sufficiency of supply are low-income countries. Compounding this are the financial access issues faced by large portions of the populations—smallholder farmers are generally net purchasers of food, and income and prices are major factors.

Another notable FSC trend in developing countries is that these economies experience a combination of high levels of food loss and low levels of food waste. For example, according to a recent FAO report, although South and South-east Asia have the second-highest levels of global food loss, accounting for approximately 25% of global food loss, their food waste is minimal. Food loss constitutes nearly 80% of all food wastage—loss plus waste—in the region.<sup>22</sup> The majority of Asia, which tends to be poor, suffers from infrastructure problems, including poor-quality roads, hot and humid weather (which drives early spoilage) and poor packaging, all of which result in large quantities of food lost during production, storage and transit.<sup>23</sup> While the economies of Asian countries are expanding rapidly, this economic expansion has not yet resulted in improved agricultural infrastructure and methods, although some Asian farmers have begun using fertilisers and farming ploughs. It has also not raised incomes sufficiently to drive high levels of food waste in most Asian countries.

Furthermore, the benefits of economic growth in Asia have been unevenly distributed across populations, limiting the food supply for the majority of people, a problem exacerbated by substantial food loss early in the food supply chain.<sup>24</sup> This issue exists across all developing regions. Sub-Saharan Africa, the poorest of the regions, despite low overall agricultural production, has high food loss. However, the region also has the

lowest food waste, in tonnes, owing to a dearth of food. The insufficient food supply in the region means that even if food has undergone degradation or gone bad by the time it reaches the consumer, it is likely to be eaten anyway.

## Food waste in developed countries

Advanced and high-income countries face a very different set of food loss and waste problems. In general, most food loss here is actually in the form of food waste occurring at the end of the food supply chain in grocery stores, restaurants and households. The US Department of Agriculture (USDA) estimates that 31% of food intended for human consumption at the retail and consumer level in the United States was wasted in 2010.<sup>25</sup> In Europe, 89m tonnes, the equivalent of 180 kg per head, are wasted between processing and consumption every year, according to the EU statistical service Eurostat.<sup>26</sup> According to the FAO, the quantity of food that is thrown away every year in industrialised countries (222m tonnes) almost matches the 230m tonnes of food produced in Sub-Saharan Africa,<sup>27</sup> which demonstrates the stark contrast that exists between food waste in the richest parts of the world and food insecurity in the poorest.

Developed countries do not lose as many fresh fruits and vegetables during the earlier stages of the FSC as a result of their significantly more robust cold-chain capacity. Additionally, advanced harvesting mechanisms, infrastructure that ensures efficient storage and transport and competent processing techniques minimise loss between the agricultural production and distribution phases. Among developed regions, North America and Oceania are more efficient than Europe, since east European countries have mildly

<sup>22</sup> "Food Wastage Footprint: Impacts on natural resources", *Technical Report*, Food and Agriculture Organisation Natural Resources and Management Department.

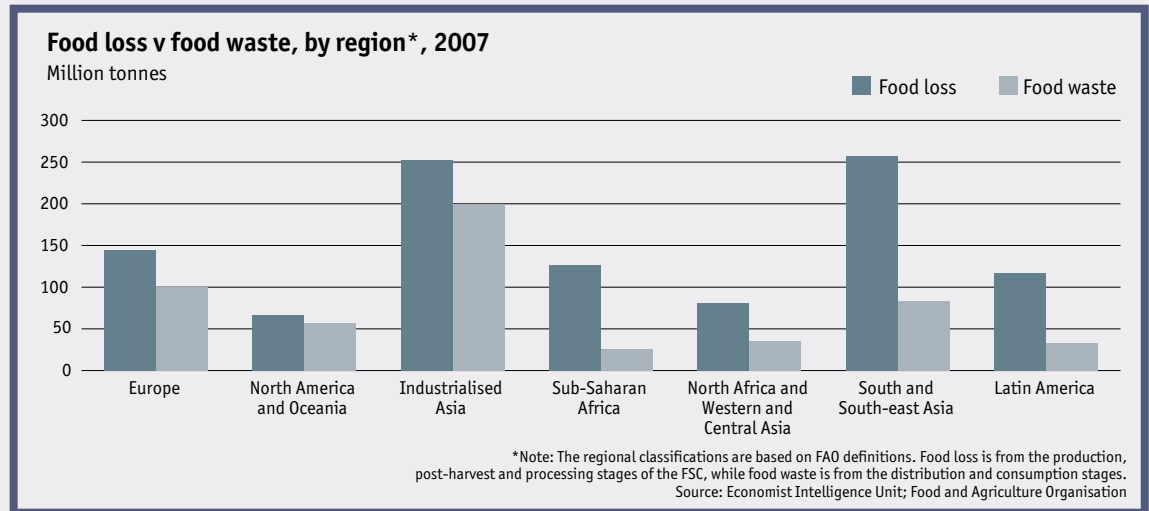
<sup>23</sup> Alisa Tang, "As millions go hungry, Asia battles food waste", Thomas Reuters Foundation, August 29th 2013.

<sup>24</sup> *Ibid.*

<sup>25</sup> Jean C. Buzby, Hodan F. Wells and Jeffrey Hyman, *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*, EIB-121, US Department of Agriculture, Economic Research Service, 2014.

<sup>26</sup> Patrice Gruskowski, "Food Waste in the EU: a study by the European Commission", presented at the Agencia de Residus de Catalunya—Workshop on Municipal Waste Prevention, Barcelona, November 24th 2011.

<sup>27</sup> "Food waste: causes, impacts and proposals", Barilla Center for Food and Nutrition, 2012.



less developed agricultural infrastructures.<sup>28</sup>

However, substantial loss does occur in developed economies during later stages of the FSC. According to the FAO, Europe, North America and Oceania have the highest levels of food waste globally, behind industrialised Asia. These regions have the highest levels of GDP per capita, the highest disposable incomes and the most developed grocery sectors, and thus more food to waste. Despite the fact that many industrialised countries in Asia have significant early-stage FSC food loss owing to inadequate infrastructures, their high levels of physical and financial access to food also yield high levels of food waste.

As a share of the population, North America and Oceania have the highest waste and loss per capita, at just under 350 kg of food wastage per person, while Europe has only slightly less.<sup>29</sup> High per-capita food waste is largely a product of the higher levels of food security in North America and Oceania. Because food security is driven by many factors—including wealth, adequate food supply and access to safe and nutritious food that has not undergone degradation—many consumers in developed countries have the luxury of being able to waste food.

In developed economies, consumer behaviour is

28 Jenny Gustavsson et al., "Global Food Losses and Food Waste: Extent, Causes and Prevention", Food and Agriculture Organisation of the United Nations, Rome, 2011.

29 "Food Waste Footprint: Impacts on natural resources", *Technical Report*, Food and Agriculture Organisation Natural Resources and Management Department, 2013.

a main driver of food going to waste. Two of the most common causes of food waste occur when too much food is cooked, prepared or served (observed in large portion sizes in restaurants) or when food is not used in time.<sup>30</sup> In addition to planning issues that prevent food from being used in time, poor comprehension of food date labelling results in extensive food waste. The Food Law and Policy Clinic (FLPC) at Harvard Law School believes that the average American household discards edible food worth between US\$275 and US\$455 per year owing to confusion over date label terminology, including "sell-by" and "best if used by."<sup>31</sup> Lack of awareness or knowledge of efficient food use, such as appropriate storage, and cultural attitudes that undervalue food compound the problem.<sup>32</sup>

Consumers are not the sole contributors to food waste in developed countries: retailers and companies such as wholesalers and packaged-goods firms also yield considerable waste. Emily Broad Leib, director of Harvard's FLPC, notes that perceived product liability risks and poor tax incentives deter food companies from donating unsellable products.<sup>33</sup> While there have been few

30 Julian Parfitt, Mark Barthel and Sarah Macnaughton, "Food waste within food supply chains: quantification and potential for change to 2050", *Philosophical Transactions of the Royal Society: Biological Sciences*, 365 (2010): 3065.

31 "The Dating Game: How Confusing Labels Land Billions of Pounds of Food in the Trash", *Harvard Food Law and Policy Clinic and NRDC Issue Brief*, 2013.

32 Patrice Gruskowski, "Food Waste in the EU: a study by the European Commission", presented at the Agencia de Residus de Catalunya—Workshop on Municipal Waste Prevention, Barcelona, November 24th 2011.

33 Interview with Emily Broad Leib, director, Harvard Law School Center for Health Law and Policy Innovation's Food Law and Policy Clinic.

## Measuring food loss in the GFSI

Food loss is included in the GFSI as an indicator in the Availability category, given that higher food loss directly reduces the available supply of food and indirectly may reveal structural deficiencies that can limit availability. In the GFSI, the indicator measures “post-harvest and pre-consumer food loss as a ratio of the total domestic supply of crops, livestock and fish commodities” and is calculated based on FAO data. This metric was selected given the extensive data availability across all 109 countries in the GFSI.

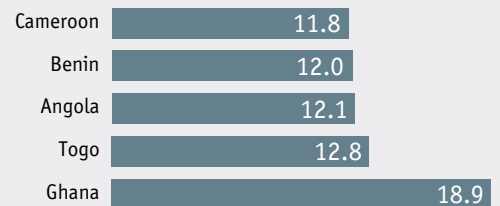
Food waste was excluded from the indicator because of its uncertain relationship with food insecurity. Whereas higher food loss is a structural issue that impacts availability, food waste is not clearly a driver of food insecurity. In fact, food waste might be a symptom of greater food security. In rich developed countries, individuals may be able to afford to be more wasteful when preparing or consuming meals. Thus food waste, despite other problems it may cause in a country, cannot reliably be considered a driver of food security.

Given the focus on structural, supply-chain food loss, highly developed countries have the best scores in the 2014 GFSI. Finland and Singapore were tied for first place with only 0.4% of the domestic food supply lost. Norway (0.8%), the US (0.9%) and the UK (1%) round out the top five.

By contrast, the worst-performing countries were generally found in Sub-Saharan Africa, owing to weak infrastructures. The bottom five countries—Cameroon (11.8%), Benin (12%), Angola (12.1%), Togo (12.8%) and Ghana (18.9%)—all lost more than one-tenth of their food supply. ■

### Highest rates of food loss

%, 2009



Economist Intelligence Unit; Food and Agriculture Organisation

### Lowest rates of food loss

%, 2009



Economist Intelligence Unit; Food and Agriculture Organisation

lawsuits involving date labels, the industry still operates in a cautionary environment that encourages food companies to be overly conservative in their decisions about food donations. The US has a robust system of food banks, and these reduce food waste by accepting donations from food companies, but the tax incentives for donating are minimal and do not offset the perceived risks.

Planning for agricultural loss can also contribute

to food waste in developed economies. The need to balance the anticipated impacts of natural disasters, such as bad weather and pest attacks, and consumer demand results in more crops being produced than are required. Given that FSC systems in advanced economies are extremely efficient and there is little food loss during the early stages of the supply chain, these surplus quantities often make it to the end of the FSC, where it is easy and inexpensive for consumers to waste.<sup>34</sup>

<sup>34</sup> Jenny Gustavsson et al., “Global Food Losses and Food Waste: Extent, Causes and Prevention”, Food and Agriculture Organisation of the United Nations, Rome, 2011.

