VALUING THE SDG PRIZE IN FOOD AND AGRICULTURE

UNLOCKING BUSINESS OPPORTUNITIES TO ACCELERATE SUSTAINABLE AND INCLUSIVE GROWTH

A paper from AlphaBeta commissioned by the Business and Sustainable Development Commission

October 2016

αlphaβeta

Business and Sustainable Development Commission
c/o Systemiq
1 Fore Street
London ECY 5EJ

info@businesscommission.org

www.businesscommission.org

AlphaBeta

singapore@alphabeta.com

www.alphabeta.com

FOREWORD

Launched in 2015, the Sustainable Development Goals (SDGs), or Global Goals, as they are commonly known, are 17 goals for ending poverty and hunger, reducing inequality, and tackling urgent challenges such as climate change, by 2030. A year on, the focus now is on how to make meaningful progress on the ambitious targets outlined in this agenda.

The Business and Sustainable Development Commission (BSDC) was established in January 2016 to articulate and quantify a compelling business case for the private sector to help deliver the SDGs. The Commission's approach has been to start with the business perspective and ask a simple strategic question: what needs to be different in key sectors and value chains in order to achieve the SDG targets by 2030. We then look to identify the biggest, most attractive business opportunities that could emerge from the delivery of the SDGs. Finally, we assess what it will take to unlock that opportunity, including actions from government, investors and companies. Delivering the SDGs will require combining the best know-how from the public and private sectors, from civil society and from the investment community. Think of the Commission as creating a strategic roadmap of the fastest-growing markets that would result from delivery of the SDGs. We believe that the SDGs represent a huge opportunity for progressive businesses, willing to drive transformative change in their sectors.

Valuing the SDG Prize in Food and Agriculture is part of a larger body of research that quantifies the value of business opportunities across four key systems: food, cities, energy & materials, and health and well-being. The findings for these systems will be revealed in the Business Commission's flagship report, to be launched in January 2017. The report will quantify the private sector opportunity across the four key systems, identify the new business models associated with them, and estimate the financing required to unlock these opportunities. The Business Commission would like to thank AlphaBeta for providing the analytical support for this project.

Many experts in academia, government, and industry have offered invaluable guidance, suggestions, and advice. Our particular thanks to Paul Polman, Jeff Seabright, Rianne Buter, Alison Cairns, and Ella Mayhew (Unilever); James Gomme, Carina Larsfalten, Fokko Wientjes and Karolina Södergren (World Business Council for Sustainable Development); Janez Potocnik (International Resource Panel and SystemiQ); Daniela Saltzman (Generation Investment Management); Marco Albani (Tropical Forest Alliance 2020); Jessica Alsford (Morgan Stanley); Nakul Saran (Fish Forever); Marc Zornes (Winnow); Jason Eis (Vivid Economics); Elizabeth Stuart (Overseas Development Institute); Ammad Bahalim, Caitlin Smethurst, and Miguel Veiga-Pestana (Bill and Melinda Gates Foundation); Juliano Assuncao (Climate Policy Initiative); Nick Godfrey (New Climate

Economy); Justin Adams (The Nature Conservancy); Elisa Moscolin and Samson Kanai (Safaricom); Nedaa Abdulaziz Al-Mubarak (Al-Dabbagh Group); Tove Stuhr Sjoblom and Martin Stuchtey (SystemiQ); Jessica Long and Philipp Buddemeier (Accenture); Celine Herweijer, Louise Scott, Gary Sharkey, Daniel Dowling, Jonathan Grant, Jim Stephenson and Laura Plant (PwC); Raimund Bleischwitz (UCL Institute for Sustainable Resources); Geoff Clarke and Pavel Kabat (International Institute for Applied Systems Analysis); John Elkington (Volans); Peter Head (Ecosequestration Trust); Guido Schmidt-Traub (Sustainable Development Solutions Network); Murray Birt (Deutsche Bank); Homi Kharas (Brookings Institution); Roland Pfeuti (RobecoSAM); Gert Wrigge (Asia Climate Partners); Chris Masila (Private Sector Innovation Programme for Health); Chad Oliver and Alan Organschi (Yale University); and Nicolas Dennis and Morten Rosse (McKinsey & Company).

We are grateful for all of their input; the final report is ours, and any errors are our own.

CONTENTS

EXECUTIVE SUMMARY

Key messages

- Business opportunities in the implementation of the SDGs related to food could be worth over US$2.3 trillion annually for the private sector by 2030. Investment required to achieve these opportunities is approximately US$320 billion per year.

- These 14 opportunities could also generate almost 80 million jobs by 2030, which represents around 2 per cent of the forecasted labour force.

- More than two-thirds of the value of the opportunities, and over 90 per cent of the potential job creation, is located in developing countries. That includes roughly 21 million jobs in Africa, 22 million jobs in India, 12 million jobs in China, and 15 million jobs in the rest of Asian developing countries.

The food system faces an unprecedented set of challenges

The food system to 2030 is faced with a number of challenges related to innovation, demand, supply and regulation. A step change in innovation is needed to meet future demand, given that growth rates in agricultural yields have been declining and are currently below world population growth, and with crop yields approaching theoretical maximums in developed countries. In terms of demand, over 800 million people are hungry, and over 2 billion suffer from micronutrient deficiencies. From a supply perspective, to meet 2030 food, feed and fuel demand would require 175 million to 220 million hectares of additional cropland, and over half of remaining land is subject to both infrastructure and political risks. Four of the nine planetary boundaries that have been exceeded relate to food systems (climate change; loss of biosphere integrity; land system change; altered biochemical cycles). Approximately 46-58 thousand squares miles of forests, which play a crucial role in the resilience of the food system, are lost each year. Water constraints will also be significant for agricultural production, given roughly 70 per cent of global water demand is related to agriculture. At least 20 per cent of the world's aquifers are overexploited, including in important production areas such as the Upper Ganges (India) and California (US). From a business perspective, financial returns in agricultural sector are already low (5 per cent) – if negative externalities are taken account of, they become negative (-10 per cent). From a regulatory perspective, there is increasing pressure to deal with the obesity impact (which has a social cost of US$2 trillion currently and is rising rapidly) and pricing of natural resource inputs (e.g., water and energy).

The Sustainable Development Goals provide a new vision for the food system

Launched in 2015, the Sustainable Development Goals (SDGs) are 17 targets for ending poverty and hunger, reducing inequality and tackling urgent challenges such as climate change, by 2030.

The SDG agenda proposes to meet these profound challenges by shifting the food system onto a sustainable development pathway. This shift will transform the entire food system, with major impacts throughout the value chain. Mapping these impacts provides a vision for a new, SDG-compatible food system (Exhibit E1).

Exhibit e1

A sustainable development pathway could result in significant shifts in the food and agriculture system

Value Chain Area	Current Value (US$ Billions)	From...	To...
Inputs	520	• Traditional fertilisers • Limited public/private collaboration • Basic cross-breeding • Aqua and land-based feedstocks operating in silos	• Microbial fertilisers • New PPPs focused on adapting technology to local conditions • Precision phenotyping and Bioinformatics • Consideration of sustainability of blended approach of aqua and land
Production	2,175	• Water, energy and land intensive products (e.g., beef) • Forest degradation through unsustainable farming practices • Heavy deforestation products (e.g., unsustainably sourced palm oil) • Arms length dealings with smallholder farmers • Loss making fishing fleets • Limited monitoring of animal welfare • Low water efficiency agriculture • Limited innovation in production • Low data, traditional farming • Farming remote from markets	• Focus on crop and meat selection with lower environmental footprint • Sustainable forestry management (e.g., agroforestry, reduced impact logging) • Sustainable agriculture approaches (e.g., holistic grazing; low till/no till agriculture) • Contract farming and new partnership models • Sustainable fishery models/ aquaculture • Animal health monitoring & diagnostics • Micro-irrigation techniques • Precision agriculture • Big data farming • Urban farming
Food processing	1,377	• High food waste processors • High sugar/fat products • Unfortified food production	• Low food waste processors • Product reformulation, low fat/ sugar products • Food fortification
Logistics	>300	• Limited storage systems • Limted traceability	• Cloud storage systems • Fully traceable product systems
Retail & Disposal	7,180	• Limited consumer differentiation for sustainable products • Low food safety focus • High levels of food waste	• Sustainably sourced and fair trade products • Food safety as business opportunity • Composting and energy capture

Source: International Resource Panel; Anterra Capital; AlphaBeta analysis

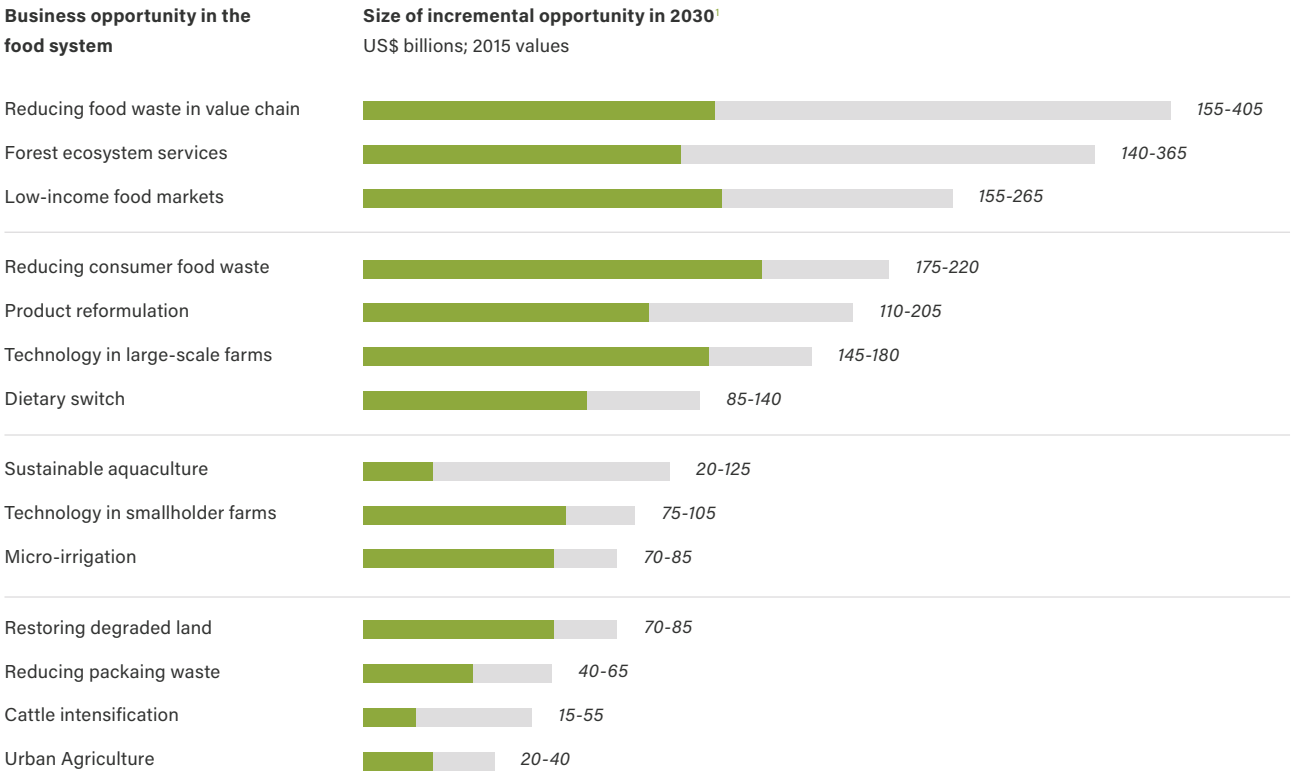
The private sector will be crucial to delivering the SDGs and there are potentially over US$2.3 trillion of business opportunities

The public sector will play a critical part in creating the enabling environment for the implementation of the SDGs, but business needs to do much of the "heavy lifting." In fact, in the food system alone, businesses can play a key role in delivering more than a quarter of the 169 SDG targets. The participation of the private sector in the implementation of the SDGs can also lead to the development of specific business opportunities. We find that 14 opportunities in food could be worth collectively over US$2.3 trillion annually by 2030 (Exhibit E2). More than two-thirds of the value of identified opportunities is concentrated in developing countries, reflecting both the large share of arable land in these countries, the high future consumption growth and the large potential upside in efficiency gains.

