



SECTION 3

Food and Land Use

The global food and land use system is at a pivotal moment. Continuing down our current path will undermine the world's ecological foundations. It will also contribute significantly to a series of challenges, including rural poverty, social conflict, hunger, obesity, malnutrition, biodiversity loss, soil erosion, and climate change. Fix it, however—based on tried and tested policy reforms, better agricultural techniques and financial instruments, and the innovations these measures are sure to catalyse—and our food and land use system could instead provide stronger and more equitable rural socioeconomic development, deliver over one-third of the climate change solution,⁶⁵¹ keep secure our vital biodiversity, and generate massive improvements in public health. There is a clear economic case for fixing this broken system: Recent analysis has shown that developing sustainable food and land use-business models could be worth up to US\$2.3 trillion and provide over 70 million jobs by 2030.⁶⁵² In short, the transition to sustainable food and land use systems represents an opportunity that no country, nor indeed the world, can afford to ignore. Not making the transition, meanwhile, entails risks and costs that no responsible leader should accept.

Current trends are disturbing. Despite the scale and urgency of this problem, today's food and land use system is failing to generate sufficient innovation, investment and attention.⁶⁵³ Forest-related finance for countries with high rates of deforestation accounts for less than 3% of global climate mitigation-related development funding (see Box 32 on Finance for Food and Land Use).⁶⁵⁴ Global demand for land to grow fuel, feed, and fibre is driving widespread deforestation and forest degradation, with just four commodities—palm oil, soy, beef, and wood products—accounting for more than 40% of tropical deforestation.⁶⁵⁵ The effect on natural infrastructure is alarming: Biodiversity has declined by more than a quarter in the past 35 years.⁶⁵⁶ The ramifications of broken food and land use systems on public health are also significant and growing. The convergence of global eating habits on resource-intensive Western-style diets—with the associated commodity consumption driving increased deforestation—is a major contributor to the rise of diet-related, non-communicable diseases that are rapidly becoming a leading cause of human mortality.⁶⁵⁷ Around 2 billion people are obese or overweight.⁶⁵⁸ At the same time, persistent inefficiencies and inequalities in the food system continue to leave 815 million people hungry⁶⁵⁹ while a third of all the food that the

world produces is lost or wasted.⁶⁶⁰ Sticking with our current, unsustainable consumption models will only push these systems further out of balance as the global middle class, with higher incomes and consumption patterns, is expected to number 2.6 billion by 2025, with over 70% of that expansion in emerging markets.⁶⁶¹

Instead, fixing our broken food and land use system could generate stronger, more resilient and inclusive economic growth, as well as better, more decent work for the several billion people whose livelihoods depend on food, forests and agriculture.⁶⁶² Reforming agricultural subsidy regimes, worth on average US\$519 billion per year (2014-2016), that often lead to inefficient and inequitable economic, development and climate outcomes, could free up valuable public resources with which to achieve a better a food and land use system.⁶⁶³ Halting deforestation could boost the global economy by as much as US\$80 billion per year, as well as make it more resilient to a changing climate.⁶⁶⁴ With a third of the planet's land degraded,⁶⁶⁵ a global effort to restore degraded lands either to natural forest or to productive use could generate major economic, employment, and climate gains. In the United States alone, restoration and conservation activities generate an estimated US\$3.8 billion a year and currently sustain 126,000 jobs.⁶⁶⁶ Coupled with a strong commitment to forest and ecosystem protection, sustainably increasing agricultural productivity is essential to meet growing food demand and achieve equitable rural growth. While there have been striking productivity increases in many regions, achieving further productivity gains while reducing agriculture's climate footprint is possible and needed (see Figure 22).⁶⁶⁷ Agriculture accounts for almost 70% of total employment in low-income countries worldwide,⁶⁶⁸ which means that increasing yields and incomes will play a fundamental role in boosting rural livelihoods and ensuring country-wide economic development. Well-managed natural infrastructure can provide sustained economic benefits, which are particularly important for low-income countries, where natural capital constitutes nearly half of the wealth.⁶⁶⁹ Women also have a vital role to play: If given equitable access to resources, women farmers could help alleviate hunger for 150 million additional people,⁶⁷⁰ and there are important efforts under way to increase women's access to knowledge, technology, and resources in the food and land use sector.⁶⁷¹

On the public health front, shifting diets from those heavy in animal-based and processed foods—and especially away from beef—towards more plant-based diets could result in global public health benefits, health-related cost savings of almost US\$1 trillion per year by 2050,⁶⁷² as well as significant positive environmental impacts. Reducing food loss and waste is a major economic prize, as well as a moral obligation. Saving just one-quarter of the food currently lost or wasted would be equivalent to the amount of food needed to feed 870 million people annually.⁶⁷³ Reducing food loss and waste also makes good business sense: Recent research of surveyed companies found a median benefit-cost ratio for investments of 14:1.⁶⁷⁴

In each of these action areas, momentum to reform our food and land use systems is growing, with a number of countries, subnational regions and companies showing the way. In addition, several valuable global collaborative efforts, platforms and sets of champions have emerged to raise ambition and accelerate efforts to reform food and land use systems. Examples of steps in the right direction include the Global Climate Action Summit's '30 x 30 Forests, Food and Land Challenge': A challenge to non-state actors across all sectors of the economy to take concrete action to ensure better forest and habitat conservation, food production and consumption, and land use, estimating that such action can deliver up to 30% of the 'climate solutions' needed by 2030. The Consumer Goods Forum's (CGF) Zero Net Deforestation Resolution, a resolution by companies to achieve zero net deforestation by 2020 in key commodity sectors, is another. The CGF's

associated partnerships, like the Tropical Forest Alliance 2020, are also helping to turn commitments into action. The New York Declaration on Forests has galvanised a coalition of stakeholders—countries, sub-national governments, companies, indigenous groups, and NGOs—with ambitious global targets to protect forests and end natural forest loss by 2030. The Bonn Challenge, a commitment to restore 150m ha of degraded land globally, created a rallying cry for countries to undertake restoration activities. Building on this, international initiatives AFR100 in Africa and Initiative 20x20 in Latin America are driving significant activity locally. Coalitions and multi-stakeholder partnerships such as the Better Buying Lab and Champions 12.3 are working to accelerate sustainable consumption patterns and efforts to reduce food loss and waste, respectively.