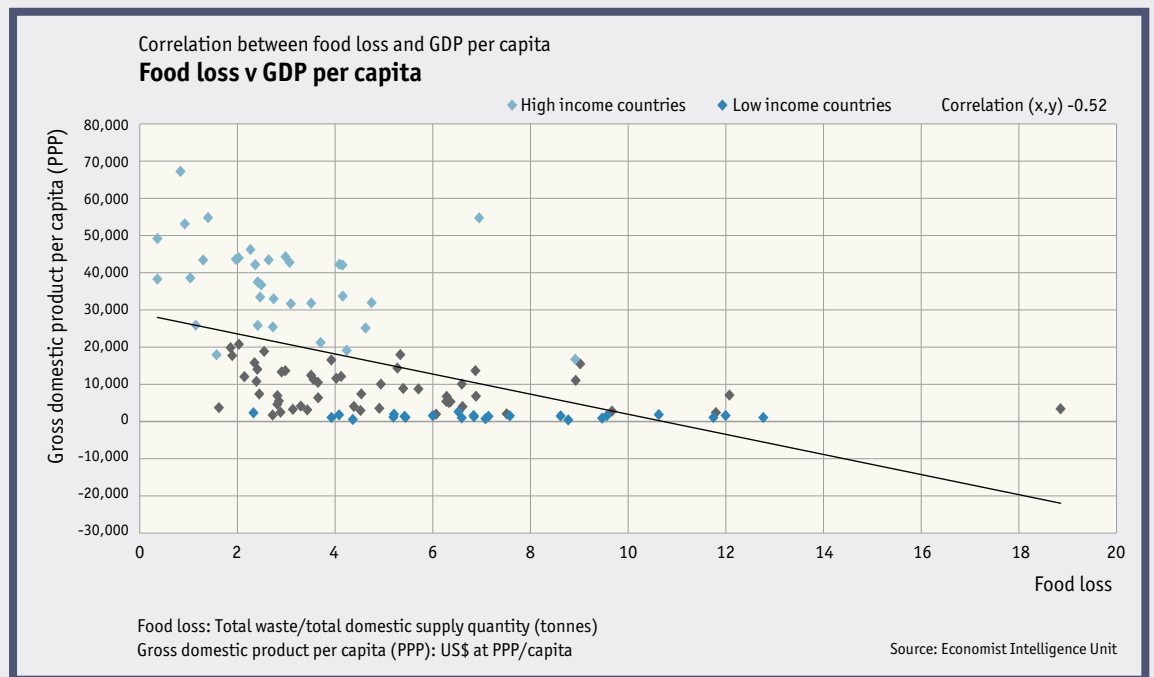
## Food loss in the Global Food Security Index

In the EIU’s GFSI, food loss has a moderately strong relationship with overall food security. Lower levels of food loss were correlated (correl = -0.59) with a higher overall score—an unsurprising finding given the negative impact of food loss on food availability.

Of all the indicators within the Availability category, food loss shared the strongest relationship (correl = -0.49) with agricultural infrastructure. This finding confirms the important role that infrastructure plays in determining food loss and linking it to food security. However, despite having the strongest relationship of all the availability indicators, agricultural infrastructure was only moderately linked to food loss. This can be explained by the narrow scope of the agricultural infrastructure indicator, which only considers storage, road and port facilities and does not address other stages and facilities that constitute the full food supply chain.

The GFSI also reveals a moderate relationship between food loss and both protein quality (correl = -0.57) and diet diversification (correl = -0.56). As levels of food loss decline, countries tend to have healthier diets. This may reflect that robust infrastructures facilitate the delivery of nutritious food, with minimal loss owing to food deterioration or degradation.

Finally, there is a general relationship between food loss and income level (measured by GDP per capita, adjusted for purchasing power parity). These two indicators are negatively correlated (correl = -0.52). High-income countries, led by the richest such as Norway and Singapore, clearly lose very little food. However, this relationship weakens among lower-income countries. While low-income countries lose considerably more food than high-income countries, the relationship in low-income countries between GDP per capita and food loss is not as strong (correl = -0.19). Cambodia and Madagascar, for example, have nearly identical levels of food loss, despite the fact that Cambodia’s GDP per capita is nearly double that of Madagascar.





A country's operating environment needs to be robust enough to facilitate efficient markets.

## Priorities and solutions

In developing countries, the solutions for reducing food loss and food insecurity are directly related. Three major components of the food supply chain and the systems that ensure the accessibility, availability and quality of food must be improved at national and regional levels: farming methods, structural infrastructure and the operating environment. Improved farming methods, including increased mechanisation and the use of fertilisers and improved seeds, result in increased efficiency during the early stages of the supply chain and minimise losses. Advanced structural infrastructure, including transport and storage systems and processing facilities, mitigates food loss.

Finally, a country's operating environment needs to be robust enough to facilitate efficient markets. Proper regulations, including effective import and export systems, stable political environments and minimal corruption, reduce the likelihood of food loss. By addressing these issues, many developing countries will be able to improve their food security while reducing their food loss.

By contrast, in developed countries most of the problems are a result of consumer behaviour, which may be addressed at both the cultural and the political level. Throughout the rich world, wasting food is socially acceptable. Changing this attitude, while undoubtedly a challenge, is a key component of reducing food waste. On the policy front, existing programmes must be analysed to determine whether they are contributing to food waste. For example, subsidies on certain food items that artificially reduce prices may be promoting increased waste. Likewise, clarifying date label terminology may reduce waste.

Perhaps the most important question is how to create a more efficient global food supply chain. Policymakers and stakeholders should delve into the mechanisms—more open markets or lower agricultural import tariffs, for example—that would allow food that is wasted during the latter stages of the food supply chain in developed regions to be directed towards developing countries that have insufficient food supplies. By converting food waste into food supplies for the hungry, the problems of both food loss and food security can be addressed. ■

## SPECIAL REPORT:

# The burden of obesity

## Its relationship with food security

- **Obesity and food security can co-exist, but their relationship is complicated, with poverty and other factors potentially impacting both. The prevalence of obesity is moderately correlated with overall GFSI scores, reflecting the complex relationship between both issues at the national level.**
- **In developing countries obesity tends to be a bigger issue for the more food secure, who are generally wealthier and have adopted middle-class, urban and Westernised lifestyles. Food insecurity, however, remains a problem for many of the poor in these countries.**
- **The prevalence of obesity is increasing in developed countries, particularly among the poor, and while its interaction with food security is currently ill-defined, access to affordable and nutritious food is important.**

Food security is a broad and multifaceted issue that is interconnected with many economic, social, political and health-related concerns. In recent years, the growing public focus on obesity has spurred considerable discussion on its relationship with food security. The relationship, like many issues connected with food security, is complex, and while policy is already being implemented, many questions remain.

Obesity contributes to the death of nearly 3m individuals every year and creates considerable woes for millions of others.<sup>1</sup> Although obesity is predominantly a developed-world phenomenon, it is increasingly evident in all but the poorest economies. In developing countries such as Syria, Mexico and Jordan nearly one-third of the population is obese, a statistic in line with that of the United States.

Unfortunately, the prevalence of obesity appears to be increasing. Worldwide, obesity levels have nearly doubled over the past 30 years, with almost half a billion individuals obese in 2008, although there has been evidence of a reversing trend in some geographies.<sup>2</sup> Over the past decade,

for example, obesity rates have declined by 43% among young children in the US.<sup>3</sup>

Nevertheless, the topic of obesity and, in particular, its relationship with food security, has received considerable attention in recent years, both within the media and among key stakeholders. Whereas obesity was once studied independently of food security, today many scholars and policymakers are attempting to discern potential linkages between the two issues.

Over the past three years The Economist Intelligence Unit (EIU) has developed a programme surrounding the Global Food Security Index (GFSI)—an annual index sponsored by DuPont—to further the dialogue on food security. This special report on obesity explores the potential relationship between food security and obesity, tracing global trends and highlighting some possible interactions between the two issues. Its aim is to provide a starting point for individuals, policymakers, private-sector leaders and other stakeholders to expand their insight and, hopefully, learn how to address both of these issues.

1 "Ensuring food and nutrition security", *World Economic and Social Survey 2013: Sustainable Development Challenges*, United Nations, 2013.

2 "Obesity and overweight", World Health Organisation, March 2013.

3 Sabrina Tavernise, "Obesity rate for young children plummets 43% in a decade", *The New York Times*, February 25th 2014.

## Problems of obesity

Obesity is a condition that often has a pernicious impact on both the physical and the mental health of millions of individuals. It is frequently related to, and may cause, a wide array of health problems, including diabetes, hypertension, cardiovascular disease, musculoskeletal disorders, sleep problems and even some cancers, such as breast and colon cancer.<sup>4</sup> It can also contribute to poor mental health through eating disorders and depressive disorders.<sup>5</sup> Additionally, obesity can be expensive, requiring greater healthcare expenditure to successfully manage the effects of the condition and even limiting an individual’s productivity and ability to work.<sup>6</sup>

On a basic level, obesity is the product of an energy imbalance, where more calories are consumed than used by the body.<sup>7</sup> Reduced caloric intake or increased activity—or some combination of the two—should theoretically address the problem. However, with genetic, biological and other factors also at work, obesity is indisputably a more complex problem.

4 “Obesity and overweight”, *World Health Organisation*, March 2013  
 5 Jane Collingwood, “Obesity and Mental Health”, *Psych Central*, 2007.  
 6 Eric A. Finkelstein, Kiersten L. Strombotne and Barry M. Popkin, “The Costs of Obesity and Implications for Policymakers”, *Choices: The Magazine of Food, Farm, and Resource Issues*, Agricultural & Applied Economics Association, 2010.  
 7 Barry M. Popkin, Linda S. Adair and Shu Wen Ng, “Now and Then: The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries”, *Nutrition Reviews*, January 2012; 70(1): 3-21.

Consequently, obesity does not simply imply that an individual is overfed. Micronutrient deficiencies—including of iron and vitamin A—may exist alongside obesity, a product of consuming excess food that lacks the appropriate nutrients.<sup>8</sup> Accordingly, an individual may be both obese and malnourished. This issue contributes to a very complex problem that simple solutions, such as reducing the consumption of food or increasing physical activity, rarely solve.

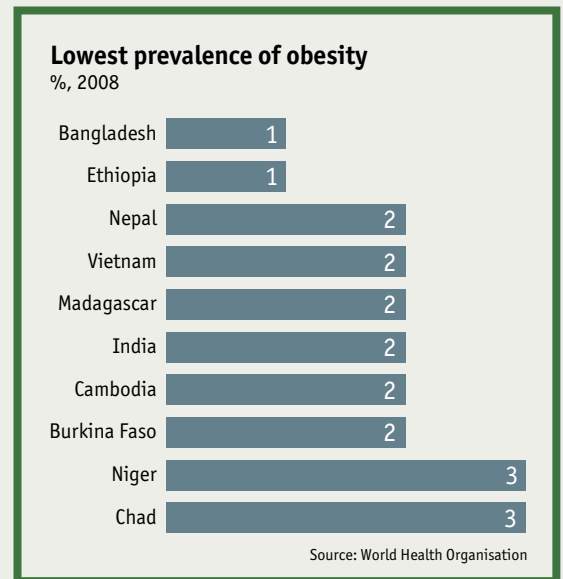
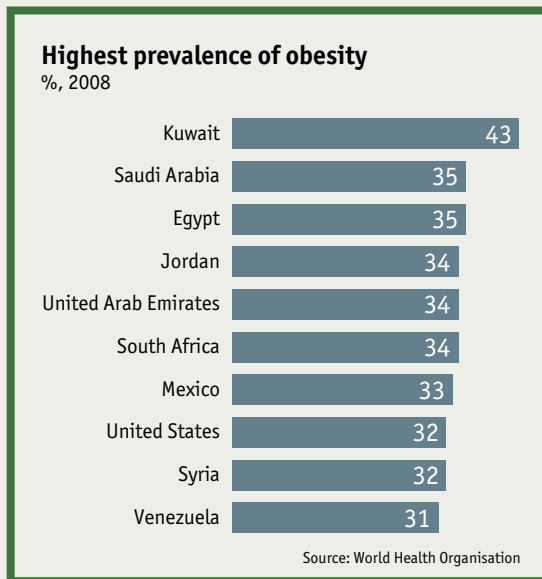
## Is there a relationship between obesity and food security?

While the challenges of obesity are readily apparent, its relationship with food security—which in the GFSI is defined as “the state in which people at all times have physical, social and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life”—is considerably nuanced.

Historically, the public policy approach to addressing food insecurity emphasised improving the affordability and availability of food. The focus, particularly in impoverished and developing countries, was on hunger. Many instances of food

8 “The developing world’s new burden: obesity”, Food and Agriculture Organisation, United Nations, January 2002.

On a basic level, obesity is the product of an energy imbalance, where more calories are consumed than used by the body.



## What is the body mass index?

The body mass index (BMI) is the most commonly used metric to measure obesity, given that it is easy to understand and measure and is readily comparable. It is calculated as a simple ratio of an individual's height and weight. The resultant ratio is compared against a standardised scale, common to men and women of all ages, to determine an individual's weight category.

However, BMI is an imperfect metric and has considerable limitations that diminish its efficacy and may result in misleading conclusions. It does not treat muscle, bone or fat differently (muscle weighs more than fat) and does not consider body shape in its calculations. For instance, an athlete who has a higher muscle-to-fat ratio than the average person may incorrectly be categorised as obese. BMI also does not distinguish among

ages or between sexes for adults, providing one uniform scale. This may artificially skew upwards the prevalence of obesity in women. In children, its use can be problematic, especially around puberty, since age-adjustments are blunt and do not account for differing rates of maturation experienced by most youths.