Our sizing of opportunities is based on current prices (except for forest ecosystem services, which includes carbon pricing). However, these largely do not reflect the cost of a range of externalities, in particular greenhouse gas (GHG) emissions, and they incorporate various subsidised and unpriced resources, including water, fossil fuels and food. To understand the impact of removing subsidies and properly pricing resources, we repriced a subset of our top opportunities for three factors for which reliable data is available: carbon, water and food. This increases the overall value of opportunities by over 90 per cent in the case of some opportunities, such as the reduction of food waste.

Exhibit e2

The largest business opportunities in the food and agriculture system could have value of over US$2.3 trillion annually in 2030



Source: Literature search; AlphaBeta analysis

[1] Based on estimated savings or project market sizings in each area. Where available, the range is estimated based on analysis of multiple sources. Rounded to nearest $5 billion.

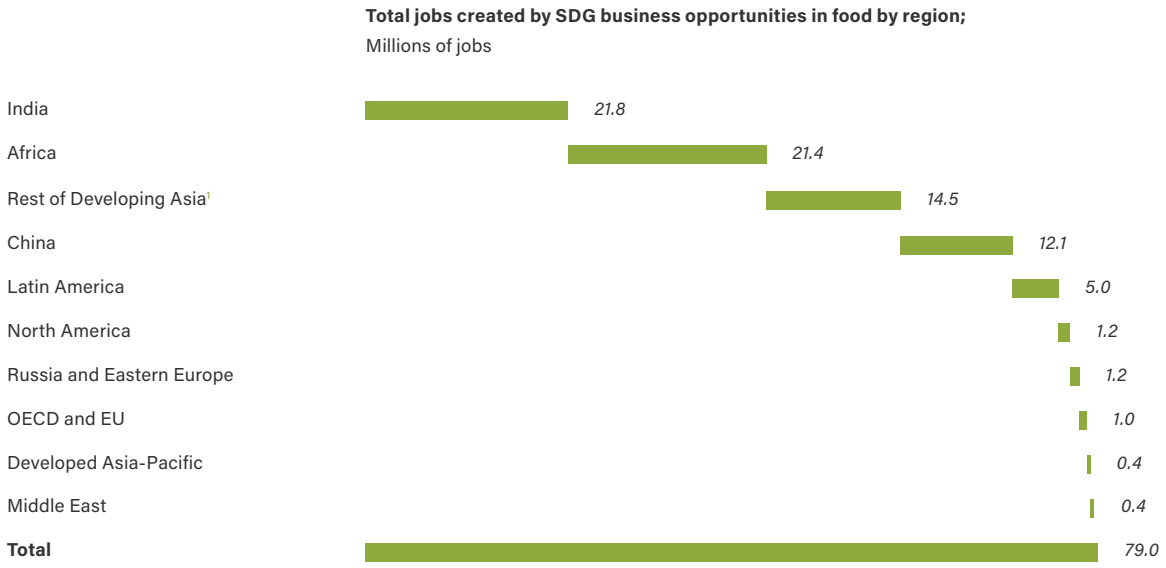
These opportunities could create almost 80 million jobs, as well as a host of benefits to food security, poverty alleviation, climate change mitigation, waste reduction and health outcomes

The identified SDG-related business opportunities could create almost 80 million jobs by 2030 (Exhibit E3). Over 90 per cent of the potential job creation is located in developing countries. That includes roughly 21 million jobs in Africa, 22 million jobs in India, 12 million jobs in China, and 15 million jobs in the rest of Asian developing countries. Given substitution effects, not all of these jobs will translate to net increases in employment.

There are also significant potential benefits to food security, poverty alleviation, climate change, mitigation, waste reduction and health outcomes. For example, reduced malnutrition and undernutrition through improved food access would have significant benefits for health and well-being – poor nutrition is responsible for 45 per cent of deaths in children under five. The world's 1.5 billion smallholder farmers have the highest incidence of poverty amongst all sectors of the global economy. Better technology in smallholder farming through aggregation, extension services, access to capital and other levers could increase yields and productivity, which would lower poverty rates. Halting all deforestation and reversing forest degradation could mitigate up to 10 per cent of total emissions globally by 2030. Product reformulation and other levers have the potential to lower obesity levels in 2030 from projected 41 per cent of global population to around 5 per cent, the level in Japan.

Exhibit e3

Almost 80 million jobs could be created by SDG business opportunities in food



Source: Literature search; AlphaBeta analysis

[1] Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Laos), and North Korea.

Achieving the SDGs will require significant investment and a new approach from business

Substantial investment will be needed to capture the SDG opportunities related to food. We estimate that the total annual investment required for the 14 major opportunities identified in the food system to be roughly US$320 billion. It is useful to compare the investment requirements to the current assets under management of investment funds focussed on ecological and regenerative agriculture and food systems. Currently these funds have just over US$500 million in assets under management.[1] Even if we consider broader agricultural funds, the capital base of the 31 leading funds amounts to just under US$4 billion.[2] While large, this is less than 1.5 per cent of the annual investment requirements.

Beyond capital investment, there will need to be additional radical departures from current approaches in order to unlock the SDG opportunities. The largest shifts required from business are in engaging with public policy and internalising social and environmental costs. Product innovation and driving sustainability through the supply chain are also critical.

[1] *The investment case for ecological farming (white paper)*, Paul McMahon, SLM Partners, January 2016.

[2] *Agricultural investment funds for developing countries*, FAO, 2010.

1. THE CHALLENGES IN THE FOOD AND AGRICULTURE SYSTEM

The food system is currently at a critical juncture. Past food demand growth has been met primarily through significant gains in productivity. However, productivity growth is slowing and the pressures on food systems are becoming increasingly severe. Addressing the current undernourished population and the rapid demand for food and feed – and competing demand for fuel – will require a radical rethink of past practices. There are important challenges in innovation, demand, supply and regulation:

▪ **Innovation.** Despite rapid demand for food in the 20th century, prices actually fell by an average of 0.7 per cent a year.[3] The main driver of this was not cropland expansion (which increased by just 0.1 per cent a year), but rather crop yield improvements, which grew at above 2 per cent a year, largely as a result of greater use of fertilisers and capital equipment, and the diffusion of better farming technologies and practices. However, yield growth has steadily fallen due to a combination of land degradation, yield growth approaching current agro-ecological potential in many countries and a lack of investment in innovation. This underinvestment in innovation in agriculture is sizeable – for example, agriculture represents 10 per cent of global GDP, but applied genetics technology (AgTech) accounts for only 3.5 per cent of global venture capital funds.[4]

▪ **Demand.** The unmet food demand at present is still substantial. Almost 800 million people worldwide are hungry, and over 2 billion suffer from micronutrient deficiencies, in particular vitamin A, iodine, iron and zinc.[5] Meeting future food needs will be complicated by growing demand for feed in the developing world as livestock production increases, with feed consumption forecast to grow 0.7 per cent faster per annum than cereal production to 2030.[6] Demand for first generation biofuels, derived from food crops such as sugar cane and corn, could add further stresses on cropland, requiring the equivalent of an additional 15 million hectares of land by 2030.[7]

▪ **Supply.** The supply challenge to meet future food demand will be equally significant. By 2030, roughly 175 to 220 million hectares of additional cropland will be needed to meet projected food, feed and fuel demand (even with continued 1 per cent improvement in annual yield growth). While there is sufficient arable land available to meet this need, over half of this land is in places with limited infrastructure and/or high political risk. In addition, the environmental degradation of agricultural systems will make future production increases more challenging. Four of the nine planetary boundaries that have been exceeded all relate to food systems (climate change; loss of biosphere integrity; land system change; altered biochemical cycles).[8] Furthermore, 33 per cent of soils

[3] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

[4] *Transforming the way we produce, move, and consume food*, Anterra Capital, March 2016.

[5] *The State of Food Insecurity in the World. Meeting the 2015 international hunger targets: taking stock of uneven progress*, FAO, International Fund for Agricultural Development and WFP, 2015.

[6] *World Agriculture: towards 2030/2050*, FAO, June 2012.

[7] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

[8] "Planetary boundaries: Guiding human development on a changing planet", W Stefen et al, Science, Vol 347, 2015.

are moderately to highly degraded due to erosion, nutrient depletion, acidification, salinisation, compaction and chemical pollution; 61 per cent of "commercial" fish populations are fully fished and 29 per cent are fished at a biologically unsustainable level and therefore overfished. Approximately 46-58 thousand squares miles of forests, which play a crucial role in the resilience of the food system, are lost each year.[9] Water constraints will also be significant for agricultural production, given roughly 70 per cent of global water demand is related to agriculture. At least 20 per cent of the world's aquifers are overexploited, including in important production areas such as the Upper Ganges (India) and California (US).[10] Overall, industrialised farming practices are estimated to cost the environment some US$3 trillion per year.[11]

▪ **Regulation.** Finally, there is a range of broader social issues confronting the food system that could be catalysts for regulatory change. Currently over 2 billion people are overweight or obese. If the prevalence of obesity continues on its current trend, almost half of the world's adult population could be overweight or obese by 2030. As a result, there is an increasing public policy focus on tackling obesity, including the consumption of high-sugar and high-fat food. Sugar taxes have been proposed or implemented in many countries. While the impact varies across geographies, and the taxes are still fairly nascent so it is difficult to understand long-term effects on demand, there are signs that the consequences of sugar taxes could be significant. In Mexico for example, early studies indicate that after the introduction of a 10 per cent sugar tax, annual sales of sodas declined 6 per cent in 2014.[12] There are other important societal pressures on the food system, given that over 60 per cent of people who live in extreme poverty work in agriculture, and there have been calls for increases in minimum wage levels. The system is also heavily affected by resource subsidies, which are an increasing financial strain for many governments. A range of subsidies currently distort food markets, including: US$490 billion of agricultural subsidies; US$35 billion in fishery subsidies and roughly US$455 billion in water subsidies (with agriculture accounting for about 70 per cent of global water demand).[13] The impact on competitive dynamics in the food system of subsidy reform and/or carbon pricing could be dramatic. Analysis by Trucost and McKinsey shows that if the environmental impact of production of food was included, the prices of soft commodities could increase by 50 to 450 per cent.[14]

[9] *Deforestation – Threats*, World Wildlife Fund.

[10] *Food systems and natural resources*, International Resources Panel, June 2016.

[11] *Natural Capital Impacts in Agriculture*, Trucost, 15 October 2015.

[12] *Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study*, BMJ, January 2016.

[13] Information sourced from the OECD and the International Monetary Fund.

[14] *Resource revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

2. A VISION FOR A SUSTAINABLE FOOD AND AGRICULTURE SYSTEM

The SDG agenda proposes to meet these profound challenges by shifting the food system onto a sustainable development pathway. This shift will transform the entire food system, with major impacts throughout the value chain. Mapping these impacts provides a vision for a new, SDG-compatible food system (Exhibit 1).

▪ **Inputs.** The inputs to the agricultural and fisheries sectors will be transformed by the SDGs' emphasis on ending hunger, improving agricultural productivity and adapting to climate change. Whilst traditional fertilisers may face constraints to volume growth, there could be a shift in value towards microbial fertilisers. New breeding techniques will be needed to develop crops appropriate to changing environmental conditions. Aquaculture disease control and feedstock innovation could transform the inputs to protein production.