But to truly fix the food and land use system, piecemeal progress to date must rapidly become a global effort to address these challenges in an integrated and systemic way, at scale. A first-order priority is to close the forest frontier once and for all through a combination of measures including land tenure reform, strengthening protected areas and indigenous peoples' reserves, effective law enforcement, and measures to ensure that agricultural development takes place on non-forested and degraded lands. Efforts to bring more 'radical transparency' to food and land use systems also need to be rapidly scaled. Enhanced transparency, traceability and legality, enabled by satellite imagery and other technologies, is now more feasible than ever before, thanks to tools such as Global Forest Watch

Photo credit: Flickr: Dow Maneerattana, World Resources Institute



and Trase.⁶⁷⁵ The publication and disclosure of detailed supply chain sourcing data from agribusinesses and traders is required to enhance financial transparency and accelerate meaningful actions by companies and investors.

To scale these and other solutions, smarter and more diverse flows of finance must be innovatively deployed to address food and land use finance gaps and policy incoherence. For example, there are ample opportunities to make smarter use of public finance by reforming agricultural subsidies, implementing 'full cost accounting' or price reforms on selected foods,

and using blended finance structures. In addition, promising food and land use innovations and new business models—from technologies to lower the cost of planting trees, to lab-grown meats and new forms of alternative proteins, to offering consumers healthier, more plant-based food options (see Box 31)—require further investment and the right policy and investment environments to achieve transformative scale (see Box 32). Governments and the private sector also need to strengthen their actions to reduce food loss and waste and ensure a sustainable, nutritious, and healthy diet for all.

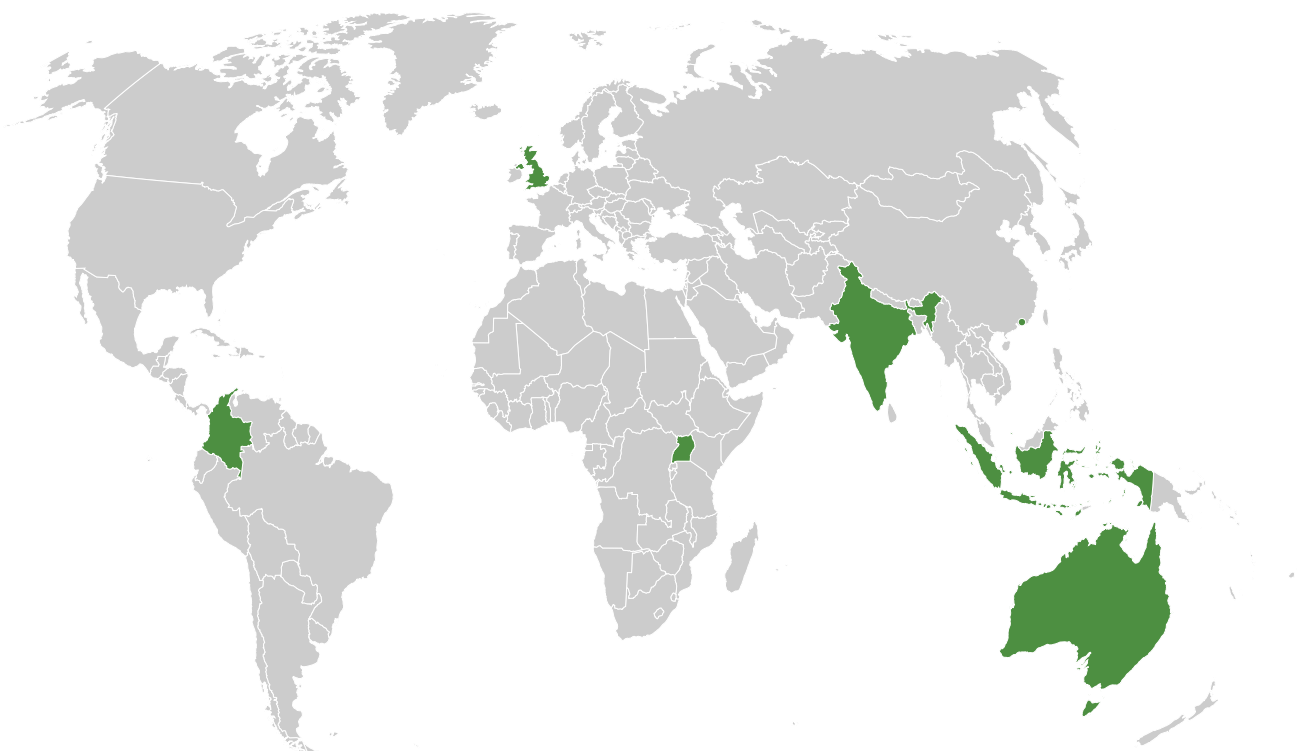
Box 31

Pret a Manger Enjoys Green Growth⁶⁷⁶

In 2016, café and sandwich brand Pret a Manger increased and improved the range of vegetarian and vegan recipes on their menus. A pop-up vegetarian-only outlet opened in London in the summer, accompanied by a “Not Just for Veggies” campaign. This promoted non-meat and plant-based dishes as appealing alternatives, particularly to non-vegetarians. The campaign was a significant commercial and reputational success. Sales in the pop-up surged, resulting in the decision to keep it open and to open two more ‘Veggie Prets’ in London in 2017. The brand credits its company-wide success in 2016 to its strengthened vegetarian range: UK sales rose by 15% compared to 2015 and profits by 11% to £93.2 million.⁶⁷⁷ Pret launched their ‘Not Just for Veggies’ campaign in the United States, Hong Kong and France in 2017, including adding a ‘Veggie Booth’ in all of their Hong Kong stores. On launching the Hong Kong campaign, Pret enjoyed three weeks of record-breaking sales.⁶⁷⁸

Figure 17

Locations of Transformative Examples in Food and Land Use Highlighted in this Report.