Additionally, although there are many sources that provide national BMI data, researchers have found that data collection processes provide additional difficulties. Many databases and studies rely on self-report surveys, where people tend to under-report their weight.<sup>1</sup>

Nevertheless, BMI has largely been adopted as a global standard, often at the expense of other measures of obesity, including waist circumference, triceps skinfold thickness, trunk fat mass and body fat. Unfortunately, the relationships between food security and these other metrics, which in some regards may be superior to BMI, are researched far less. Studies that explore multiple metrics tend to be more robust.<sup>2</sup>

### BMI scale, adults

Category	BMI
Underweight	<18.5
Normal weight	18.5-24.9
Overweight	25.0-29.9
Obese	≥30.0

<sup>1</sup> Institute of Medicine, *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

<sup>2</sup> Craig Gundersen, Steven Garasky and Brenda J. Lohman, "Food Insecurity is Not Associated with Childhood Obesity as Assessed Using Multiple Measures of Obesity", *The Journal of Nutrition*, June 2009, 139(6), 1173-1178.

“What is complicated about doing research in this area is that... obesity is caused by so many things. The multitude of factors that affect obesity make studies really hard to conduct.”

Marlene Schwartz,  
director of the Yale Rudd  
Center for Food Policy &  
Obesity

insecurity constituted cases where individuals or communities simply did not have sufficient food. In extreme cases, images of starving children came to define this perspective.

However, in recent years there has been an increasing focus on an expanded understanding of food security. In particular, research has begun exploring the relationship between obesity and food security, with some arguing that obesity is a direct result of food insecurity. While there has been much independent discussion about both issues, the extent of their relationship has yet to be determined. Evidence has been presented that both supports and refutes the existence of a relationship between the two factors.

One difficulty in understanding the relationship is a level-of-analysis problem. At its heart, obesity is an individual problem and can be influenced by many factors, including diet, level of activity, income level, access to food, genetics, lifestyle choices and culture.<sup>9</sup> By contrast, particularly as addressed in the GFSI, food security is a national problem that is concerned with structural issues, such as corruption, infrastructure and food supply. This creates difficulties in tracking how broad, structural issues impact individual problems.

Other difficulties involve measurement and

<sup>9</sup> Margaret Andrews, "IOM Workshop on Food Insecurity and Obesity: Session 8: Panel on Research Gaps-An Economic Perspective", USDA, Economic Research Service.

definition problems. Collecting information on both food security and obesity can be challenging (see the box on BMI), and researchers have struggled to quantify complex concepts in manageable but appropriate ways. The concept of food security, for example, is multifaceted and interconnected with other issues, such as poverty, which can yield complications when trying to discern relationships. Marlene Schwartz, the director of the Yale Rudd Center for Food Policy & Obesity, argues: "What is complicated about doing research in this area is that... obesity is caused by so many things. The multitude of factors that affect obesity make studies really hard to conduct."<sup>10</sup>

## Co-existence does not mean related

One thing, at least, is clear: obesity and food insecurity can co-exist. Both problems can be readily found within the same countries and communities, and there is evidence that they can co-exist in the same household and maybe even in the same individual. However, co-existence need not mean the two issues are directly, or even indirectly, connected. According to Dr Schwartz, "there is definitely overlap [between obesity and food security]... particularly in the US...but when we start talking about causal relationships there is a lot of disagreement".<sup>11</sup>

In the developed world, there is an ongoing debate about the relationship between the two factors. Most studies show that there is no relationship between the two issues for children, although some show the opposite result.<sup>12</sup> Similarly, for adolescents most studies have shown only a slight or inverse relationship, while a few studies have provided support for a positive relationship for adolescents in the presence of maternal stressors or

under certain conditions for adolescent women. For adult males, no relationships or inverse relationships have been demonstrated in nearly all studies. The most robust data in support of a strong relationship have been for adult females, where some evidence has shown a greater likelihood of being obese if one is food insecure.<sup>13</sup> Such a relationship has been found for women in parts of the US, Europe and Australia.<sup>14</sup> The results become even more varied when socioeconomic or ethnic sub-groups are considered.<sup>15</sup>

Although considerably less research has been conducted in developing countries, there has been as much ambiguity about the relationship between obesity and food security as in developed countries. A recent study has shown substantial complexity in rural Malaysia,<sup>16</sup> while in Ghana<sup>17</sup> and Trinidad and Tobago<sup>18</sup> two separate studies have shown that greater food insecurity is correlated with underweight, not obesity. Likewise, an analysis done on adults and children in Bogota, Colombia indicates that food insecurity predicts underweight.<sup>19</sup> On the other hand, an association existed between obesity and severe food insecurity for women in Tehran, Iran, but there was no evidence of a causal relationship.<sup>20</sup> In Uganda a study found that food-insecure females (but not males) were significantly more likely to be overweight; however, this effect disappeared when controlling for certain environmental factors.<sup>21</sup>

10 Interview with Marlene B. Schwartz, director, and Tatiana Andreyeva, director of economic initiatives at the Yale Rudd Center for Food Policy & Obesity.

11 *Ibid.*

12 Brandi Franklin, Ashley Jones, Dejuan Love, Stephane Puckett, Justin Macklin and Shelley White-Means, "Exploring Mediators of Food Insecurity and Obesity: A Review of Recent Literature", *Journal of Community Health*, February 2012; 37(1): 253-264; Elizabeth Miller, Kristin M. Wieneke, J. Michael Murphy, Sheila Desmond, Andrew Schiff, Katia M. Canenguez, Ronald E. Kleinman, "Child and Parental Poor Health Among Families at Risk for Hunger Attending a Community Health Center", *Journal of Health Care for the Poor and Underserved*, May 2008, 19(2), 550-561.

13 Institute of Medicine, *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

14 "Overweight and Obesity: The hidden role of food insecurity", Sydney Food Fairness Alliance and Food Fairness Illawarra, February 23rd 2009.

15 Institute of Medicine, *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

16 Z. Mohd Shariff and G. L. Khor, "Obesity and household food insecurity: evidence from a sample of rural households in Malaysia", *European Journal of Clinical Nutrition*, 2005; 59, 1049-1058.

17 Mahama Saaka and Shaibu Mohammed Osman, "Does Household Food Insecurity Affect the Nutritional Status of Preschool Children Aged 6-36 Months?" *International Journal of Population Research*, Volume 2013 (2013).

18 Edward A. Frongillo, "Commentary: Assessing food insecurity in Trinidad and Tobago", *International Journal of Epidemiology*, 2003; 32(4): 516-517.

19 Sheila Isanaka, Mercedes Mora-Plazas, Sandra Lopez-Arana, Ana Baylin and Eduardo Villamor, "Food insecurity is highly prevalent and predicts underweight but not overweight in adults and school children from Bogota, Colombia", *The Journal of Nutrition*, December 2007, 137(12):2747-2755.

20 Fatemeh Mohammadi, Nasrin Omidvar, Gail G. Harrison, Mahmood Ghazi-Tabatabaei, Morteza Abdollahi, Anahita Houshiar-Rad, Yadollah Mehrabi and Ahmad Reza Dorosty, "Is Household Food Insecurity Associated with Overweight/Obesity in Women?", *Iranian Journal of Public Health*, 2013, 42(4): 380-390.

21 Jean-Philippe Chaput, Jo-Anne Gilbert and Angelo Tremblay, "Relationship between food insecurity and body composition in Ugandans living in urban Kampala", *Journal of the American Dietetic Association*, 2007, 107:1978-82.

## So what, then, is the connection?

Despite the opacity of whether there is a direct relationship between obesity and food security, much thought has been given to what an association may look like. The relationship, if it exists, is still unclear and could range from a simple linear one to a more complex one (for example U-shaped, where obesity is positively correlated with moderate, but not severe, food insecurity).<sup>22</sup> Food security and obesity may both be influenced by tertiary drivers, such as poverty, or affect each other through mitigating factors. Additionally, the direction of causation—whether obesity causes food security or vice-versa—is still an open question.

Regardless, a number of theories have been offered to explain a potential relationship. The most basic explanations examine access to nutritious and quality food. Such arguments hold that the most food insecure, who are often the poorest, do not have sufficient access to quality food. Particularly in developed countries, such arguments posit, there is a dearth of healthy food available for the poorest. Grocery stores with fresh fruits and vegetables are rare in these communities, and high-calorie but low-nutrient food is cheaper. The prevalence of fast-food restaurants is also frequently cited as a deterrent to healthy eating. This environment may lead to dependence on energy-dense food products, which do not provide sufficient nutrition and ultimately lead to obesity.<sup>23</sup> An analogous argument is made with regard to access to opportunities for physical activities.<sup>24</sup>

Although considerably less research has been conducted in developing countries, there has been as much ambiguity about the relationship between obesity and food security as in developed countries.

While there has been some evidence of this relationship in the US, such dynamics have not been found in other countries, such as the UK and Australia.<sup>25</sup> A controlled study conducted in Scotland found that dietary choices did not change when access to quality food improved.<sup>26</sup> Such arguments are also often unsubstantiated in the poorest countries, which do not have similar markets for groceries.

Another theory explores what is known as the feast-famine cycle, where food-insecure individuals and households oscillate between times of a relative dearth of food and ones of increased

### What causes obesity?

Potential drivers of obesity

#### Food security-related drivers

- Access to quality food
- Opportunities for physical activity
- Feast-famine cycle
- Sacrifice theory
- Public feeding programmes
- Childhood food insecurity

#### Other potential drivers

- Genetics and biology
- Culture and lifestyle
- Poverty
- Stress
- Urbanisation
- Changing diets

supply and excessive consumption.<sup>27</sup> Such swings between bingeing and restriction can lead to changes in an individual's metabolism that can yield increased accumulation of fat.<sup>28</sup>

A third explanation—the sacrifice theory—attempts to elucidate the seemingly contradictory existence of obesity and underweight or normal body weight within a single household, by exploring the distribution of food. In particular, the sacrifice theory holds that adults, especially mothers, are more likely to give available healthy food to their children, reserving the cheaper and less nutritious supply for themselves. By sacrificing for their children, they increase their own likelihood of

22 Brandi Franklin, Ashley Jones, Dejuan Love, Stephane Puckett, Justin Macklin and Shelley White-Means, "Exploring Mediators of Food Insecurity and Obesity: A Review of Recent Literature", *Journal of Community Health*, February 2012; 37(1): 253-264.

23 Barry M. Popkin, Linda S. Adair, and Shu Wen Ng, "Now and Then: The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries", *Nutrition Reviews*, January 2012; 70(1): 3-21.

24 Fatemeh Mohammadi, Nasrin Omidvar, Gail G. Harrison, Mahmood Ghazi-Tabatabaei, Morteza Abdollahi, Anahita Houshiar-Rad, Yadollah Mehrabi and Ahmad Reza Dorosty, "Is Household Food Insecurity Associated with Overweight/Obesity in Women?" *Iranian Journal of Public Health*, 2013, 42(4): 380-390.

25 "Food environments and obesity—neighbourhood or nation?", *International Journal of Epidemiology*, February 2006, 35(1): 100-104.

26 *Ibid.*

27 Margaret Andrews, "IOM Workshop on Food Insecurity and Obesity: Session 8: Panel on Research Gaps—An Economic Perspective", USDA, Economic Research Service.

28 Nathaniel L. DeBono, Nancy A. Ross and Lea Berrang-Ford, "Does the Food Stamp Program cause obesity? A realist review and a call for place-based research", *Health & Place*, 18(2012): 747-756.



Culture and lifestyle—potentially determined by an individual's class, ethnicity, religion or socioeconomic background—might change priorities, goals and values in a manner that leads to more (or less) obesity.

obesity, while minimising it in the youngest.<sup>29</sup>

Likewise, public feeding programmes, such as the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) in the US, may be a contributing factor in driving obesity among the food insecure. Considerable research has been conducted—with mixed results—exploring the implications of these programmes on obesity.<sup>30</sup> Research in this space posits a number of pathways for this relationship, including the food stamp cycle (analogous to famine–feast cycle, but driven directly by periodic payment of benefits); psychological effects of long-term poverty, including stress; income effects, where food benefits yield greater expenditure on food than would otherwise occur; and greater consumption of energy-dense foods instead of nutritious food, as discussed above.

Food insecurity may also impact obesity over the duration of individuals' lives—even if such insecurity was only experienced at a finite point. If an infant, or foetus, experiences severe malnutrition during crucial stages of its development, it may be more prone to developing obesity, among other chronic conditions, later in life.<sup>31</sup> Early deprivation may create a long-term relationship between food insecurity and obesity. Regrettably, such inter-temporal dynamics have not been considered by most studies, which generally only explore simultaneous instances of food insecurity and obesity.