▪ **Production.** The production area of the value chain will experience some of the largest shifts as the SDGs are implemented. Water, energy and land-intensive products (e.g., beef) will face constrained growth from rising costs caused by reductions in resource subsidies and the pricing of environmental externalities. In their place, less resource-intensive food groups, such as cereals, fish and poultry, will experience faster growth. Forest degradation through unsustainable farming practices will be replaced by more sustainable forest management practices, such as reduced impact logging and agroforestry approaches. There will be shifts towards sustainable agriculture approaches including holistic farming, no-till agriculture and micro-irrigation, as well as increased focus on animal health and welfare. Contract farming and new partnership models with smallholder farmers will become increasingly prevalent and there will be a step change in the application of technology to farming, with increasing utilisation of big data to enable precision farming. The SDGs also call for the ending of overfishing and unregulated fishing, which could further drive the development of aquaculture.

▪ **Food processing.** There will be a shift of value towards low-waste producers given a combination of cost concerns and consumer focus, supported by increasing sustainability reporting requirements for food retailers. Concerted efforts to reduce the impact of non-communicable diseases, including obesity, are an important element of the SDGs and a growing concern for governments and consumers. In response, producers will need to focus on product reformulation to reduce fat and sugar, and improve the nutritional content of processed food.

Exhibit 1

A sustainable development pathway could result in significant shifts in the food and agriculture system

Value Chain Area	Current Value (US$ Billions)	From...	To...
Inputs	520	• Traditional fertilisers • Limited public/private collaboration • Basic cross-breeding • Aqua and land-based feedstocks operating in silos	• Microbial fertilisers • New PPPs focused on adapting technology to local conditions • Precision phenotyping and Bioinformatics • Consideration of sustainability of blended approach of aqua and land
Production	2,175	• Water, energy and land intensive products (e.g., beef) • Forest degradation through unsustainable farming practices • Heavy deforestation products (e.g., unsustainably sourced palm oil) • Arms length dealings with smallholder farmers • Loss making fishing fleets • Limited monitoring of animal welfare • Low water efficiency agriculture • Limited innovation in production • Low data, traditional farming • Farming remote from markets	• Focus on crop and meat selection with lower environmental footprint • Sustainable forestry management (e.g., agroforestry, reduced impact logging) • Sustainable agriculture approaches (e.g., holistic grazing; low till/no till agriculture) • Contract farming and new partnership models • Sustainable fishery models/ aquaculture • Animal health monitoring & diagnostics • Micro-irrigation techniques • Precision agriculture • Big data farming • Urban farming
Food processing	1,377	• High food waste processors • High sugar/fat products • Unfortified food production	• Low food waste processors • Product reformulation, low fat/ sugar products • Food fortification
Logistics	>300	• Limited storage systems • Limted traceability	• Cloud storage systems • Fully traceable product systems
Retail & Disposal	7,180	• Limited consumer differentiation for sustainable products • Low food safety focus • High levels of food waste	• Sustainably sourced and fair trade products • Food safety as business opportunity • Composting and energy capture

Source: International Resource Panel; Anterra Capital; AlphaBeta analysis

▪ **Logistics.** The SDGs aim to reduce food losses along production and supply chains. Logistics will therefore need to change, with the rapid growth of cold storage systems and full traceability of products to address food safety and sustainability concerns of consumers.

▪ **Retail & disposal.** The retail sector will be one of the most transformed areas of the value chain, with opportunities for new markets serving low-income consumers and sustainably sourced products emerging from a niche category to the industry standard. According to Nielsen's Global Health and Wellness Survey – a survey of 30,000 consumers in 60 countries – young people are much more interested in sustainably-sourced food and willing to pay a premium for it. Among consumers under age 20, 41 per cent said they would willingly pay a premium for sustainable products, compared to 21 per cent of Baby Boomers (aged 50 to mid-60s).[15] Consumers are also increasingly concerned with animal treatment, animal-welfare standards and overall farming conditions. At the end of the value chain, traditional waste management will be replaced with improved composting and energy capture processes (e.g., biogas production).

[15] USA Today, 9 Jan 2015.

3. BUSINESS OPPORTUNITIES IN AN SDG-COMPATIBLE WORLD

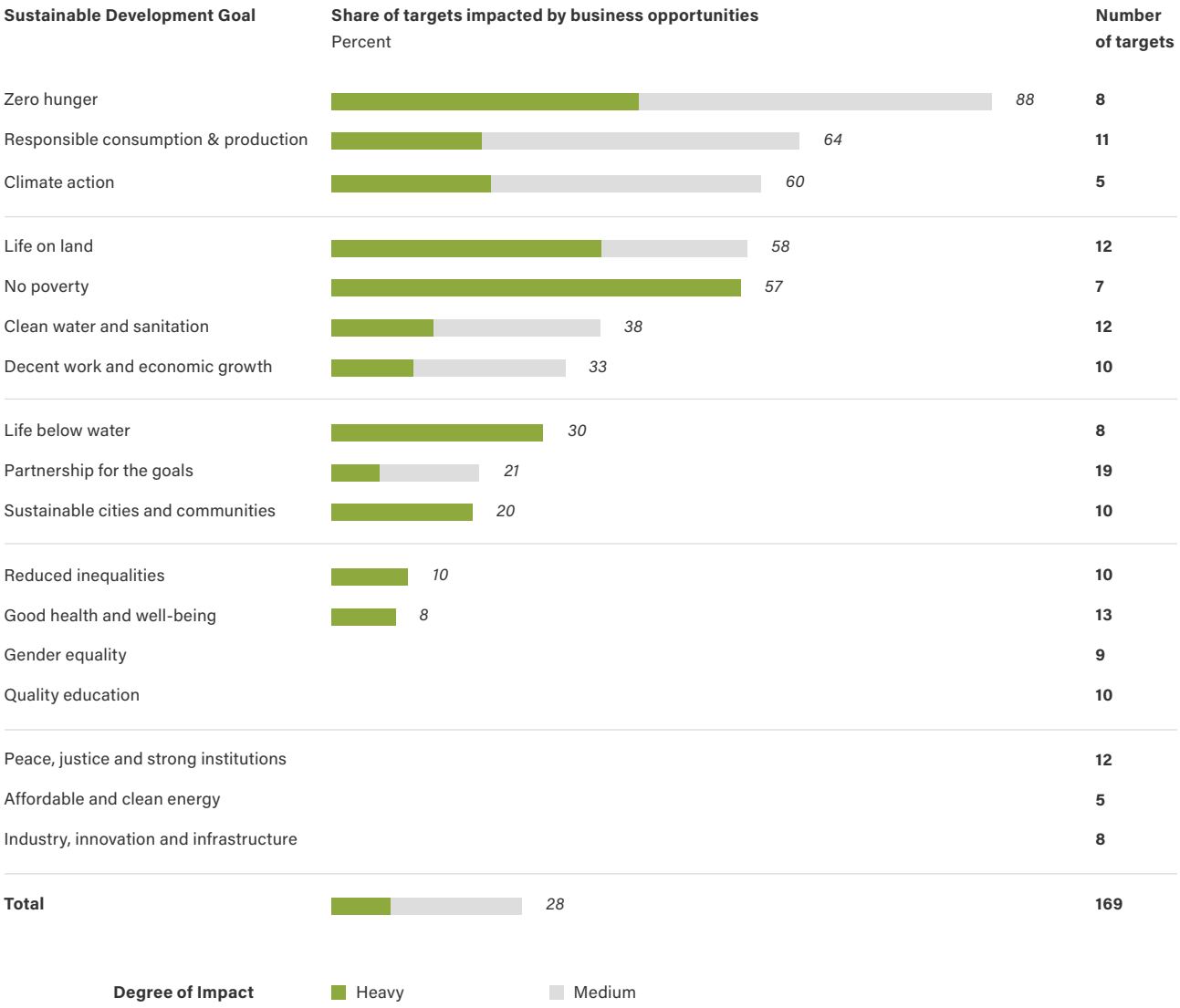
Businesses, for the most part, did not focus on the Millennium Development Goals (MDGs) as they were largely aimed at developing countries. The 17 SDGs are very different however, given they have a truly global focus and are far broader than the MDGs – they aim to fundamentally transform the economic growth model. The MDGs, created in 2000, were eight development objectives to end hunger and poverty, and promote education, health and gender equality by 2015.

If business chooses not to engage with the SDGs, this is likely to lead to two undesirable consequences. Firstly, the costs of global burdens outlined in Chapter 1 will only increase, resulting in less stable and equitable societies, an irreversibly damaged environment and poorer governance. Increased volatility will weaken business conditions and further curtail growth. Secondly, as the private sector resists cooperation to develop a new growth model, governments will be forced to turn to strong regulation to attempt to avert the worse impacts of the challenges we face.

While the private sector cannot afford to ignore the SDGs, it is also true that the world cannot afford the private sector to ignore them. In the food system alone, we find that the private sector can play a crucial role in more than a quarter of the 169 SDG targets (Exhibit 2).

Exhibit 2

The business opportunities in the food and agriculture system impact more than a quarter of SDG targets



Source: AlphaBeta analysis

The SDGs will also reshape the business landscape through three main channels:

▪ **Providing new growth markets.** The SDGs offer a pathway to create new markets or accelerate the growth of existing markets. These include the impact on existing product ranges (e.g., increasing the supply of affordable housing); growth of a new consuming class (e.g., transition of markets below poverty line to reach consuming class level); changing incomes of existing consuming class (e.g., reductions in inequality) and enhancement of existing products to achieve price premium (e.g., healthier food options).

▪ **Production and supply chain improvements.** This relates to shifts in production systems and supply chains that are called for in the SDGs agenda. These include reducing waste (e.g., tackling food waste) and improving productivity (including agricultural yields and water-use efficiency).

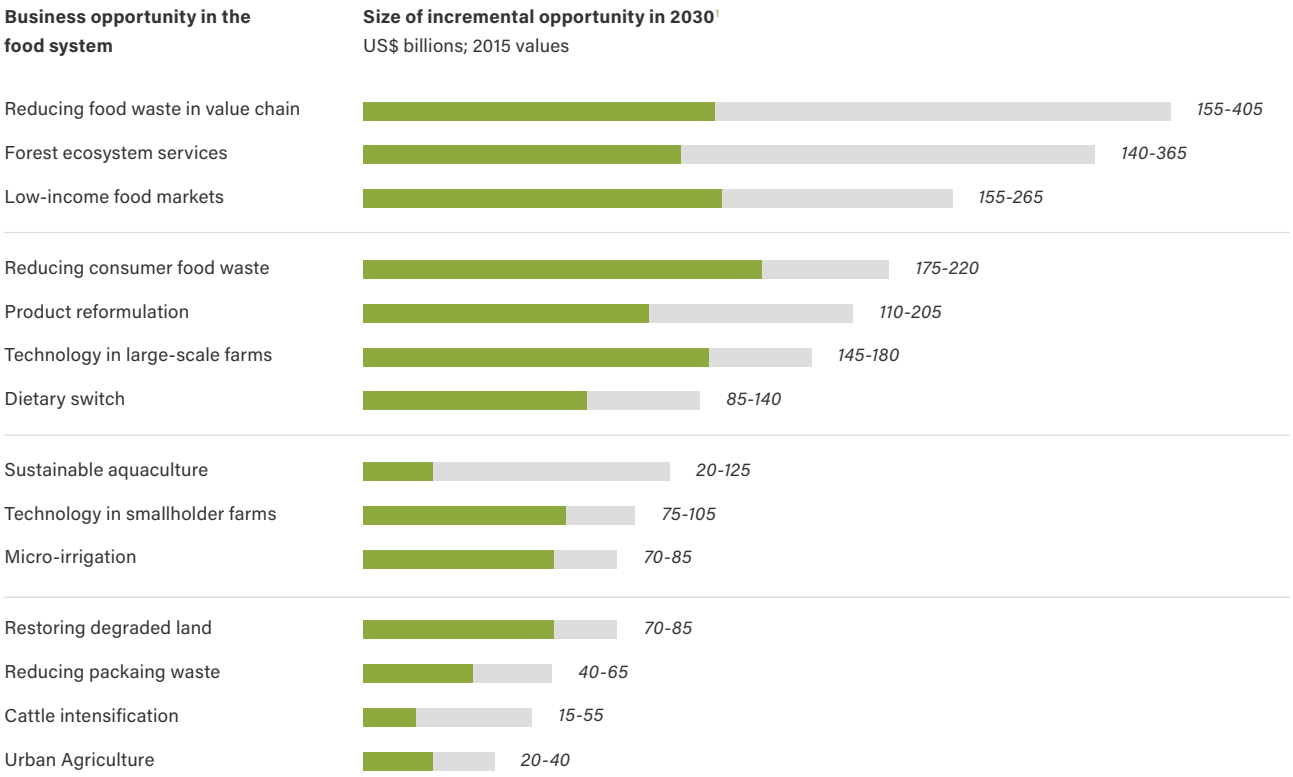
▪ **Initiating regulatory changes.** The SDGs could engender a range of regulatory interventions, which would require business to respond. These include environmental regulation to address greenhouse gas emissions and encourage resource efficiency; measures to protect labour rights and address discrimination in employment; regulation to tackle negative social externalities (e.g., sugar taxes aiming to reduce obesity); and measures aiming to strengthen governance (e.g., tackling corruption, land rights).