Box 32

Finance for Food and Land Use

The transformation of the world's food, forests and land use system is critical to achieving economic growth, climate action, and the fulfilment of the SDGs. For many low-income countries, natural capital remains their most important asset—constituting over half their overall wealth. Public, private, domestic and international flows of finance will need to be substantially redeployed and re-tailored to deliver a new food and land use economy capable of nurturing and restoring this natural capital, and in so doing meeting the Paris Agreement and the SDGs.

Despite the scale of the role that the food and land use sector must play in delivering emission reductions by 2030,⁶⁷⁹ since 2010, less than US\$1.2 billion per year of global climate finance is estimated to have been invested to limit GHG emissions from deforestation and land use—a striking mismatch.⁶⁸⁰ Indeed, overall investment in 'natural' infrastructure—forests, wetlands, peatlands, mangroves, and other critical ecosystems—is grossly undercapitalised and overlooked, despite its critical role in sustaining the climate and enabling development.

Halting deforestation, restoring degraded land and achieving more sustainable, climate smart agriculture will require much larger investments in these areas than those that exist today, particularly in developing countries. The private sector has a particularly critical role to play. For instance, previous work undertaken for the Global Commission estimated the gross investment needed to restore 350 million hectares of degraded forest landscapes to be between 2015 and 2030 at between US\$350 billion and US\$1 trillion, or US\$23–67 billion per year, exclusive of land values.⁶⁸¹

In addition to increasing investment in a more sustainable food and land use system, existing capital flows should also be refashioned to deliver greater conservation and restoration outcomes within a landscape.⁶⁸² The world's zero-deforestation commitments can only be achieved if commodity companies and their investors make their investments in agriculture conditional on zero deforestation being achieved.⁶⁸³

Another essential precondition for better food and land use systems would be for national governments to reform agricultural subsidies.⁶⁸⁴ Across developed and developing countries, government subsidies to the agriculture sector currently amount to some US\$519 billion on average per year (2014–2016).⁶⁸⁵ These public subsidies, in addition to being economically inefficient, often lead to negative outcomes for the climate and environment, such as increased deforestation due to agricultural expansion in rainforest areas.⁶⁸⁶

Beyond subsidy reform, a range of other policies and instruments are available to governments. Better pricing and 'full cost accounting' to recognise externalities and public goods in the food and land use sector is of fundamental importance to creating markets that take into account carbon, ecosystems, waste, and health outcomes. For example, with the right land tenure policies, governments can incentivise forest protection, restoration, and better farming practices by giving landholders payments for the ecosystem services (PES) they provide; these payments can be results-based, following the REDD+ framework to reduce deforestation.⁶⁸⁷ National instruments such as tax breaks or lower interest rates can incentivise greater investment in sustainable forest and landscape SMEs.

Using public money to mitigate investor risks in a particular project or fund is another way to mobilise more commercial capital to sustainable land use projects. Innovative blended finance structures like the Tropical Landscape Finance Facility (TLFF) in Indonesia provide long-term loans for rural project investments adhering to sustainability criteria. In February 2018, TLFF issued the first ever US\$95 million sustainable land use bond (see Box 35).⁶⁸⁸ Other examples include the new &Green Fund,⁶⁸⁹ the Terra Bella Colombia Fund⁶⁹⁰ and the US\$1 billion Rabobank sustainable land use fund⁶⁹¹ announced with the UN Environment Programme.

Categorising forests and other sustainable land use investments as an asset class (for example, as natural infrastructure, real assets or commodities, or payments for ecosystem services) will also help facilitate commercial investment, as it may allow investors to better categorise risk characteristics and include these investments within existing asset allocations. The Climate Bonds Initiative is helping to standardise this natural infrastructure as an asset class by developing guidance for the use of proceeds from green bonds that target 'nature-based assets' including agricultural land, forests, wetlands, degraded lands, coastal infrastructure and land remediation.⁶⁹²

Disclosure and divestment are also powerful instruments. For example, in 2015, Norway's sovereign wealth fund dropped six palm oil and four pulp and paper companies from its portfolio, due to their involvement in destroying forests, as part of the country's commitment to divest from assets that contribute to deforestation.⁶⁹³

Better pricing of food also offers a key instrument to help shift demand away from high environmental impact foods (those high in animal protein) and to achieve better health outcomes. Whilst achieving widespread behavioural change is difficult, promising examples show that careful taxation reforms may be an effective part of a broad behavioural change strategy that also includes labelling and education. Examples of pricing reforms to shift diets can be found in several countries including Chile, France and local governments in the United States, who have recently experimented with taxing certain foods (for example, those high in fat, salt, or sugar) to make other foods comparatively more affordable. Mexico's sugar tax, approved in October 2013, constitutes a 1 MXN per litre tax (around US\$0.08) on sodas, along with a 5% tax on junk food. Data show that the tax is causing a fall in consumption of high sugar drinks, now for the second year in a row, although it is still too early to assess the health impact.⁶⁹⁴