While these explanations attempt to directly link food security and obesity, other factors may also be driving higher levels of obesity. Genetics and biology undoubtedly play an important role in determining an individual's likelihood of obesity. Likewise, poor personal choices are a key factor that muddies the relationship between obesity and

food security. Culture and lifestyle—potentially determined by an individual's class, ethnicity, religion or socioeconomic background—might change priorities, goals and values in a manner that leads to more (or less) obesity.<sup>32</sup>

For example, studies have shown that larger body sizes are considered ideal in African American communities, while a preference for slimmer profiles often leads to dietary restraint in white communities. Moreover, certain communities place a heavy cultural emphasis on food, which may lead to increased obesity depending on the content of traditional diets—in African American communities this tends to increase obesity, while in Asian communities it has the opposite effect.<sup>33</sup> Craig Gundersen, professor of agricultural strategy at the University of Illinois at Urbana-Champaign, states that “in a lot of developing countries, being overweight is considered a good thing. It shows you have wealth.”<sup>34</sup> If these cultural characteristics are correlated with communities that experience greater food insecurity, it may lead to the identification of spurious relationships between obesity and food insecurity.

Additionally, tertiary factors may be simultaneously driving both obesity and food insecurity. This would imply that the two factors are only indirectly related. The most commonly cited example is poverty.<sup>35</sup> As one study emphasised: “Obesity and poverty are associated, and food insecurity and poverty often coexist.”<sup>36</sup> Likewise, stress has been offered as a mechanism that may drive obesity.<sup>37</sup> Such arguments hold that food insecurity causes stress, which in turn causes obesity. However, stress can come from many

29 Brandi Franklin, Ashley Jones, Dejuan Love, Stephane Puckett, Justin Macklin and Shelley White-Means, “Exploring Mediators of Food Insecurity and Obesity: A Review of Recent Literature”, *Journal of Community Health*, February 2012; 37(1): 253–264.

30 Nathaniel L. DeBono, Nancy A. Ross and Lea Berrang-Ford, “Does the Food Stamp Program cause obesity? A realist review and a call for place-based research”, *Health & Place*, 18(2012): 747–756; Lauren M. Dinour, Dara Bergen and Ming-Chin Yeh, “The Food Insecurity–Obesity Paradox: A Review of the Literature and the Role Food Stamps May Play”, *Journal of the American Dietetic Association*, 2007, 107:1952–1961.

31 Barry M. Popkin, Linda S. Adair and Shu Wen Ng, “Now and Then: The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries”, *Nutrition Reviews*, January 2012; 70(1): 3–21.

32 Institute of Medicine. *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

33 Sonia Caprio, Stephen R. Daniels, Adam Drewnowski, Francine R. Kaufman, Lawrence A. Palinkas, Arlan L. Rosenbloom and Jeffrey B. Schwimmer, “Influence of Race, Ethnicity, and Culture on Childhood Obesity: Implications for Prevention and Treatment”, *Diabetes Care*, November 2008, 31(11): 2211–2221.

34 Interview with Craig Gundersen, Soybean Industry Endowed Professor of Agricultural Strategy at the University of Illinois at Urbana-Champaign.

35 Fatemeh Mohammadi, Nasrin Omidvar, Gail G. Harrison, Mahmood Ghazi-Tabatabaei, Morteza Abdollahi, Anahita Houshiar-Rad, Yadollah Mehrabi and Ahmad Reza Dorosty, “Is Household Food Insecurity Associated with Overweight/Obesity in Women?”, *Iranian Journal of Public Health*, 2013, 42(4): 380–390.

36 Institute of Medicine. *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

37 “Food Insecurity and Obesity: Understanding the Connections”, Food Research and Action Center, Spring 2011.

sources and contribute to both obesity and food insecurity. If poverty or stress simultaneously drive obesity and food insecurity, any relationship between the latter two may be irrelevant.

Finally, the question of direction of causality remains. Much of the literature assumes that food insecurity causes obesity. Nevertheless it is possible that the causality is reversed, that obesity causes food insecurity. In fact, the causality might simultaneously go in both directions—food insecurity can be a risk factor for obesity, while obesity is also a risk factor for food insecurity. Obesity may cause food insecurity through a number of avenues, for instance, by reducing household productivity (through depression or chronic diseases that inhibit the ability to work, for example) and thus income, restricting mobility and thus access to food, or by increasing the need for greater quantities of food, which may prove problematic within the constraints of limited budgets.<sup>38</sup> Unfortunately, very little research has been conducted on this question, and clearer insight is necessary in order to fully understand both of these issues.<sup>39</sup>

## Different relationships in developing countries

While many of these potential relationships apply to both developing and developed countries, there are a number of key differences in how obesity relates to food insecurity across the globe. One of the starkest differences between developed and developing countries is that obesity is more prevalent among the poorest individuals in developed countries and among the richest in developing countries.<sup>40</sup> According to one recent article, “[t]he evidence is that in low-income countries, obesity is associated with affluence, but in high-income countries, obesity is more often

associated with lower socioeconomic status...”.<sup>41</sup>

Consequently, in developing countries the presence of food insecurity and obesity might be due to subnational factors—different people within the same countries are experiencing different phenomena. Those in the highest income levels may be solely grappling with obesity, while food insecurity still remains the predominant problem for the poorest.<sup>42</sup>

This would mitigate the complexities discussed above. If such a dynamic is proven correct, more traditional explanations for the growing prevalence of obesity may suffice. Increasing wealth and incomes, urbanisation, greater access to supermarkets, declining food prices and changing diets may contribute to increased obesity.<sup>43</sup> Eric Finkelstein of the Global Health Institute at Duke University, has posited that economic growth has contributed to the increasing prevalence of obesity across the globe.<sup>44</sup> In particular, as individuals in developing countries transition into the middle class, they often exchange traditional foods for more Westernised diets.<sup>45</sup> This frequently signifies a shift from a vegetable and grain-heavy diet, which is often prepared within the home, to diets that include more animal products, fats and oils.<sup>46</sup> Consumption patterns also change when working women have less preparation time for meals and substitute convenience foods instead.<sup>47</sup> Other changes in lifestyle that can accompany Westernisation and urbanisation, such as reduced activity levels owing to greater mechanisation of life, may also have played a role in the dramatic increase in per capita

“...in a lot of developing countries, being overweight is considered a good thing. It shows you have wealth.”

Craig Gundersen, professor of agricultural strategy at the University of Illinois at Urbana-Champaign

38 Margaret Andrews, “IOM Workshop on Food Insecurity and Obesity: Session 8: Panel on Research Gaps—An Economic Perspective”, USDA, Economic Research Service.

39 Institute of Medicine. *Hunger and Obesity: Understanding a Food Insecurity Paradigm: Workshop Summary*. Washington, DC: The National Academies Press, 2011.

40 Interview with Stacey Rosen, USDA Economic Research Service podcast.

41 Mahama Saaka and Shaibu Mohammed Osman, “Does Household Food Insecurity Affect the Nutritional Status of Preschool Children Aged 6–36 Months?” *International Journal of Population Research*, Volume 2013 (2013).

42 Stacey Rosen and Shahla Shapouri, “Obesity in the Midst of Unyielding Food Insecurity in Developing Countries”, *Amber Waves*, USDA Economic Research Service, September 1st 2008.

43 *Ibid.*

44 Interview with Eric A. Finkelstein, Duke University.

45 Prakash Shetty and Josef Schmidhuber, “Nutrition, lifestyle, obesity and chronic disease”, United Nations Department of Economic and Social Affairs, Population Division, Expert Paper No. 2011/3.

46 “Globalization of food systems in developing countries: impact on food security and nutrition”, *FAO Food and Nutrition Paper 83*, Food and Agriculture Organisation of the United Nations, Rome, 2004.

47 Prakash Shetty and Josef Schmidhuber, “Nutrition, lifestyle, obesity and chronic disease”, United Nations Department of Economic and Social Affairs, Population Division, Expert Paper No. 2011/3.

Although the relationship between food security and obesity is often ill-defined, when dealing with extreme poverty it is simpler.

calorie consumption in the developing world.<sup>48,49</sup>

Additionally, some studies have suggested that biology in developing countries is an important factor in driving higher obesity rates. First, “populations of developing countries have on average a genetic predisposition towards developing obesity”. Second, rapid transition from hunger and undernourishment to an environment of relative abundance can yield obesity, a process that operates through an individual’s rate of metabolism.<sup>50</sup>

Finally, the severity of food insecurity experienced in a country might explain the divergence between the developing and developed world. In the developed world, mild and moderate (or relative) food insecurity is more pervasive, while in the developing world more severe forms may be more prevalent. A number of studies have argued that “although mild or moderate food insecurity [may be] associated with a higher risk of obesity, severe food insecurity is associated with a lower risk”.<sup>51</sup>

## Interaction with the GFSI

As discussed throughout this report, the relationship between food security and obesity is fraught with difficulties. Unsurprisingly, the ways in which the indicator interacts with the index, categories and individual indicators within the Global Food Security Index reflect these intricacies.

In general, the relationships between the obesity indicator and the GFSI are not overly strong. The overall index is only moderately correlated with obesity (correl = 0.60), highlighting the complex relationship between obesity and food security. Of the three categories—Affordability, Availability, and Quality & Safety—Availability demonstrates the weakest relationship

with obesity (correl = 0.50).

Although the relationship between food security and obesity is often ill-defined, when dealing with extreme poverty it is simpler. Countries that have high proportions of their population under the global poverty line (living on less than US\$2 per day), tend to have a very low prevalence of obesity. This indicator has the strongest relationship with obesity out of any in the GFSI (correl = -0.74). Seemingly, extreme poverty, where lack of access to food is a great concern, limits the onset of obesity. In countries that do not have such high levels of extreme poverty, other factors, such as lifestyle, culture and access to healthy foods, tend to play a more prominent role. This reinforces the argument that obesity’s relationship with food security varies depending on the severity of the latter.

By contrast, the GFSI reveals that there is a weak relationship between obesity and nutritional standards (correl = 0.20). This is an important finding given the considerable emphasis on instituting policies, such as the US’s MyPlate, that aim to educate and inform individuals and monitor national nutrition. Although the GFSI does not explicitly explore the quality of national dietary guidelines or nutrition plans, or the extent of nutritional monitoring and surveillance, the existence of these programmes appears to have little bearing on the prevalence of obesity.

Likewise, obesity has a slight relationship with micronutrient availability (correl = 0.42), although protein quality (correl = 0.62) has a moderate one. This finding indicates that obesity is about much more than the nutritional content of an individual’s diet.

## Solutions and limitations

While there is extensive research that must still be conducted to determine whether there is a meaningful relationship between food security and obesity and, if so, through what avenues it operates, there have already been steps taken to begin tackling the issues. As Theresa Nicklas and Carol O’Neil wrote in a recent report published by the Food and Agriculture Organisation (FAO) of the

48 *Ibid.*

49 Stacey Rosen and Shahla Shapouri, “Obesity in the Midst of Unyielding Food Insecurity in Developing Countries”, *Amber Waves*, USDA Economic Research Service, September 1st 2008.

50 “Globalization of food systems in developing countries: impact on food security and nutrition”, *FAO Food and Nutrition Paper 83*, Food and Agriculture Organisation of the United Nations, Rome, 2004.

51 Cate Burns, “A review of the literature describing the link between poverty, food insecurity and obesity with specific reference to Australia”, Victorian Health Promotion Foundation, April 2004.

## Measuring obesity in the GFSI

In the GFSI, obesity is considered a background variable—provided to serve as a basis of comparison—and is not included within the index framework of Affordability, Availability, and Quality & Safety as an indicator that drives food security. This is a logical treatment of the topic, given the ambiguity of the causal relationship between food security and obesity.

The GFSI explores the prevalence of obesity through a variable that measures the percentage of each country’s population over the age of 20 that has an age-standardised body mass index (BMI) greater than 30.0. This metric, which relies

on data and definitions from the World Health Organisation (WHO), is an industry standard. See the box on page 44, which discusses BMI and its limitations.