The delivery of the SDGs could create specific business opportunities worth over US$2.3 trillion in the food and agriculture system by 2030.

The participation of the private sector in the implementation of the SDGs can also lead to the development of specific business opportunities. Based on an extensive literature scan and deep engagement with experts across the food system, we have identified the 14 largest business opportunities (Exhibit 3, see Box 1 and the Appendix for further details on the methodology).

Exhibit 3

The largest business opportunities in the food and agriculture system could have value of over US$2.3 trillion annually in 2030



Source: Literature search; AlphaBeta analysis

[1] Based on estimated savings or project market sizings in each area. Where available, the range is estimated based on analysis of multiple sources. Rounded to nearest $5 billion.

Box 1. Quantifying the business opportunities related to the SDGs

In the food and agriculture system, the team engaged extensively with industry and academic experts, industry reports and the academic literature to identify and size the major opportunities (worth at least US$25 billion in 2030) for the private sector. Some of the benefits of implementation of the SDGs are diffuse across the economy, such as increased workforce participation through gender equality. We focused instead on concentrated shifts in profit pools, generating specific opportunities for business. The opportunities that we selected are based on existing, commercialised technology, though we note that many important opportunities in the implementation of the SDGs will arise from technologies as yet unknown or embryonic in their development.

The sizing reflects the annual opportunity in 2030 (calculated in 2015 US dollars), rounded to the nearest US$5 billion, based on the estimated savings (e.g., value of land saved from improving smallholder yields) or market size (e.g., size of food market demand by low income consumers who move above extreme poverty line). In each case, we have measured the incremental size of the opportunity in a SDG versus "business-as-usual" (BAU) scenario. For example, the smallholder farm yields opportunity is the additional productivity improvement opportunity from implementation of the SDGs, above that expected in a BAU scenario. The SDG scenarios are based on achieving all relevant SDG targets and a 2-degree climate pathway, but do not build in pricing of carbon or other externalities (except for forest ecosystem services, where carbon pricing is a principal revenue source). The BAU scenarios are derived from existing policies and policy announcements. Where possible, we have used multiple sources for each opportunity to generate a range. The sizings are a "bottom-up" microeconomic perspective and do not take into account interaction and general equilibrium effects.

The major opportunities in the food system include:

▪ **Reducing food waste in the value chain (US$155-405 billion).** Between 20 and 30 per cent of food is wasted somewhere along the value chain, even before allowing for food waste at the point of consumption.[16] The majority of losses in the value chain occur in developing countries, where poor storage facilities and inadequate transport infrastructure mean that a significant share of food is wasted after harvest. Basic technologies, such as plastic storage bags, small metal silos and plastic crates, can have a major impact through improved storage and transportation of food. Pilot efforts in Benin, Cape Verde, India and Rwanda have documented reductions of food loss by more than 60 per cent during field trials of a variety of low-cost storage techniques and handling practices.[17] Of those

[16] *Global food losses and food waste*, FAO, 2011.

[17] *Identification of appropriate postharvest technologies for improving market access and incomes for small horticultural farmers in Sub-Saharan Africa and South Asia. Part 2: Postharvest Loss Assessments*. Lisa Kitinoja and Marita Cantwell, World Food Logistic Organization, 2010.

available techniques, 81 per cent were found to be able to increase the incomes of smallholders by more than 30 per cent. Key barriers relate to capital requirements (particularly for cold storage systems) and the need for significant behavioural change of key actors, particularly smallholder farmers.

▪ **Forest ecosystem services (US$140-365 billion).** Reducing deforestation and forest degradation will be critical to achieving the greenhouse gas abatement needed to avoid the worst impacts of climate change. At present, deforestation and forest degradation account for 17 per cent of global emissions, which is more than the transport sector.[18] The natural capital in forests is closely linked to the resilience of the food system: forests play a critical role in soil management, nutrient cycling and water systems. It is estimated that the production of soy, beef, paper and pulp, and palm oil account for about half of the world's current tropical deforestation. Some companies have already made commitments to eliminating deforestation from their supply chains for agricultural commodities by 2020 through the New York Declaration on Forests.[19] The business opportunity in forest ecosystem services is a combination of sustainable forestry management approaches, combined with payment mechanisms for ecosystem services. The New Climate Economy (NCE) has estimated that reduced deforestation and forest degradation have the potential to achieve carbon abatement of 2.8-7.3 $GtCO_2e$ by 2030.[20] Assuming a carbon price of US$50, which is broadly consistent with that used by many leading companies today, as well as estimates of the required internal rate of return for private sector participants, the total opportunity could be anywhere from US$140-365 billion by 2030.[21] The further development of payment for ecosystem services (PES), including climate change mitigation, watershed services and biodiversity conservation, will be essential for enabling private sector participation in this opportunity, particularly as many sustainable forestry approaches have long payback periods.

▪ **Low-income food markets (US$155-265 billion).** The world's poorest spend as much as 60 per cent of their income on food.[22] Despite this, calorie deficiency and malnourishment persist as populations cannot access or afford enough of the right kinds of food.[23] Populations in Sub-Sharan Africa and South Asia face deficits of 300-500 kCal per day.[24] Consumer goods companies can play a role in addressing this gap by investing in supply chains and food innovation to make available food products that are more nutritious and accessible. If the SDG target of ending extreme poverty is met, an additional 800 million people could emerge as consumers with incomes capable of addressing their food needs.[25] The recognition of this market power by consumer goods companies will be a vital step in meeting the SDG target of ensuring universal access to "safe, nutritious and sufficient" food. Understanding local food demand patterns will be a key

[18] *About REDD+*, UN-REDD Programme, May 2016.

[19] UN Climate Summit New York Declaration on Forest, UNDP, September 2014. New public-private partnerships like the Tropical Forest Alliance (TFA) 2020 haf reducing tropical deforestation associated with the sourcing of commodities.

[20] *Estimates of Emissions Reduction Potential for the 2015 Report: Technical Note,* New Climate Economy, 2015.

[21] This estimate is based only on carbon payments and does not include additional revenues from agroforestry and reduced impact logging. Robust estimates for the potential value of these activities are difficult given available data.

[22] *Global Consumption Database,* The World Bank.

[23] *The state of food insecurity in the world 2015,* FAO, 2015

[24] *Undernourishment around the world 2015,* FAO.

[25] *An Update to the World Bank's estimates of consumption poverty in the developing world,* World Bank, 2012.

barrier to realising value from this consumer pool. For example, populations continue to consume locally popular grains (e.g., rice in Asia) even though more calorie-efficient and cheaper grains (e.g., millets) may be available.[26]

▪ **Reducing consumer food waste (US$175-220 billion).** According to the FAO, total food waste is worth about US$1 trillion today. World Resources Institute (WRI) estimates that roughly 35 per cent of food is wasted at the consumption level.[27] Most of this occurs in developed countries: for example, one third of fruits and vegetables purchased by consumers in North America and Oceania are thrown away, whereas only 5 per cent is wasted in Sub-Saharan Africa.[28] Given the SDG goal of halving consumer waste, this implies an opportunity of around US$175 billion annually at present, which could increase to US$220 billion by 2030 if food demand continues to grow at historical levels.[29] There are a range of technologies and business models that can be harnessed to reduce consumer food waste. These include packaging solutions to avoid spoilage (like BluWrap and ethylene-removal technology); retrofitting dining facilities to switch to trayless dining (smaller plates and trayless dining can nudge customers to waste less in all-you-can-eat settings); better tracking of waste within restaurants and food service; and the promotion of "secondary retailers" who can make products from the still-usable produce.[30] Key barriers include low consumer incentives (given food is a relatively low budget item for consumers in developed countries) and the need for behaviour change amongst consumers, retailers and restauranteurs.

▪ **Product reformulation (US$110-205 billion).** Reformulating meals and processed-food products to rebalance nutritional content is one of the major levers to tackle non-communicable diseases, such as obesity and cardiovascular disease. Product reformulation has been successfully applied to reduce salt intake in the United Kingdom, Australia, New Zealand and Canada, and there is strong evidence for its efficacy.[31] Given the largest beneficiaries are disadvantaged groups in the population, it also plays a role in reducing health inequality. In the UK, product reformulation was estimated to have the potential to save 1,709 thousand of DALYs (Disease Adjusted Life Years) at an average cost of US$2,600 per DALY.[32] Product reformulation could provide food manufacturers with the ability to tap new markets of health-conscious consumers. However, there are barriers to overcome including boosting R&D investment, ensuring consumer acceptance, and adapting manufacturing and supply chain processes. For instance, substitution of sugar for sweetener can impact baking time, shelf-life and other inputs.

▪ **Technology in large scale farms (US$145-180 billion).** Large-scale farms (farms with more than two hectares of land) account for an estimated 70 per cent of global land under cultivation.[33] While large-scale farms have on average double the yields of equivalent smallholder

[26] *The Economic Lives of the Poor,* A.V. Banerjee & E. Duflo, Abdul Latif Jameel Poverty Action Lab MIT, October 2006.

[27] *Reducing food loss and waste,* World Resources Institute and UNEP, June 2013.

[28] *Global food losses and food waste,* FAO, 2011.

[29] *World Agriculture: towards 2030/2050,* FAO, June 2012.

[30] *A roadmap to reduce US food waste by 20 percent,* ReFED, 2016.

[31] *Effectiveness of product reformulation as a strategy to improve population health: Rapid review of the evidence,* National Health Foundation of Australia, 2012.

[32] *How the world could better fight obesity,* McKinsey Global Institute, November 2014.

[33] Note that individual countries apply different definitions for large and small-scale farms. In Brazil, for instance, smallholder farms can be up to 40 hectares.

farms, academic evidence shows there is still the opportunity for a further 40 per cent improvement in their yields over the next 20 years.[34] One of the key strategies is to improve the diffusion of technologies. For example, the Brazilian Agricultural Research Corporation, known as Embrapa, has pioneered more than 9,000 technology projects to develop Brazilian agriculture, including designing tropical strains of the soybean and other crops that can thrive in Brazil's climate.[35] Other applications of technology associated with this opportunity include using big data techniques to optimise crop yield, fitting tractors with global-positioning-systems (GPS) and multispectral sensors (to allow precise application of nitrogen), farm-management software, drone technology and advanced robotics.[36] The critical barriers relate to capital requirements (and gaps in local financial systems) to support investment in precision farming; lack of basic infrastructure connecting farms to markets and the need to manage potential negative impacts on the environment through appropriate use of fertilisers and soil management.