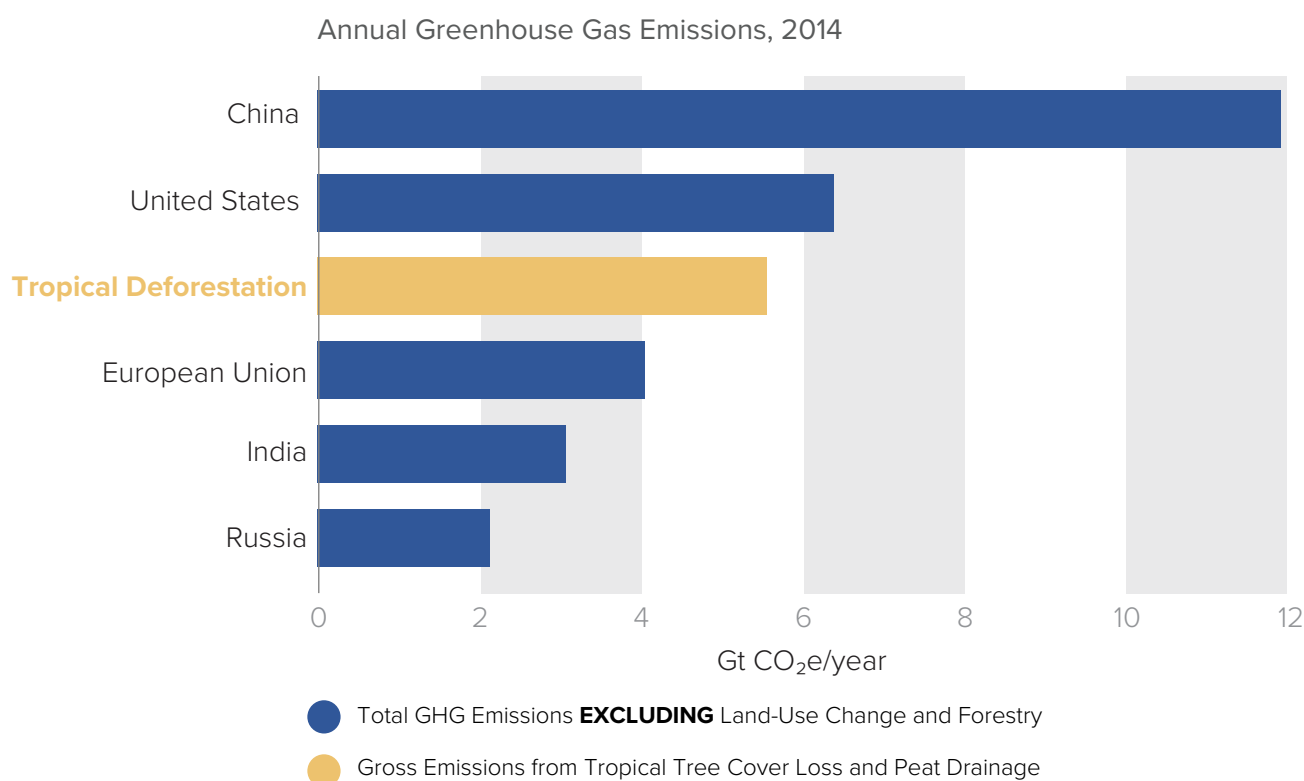
This chapter explores five inter-linked opportunities with the combined potential to shape global food and land use systems to meet humanity's needs while stabilising the climate. These opportunities include putting an end to deforestation and forest degradation by 'closing the forest frontier'; restoring degraded agricultural and forest lands, either to natural forest or to productive use; farming smarter to increase productivity on existing agricultural land; shifting diets to more sustainable, nutritious, health-promoting foods; and reducing food loss and waste. Together, these five sets of solutions will be instrumental to achieving a new climate economy, the Paris Agreement, and the SDGs. There is no time to lose.

3.A. Closing the Forest Frontier: Avoiding Further Deforestation and Degradation of the World's Forests

The world's forests (tropical, temperate and boreal) are major economic assets and could be drivers of growth for the countries and regions where they are found. Forests directly support the livelihoods of more than 1 billion people.⁶⁹⁵ They generate multiple economic benefits, including improving soil quality, protecting biodiversity, and supporting ecotourism.⁶⁹⁶ They underpin and regulate the climate on which the global economy and food security relies.⁶⁹⁷ Critically, forests are the only currently available large-scale, proven, and cost-effective technology for carbon capture and sequestration.

Notwithstanding these national and global benefits,⁶⁹⁸ deforestation—particularly (although by no means exclusively) in tropical countries—continues with alarming consequences. Indeed, if tropical deforestation were a country, its emissions would be greater than those of the European Union (Figure 18).⁶⁹⁹ The Paris Agreement cannot be met without rapidly slowing and then halting and aggressively reversing, tropical deforestation.⁷⁰⁰ Definitively 'closing the forest frontier'—through a combination of actions, including protected areas, indigenous peoples reserves, better land use planning and enforcement, land tenure reform and improved forest governance—will be critical to the global climate effort. Closing the forest frontier will also incentivise the necessary agricultural innovation and transformation in the degraded lands adjoining the forest, thereby putting an end to the perversity of the value-added economic activity of agriculture being outdone by free access to a good that serves a massive public function and that those exploiting have not invested in developing. 'Closing the forest frontier' globally will require decisive political will and leadership from countries and subnational governments, while the private sector, civil society organisations, donors, and the financial sector also all have critical roles to play.

Figure 18
Emissions from Tropical Forest Loss.