According to this metric, there is considerable variation in the prevalence of obesity across the globe. The lowest rates occur in South and South-east Asia and Sub-Saharan Africa, led by Bangladesh (1.1%), Ethiopia (1.2%), Nepal (1.5%) and Vietnam (1.6%). This is in marked contrast to Kuwait (42.8%) and Saudi Arabia (35.2%), which have the highest prevalence of obesity of the 109 countries in the GFSI. ■

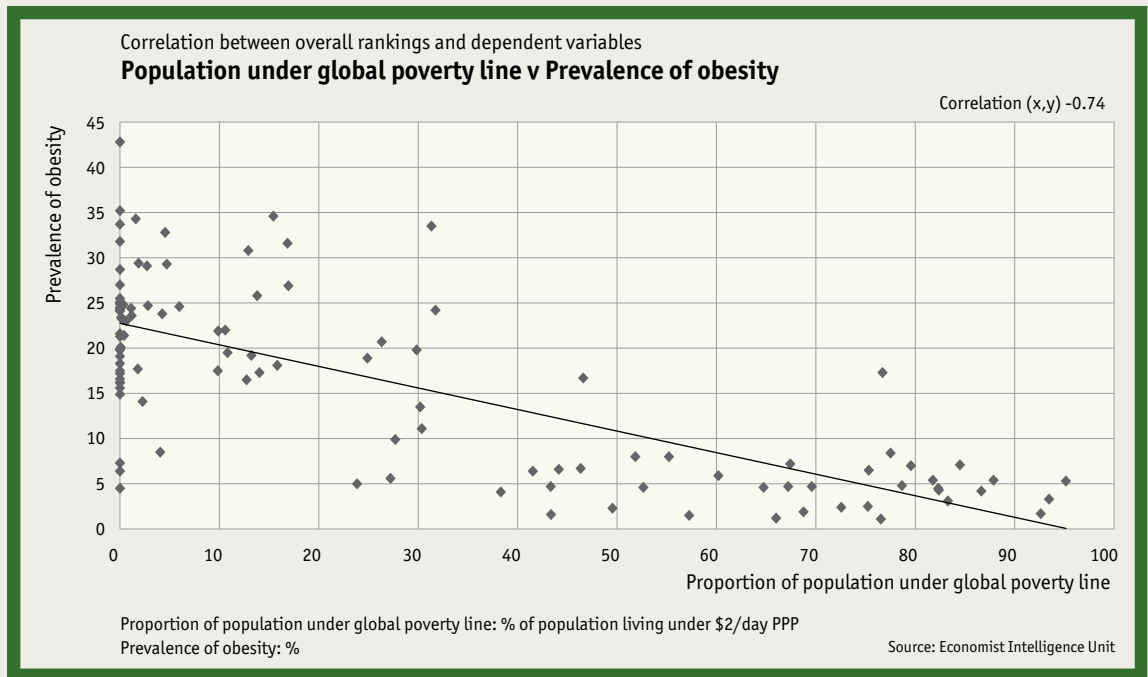
United Nations and the WHO: “The obesity epidemic in the US and other industrialised countries has created the impetus to find an immediate and simple solution to a complex problem.”<sup>52</sup> Understandably, policymakers and other leaders need to define carefully what they are

<sup>52</sup> Theresa A. Nicklas and Carol E. O’Neil, *Prevalence of Obesity: A Public Health Problem Poorly Understood*, Food and Agriculture Organisation of the United Nations and the World Health Organisation, 2013.

trying to accomplish and which paths will achieve those goals in the most appropriate manner.

A primary approach has been to propose either restrictions or taxes to alter consumers’ behaviours. Both Denmark and South Korea have instituted taxes on “fatty” foods,<sup>53</sup> and some policymakers, including New York City’s former

<sup>53</sup> Fat tax elicits mixed reactions from S. Korean public”, *Xinhua*, January 1st 2012.



“  
The obesity epidemic in the US and other industrialised countries has created the impetus to find an immediate and simple solution to a complex problem.  
”

Theresa Nicklas and  
Carol O’Neil

mayor, Michael Bloomberg, have tried to implement bans on certain foods such as sodas and sweetened beverages. Many of these policies have proven to be deeply unpopular, and their effectiveness remains an open question.

Production-level interventions—for instance, sugar subsidies—are rather complicated and become intertwined with other policy areas, including trade law. Some studies have shown that such blunt tools have minimal impact on consumer prices and hence on consumer behaviour.<sup>54</sup>

While consumption-level policies—especially those aimed at targeting energy-rich products—might have greater potential to curb obesity, they have their own limitations, particularly at higher-income levels, where consumers are less sensitive to price. Consumption taxes are generally complicated and can have undue and unexpected side-effects on consumption patterns. Such policies may promote undernourishment and thereby increase food insecurity or change behaviours in areas not pertaining to obesity—for instance, by impacting food waste.<sup>55</sup> More extreme proposals, such as direct taxes on excessive body weight, have been tendered as well. Although no formal “obesity taxes” have been implemented to date, indirect “taxes”, in terms of social and private-sector costs, already put an increased burden on the obese.<sup>56</sup>

A second approach is to promote further education on how to lead healthy, nutritious lifestyles. Proponents argue that this may provide the necessary insight to limit obesity among the food secure and food insecure. Both Norway and South Korea have been applauded for their comprehensive nutritional programmes, which include educational components.

However, education programmes face their own problems, since it is surprisingly difficult to define a healthy lifestyle. Not only do different people require different amounts and types of food and physical activity, but scientists and advocates are

not even fully cognisant of which foods and behaviours are “good” or “bad”—if such concepts even exist. Most education programmes, such as the Let’s Move! campaign in the US developed by the First Lady, Michelle Obama, advocate diets that avoid sweets, fat and other supposed junk foods and place a heavy emphasis on losing weight. Many nutritionists, however, argue that there is no such thing as bad foods and that people should be encouraged to address their cravings appropriately (to avoid bingeing). This is important in managing a healthy approach to food and avoiding the pernicious side-effects, such as eating disorders, that may develop if the wrong messages are sent. Additionally, one-size-fits-all approaches are often inadequate when defining something as personal as individual diet and exercise.

For instance, despite copious public service messages that emphasise the importance of reducing fat content in individuals’ diets, studies are showing that low-fat dairy may actually promote obesity. A recent study at the Harvard School of Public Health argues that “full-fat dairy may help control weight because it promotes more of a feeling of satiety than low-fat. Another possibility is that the fatty acids in full-fat dairy may help with weight regulation.”<sup>57</sup>

Other approaches advocate addressing the issue at the source, rather than the consumer. Mitigating the reach and impact of food marketing, particularly on children, or encouraging expanded food and nutrition labelling have been proposals that have gained some traction. Likewise, school lunch programmes, which are often responsible for feeding a large proportion of the youth population, have been a topic of debate, with some experts claiming they are an optimal area to combat obesity. However, as Craig Gundersen of the University of Illinois argues, focusing on obesity in school lunch programmes may accelerate food insecurity in vulnerable populations.<sup>58</sup> While approaches that enter at earlier stages along the

54 “Globalization of food systems in developing countries: impact on food security and nutrition”, *FAO Food and Nutrition Paper 83*, Food and Agriculture Organisation of the United Nations, Rome, 2004.

55 *Ibid.*

56 *Ibid.*

57 “Full-fat dairy may reduce obesity risk”, *HSPH News*, Harvard School of Public Health.

58 Barry M. Popkin, Linda S. Adair and Shu Wen Ng, “Now and Then: The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries”, *Nutrition Reviews*, January 2012; 70(1): 3-21.



supply chain have the benefits of greater control by policymakers and a certain ease of implementation, they often run into questions of efficacy and appropriateness.

## Conclusion

Undoubtedly, the obesity–food security relationship is complex, nuanced and still not fully understood. There are potentially different patterns and drivers exhibited across demographics, including socioeconomic status, culture, ethnicity, age and sex, and countries. While some experts argue that there may be a trade-off between policies that address obesity and those that tackle food security, particularly in developed countries, others, such as Dr Schwartz at the Yale Rudd Centre, claim that “it certainly does not make sense for people truly interested in food security and those who are truly interested in obesity to be working at cross-purposes”.<sup>59</sup> The goal in both areas—to see that individuals have access to sufficient and nutritious food—may be simultaneously obtainable. Nonetheless, potential solutions in both the private and the public sector are often imperfect and rarely simple.

Such a high level of intricacy offers compelling reasons to avoid trying to comprehend the obesity–food security relationship within an overly narrow and unduly rigid perspective. Broad-sweeping policy solutions, on global, regional and national levels, may be inadequate given the complex nature of the issue, the significant role

played by personal circumstances, and the many unanswered questions that remain. In recent years the harm of such one-dimensional policymaking has become apparent as the historical approach to addressing undernutrition, particularly in developing countries, has contributed to the growing prevalence of obesity. “As the experiences in Mexico and Brazil show, traditional poverty alleviation and food programmes can have unforeseen consequences, especially in environments where activity patterns have shifted toward more sedentary activity.”<sup>60</sup>

Solutions to these problems may be easier to come by if stakeholders, including policymakers, politicians, non-governmental organisation (NGOs), individuals and the private sector, understand the complexity and uncertainty of the issue and work towards developing approaches that directly target the problems experienced by individuals or small groups. Such an approach would allow for the greater customisation of solutions and enable stakeholders to sort through the intricacies that have arisen on national-level analyses.

Whatever solutions are offered, it will be important to re-evaluate programmes continuously to ensure that they are yielding the desired results and create no spillover effects.<sup>61</sup> Further research, discussion and debate will advance the understanding of these complex issues and hopefully show the way towards meaningful solutions. ■

Additionally, one-size-fits-all approaches are often inadequate when defining something as personal as individual diet and exercise.

<sup>59</sup> Interview with Marlene B. Schwartz, director, and Tatiana Andreyeva, director of economic initiatives, of the Yale Rudd Center for Food Policy & Obesity.

<sup>60</sup> *Ibid.*

<sup>61</sup> *Ibid.*



## Appendix: Methodology

The objective of the Global Food Security Index is to determine which countries are most and least vulnerable to food insecurity. To do this, The Economist Intelligence Unit (EIU) created the Global Food Security Index (GFSI) as a dynamic quantitative and qualitative benchmarking model, constructed from 28 unique indicators, that measures drivers of food security across 109 countries. Definitions of the indicators are provided below.

### Scoring criteria and categories

Categories and indicators were selected on the basis of EIU expert analysis and consultation with a panel of food security specialists. The EIU convened this panel of food security specialists in February 2012 to help select and prioritise food security indicators through a transparent and robust methodology. The goal of the meeting was to review the framework, selection of indicators, weighting, and overall construction of the index.

Three category scores are calculated from the weighted mean of underlying indicators and scaled from 0-100, where 100=most favourable. These categories are: Affordability, Availability, and Quality & Safety. The overall score for the GFSI (from 0-100) is calculated from a simple weighted average of the category scores.

A new indicator—(2.8) Food loss—was added to the 2014 index in the Availability category. Additionally, a new output variable—(4.7) Prevalence of obesity—was added to the model workbook for comparative purposes.

The categories and indicators are:

### 1. Affordability

- 1.1 Food consumption as a share of household expenditure
- 1.2 Proportion of population under the global poverty line
- 1.3 Gross domestic product per capita (PPP)
- 1.4 Agricultural import tariffs
- 1.5 Presence of food safety net programmes
- 1.6 Access to financing for farmers

### 2. Availability

- 2.1 Sufficiency of supply
  - 2.1.1 Average food supply
  - 2.1.2 Dependency on chronic food aid
- 2.2 Public expenditure on agricultural R&D
- 2.3 Agricultural infrastructure
  - 2.3.1 Existence of adequate crop storage facilities
  - 2.3.2 Road infrastructure
  - 2.3.3 Port infrastructure
- 2.4 Volatility of agricultural production
- 2.5 Political stability risk
- 2.6 Corruption
- 2.7 Urban absorption capacity
- 2.8 Food loss

### 3. Quality & Safety

- 3.1 Diet diversification
- 3.2 Nutritional standards
  - 3.2.1 National dietary guidelines
  - 3.2.2 National nutrition plan or strategy
  - 3.2.3 Nutrition monitoring and surveillance
- 3.3 Micronutrient availability
  - 3.3.1 Dietary availability of vitamin A
  - 3.3.2 Dietary availability of animal iron
  - 3.3.3 Dietary availability of vegetal iron
- 3.4 Protein quality
- 3.5 Food safety
  - 3.5.1 Agency to ensure the safety and health of food
  - 3.5.2 Percentage of population with access to potable water
  - 3.5.3 Presence of formal grocery sector

Data for the quantitative indicators are drawn from national and international statistical sources.

Where quantitative or survey data were missing values, the EIU has used estimates. Estimated figures have been noted in the model workbook. Some qualitative indicators have been created by the EIU, based on information from development banks and government websites; others have been drawn from a range of surveys and data sources and adjusted by the EIU.

The main sources used in the Global Food Security Index are the EIU; the World Bank Group; the International Monetary Fund (IMF); the Food and Agriculture Organisation of the United Nations (FAO), the United Nations Development Programme (UNDP), the World Health Organisation (WHO); the World Trade Organisation (WTO); the World Food Programme (WFP); Agricultural Science and Technology Indicators (ASTI); and national statistical offices.