▪ **Dietary switch (US$85-140 billion).** The environmental footprint of vegetarian diets is substantially lower than diets based on animal consumption – less land, water and fertiliser are required. Similarly, the resource intensity of producing beef has been estimated to be ten times larger than a calorie-equivalent amount of poultry and pork: up to 26 times more land, 10 times more water and five times as much GHG and nitrogen emissions.[37] The resource difference is such that the production of meat – and beef in particular – often requires subsidies in order to be viable. While meat production may decline, the shift to less resource-intensive diets could generate considerable growth for the private sector in other areas of agricultural production. Consumer preferences are already starting to change in some developed countries, and may be further pushed by price signals as resource subsidies are removed. Better education of consumers will also be important – there is an information failure related to the benefits of different diets, including the ability of plant-based diets to provide the required amount of nutrients and protein.[38] The Chinese government, for example, has recently issued new dietary guidelines and begun a public education campaign aimed at reducing meat consumption by up to 50 per cent.[39] Capital investment would also be required to increase the productive capacity for cereals and vegetables, and/or pork and poultry. This cost may be able to be offset by increasing land values as pasture land is transformed to crop land.

▪ **Sustainable aquaculture (US$20-125 billion).** High-value aquaculture is a promising source of sustainable nutrition. Overfishing of wild caught fish combined with increasing demand for food mean that aquaculture is a growing industry, projected to almost double in size in the next 15 years.[40] At the same time, aquaculture is a relatively immature practice with large scope for technological improvement. Compared to livestock, the feed,

[34] *Resource Revolution: Meeting the world's energy, materials, food, and water needs,* McKinsey Global Institute, November 2011.

[35] *Agropastoral systems for the tropical savannas of Latin America*, Elcio Perpétuo Guimarães et al.,eds., International Center for Tropical Agriculture (CIAT) and Brazilian Agricultural Research Corporation (Embrapa), 2004.

[36] *The future of agriculture*, The Economist, June 2, 2016.

[37] Eshel, G; Shepon, A; Makov, T; Milo, R; *Land, irrigation, water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States*, Proceedings of the National Academy of Sciences, Vol. 111, No. 33, June 2014.

[38] *Shifting Diets for a Sustainable Future*, World Resources Institute, April 2016.

[39] China's plan to cut meat consumption by 50% cheered by climate campaigners", *The Guardian*, 20 June 2016.

[40] *Fish to 2030: Prospects for Fisheries and Aquaculture*, The World Bank, December 2013.

disease control, waste management and other farming techniques are underdeveloped in aquaculture. The increased productive capacity that will be enabled through technological improvements and improved waste management systems alone implies a US$20 billion supply opportunity. There is also strong potential for growth in the sustainable aquaculture market to accelerate as communities adopt more sustainable diets.

▪ **Technology in smallholder farms (US$75-105 billion).** Some 1.5 billion people are dependent on smallholder farm production (defined as farms with less than two hectares of land). They are still operating at a low-income, subsistence level, and are vulnerable to ongoing environmental risk.[41] Helping these farmers to raise yields is important not only for food production and environmental stewardship (given they account for 30 per cent of cropland), but for tackling rural poverty. The scope for improvement is large. For example, smallholder Indonesian palm oil producers account for one-third of production and achieve yields that are approximately 50 per cent lower than large plantations.[42] Academic evidence shows there is the potential to double current yields – more than on large-scale farms.[43] The range of levers for achieving this yield improvement include extension services, new technology for greater connectivity, improved access to capital (to fund acquisition of necessary equipment), aggregation mechanisms (to achieve economies of scale among smallholders) and better links to markets. A meta-study of smallholder extension services found a median rate of return of 58 per cent, and the available case study evidence demonstrates the large potential impact on total factor productivity (through more capital per worker, better utilisation of fertilisers and improved farming practices).[44]

▪ **Micro-irrigation (US$70-85 billion).** Many farms continue to rely on the outdated technique of flood irrigation to water their crops, whereby water is delivered to the surface of the cropland and allowed to be absorbed by the plants. This sees a large amount of water loss due to evaporation and runoff. Sprinkler and drip irrigation systems deliver a lower amount of water more efficiently. The use of sprinklers can improve yields by 5 to 20 per cent and reduce the water required by 15 per cent. Drip irrigation is even more effective, improving yields by 15 to 30 per cent while reducing the water required by 20 to 60 per cent. Together, these levers have the potential to save net withdrawals of 250 billion to 300 billion cubic meters of water in 2030.[45] Barriers include capital requirements, lack of information about benefits of irrigation techniques and high subsidies for water in many countries.

▪ **Restoring degraded land (US$70-85 billion).** Land degradation can be physical (such as soil erosion), chemical (e.g., leaching, salinization) or biological (through loss of vegetation and deforestation).[46] The FAO found that 33 per cent of land globally is moderately or highly degraded.[47] Each

[41] "Science review: SR25, A future for small-scale farming," Julian Quan, Foresight Project on Global Food and Farming Futures, 2011.

[42] *Indonesia Country Appraisal: Opportunities for UK support to Forestry and Climate Change*, D. Elsom, Unpublished consultancy report for DfID, 2011.

[43] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

[44] *A Meta-Analysis of Rates of Return to Agricultural R&D: Ex Pede Herculem?*, Julian M. Alston, Connie Chan-Kang, Michele C. Marra, Philip G. Pardey, TJ Wyatt, International Food Policy Research Institute, 2000.

[45] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

[46] *The investment case for ecological farming (white paper)*, Paul McMahon, SLM Partners, January 2016.

[47] *Status of the World's Soil Resources*, FAO, 2015.

year about 12 million more hectares are degraded. Research indicates that soil degradation could reduce the yield of soils currently in agricultural production by about 30 per cent by 2050.[48] The net rates at which land degradation is occurring can be reduced either by preventing ongoing degradation through more conservational farming practices, such as no-till agriculture, or restoring degraded land through such practices as terracing and the replacement of topsoil. This can have short-term productivity costs, but the academic evidence suggests that over the longer-term (5-10 years), yields are likely to increase and could come close to or reach conventional tillage yields. Moreover, when practiced together with residue retention and crop rotation activities in the context of conservation agriculture, there could be further improvements in land productivity.[49] In some cases rural incomes have more than doubled after implementation of land rehabilitation programmes. Key challenges include the capital-intensive nature of the process (particularly for severely degraded land), lack of clear land ownership, and the need for significant behaviour change and capability building among smallholder farmers to adopt practices such as no-till or low-till agriculture.

▪ **Reducing packaging waste (US$40-65 billion).** Over 95 per cent of the economic value of plastic packaging is lost, with only 15 per cent of produced material collected for recycling, and a recycling value yield of only 30 per cent. The plastic packaging economy is meanwhile expected to double in value by 2030.[50] With a third of produced plastic lost to pollution in ocean and land ecosystems, and just under half placed in landfills, there are ample opportunities to increase the amount of material that is recycled. Recovering the amount currently lost to landfills and pollution will require a major change in consumer behaviour. Public policy and business initiatives will need to cooperate to identify the most effective means to change recycling habits. Success in improving recycling rates in other resources suggests there is good reason to believe improvement is achievable – for example, over 60 per cent of the value of paper is captured through recycling.[51]

▪ **Cattle intensification (US$15-55 billion).** Around 70 per cent of the grains used by developed countries are fed to animals. Overall, livestock consume an estimated one-third or more of the world's cereal grain, with 40 per cent of such feed going to ruminants, mainly cattle.[52] There are opportunities to improve productivity and reduce the impact of cattle on forests through control of transmissible diseases, adopting smart supplements (the productivity of ruminant animals can often be boosted with supplements, some of which encourage microbes in the rumen to grow quickly and to provide better nutrition) and selection of marginal areas (e.g., mountainsides or low-lying wet grasslands) for grazing.[53] Experts suggest that there is an opportunity for a 15-20 per cent feed efficiency improvement through feed additives and improved practice.[54] Academic

[48] "Peak Soil" Threatens Future Global Food Security', *Reuters*, 17 Jul 2015.

[49] "When does no-till yield more? A global meta-analysis", Cameron M. Pittelkowa, Bruce A. Linquist, Mark E. Lundy, Xinqiang Liang, Kees Jan van Groenigen, Juhwan Lee, Natasja van Gestel, Johan Six, Rodney T. Ventereae and Chris van Kessel, *Field Crops Research*, Vol. 183, November 2015.

[50] *The New Plastics Economy: Rethinking the future of plastics*, Ellen Macarthur Foundation, January 2016.

[51] *The New Plastics Economy: Rethinking the future of plastics*, Ellen Macarthur Foundation, January 2016.

[52] *Food and Agriculture Organization of the United Nations World Agriculture: Towards 2015/2030*, FAO, 2002.

[53] "Agriculture: Steps to sustainable livestock", Mark C Eisler et al., *Nature*, Vol 507, 5 March, 2014.

[54] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

evidence also suggests that cattle stock intensification leads to reduced deforestation. For example, between 1996 and 2006, the productivity of cattle grew by 57.5 per cent in the average Amazon municipality, and this was associated with reduced deforestation.[55] Continued research to support innovation in feed additives and disease control will be essential to support this opportunity.

▪ **Urban agriculture (US$20-40 billion).** An estimated 800 million people grow food in urban and peri-urban environments, both for their subsistence and as a supplementary source of income.[56] Urban agriculture improves the food security of the urban poor by increasing the supply of food to growing urban populations and lowering costs due to reduced transportation and storage. In addition to catering to growing demand, urban agriculture also increases resource efficiency, improves the economic independence of women and may help to mitigate climate change.[57] The vast majority of urban agriculture currently occurs at small scale and yields are low. By connecting urban farmers to regional supply chains and offering training and better equipment, productivity could be significantly increased. For example, in recent years several cities in Latin America have been successful at improving the incomes of households which are involved in urban agriculture by facilitating the growth of networks and businesses which provide productivity-enhancing services.[58]

What is not on this list? Some opportunities may have long-term impact, but minimal impact by 2030. For example, second generation biofuels, also known as advanced biofuels, are fuels that can be manufactured from various types of biomass (i.e., any source of organic carbon that is renewed rapidly as part of the carbon cycle). Second generation biofuels are not yet produced commercially, but a considerable number of pilot and demonstration plants have been announced or set up in recent years, with research activities taking place mainly in North America, Europe and a few emerging countries (e.g., Brazil, China, India and Thailand). The International Energy Agency (IEA) has estimated that second generation biofuels could account for 90 per cent of biofuels by 2050, but uptake before 2030 is likely to be low.[59]

Pricing of externalities could increase the value of opportunities

Our sizing of opportunities is based on current prices (except for forest ecosystem services, which includes carbon pricing). However, these largely do not reflect the cost of a range of externalities, in particular GHG emissions, and they include various subsidised and unpriced resources, including water, fossil fuels and food. The value of these resource subsidies globally is estimated to be over US$1 trillion annually.[60] To understand the impact of removing subsidies and properly pricing resources, we repriced

[55] *The conservation versus production trade-off: does livestock intensification increase deforestation? Evidence from the Brazilian Amazon*, Petterson Molina Vale, Grantham Research Institute on Climate Change and the Environment, Working Paper No.174, December 2014.

[56] *Urban Agriculture*, FAO, 2016.

[57] *Urban Agriculture*, FAO, 2016; Women Feeding Cities, Practical Action Publishing, 2009; Integrating Urban Agriculture into climate action plans: Lessons from Sri Lanka and Argentina, RUAF Foundation, January 2015.

[58] *Growing Greener Cities in Latin America and the Caribbean*, FAO, 2014.