Source: Data from Climate Watch and Global Forest Watch. Author calculations⁷⁰¹

Evidence of the Benefits

Forests are critical to mitigating climate change because they act as a carbon sink, soaking up carbon dioxide that accumulates in the atmosphere. Halting tropical deforestation, while allowing damaged forests and other lands to recover, could secure an amount of carbon equivalent to one third of the emissions reductions needed for a below 2°C pathway.⁷⁰²

Forest industries contribute an estimated US\$450 billion to annual national incomes globally⁷⁰³ and over US\$250 billion per year to developing country economies.⁷⁰⁴ For example, forests have underpinned Costa Rica's tourism industry growth, which at 7.4% in 2011 was the strongest of the Americas,⁷⁰⁵ with ecotourists representing more than half of the 2 million international visitors to the country each year.

Avoiding further deforestation could boost the global economy by at least US\$40–80 billion per year.⁷⁰⁶ Many of the benefits forests provide are in the form of ecosystem services, such as fuelwood and provision of other forest products, water purification, climate regulation, pollination, erosion control, and habitat

protection. In Colombia, for example, maintaining the forested lands of the Colombian Amazon held by indigenous communities could yield as much as US\$123 billion to US\$277 billion in total ecosystem benefits over a 20-year period (see Box 33).⁷⁰⁷

Forests and mangroves also play a key role in adaptation: They reduce economic losses and overall risk from floods and droughts, which caused US\$1.5 trillion in damage worldwide between 2003 and 2013,⁷⁰⁸ and are expected to worsen with climate change. Unchecked climate change might result in global economic losses in the order of trillions of US dollars.⁷⁰⁹ Given forests' vital role in climate regulation, therefore, the true economic benefits of reducing deforestation and forest degradation are of a similar order of magnitude.

Challenges

Deforestation happens for a host of reasons, including weak governance, policy incoherence, market failure and growing global demand for forest risk commodities. A lack of formal recognition of land tenure (see Box 33),⁷¹⁰ the misalignment of national

agricultural subsidies, and infrastructure development (particularly road construction) all drive forest encroachment. Insufficient or inadequate capacity for and enforcement of spatial and land use planning further undermines efforts to protect forests.⁷¹¹ In the absence of a robust market that values the full range of services forests provide—in terms of carbon storage, water provision, climate regulation, and biodiversity—forests are generally considered more valuable for timber, cropland, or pasture than they are as standing, healthy, climate-protecting systems. The global public goods benefits from forests, which would be in the order of trillions if properly counted, are obscured by the more tangible private benefits through priced goods—timber, land for agriculture—accruing to those able to seize them. A first-order priority, therefore, is to recognise the true economic value forests offer; and then to establish a ‘new forest economy’ which reflects that value.

The drivers of deforestation vary: Whereas in the Amazon Basin it is primarily driven by cattle ranching and soya,⁷¹² deforestation in sub-Saharan Africa is often attributable to the unsustainable use of biomass for cooking and energy (see also Section 1.D).⁷¹³ Across the world, commercial-scale clearing for agriculture is a major cause. Emerging market importers (China and India) and major emerging market producers and consumers (Brazil and Indonesia) account for a growing share of global demand for commodities linked to deforestation. There is a real opportunity for all countries to strengthen their supply chain sustainability commitments, enhancing their long-term resilience against water variability, reputational risk and price fluctuations. Where there are significant risks to the long-term resilience of these supply chains if sustainability concerns are not addressed, greater leadership from emerging markets could have a transformative impact.

The zero-deforestation commitments made by companies to date are limited by challenges in implementation and monitoring: Without harmonised definitions across company commitments, comprehensive tracking, and systems to account for third-party suppliers, it is difficult to assess progress and optimise the impact of these commitments.⁷¹⁴ Encouragingly, in February 2018, Unilever became the first consumer goods company to disclose its palm oil suppliers—a mapping exercise of over 1,400 mills and more than 300 direct suppliers⁷¹⁵—following similar commitments from suppliers. Nestlé followed soon thereafter. It is hoped that many other CGF companies will do the same. Meanwhile, a growing number of investors and companies are using their

financial power to respond to the financial and reputational risks associated with deforestation, including through divestment from companies with a significant forest footprint (see Figure 20). Technical assistance programmes such as Partnerships for Forests have an important role to play in turning commitments into action by catalysing public-private investment. Greater effort needs to be made to encourage further commitments across the world’s markets to achieving fully traceable and transparent zero-deforestation commodity supply chains, while urgently delivering on the commitments that have already been made.

Efforts to reduce deforestation are also hampered by a lack of enforcement of laws and policies protecting forests. Communities or supply chains causing deforestation or harvesting timber illegally often face very little risk of getting caught.⁷¹⁶ However, improvements in satellite and monitoring capability, supply chain and blockchain technology, and fiscal and policy incentives offer options to help both companies and governments tackle some of these barriers, as well as to improve land tenure and land-use planning. The ‘radical transparency’ agenda—driven by increasingly sophisticated satellite imagery and data collection techniques, underpinning initiatives like Global Forest Watch and Trase—makes it possible to map suppliers at granular levels of detail, while blockchain technology could potentially offer ways to securely, transparently and efficiently track transactions along the supply chain.⁷¹⁷