## Country selection

The 109 countries in the index were selected by the EIU based on regional diversity, economic importance and size of population. Two new countries, Kuwait and the United Arab Emirates, were added to the index this year. The countries in the 2014 index are:

Asia & Pacific	Central & South America	Europe	Middle East & North Africa	North America	Sub-Saharan Africa
Australia	Argentina	Austria	Algeria	Canada	Angola
Azerbaijan	Bolivia	Belarus	Egypt	Mexico	Benin
Bangladesh	Brazil	Belgium	Israel	United States	Botswana
Cambodia	Chile	Bulgaria	Jordan		Burkina Faso
China	Colombia	Czech Republic	Kuwait		Burundi
India	Costa Rica	Denmark	Morocco		Cameroon
Indonesia	Dominican Republic	Finland	Saudi Arabia		Chad
Japan	Ecuador	France	Syria		Congo (Dem. Rep.)
Kazakhstan	El Salvador	Germany	Tunisia		Côte d'Ivoire
Malaysia	Guatemala	Greece	Turkey		Ethiopia
Myanmar	Haiti	Hungary	United Arab Emirates		Ghana
Nepal	Honduras	Ireland	Yemen		Guinea
New Zealand	Nicaragua	Italy			Kenya
Pakistan	Panama	Netherlands			Madagascar
Philippines	Paraguay	Norway			Malawi
Singapore	Peru	Poland			Mali
South Korea	Uruguay	Portugal			Mozambique
Sri Lanka	Venezuela	Romania			Niger
Tajikistan		Russia			Nigeria
Thailand		Serbia			Rwanda
Uzbekistan		Slovakia			Senegal
Vietnam		Spain			Sierra Leone
		Sweden			South Africa
		Switzerland			Sudan
		Ukraine			Tanzania
		United Kingdom			Togo
					Uganda
					Zambia

## Weighting

The weighting assigned to each category and indicator can be changed to reflect different assumptions about their relative importance. Two sets of weights are provided in the index. The first option, called neutral weights, assumes equal importance of all indicators and evenly distributes weights. The second option, called peer panel recommendation, averages the suggested weights from five members of an expert panel. The expert weights are the default weights in the model. The model workbook also provides the ability to create customised weightings to allow the users to test their own assumptions about the relative importance of each indicator.

## Data modelling

Indicator scores are normalised and then aggregated across categories to enable a comparison of broader concepts across countries. Normalisation rebases the raw indicator data to a common unit so that it can be aggregated. The indicators where a higher value indicates a more favourable environment for food security—such as GDP per capita or average food supply—have been normalised on the basis of:

$$x = (x - \text{Min}(x)) / (\text{Max}(x) - \text{Min}(x))$$

where  $\text{Min}(x)$  and  $\text{Max}(x)$  are, respectively, the lowest and highest values in the 109 economies for any given indicator. The normalised value is then transformed from a 0-1 value to a 0-100 score to make it directly comparable with other indicators. This in effect means that the country with the highest raw data value will score 100, while the lowest will score 0.

For the indicators where a high value indicates an unfavourable environment for food security—such as volatility of agricultural production or political stability risk—the normalisation function takes the form of:

$$x = (x - \text{Max}(x)) / (\text{Max}(x) - \text{Min}(x))$$

where  $\text{Min}(x)$  and  $\text{Max}(x)$  are, respectively, the lowest and highest values in the 109 economies for any given indicator. The normalised value is then transformed into a positive number on a scale of 0-100 to make it directly comparable with other indicators.

## Food price adjustment factor

Food prices play an integral role in food security by affecting affordability. High food prices have the greatest impact in developing countries, where the poor typically spend a large share of their income on food and a price spike can significantly reduce food consumption. While food producers may benefit from price increases, and thus higher revenue, this is typically a medium- to long-run phenomenon and is not considered for the purpose of our index.

To measure the effect of food prices on affordability, in each quarter following the launch of the index we will apply a food price adjustment factor to each country's affordability score in the GFSI, as we did for the past two models. This factor will be based on quarterly changes in global food prices, as measured by the FAO Food Price Index.

The global price is multiplied by what we call the "local food price pass-through rate", to adjust for local circumstances. We define this rate as the ratio of the change in local food prices to the change in global food prices between 2000 and 2012. If local food prices in country X rose by 20% of the FAO index change during the historical period, we will assume, going forward, a 20% pass-through of global prices. The size of the pass-through factor is capped at 100% of the FAO global change, so that in no case would a country's local price change have a higher magnitude than the global change.

To capture other elements of affordability, we consider two additional factors—exchange rates and income. Each country's local food price change is adjusted according to the change in the local currency's US dollar exchange rate to incorporate any change in the relative cost of imports. The quarterly change in the exchange rate is first adjusted by the import dependency ratio to account for the relative importance of foreign

trade. Thus countries that are more heavily reliant on imports will experience a greater impact on the affordability score from fluctuations in the exchange rate, while more autarkic countries will experience small impacts from such changes.

Additionally, the price factor is adjusted to account for quarterly growth in income per head—as forecast by the EIU. All things being equal, higher incomes generally imply a greater

ability to afford food products.

The food price adjustment factor is calculated every quarter following the launch of the yearly baseline model. This provides three comparative quarterly models that track the effects of food price changes over the year. The first quarterly adjustment for the 2014 model will be released in Q3 2014. ■

## Sources and definitions

Where the quantitative or survey data have missing values, the EIU has estimated the scores.

Indicator	Primary source(s)	Year	Indicator definitions and construction
<b>1) Affordability</b>			
Food consumption as a share of household expenditure	Food and Agriculture Organisation (FAO); United Nations	Latest available year in 1990-2014	A measure of the percentage of household expenditure that is spent on food at a national level.
Proportion of population under global poverty line	World Bank, World Development Indicators; UN Development Programme (UNDP)	Latest available year in 2001-11	A measure of the prevalence of poverty, calculated as the percentage of the population living on less than US\$2/day in purchasing power parity.
Gross domestic product per capita (PPP)	Economist Intelligence Unit (EIU)	2013	A measure individual income and, hence, affordability of food, calculated in US dollars at purchasing power parity.
Agricultural import tariffs	World Trade Organisation (WTO)	Latest available year in 2009-12	Measured as the average applied most-favoured nation (MFN) tariff on all agricultural imports.
Presence of food safety net programmes	Qualitative scoring by EIU analysts	Latest available year in 2009-14	<p>A measure of public initiatives to protect the poor from food-related shocks. This indicator considers food safety net programmes, including in-kind food transfers, conditional cash transfers (ie, food vouchers), and the existence of school feeding programmes by the government, NGOs or the multilateral sector.</p> <p>Measured on a 0-4 scale based on the prevalence and depth of food safety net programmes:</p> <p>0=Minimal evidence of food safety net programmes or programmes run only by NGOs or multilaterals. Emergency food aid programmes funded by multilaterals are not considered;</p> <p>1=Moderate presence of food safety net programmes, but mainly run by NGOs or multilaterals. Depth and/or prevalence is inadequate;</p> <p>2=Moderate prevalence and depth of food safety net programmes run by the government, multilaterals, or NGOs;</p> <p>3=National coverage, with very broad, but not deep coverage of food safety net programmes;</p> <p>4=National government-run provision of food safety net programmes.</p> <p>Depth indicates the quantity of funds available to recipients. Breadth indicates the range of services available.</p>



Indicator	Primary source(s)	Year	Indicator definitions and construction
Access to financing for farmers	Qualitative scoring by EIU analysts	Latest available year in 2006-14	<p>A measure of the availability of financing to farmers from the public sector.</p> <p>Measured on a 0-4 scale based on the depth and range of farmer financing:</p> <p>0=No access to government or multilateral farmer financing programmes (typically, but not necessarily a developing economy);</p> <p>1=Limited multilateral or government farmer financing programmes (typically, but not necessarily a developing economy);</p> <p>2= Some multilateral or government financing (typically, but not necessarily an emerging-market economy);</p> <p>3= Broad, not deep farmer financing (typically, but not necessarily a developed economy) OR well-developed multilateral farmer financing programmes (typically, but not necessarily an emerging market economy);</p> <p>4=Access to deep farmer financing (typically, but not necessarily an advanced economy)</p> <p>Depth indicates the quantity of funds available. Range covers credit and insurance.</p>

## 2) Availability

Sufficiency of supply	EIU scoring	-	<p>A composite indicator that measures the availability of food. It is comprised of the following sub-indicators:</p> <ul style="list-style-type: none"> <li>• Average food supply in kcal/capita/day</li> <li>• Dependency on chronic food aid</li> </ul>
Average food supply	FAO	2009	<p>An estimate of the per-capita amount of food available for human consumption in kilocalories/capita/day.</p>
Dependency on chronic food aid	World Food Programme (WFP)	2006-12	<p>Measures whether a country is a recipient of chronic food aid. For the purpose of this index, chronic aid recipients are defined as those countries that have received non-emergency food aid over a five-year time span.</p> <p>It is measured on a 0-2 scale:</p> <p>0=Received chronic food aid on an increasing basis over the last five years;</p> <p>1=Received chronic food aid on a decreasing basis over the last five years;</p> <p>2=Receives little to no food aid or only on an emergency basis</p>

Indicator	Primary source(s)	Year	Indicator definitions and construction
Public expenditure on agricultural R&D	EIU estimates based on OECD, World Bank, Agricultural Science and Technology Indicators (ASTI); EIU data	Latest available year in 2001-13	<p>A measure of government spending on agricultural research and development. Expenditure on agricultural R&amp;D is a proxy for agricultural innovation and technology that increases market efficiency and access.</p> <p>It is measured as a percentage of agricultural GDP and is scored on a nine-point scale:</p> <p>1= 0-0.5%;            2= 0.51-1.0%;            3= 1.01-1.5%;            4= 1.51-2.0%;            5= 2.01-2.5%;            6= 2.51-3.0%;            7= 3.01-3.5%;            8= 3.51-4.0%;            9= 4.01-4.5%</p>
Agricultural infrastructure	EIU scoring	-	<p>This is a composite indicator that measures the ability to store and transport crops to market. Sub-indicators include:</p> <ul style="list-style-type: none"> <li>• Existence of adequate crop storage facilities</li> <li>• Road infrastructure</li> <li>• Port infrastructure</li> </ul>
Existence of adequate crop storage facilities	Qualitative scoring by EIU analysts	Latest available year in 2007-14	<p>This binary indicator assesses the presence of sufficient crop storage facilities based on size of agricultural sector and population. It is measured on a 0-1 scale:</p> <p>0=No            1=Yes</p>
Road infrastructure	EIU Risk Briefing	2014	This qualitative indicator measures the quality of road infrastructure and is measured on a 0-4 scale, where 4=best.
Port infrastructure	EIU Risk Briefing	2014	This qualitative indicator measures the quality of port infrastructure and is measured on a 0-4 scale, where 4=best.
Volatility of agricultural production	FAO	1992-2011	This indicator measures the standard deviation of the growth of agricultural production over the most recent 20-year period for which data are available.
Political stability risk	EIU Risk Briefing	2014	A measure of general political instability. Political instability has the potential to disrupt access to food through such avenues as transport blocks or reduced food aid commitments.
Corruption	EIU Risk Briefing	2014	This indicator measures the pervasiveness of corruption in a country by assessing the risk of corruption. Corruption can impact food availability through distortions and inefficiencies in the use of natural resources, as well as bottleneck inefficiencies in food distribution. Measured on a 0-4 scale, where 4=highest risk.

Indicator	Primary source(s)	Year	Indicator definitions and construction
Urban absorption capacity	World Bank, World Development Indicators; EIU	2012-14	This indicator measures the capacity of a country to absorb the stresses placed on it by urban growth and still ensure food security. It does so by evaluating a country's resources (real GDP) against the stress of urbanisation (urban growth rate). It is calculated as the percentage of real change in GDP minus the urban growth rate.
Food loss	FAO	2009	A measure of post-harvest and pre-consumer food loss as a ratio of the domestic supply (production, net imports and stock changes) of crops, livestock and fish commodities (in tonnes).