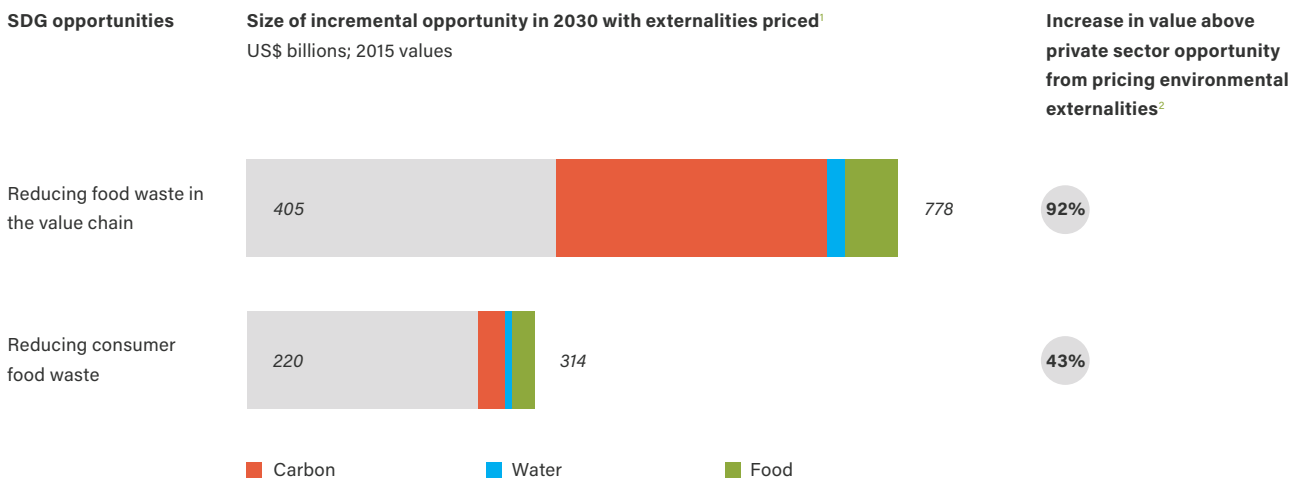
[59] *Sustainable production of second generation biofuels*, IEA, February 2010.

[60] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

a subset of our top opportunities for three factors for which reliable data is available: carbon, water and food. This increases the overall value of opportunities by over 90 per cent in the case of some opportunities such as the reduction of food waste in the value chain (Exhibit 4).

Exhibit 4

Pricing externalities could add more than 90 per cent to the value of some of the food opportunities



Source: Literature search; AlphaBeta analysis

1 Based on estimated savings or projected market sizings in each area. Only the high case opportunity is shown here.

2 Externality sizing assumptions: carbon price of US$50 tCO_2e; average water price increased by US$0.08 for agricultural water and $0.40 for industrial use (based on removal of subsidies); food prices increased by US$44/t due to removal of subsidies. Rounded to nearest US$5 billion.

Unlike the Millennium Development Goals, the potential impact of the SDGs is truly global

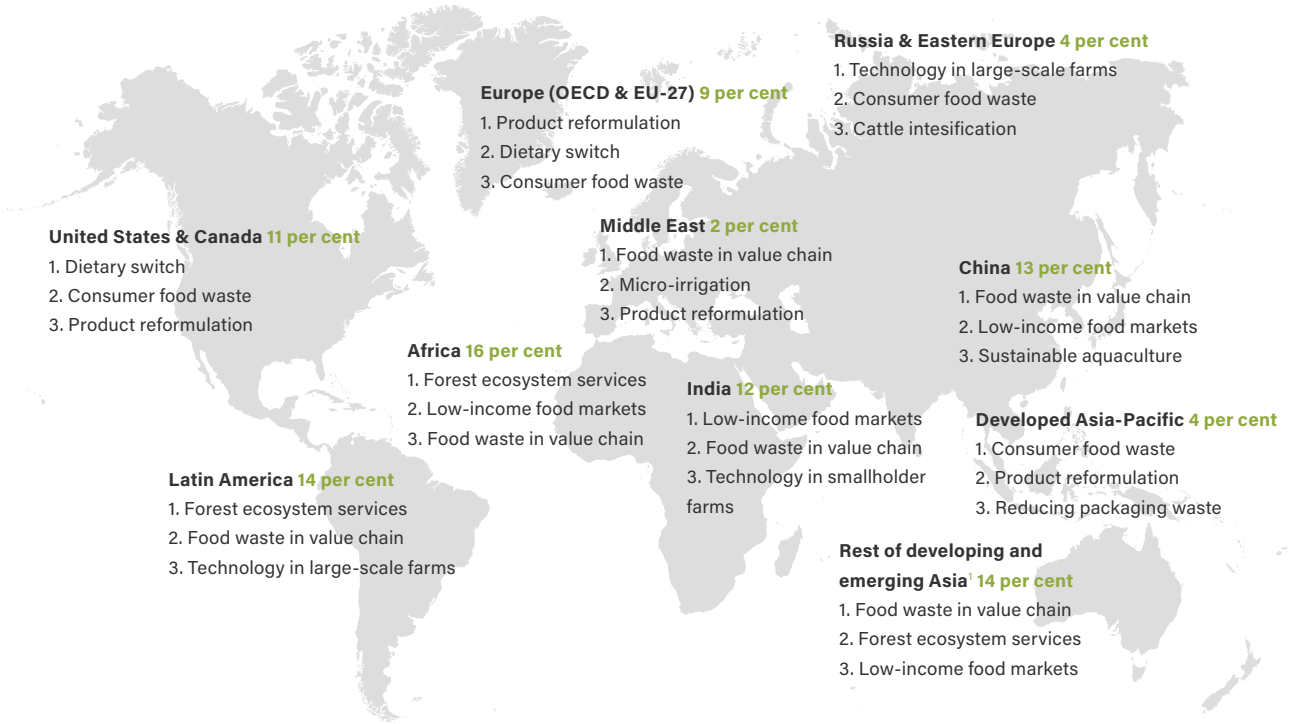
More than two-thirds of the identified opportunities are concentrated in developing countries, reflecting the large share of arable land in these countries, the high future consumption growth and the large potential upside in efficiency gains (Exhibit 5). The importance of individual opportunities also varies by region, with stark differences between developed and developing countries. In developing Asia, the largest opportunity is related to reducing food waste in the value chain. In developed Asia, the largest opportunity is in reducing end consumer waste, reflecting the higher incomes and greater food consumption and wastage in these markets. Low-income food markets is the largest opportunity in India. Forest ecosystem services is most significant in Latin America and Africa, given their large share of the world's tropical forests.

Exhibit 5

The main SDG business opportunities in food and agriculture vary somewhat by region

Top business operations by region

Share of value of SDG business opportunities in food by region; Percent



Source: Literature search; AlphaBeta analysis

[1] Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Lao PDR), and North Korea.

4. BENEFITS OF A MORE SUSTAINABLE FOOD AND AGRICULTURE SYSTEM

The realisation of these business opportunities in the food system could also help deliver a wide range of societal benefits, including job creation and benefits to food security, poverty alleviation, waste, and health outcomes.

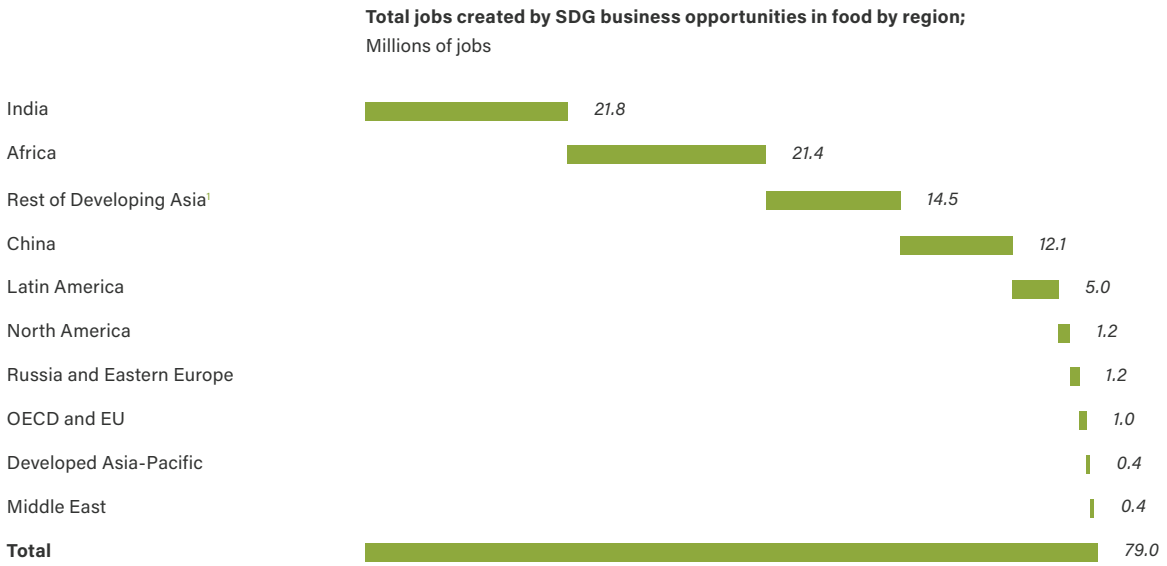
These business opportunities could also create almost 80 million jobs

The SDG opportunities could make a substantial contribution to job creation over the next 15 years. We estimate that the 14 opportunities could collectively generate almost 80 million new jobs by 2030, which is around 2 per cent of the forecasted size of the labour force in 2030.[61] For some opportunities, such as improving technology in large-scale farms, this additional employment will be primarily associated with the investment needed. Other opportunities will create jobs through the ongoing operation of new businesses and value chains. The development of low-income food markets, for example, will lead to increased employment in food processing, distribution and retail trade, and potentially some growth in agricultural workforces. The job creation potential of the SDG business opportunities is primarily located in the developing world (Exhibit 6). That includes roughly 15 million jobs in developing Asia, 21 million jobs in Africa and 22 million jobs in India. Given substitution effects, not all of these jobs will translate to net increases in employment.

[61] *The world at work: Jobs, pay and skills for 3.5 billion people*, McKinsey Global Institute, June 2012.

Exhibit 6

Almost 80 million jobs could be created by SDG business opportunities in food and agriculture



Source: Literature search; AlphaBeta analysis

[1] Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Laos), and North Korea.

The business opportunities could also create benefits to food security, poverty alleviation, environmental concerns and health outcomes

Beyond the direct job creation impact, these SDG-related opportunities in food could provide a host of additional societal benefits (Exhibit 7).

Exhibit 7

Business opportunities in food could also deliver a range of societal outcomes, linked to the SDGs

Challenge	Business opportunities	Relevant SDGs	Societal outcomes
Food security	• Sustainable aquaculture • Low-income food markets • Technology in large scale farms • Urban agriculture		• Ensure food security • Reduced malnutrition impacting over **800 million** people that are hungry
Poverty alleviation	• Technology in smallholder farms • Restoring degraded land		• Potential to **double** incomes of **1.5 billion** smallholder farmers
Addressing climate change	• Dietary switch • Cattle intensification • Forest ecosystem services		• Reduction in the **24%** of GHG emissions that come directly from food production • Potential to mitigate total emissions by up to **10%** by 2030 through improved forestry management
Reducing waste	• Micro-irrigation • Reducing food waste in the value chain • Reducing consumer food waste • Reducing packaging waste • Dietary switch • Restoring degraded land		• Agricultural water consumption falling by **15%** • **Halving** of consumer food waste • Reduction of food wasted in the supply chain • Plastic waste reduced in the oceans • **Zero** further degradation of cropland
Better health & well-being	• Product reformulation • Dietary switch • Low-income food markets		• Global obesity in 2030 falls from projected 41% of population to Japanese levels (5%), implying over **3 billion** less people that are obese • Reduction in child mortality, **45%** of which is attributable to poor nutrition

Source:McKinsey Global Institute; FAO; WHO; Ellen MacArthur Foundation; The Lancet; Team analysis

These include:

▪ **Food security:** Improved technology in large-holder farms would substantially increase agricultural yields and productivity, helping to better feed over 800 million people who are hungry. Growth of sustainable aquaculture could also support food security by expanding the supply of efficient, affordable protein in developing countries. Adequacy of food supply, however, is only one element of the food security challenge. Distribution is also critical to ensure safe and affordable food is available to all people all the time. Stronger private sector participation in low-income food markets could enhance distribution systems and better ensure access for the poor.