Box 33

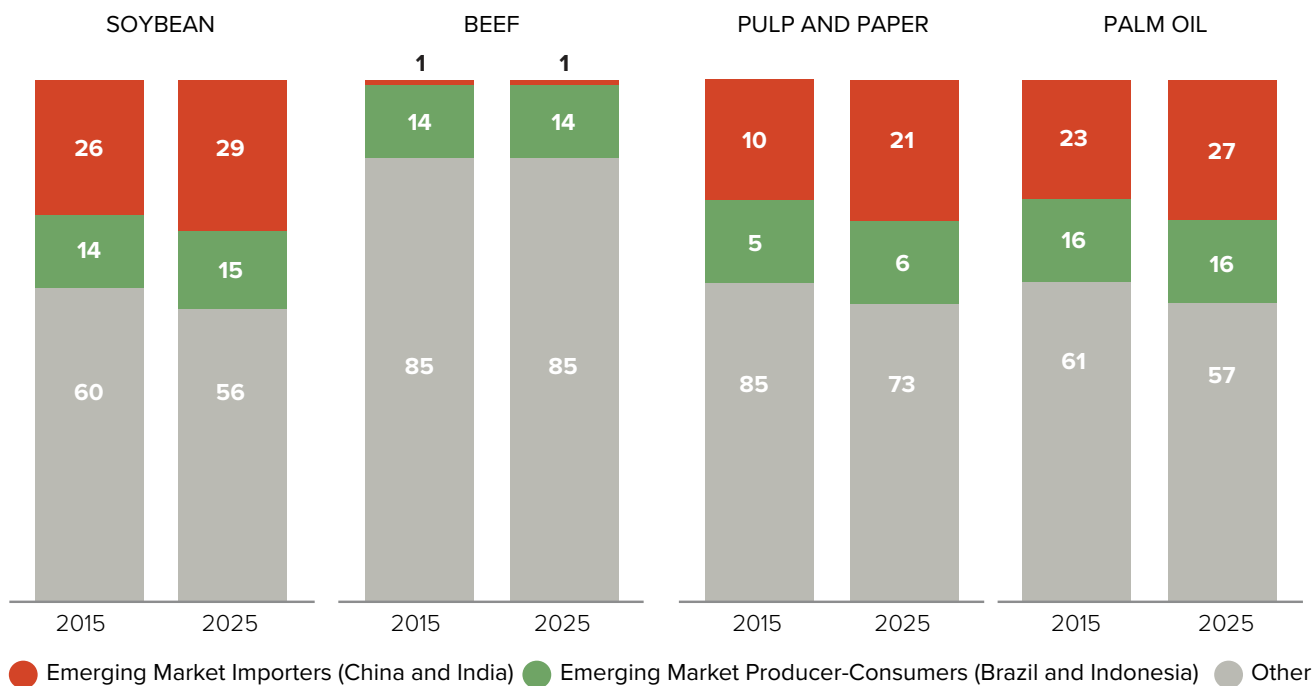
Indigenous Rights and Land Tenure Reform in Colombia⁷¹⁸

In the late 1980s and early 1990s, Colombia gave 30 million ha, approximately one-quarter of its land area, the formal status of indigenous reserves.⁷¹⁹ It also granted indigenous and forest communities legal recognition and recourse if their rights were infringed. Since then, large areas of the Colombian Amazon—7% of the Amazon biome—have enjoyed relatively high levels of forest conservation. The deforestation rate inside tenure-secure indigenous forestlands has been half the rate outside, where the drivers of deforestation—cattle, illegality, land speculation—are strong (and growing). The value of the total ecosystem benefits associated with securing indigenous forestland tenure in Colombia over the next 20 years is estimated at US\$123 billion to US\$277 billion. In carbon terms, securing indigenous tenure of forestland in the country has the potential to avoid more than 1 Mt CO₂ emissions per year, equivalent to taking 635,000 cars off the road over the same period.⁷²⁰

Figure 19

Share of Global Demand in 2015 and Estimated Demand in 2025 (Percent)

Share of Global Demand in 2015 and Estimated Demand in 2025 (Percent)



Source: Tropical Forest Alliance 2020, 2018.⁷²¹

Accelerators

- **Countries should follow through on their commitments to protect and safeguard the rights and territories of Indigenous Peoples.** Governments and their partners should implement (or where necessary reform) their laws to provide Indigenous Peoples and communities with sufficient legal protections, and take other necessary actions to strengthen land rights, including mapping, demarcating, and formally registering this land (see Box 33).
- **Forest countries—with support from partners—should increase their efforts to take all necessary steps to close their forest frontier.** Critical measures to achieve this include strengthening protected areas; overseeing comprehensive land tenure reform; and ensuring robust and integrated spatial planning, enforcement, and land management. Examples of where elements of these efforts have been achieved—including in Brazil, Costa Rica, Colombia, Indonesia, Liberia, and Sierra Leone—demonstrate the significant climate and economic benefits and importance of these multi-sectoral or landscape approaches to closing the forest frontier.
- **Governments and companies should scale up their efforts to achieve radical**

transparency in the forest sector, especially for forest commodity supply chains. Radical transparency—achieved through enhanced governance, disclosure and technological innovation—can lead to multiple economic benefits to forest countries, in terms of increased tax revenue and reduced illegality. In key forest commodity supply chains—from producer to trader, through to the consumer goods company and owner/financier—companies should commit to make their supply chain information publicly available in real time, from the individual farmer to consumers. In early 2018, Unilever and Nestlé became the first consumer goods companies to publicly disclose their palm oil suppliers and mills.⁷²² Separately, a number of other companies—including Colgate Palmolive, General Mills, Mars, Mondelez, P&G, and Reckitt Benckiser—have disclosed their palm oil producer lists. Although all the companies revealed supplies included from deforesting producers, the release of this information is raising hopes that full supply-chain transparency will inevitably become standard industry practice.⁷²³

- **Accelerate delivery on the zero-deforestation commodity supply chain agenda, bringing in new actors and strengthening implementation of**