### 3) Quality and Safety

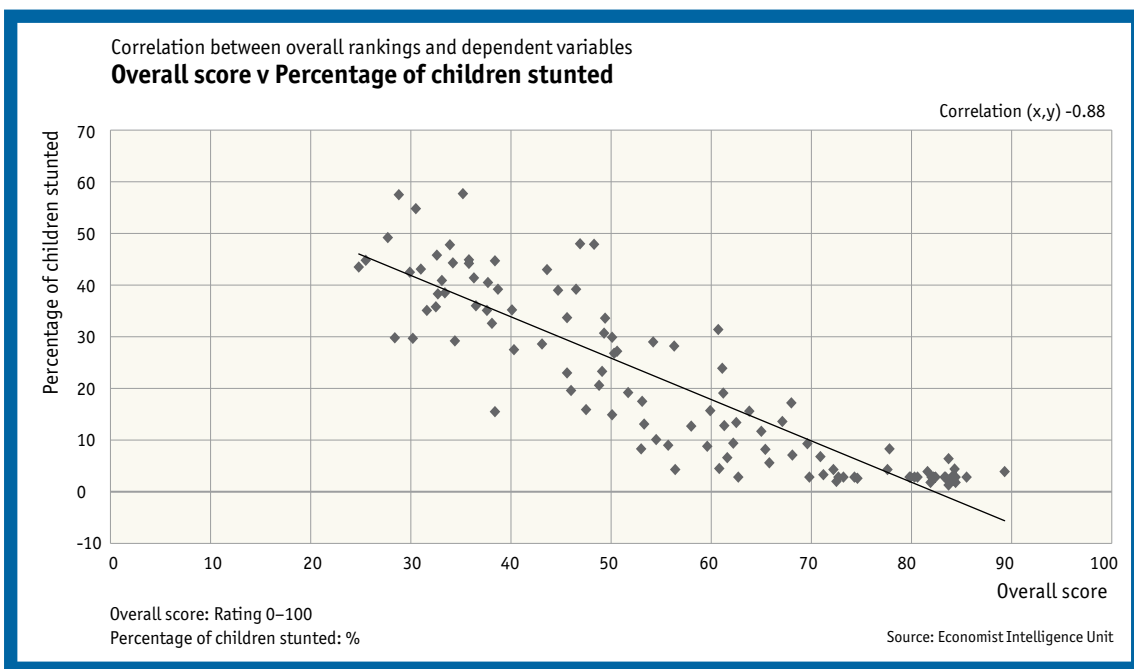
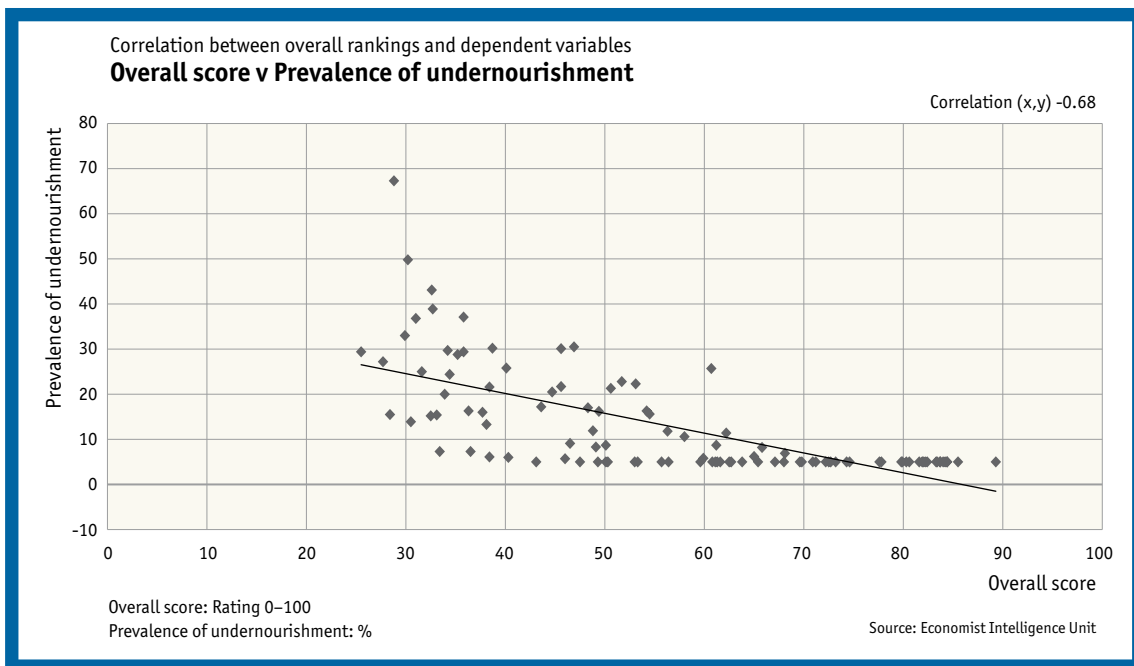
Diet diversification	FAO	2008-10	<p>A measure of the share of non-starchy foods (all but cereals, roots and tubers) in total dietary energy consumption. A larger share of non-starchy foods signifies a greater diversity of food groups in the diet.</p> <p>This is a composite indicator that measures government commitment to increasing nutritional standards. It is comprised of the following binary sub-indicators:</p> <ul style="list-style-type: none"> <li>• National dietary guidelines</li> <li>• National nutrition plan or strategy</li> <li>• Nutrition monitoring and surveillance</li> </ul>
Nutritional standards	EIU scoring	-	-
National dietary guidelines	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents	Latest available year in 1996-2014	<p>This is a binary indicator that measures whether the government has published guidelines for a balanced and nutritious diet:</p> <p>0=No 1=Yes</p>
Nutrition plan or strategy	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents	Latest available year in 1996-2014	<p>This is a binary indicator that measures whether the government has published a national strategy to improve nutrition:</p> <p>0=No 1=Yes</p>
Nutrition monitoring and surveillance	Qualitative scoring by EIU analysts based on WHO, FAO and national health ministry documents	Latest available year in 2000-14	<p>This is a binary indicator that measures whether the government monitors the nutritional status of the general population. Examples of monitoring and surveillance include the collection of data on undernourishment, nutrition-related deficiencies, etc.</p> <p>0=No 1=Yes</p>
Micronutrient availability	EIU	-	<p>A composite indicator that measures the availability of micronutrients in the food supply. Sub-indicators include:</p> <ul style="list-style-type: none"> <li>• Dietary availability of vitamin A</li> <li>• Dietary availability of animal iron</li> <li>• Dietary availability of vegetal iron</li> </ul>

Indicator	Primary source(s)	Year	Indicator definitions and construction
Dietary availability of vitamin A	FAO	2005-07	The dietary availability of vitamin A is calculated by converting the amount of food available for human consumption (as estimated by the FAO Food Balance Sheets) into the equivalent of vitamin A. This indicator is expressed in micrograms of retinol activity equivalent/capita/day on a 0-2 scale. 0= less than 300 mcg RAE/capita/day; 1= 300-600 mcg RAE/capita/day; 2= more than 600 mcg RAE/capita/day
Dietary availability of animal iron	FAO	2005-07	The dietary availability of iron is calculated by converting the amount of food available for human consumption (as estimated by the FAO Food Balance Sheets) into the equivalent of iron. Animal iron is obtained from products such as meat, milk, fish, animal fats, eggs. This indicator is expressed in mg/capita/day.
Dietary availability of vegetal iron	FAO	2005-07	The dietary availability of iron is calculated by converting the amount of food available for human consumption (as estimated by the FAO Food Balance Sheets) into the equivalent of iron. Vegetal iron is obtained from products such as cereals, pulses, roots and tubers, vegetable oils, fruits, vegetables, etc. This indicator is expressed in mg/capita/day.
Protein quality	EIU calculation based on data from FAO, WHO and USDA Nutrient Database	2005-10	This indicator measures the grams of quality protein using the methodology of the Protein Digestibility Corrected Amino Acid Score (PDCAAS). The PDCAAS methodology assesses the presence of nine essential amino acids in the average national diet. The inputs of this calculation include: the amino acid profile, protein digestibility value and the average grams consumed of each food item that contributes a minimum of 2% to protein consumption.
Food safety	EIU scoring	-	This is a composite indicator that measures the enabling environment for food safety. Sub-indicators include: <ul style="list-style-type: none"> <li>• Agency to ensure the safety and health of food</li> <li>• Percentage of population with access to potable water</li> <li>• Presence of formal grocery sector</li> </ul>
Agency to ensure the safety and health of food	Qualitative scoring by EIU analysts	Latest available in 2009-14	Binary indicator that measures the existence of a regulatory or administrative agency to ensure the health and safety of food: 0=No 1=Yes
Percentage of population with access to potable water	World Bank	Latest available in 2007-11	Access to potable water is the proportion of people using improved drinking water sources: household connection; public standpipe; borehole; protected dug well; protected spring; rainwater.
Presence of formal grocery sector	Qualitative scoring by EIU analysts	Latest available in 2010-14	Qualitative indicator measuring the prevalence of a formal grocery sector measured on a 0-2 scale: 0=Minimal presence; 1=Moderate presence; 2=Widespread presence

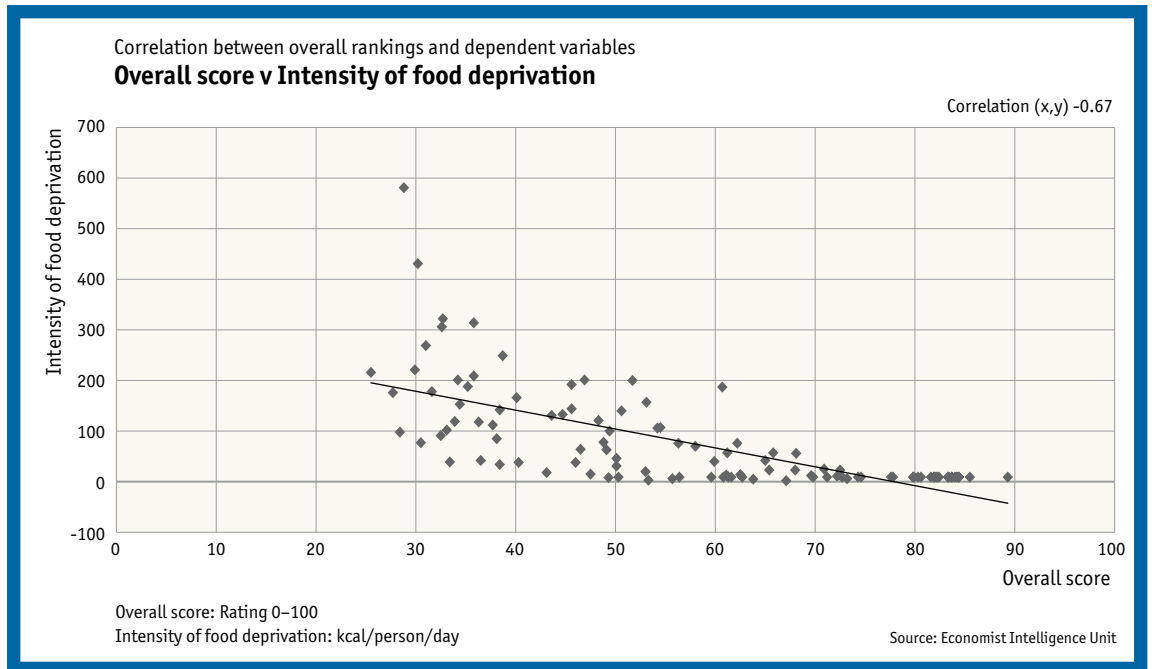
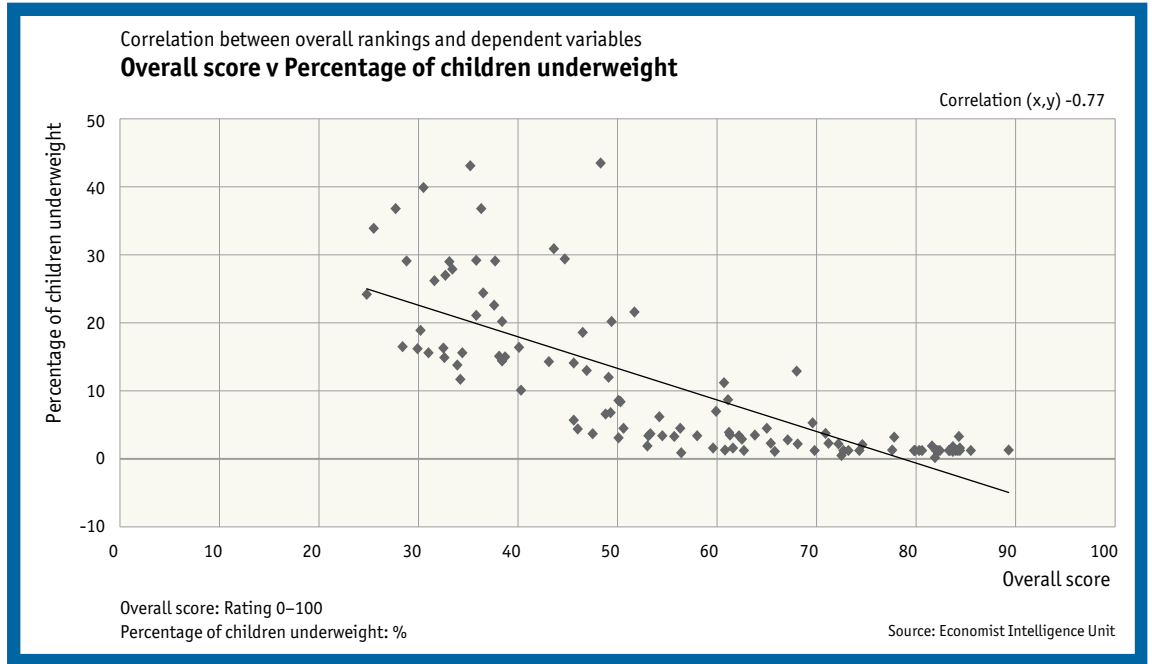
Indicator	Primary source(s)	Year	Indicator definitions and construction
<b>4) Output variables</b>			
Prevalence of undernourishment	FAO	2011-13	The proportion of the population who do not receive the minimum number of required calories for an average person, as defined by the FAO/WHO/UNU Expert Consultation in 2001.
Percentage of children stunted	WHO	Latest available year in 1972-2012	The percentage of children under five years who have a height-for-age below minus two standard deviation from the National Centre for Health Statistics (NCHS)/WHO reference median.
Percentage of children underweight	WHO	Latest available year in 1972-2012	The percentage of children under five years who have a weight-for-age below minus two standard deviation from the NCHS/WHO reference median.
Intensity of food deprivation	FAO	2011-13	A measure of how much people, on average, fall below the dietary energy requirement. It is measured as the difference between the minimum dietary energy and the average dietary energy intake of the undernourished population.
Human Development Index	UNDP	2012	A composite index that measures development by combining indicators on life expectancy, educational attainment and income.
Global Gender Gap Index	World Economic Forum (WEF)	2013	The Global Gender Gap Index seeks to measure one important aspect of gender equality: the relative gaps between women and men, across a large set of countries and across the four key areas of health, education, economy and politics.
EIU Democracy Index	EIU	2012	The Democracy Index provides a snapshot of the state of democracy in 165 states and 2 territories. The index includes indicators in the following five categories: electoral process and pluralism, functioning of government, political participation, political culture, and civil liberties.
Prevalence of obesity	WHO	2008	Measures the percentage of the population over 20 years of age that is obese. Obesity is defined as having an age-standardised body mass index (BMI) greater than 30.0.