▪ **Poverty alleviation:** The world's 1.5 billion smallholder farmers have the highest incidence of poverty amongst all sectors of the global economy. Better technology in smallholder farming through aggregation, extension services, access to capital and other levers could increase yields and productivity, which would lower poverty rates. While smallholder farmers only account for a relatively small share of global agricultural output, in some developing countries they contribute up to 90 per cent of agricultural production and over half of all employment.[62] Improving their livelihoods would make a major contribution to poverty reduction efforts worldwide.

▪ **Addressing climate change:** A number of opportunities could reduce the impact of the food system on greenhouse gas emissions and hence climate change. Dietary switch to vegetarian diets or pork and poultry, because of their lower carbon intensity, could lower emissions by a factor of six. Intensification of cattle production could reduce land demands and associated deforestation. Halting all deforestation and reversing forest degradation could mitigate up to 10 per cent of total emissions globally by 2030.[63]

▪ **Reducing waste:** More sustainable and efficient use of resources will be critical to meeting growing food demand. Food waste in both the supply chain and at the consumer level – which amounts to about 24 per cent of all calories produced for human consumption – could be reduced by up to 50 per cent.[64] Use of micro-irrigation techniques could lead to savings of 15 per cent in agricultural water consumption. The food packaging system is also a major source of waste and resource inefficiency. The move to a more circular model could significantly decrease landfill waste and ocean pollution. Restoration of degraded land would also lessen waste and inefficiency in land usage, and prevent deforestation by increasing the supply of quality land for agriculture.

▪ **Better health and well-being:** Obesity is estimated to have a global social cost of over US$2 trillion at present.[65] Product reformulation – and other levers – have the potential to lower obesity levels in 2030 from

[62] *Sub-Saharan Africa: The state of smallholders in agriculture*, Geoffrey Livingston, Steven Schonberger and Sara Delaney, International Fund for Agricultural Development, January 2011.

[63] *Estimates of Emissions Reduction Potential for the 2015 Report: Technical Note*, New Climate Economy, 2015.

[64] *Reducing food loss and waste*, World Resources Institute and UNEP, June 2013.

[65] *How the world could better fight obesity*, McKinsey Global Institute, November 2014.

projected 41 per cent of global population to around 5 per cent, the level in Japan. Reduced malnutrition and undernutrition through improved food security would have significant benefits for health and well-being – poor nutrition is responsible for 45 per cent of deaths in children under five.[66]

[66] "Maternal and Child Nutrition", *The Lancet*, Vol 382, August 2013.

5. MAKING IT HAPPEN

Making this happen will require a new approach from business, and development of new business models. In many cases, insurgents enjoy the advantage of being able to start with a clean sheet, whereas incumbents may be less free to take risks with their brands and capital. Yet there is also a growing number of "radical incumbents" who are learning how to be as agile and innovative as their new "attackers."

Given the transformative nature of the change required across the global economy, substantial investment will be needed to capture the SDG opportunities in food. We estimate the total annual investment required for the 14 major opportunities identified in the food system to be roughly US$320 billion (Exhibit 8). It is useful to compare the investment requirements to the current assets under management of investment funds focussed on ecological and regenerative agriculture and food systems. Currently these funds have just over US$500 million in assets under management.[67] Even if we consider broader agricultural funds, the capital base of the 31 leading funds amounts to just under US$4 billion.[68] While large, this is less than 1.5 per cent of the annual investment requirements.

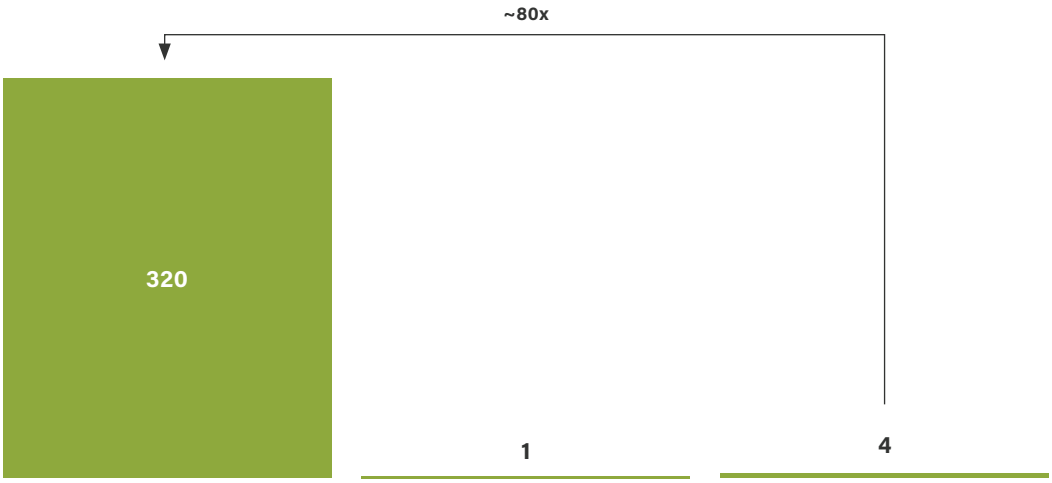
[67] *The investment case for ecological farming (white paper)*, Paul McMahon, SLM Partners, January 2016.

[68] *Agricultural investment funds for developing countries*, FAO, 2010.

Exhibit 8

The capital requirements to support the identified SDG opportunities in food are significantly larger than current funds in this area

US$ billions; 2015 values[1]



Source: AlphaBeta analysis

[1] Based on estimated investment requirements to capture SDG opportunities in the food system. Rounded to nearest US$5 billion.

[2] Capital base of investment funds focussed on ecological and regenerative agriculture and food systems.

[3] Capital base of the 31 leading agriculture investment funds, according to FAO.

Capital is not the only challenge. Several other levers will be important for the private sector in unlocking these business opportunities:

- **Engaging with public policy.** Action by governments will be critical to fully capturing the value of many of the SDG opportunities, and business needs to engage to ensure the requisite policy tools are in place. These include regulatory frameworks, such as measures to catalyse investment, infrastructure, pricing of social and environmental externalities, and land titling. UN-Habitat estimates that 70 per cent of land in developing countries is unregistered, which discourages investment and reduces access to finance.[69]

- **Product innovation.** Businesses will need to understand potential opportunities emerging from the SDG areas in their sector and how to

[69] *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

better partner with government (and particularly research agencies) on developing new solutions. This is particularly important in areas such as product reformulation and improving seed quality.

▪ **Driving sustainability through supply chains.** Companies will need to rethink supply chain management, with greater focus on transparency, partnering with local producers and driving efficiency gains. For example, partnering with local producers will be particularly crucial in agriculture (with smallholder farmers) in order to raise productivity. Companies will also need to apply the same discipline to resource efficiency as they did in the past to labour. CPG manufacturers have been able to achieve savings of up to 50 per cent on their energy and water costs by pulling productivity levers with payback after less than three years.[70]

▪ **Internalising social and environmental costs.** While governments have for the most part made limited progress in reforming tax systems to price environmental and social costs (and benefits) accurately, the most progressive companies are forging ahead with internal "shadow pricing" to increase the value on positive social and environmental outcomes. The Carbon Pricing Leadership Initiative, which brings together public, private and social sectors to build momentum for carbon pricing, reports that over 1,000 companies globally are already disclosing their current or intended internal carbon pricing.[71] There is also increasing pressure from investors for businesses to disclose their environmental impacts, through mechanisms such as the CDP (formerly the Carbon Disclosure Project). Incorporating social costs in economic activities could help stimulate incentives for change. As shown in Chapter 3, pricing some of the externalities associated with these food opportunities can significantly raise their value.

▪ **Educating consumers.** While insurgents must build brands, incumbents have them to start with – and can ally them with sustainability to capture market share. Consumer preferences on sustainability are changing fast: in 2015, 66 per cent of consumers in 14 countries were willing to pay more for sustainable products, compared to 50 per cent in 2013 – and incumbents can be better placed to serve them.[72] In many areas, businesses will need to educate consumers around new SDG-related business models. For example, tackling consumer waste requires educating people about the relevance of these issues, particularly when price signals are often insufficient to drive change in many developed markets.

▪ **Turning Public-Private Partnerships into real business opportunities.** Partnerships have already yielded combined social benefit and private sector opportunity in many contexts: consider for instance the Global Alliance on Vaccines and Immunisation (GAVI), which has, since 2000, vaccinated half a billion children, saved 7 million lives and achieved US$80-100 billion in economic benefits. The challenge for business is how to

[70] *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

[71] "CPLC highlights internal carbon pricing at 'Pathways to Impact' Conference", Carbon Pricing Leadership Coalition, 8 July 2016.

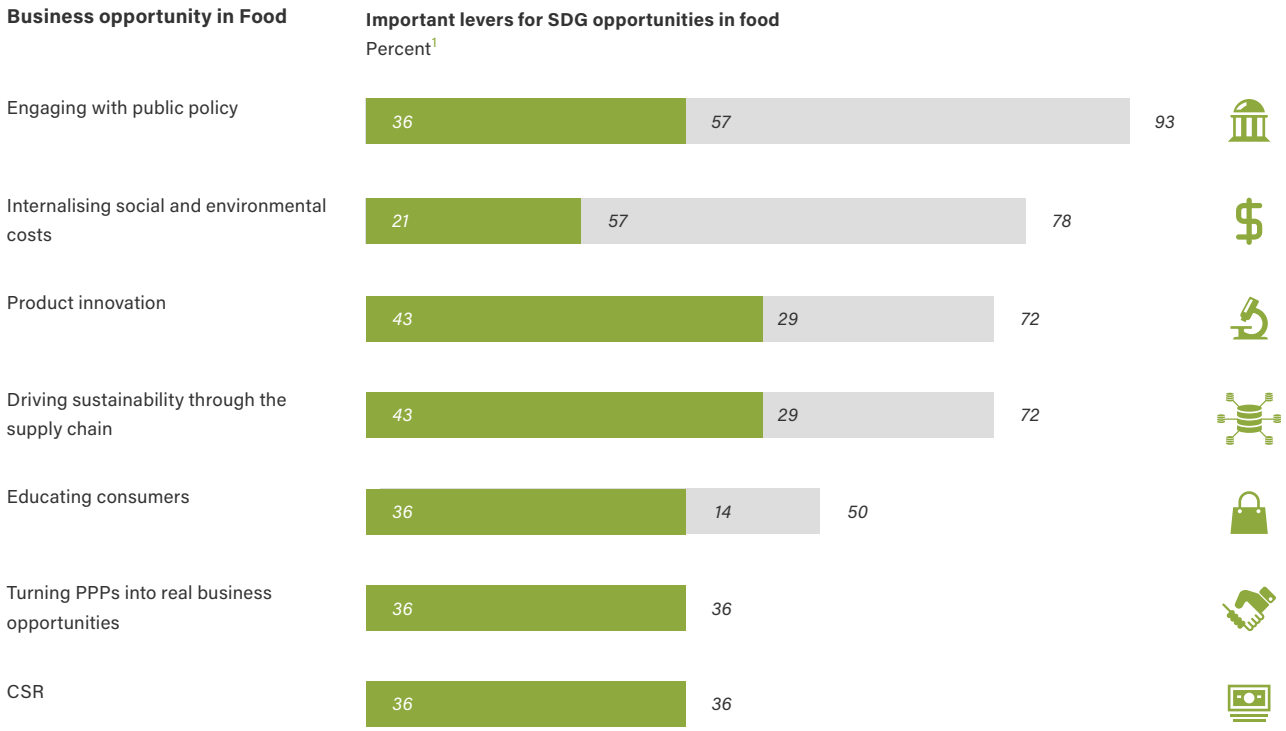
[72] *Global Sustainability Report*, Nielsen, October 2015.

identify areas where a PPP would make sense (and not make sense), and ensure that the PPP is designed appropriately to capture the opportunity.