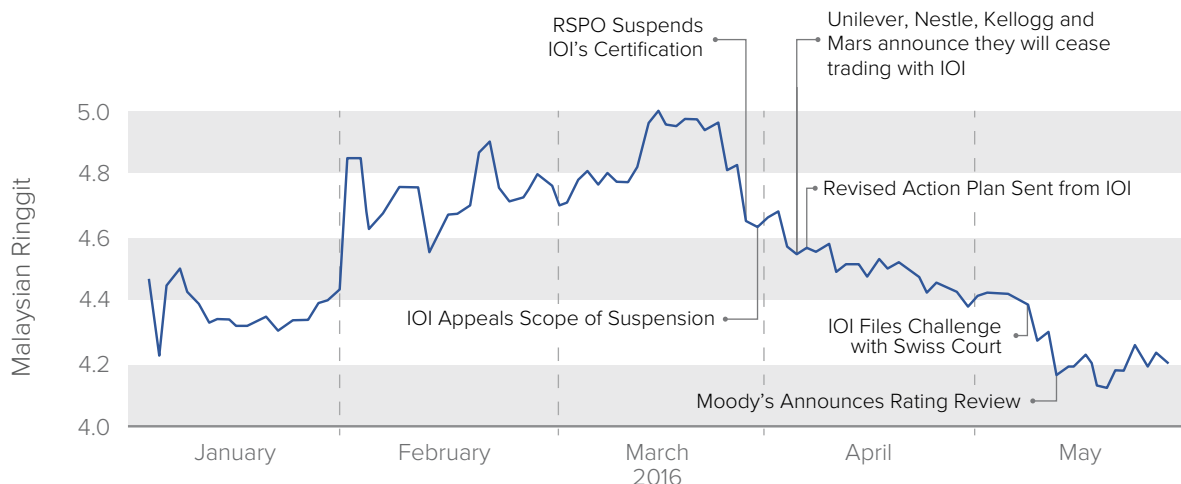
existing commitments. Companies from across developed and emerging markets should urgently accelerate their implementation of zero-deforestation commitments, learning from progress made to date (including in timber, palm oil, and cocoa). China, India, and other globally significant commodity importer markets should further step up their efforts to encourage sustainable commodity production. Already, the Sustainable Soy Trade Platform is working to boost Chinese demand for responsibly produced South American soy.⁷²⁴ And Chinese food and agribusiness giant COFCO now has two facilities in China that are certified by the Roundtable on Sustainable Palm Oil. COFCO has also become a member of the Round Table on Responsible Soy.⁷²⁵

- International investors, including DFIs, should more closely screen collaboration and investment in deforestation-risk companies and divest from those that are not sustainable.** In doing so, investors can protect themselves against financial and reputational risks and help to shift the financial system towards greater sustainability. Investors are increasingly beginning to respond to these risks. In 2015, Norway’s sovereign wealth fund dropped 10 palm or pulp and paper companies from its portfolio due to their involvement in destroying forests.⁷²⁶ In 2016, the share price of palm oil producer IOI suffered significantly after it was suspended for six months from the RSPO and credit ratings agency Moody’s considered downgrading the company (see Figure 20).⁷²⁷ Only after IOI demonstrated sustainability improvements, committed to commission an

independent verification of their actions, and was reinstated by the RSPO did its shares improve. IOI continues to suffer lack of access to buyers’ and financial markets due to lingering reputational risk, and its share price has yet to return to pre-suspension levels.⁷²⁸

- National governments should establish full policy coherence and alignment in policy frameworks to reduce deforestation as well as provide fiscal incentives for sub-national governments to maintain standing forests.** The more successful attempts to reduce deforestation, including Brazil’s, have demonstrated the importance of a whole-of-government approach, ensuring alignment of policy and fiscal incentives and disincentives to protect forests. Brazil blacklisted municipalities responsible for deforestation, reformed its agricultural subsidies to encourage farmers to protect and restore forests, and rigorously enforced these policies.⁷²⁹ India’s National Agroforestry Policy (see Box 34) is another example. National governments should also provide fiscal incentives to sub-national governments to maintain their high levels of forest cover.⁷³⁰ India’s forest cover measure, which is directing an estimated US\$6.9–12 billion per year of additional tax revenue to states from 2015 to 2020, rewards states on the basis of the extent of their forest cover.⁷³¹ This type of fiscal regime and similar (sub-national) fiscal incentives can be replicated in other geographies, such as in Indonesia, to complement ongoing flows of international REDD+ finance to support jurisdictions in their efforts to reduce deforestation and forest degradation.

Figure 20
IOI Share Price (Malaysian Ringgit) from January to May 2016.



Source: University of Cambridge Institute for Sustainability Leadership (CISL), 2016.⁷³²

India's Agroforestry Policy

In 2014, the Indian government introduced a National Agroforestry Policy aiming to increase tree cover (with a national goal set at 33%), meet growing timber demand, improve farmer livelihoods, and tackle climate change. India saw the economic opportunity to meet increasing demand by scaling up agroforestry. At the time, 20% of India's timber was imported. The policy directs investments into research, extension services, and capacity-building as well as promoting agroforestry for renewable energy and sustainable development projects. It also provides farmers with incentives, insurance mechanisms, and greater access to markets for agroforestry products.⁷³³ In 2016, the national government budgeted US\$150 million to boost agroforestry. An additional US\$60 million to be leveraged from state finances brought the total up to US\$210 million, with money going to states that demonstrated progress in implementation. By 2016, seven major Indian states had reformed their regulations to support the policy.⁷³⁴ The National Agroforestry Policy—coupled with India's forest cover measure target—demonstrates the power of national policy to drive real change to drive real change.