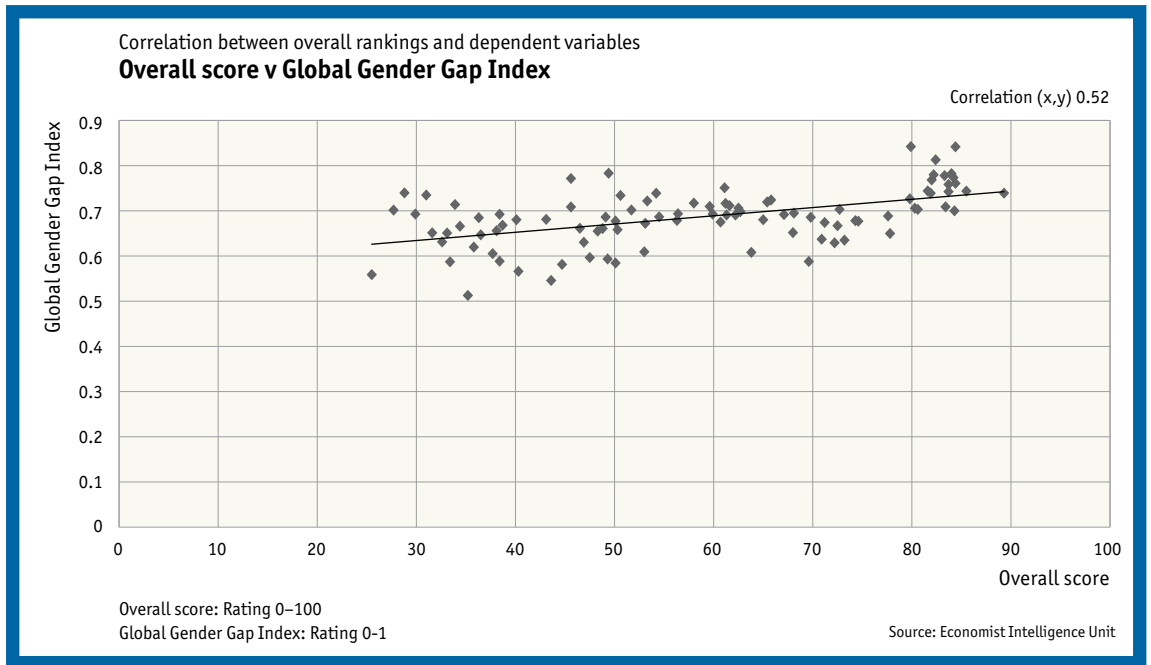
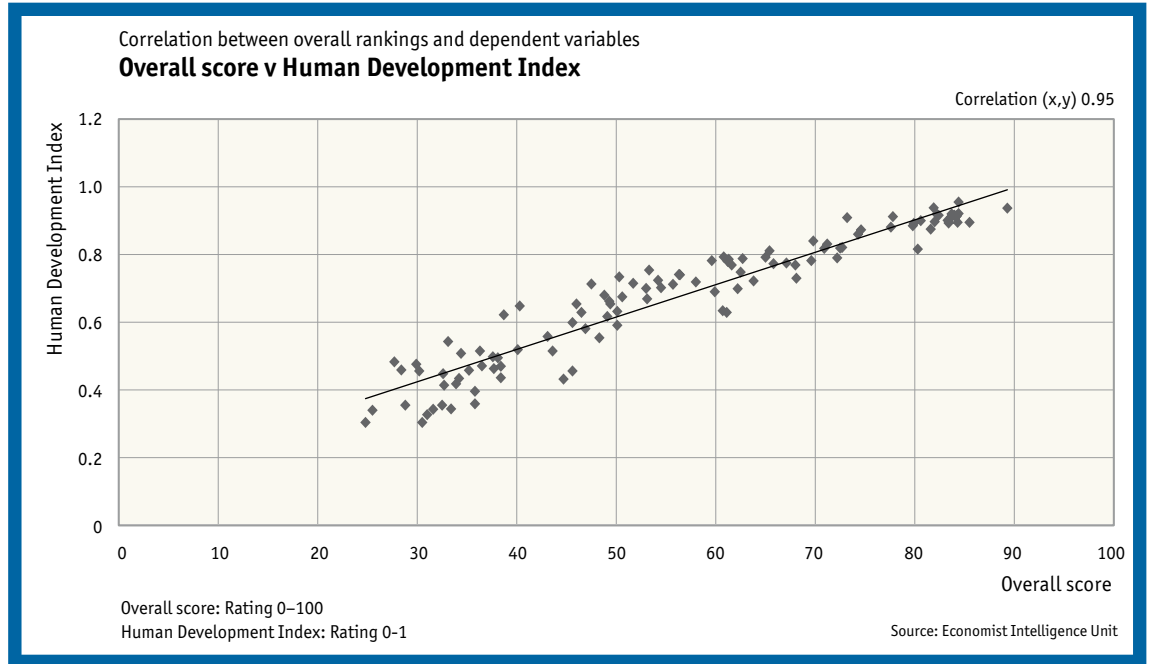
## Scattergraphs

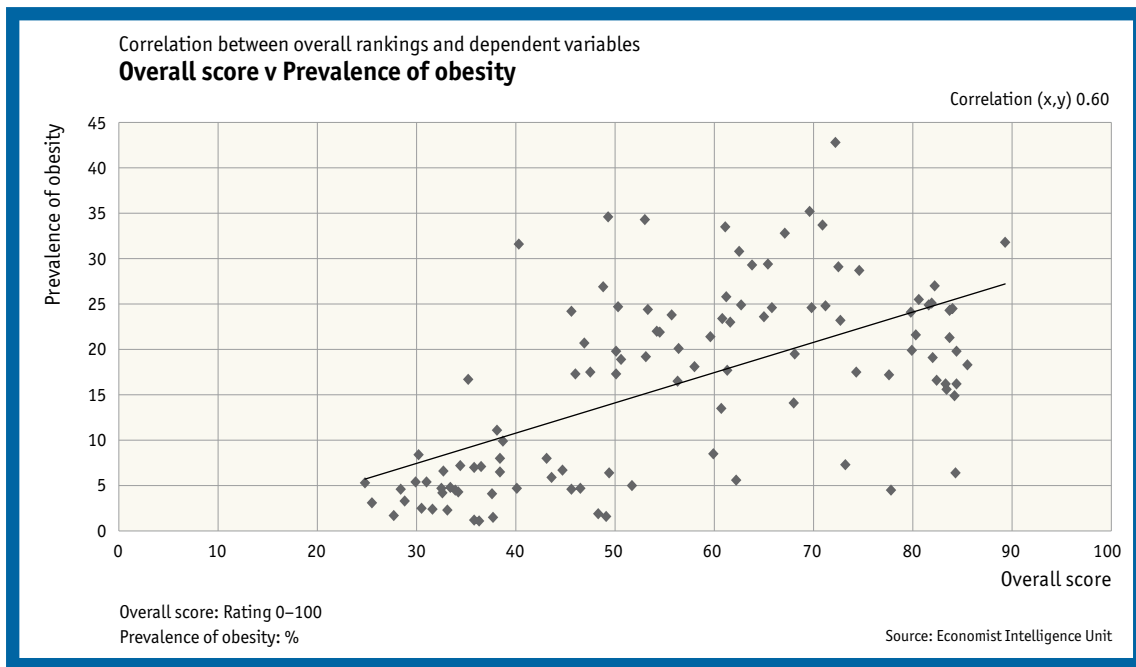
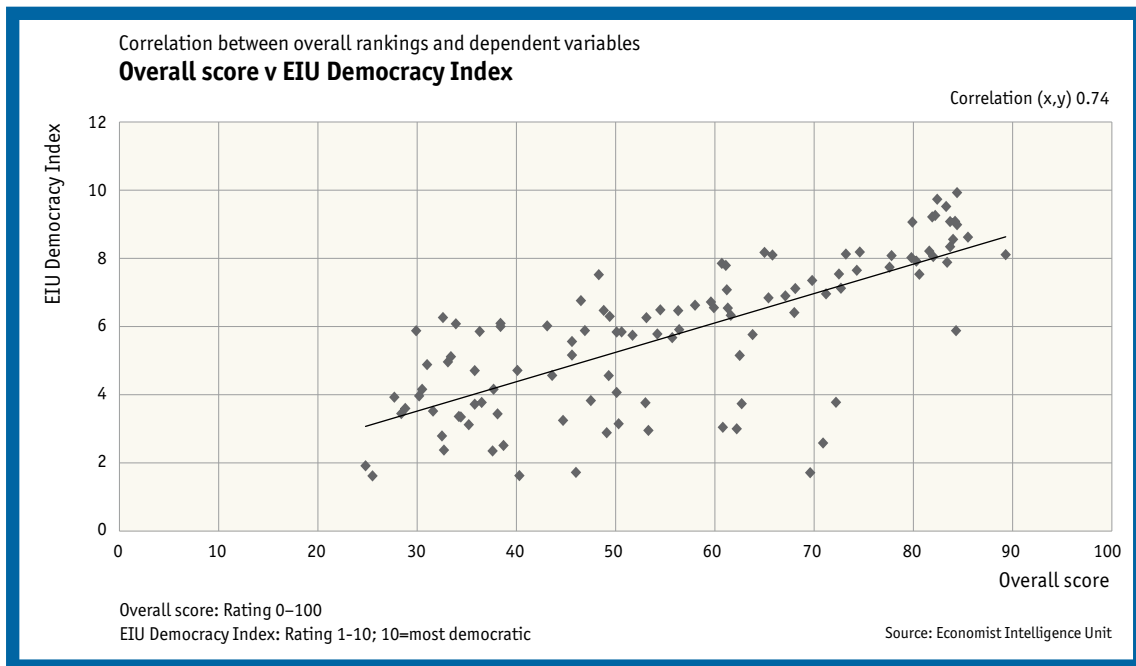
Correlation between overall rankings and dependent variables











Whilst every effort has been taken to verify the accuracy of this information, neither The Economist Intelligence Unit Ltd. nor the sponsor of this report can accept any responsibility or liability for reliance by any person on this white paper or any of the information, opinions or conclusions set out in the white paper.

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