So which levers are most important? Assessed against the 14 business opportunities from an SDG-compatible world identified in the food system, we find the most important levers are around engaging with public policy and internalising social and environmental costs (Exhibit 9). Product innovation and driving sustainability through the supply chain are also critical. What is also interesting is what doesn't matter – CSR is generally a side issue to achieving the main business opportunities identified.

Exhibit 9

Engaging public policy and product innovation are the most important levers for business in the food system



Source: AlphaBeta analysis

[1] Refers to the percentage of SDG-related business opportunities identified in the food system where this lever could have either a medium or large impact on the likelihood of successful implementation of the opportunity.

This report is part of a larger body of research that quantifies the value of business opportunities across four key systems – food, cities, energy and materials, and health and well-being.The findings for these systems will be revealed in the Business Commission's flagship report, to be launched in January 2017. In addition to revealing the economic value of the remaining three key systems (health and well-being; cities and mobility; and energy and materials), the Business Commission will make recommendations for how the private sector can move beyond incremental change to realise the transformations necessary to achieve sustainable development.

APPENDIX A: METHODOLOGY FOR SIZING BUSINESS OPPORTUNITIES IN FOOD AND AGRICULTURE

The value of each opportunity is calculated as the difference between an estimate of the business-as-wusual scenario (BAU) in 2030 and the SDG scenario in 2030 (SDG). The dollar amount therefore represents the incremental annual value in 2030, and is expressed in 2015 US dollars. In some instances, we use multiple methods of estimation to inform our range.

Reducing food waste in value chain (US$155-405 billion)

Description	Sizing Assumptions	Sources
Reduction in supply chain food waste, including post-harvest	**BAU:** FAO estimates US$1 trillion worth of food wasted globally at present. Applying growth rate of demand for food (1.5%) implies US$1.25 trillion worth of food wasted globally in 2030. WRI estimates that 65% of waste occurs in the value chain. **SDG:** WRI estimates that food waste is reduced by 50%, in keeping with SDG targets. Alternate estimate by MGI is used to form our estimated range.	*Seeking an end to loss and waste of food*, AO Food Loss (2011) *Reducing Food Loss and Waste*, World Resources Institute, 2013 *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011

Forest ecosystem services (US$140-365 billion)

Description	Sizing Assumptions	Sources
Reduced deforestation and forest degradation	**BAU:** Emissions from deforestation and forest degradation continue based on IPCC and UNEP forecasts. **SDG:** NCE estimate that halting deforestation and restoring 350 hectares of degraded forests will lead to annual GHG mitigation of 2.8-7.3 $GtCO_2e$ by 2030. Assume a carbon price of US$50 tCO_2e, which is broadly consistent with that used by many leading companies today, as well as estimates of the required internal rate of return for private sector participants.	*Estimates of Emissions Reduction Potential for the 2015 Report: Technical Note*, New Climate Economy, 2015

Low income food markets (US$155-265 billion)

Description	Sizing Assumptions	Sources
Development of better products and distribution systems to meet food demand of low-income consumers	**BAU:** 800 million people living in extreme poverty, with an average income of $1 a day. 35-60% of total income is spent on food. **SDG:** The average income of those living in extreme poverty increases to US$2.50 a day, leading to aggregate increase in their income of US$438 billion per year. Their spending on food remains at the same proportion of their income as they reduce their calorie deficiency and improve their nutritional intake.	*The Bottom of the Pyramid Strategy for Reducing Poverty*, UN Department of Economic and Social Affairs, 2009

Reducing consumer food waste (US$175-220 billion)

Description	Sizing Assumptions	Sources
Reduction in food thrown out at the consumption level by 50%	**BAU:** FAO estimates US$1 trillion worth of food wasted globally at present. Applying growth rate of demand for food (1.5%) implies US$1.00-1.25 trillion worth of food wasted globally in 2030. WRI estimates 35% of waste occurs at consumption. **SDG:** WRI estimates that food waste is reduced by 50%, in keeping with SDG targets.	*Seeking an end to loss and waste of food,* FAO, 2011 *Reducing Food Loss and Waste*, World Resources Institute, 2013

Product reformulation (US$110-205 billion)

Description	Sizing Assumptions	Sources
Decreasing incidence of obesity by amending composition of foods to be healthier (e.g. sugar free varieties)	*Method 1* BAU: No product reformulation interventions. SDG: MGI estimates that in the UK the most cost-effective product reformulation strategy will save 1.7 million Disease Adjusted Life Years and require spending of US$4.4 billion. This is scaled to a global opportunity with reference to UK's share of global spending to combat obesity. A global economic growth rate of 3.2% to 2030 is then applied. *Method 2* BAU: The reformulated food market, estimated by SAM to be worth US$60 billion in 2009, grows at the lower end of the estimated 3-6% rate range, implying a US$112 billion value in 2030. SDG: The market is worth US$204 billion, growing at the higher end of SAM's estimated range at 6%.	*Overcoming obesity: An initial economic analysis*, McKinsey Global Institute, November 2014 *Healthy Living: Obesity - A Heavy Burden*, Sustainable Asset Management AG, 2012

Technology in large scale farms (US$145-180 billion)

Description	Sizing Assumptions	Sources
Improving yields on large-scale farms (more than 2 hectares) by adopting new technology and farming practices	**BAU:** Yields grow at current rates. **SDG:** MGI estimates intervention will lead to yield improvements over base-case of 15% in developed countries, and 50% in developing countries. Producing the same amount of food will therefore require between 150 million and 180 million fewer hectares.	*Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011

Dietary switch (US$85-140 billion)

Description	Sizing Assumptions	Sources
Reducing the global consumption of beef with a shift toward pork/poultry products, or substituting meat entirely with vegetarian diets, to reduce resource intensity of food production	*Method 1 - Shift to pork & poultry* **BAU:** 2030 consumption pattern remains at 2009 distribution. **SDG:** WRI assumes that consumption of beef is reduced by 30% in regions where beef consumption is currently above the global average, substituting pork and poultry products instead. Assume 170 million hectares of pastureland is saved as a result, valued at US$500-740 per hectare. *Method 2 - Shift to vegetarian diet* **BAU:** 2030 consumption patterns remain at 2009 distribution. **SDG:** WRI models a scenario where 50% of the North American and European population shifts to a vegetarian diet. Assuming a reduction in demand for pastureland (valued at US$500-740 per hectare) by 113 million hectares, and for cropland (valued at US$1,250 per hectare) by 37 million hectares.	*Shifting Diets to a Sustainable Future*, World Resources Institute, 2016.

Sustainable aquaculture (US$20-125 billion)

Description	Sizing Assumptions	Sources
Increase in use of aquaculture to satisfy food demand	**BAU:** Aquaculture meets a baseline demand of 93.6 million tons. **SDG:** We assume a growth in demand of between 10- 30%. Lower end of range assumes improvements in aquaculture practices (e.g. waste management). Higher end of range assumes an increase in consumer demand for higher value aquaculture (mainly from China).	*Fish to 2030: Prospects for Fisheries and Aquaculture*, The World Bank Group, 2013

Technology in smallholder farms (US$75-105 billion)

Description	Sizing Assumptions	Sources
Improving yields on smallholder farms (less than 2 hectares)	**BAU:** Yields grow at current rates. **SDG:** MGI estimates intervention will lead to yield improvements over base-case of 15% in developed countries and 50% in developing countries. Producing the same amount of food will therefore require between 75 million and 105 million fewer hectares of land.	*Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011

Micro-irrigation (US$70-85 billion)

Description	Sizing Assumptions	Sources
Adoption of more efficient irrigation techniques (sprinkler and drip irrigation systems, instead of flood irrigation)	**BAU:** Yields and the rate of adoption increase at current levels. **SDG:** In sprinkler irrigation systems, MGI assumes a yield improvement of 15%, with a 10% increase in adoption over base case. With regard to drip irrigation systems, MGI assumes a yield improvement of 45%, with a 10-20% increase in adoption over base case. These lead to water savings in a range of 250-300 cubic kilometres, as well as energy savings and higher food production.	*Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011

Restoring degraded land (US$70-85 billion)

Description	Sizing Assumptions	Sources
Reducing the degradation of land and restoring land that is already degraded	*Method 1* **BAU:** 10% of cropland degradation is prevented, with no restoration of previously degraded land. **SDG:** MGI estimates that 45% of cropland degradation is prevented. MGI estimates it is possible to restore 80% of land suffering low to moderate levels of degradation and 60% in the case of severe to very severe degradation. *Method 2* **BAU:** No change to rate of degradation or recovery of value. **SDG:** We assume that the value currently lost to degradation is recaptured. 33% of global agricultural land is currently degraded (with a further 12 million hectares being degraded each year to 2030), at an economic cost of US $125 per hectare.	*Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011 *Status of the World's Soil Resources*, FAO, 2015. *Living with the Earth, Third Edition: Concepts in Environmental Health Science*, Gary Moore, CRC Press, Google books, 2007.

Reducing packaging waste (US$40-65 billion)

Description	Sizing Assumptions	Sources
Increased recycling of plastic food and beverage packaging	**BAU:** The market for packaging plastics in 2030 grows to $170-250 billion. The proportion of value recaptured through recycling remains at the current 5%. **SDG:** The value captured by recycling is grown to 30%. This increase in value capture is composed of an increase in amount captured for recycling from 15% to 50%, and an increase in yield of recycled product from 30% to 60%.	*The New Plastics Economy*, Ellen Macarthur Foundation, 2016.

Cattle intensification (US$15-55 billion)

Description	Sizing Assumptions	Sources
Sustainable cattle intensification, including through improved feed supplements	*Method 1* **BAU:** Feed efficiency improves 10% above current rates. **SDG:** MGI estimates a 15 – 20% feed efficiency improvement through feed additives and improved practice. *Method 2* **BAU:** Cattle management practice remains at current levels. **SDG:** TNC estimates a US$54 per year per hectare annuity from cattle intensification intervention. A 20% penetration rate of this intervention is assumed.	*Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November, 2011 *Green growth and sustainable cattle intensification in Para*, The Nature Conservancy, 2015.

Urban agriculture (US$20-40 billion)

Description	Sizing Assumptions	Sources
Improving the scale and efficiency of food grown in urban environments, especially in developing countries	**BAU:** The productivity of urban farms remains constant, whilst population grows at current rates. Academic estimates are that a quarter of the 800 million people engaged in urban agriculture earn an income from it. Average of African and Latin American case studies by the FAO indicate an annual income of US$600-1,300 per household. Population is estimated to grow at 1.3% and a household is assumed to include four people. **SDG:** We assume a 50% yield improvement (using the MGI estimate of smallholder yield growth potential in developing countries).	*Urban Agriculture*, FAO, 2016. *Urban Agriculture in the developing world: a review*, Agronomy for Sustainable Development, 2013.

About the Business and Sustainable Development Commission

The Business and Sustainable Development Commission aims to accelerate market transformation and advance the world's transition to a more prosperous, inclusive economy. Our mission is to make a powerful case—supported by sound evidence, rigorous research and compelling real-world examples—for why the private sector should seize upon sustainable development as the greatest economic opportunity of a lifetime. Our flagship report, to be launched in January 2017 will show how the Sustainable Development Goals (SDGs) —17 objectives to end poverty, reduce inequality and tackle climate change and other urgent challenges by 2030—provide the private sector with the framework for achieving this market shift. The report will serve as the foundation for launching initiatives to inspire and mobilise businesses to achieve the SDGs.

www.businesscommission.org

About AlphaBeta

AlphaBeta is an economic strategy firm with offices in Singapore and Sydney. By integrating strategy and economics, AlphaBeta aims to help solve the world's most important economic, environmental and societal challenges. In the area of sustainable development, AlphaBeta works with corporations, investors, governments and NGOs on areas such as natural resource productivity, food supply, renewable energy development, and sustainable management of natural resources, including forests and water.

www.alphabeta.com