3.B. Seeing the Restoration for the Trees: Scaling Up Forest Landscape Restoration

Some two billion hectares of the world's landscapes offer opportunities for restoration. Restoring some of these landscapes to natural forest or to sustainable agricultural use would contribute to meeting the Aichi Biodiversity Targets,⁷³⁵ SDGs 13 and 15, and the Paris Agreement. It would also be a major win for the economy: For example, restoring the 160 million ha of degraded land committed by over 40 countries under the Bonn Challenge could provide an estimated US\$84 billion in annual economic benefits worldwide.⁷³⁶ The climate gains alone (particularly from restoration to natural forests) would be remarkable. Nature-based climate solutions—including the restoration of forests, grasslands, and wetlands as well as avoided deforestation and better land management—could provide almost 24 billion tonnes of CO₂e savings per year through 2030.⁷³⁷ Landscape restoration would also make a lasting contribution to adaptation, resilience and decreasing migration: The worsening impacts of climate change could force over 140 million people to move within their countries, due to a series of growing problems that could be addressed by restoring degraded lands into productive and healthy ecosystems.⁷³⁸

Large-scale restoration (including through reforestation, natural regeneration, and afforestation) is gaining increasing attention as a negative emissions technology (NETs), the term given to mechanisms for removing CO₂ from the atmosphere. Compared

to many other NETs, which are either high cost (such as direct air capture)⁷³⁹ or which involve changing ecosystems (such as ocean fertilization),⁷⁴⁰ forest- and landscape-based restoration presents an attractive, proven, and cost-effective solution.

A number of international commitments have been made to restore degraded forests and agricultural lands. In addition to international initiatives like the Bonn Challenge and 4 per 1000,⁷⁴¹ regional initiatives such as AFR100 in Africa and Initiative 20x20 in Latin America have begun in recent years⁷⁴² and are beginning to deliver important action on the ground.

Evidence of the Benefits

Investments in restoration can create a variety of new income streams, including from the periodic sales of sustainably harvested wood (including for timber in buildings) and annual revenues from ecotourism. New income streams from such sources could boost smallholder farmers' incomes in developing countries by an estimated US\$35–40 billion per year within 15 years.⁷⁴³ In the United States, restoration and conservation activities generate an estimated US\$3.8 billion a year and currently sustain 126,000 jobs.⁷⁴⁴

Restoration projects and better land management can also increase the capital value of the land as it becomes more productive,⁷⁴⁵ improving total returns on investment. The New Forest investment model in Australia and New Zealand, replicated in Southeast Asia, is one example of the scale of returns to be made from long-term investments in sustainable forest management, ecosystem restoration, and conservation.⁷⁴⁶ Peatland restoration under way

in Indonesia has the potential to deliver globally significant climate as well as lasting economic benefits to peatland owners, farmers, and communities.⁷⁴⁷

Restored land can also protect people from natural disasters, delivering a key adaptation benefit. Over the past few decades, South Korea has restored more than 6 million ha of degraded, sloping lands. The resulting erosion control and prevention of landslides have been valued at US\$11.23 billion, and US\$3.95 billion respectively.⁷⁴⁸ Restoration in the Tigray region of Ethiopia and better land husbandry in Rwanda has enhanced farmers' resilience, water availability, and livelihoods in areas previously subject to poverty and desertification.⁷⁴⁹ Restoring mangroves to their geographic coverage of the 1950s in the Philippines would deliver more than US\$450 million per year in additional flood protection benefits.⁷⁵⁰

Challenges

Despite a multitude of examples of excellent progress at the project or even landscape scale, there are few examples of significant, national-scale restoration to date.⁷⁵¹ The institutional impediments to large-scale restoration are significant and include the absence of land tenure reform and adequate land-use planning, both of which are essential prerequisites for restoration to go to scale.

As a result of these impediments, there has been limited appetite to date from institutional investors to invest at scale in restoration. Investors have been put off by the inherent challenges with these kinds of investments, including scale, bankability, delayed revenue flows, and a lack of market mechanisms to monetise returns (such as a carbon price for the avoided GHG emissions or additional carbon stocks achieved by restoration). Land-use models that rely on novel environmental markets as important sources of revenue are often perceived as bearing additional risk and uncertainty. Even investors in more mature land-based asset classes, such as timber and agriculture, often require higher returns from sustainable ventures.⁷⁵² Despite the development of promising business and investment models for natural infrastructure, it remains a niche investor class. This is partly because private investors in restoration projects face considerable barriers to entry, such as high transaction costs, uncertainty around returns translating into high risk, and the lack of liquidity.⁷⁵³

Today, most of the returns to forest landscape restoration are either inadequately monetised or misunderstood, leaving the majority of forest landscape restoration efforts to rely on modest public financing.⁷⁵⁴ Restoring degraded and deforested land at scale will require high-level government backing and political will, including alignment of regulations

Photo credit: Flickr: Mokhamad Edliadi/CIFOR



and incentives, alongside substantial institutional support. Initiatives like Initiative 20x20 and AFR100 represent positive steps in this direction by bringing together and matching public restoration and financing commitments with private investors, who have committed more than US\$3 billion as part of the initiatives.⁷⁵⁵ However, for forest restoration to truly take off and become a viable option for private investors at scale, tailored revenue generation models, financial structures and, at least initially, de-risking instruments will be required. Together, these can support the creation and capture of restoration's long-term economic value and attract private capital.⁷⁵⁶

Ultimately, restoration can only succeed if the world closes the forest frontier: Land degradation is a symptom of a cheap and poorly enforced forest frontier, with the 'free' wood produced by nature over thousands of years undermining value creation outside the forest. Once the frontier becomes more expensive (politically, economically, legally, or reputationally), investors will have more incentives to invest to improve the productivity of already cleared or degraded areas.

Accelerators

- Governments should work to find and prioritise action on tracts of land most amenable to assisted natural regeneration.** To achieve low-cost restoration, the restoration community should make a concerted effort to identify those tracts of land most amenable to assisted natural regeneration. The success factors for assisted natural regeneration are capable of being assessed, mapped, and prioritised. Strategic interventions that reduce the existing pressure on the tract of land—such as pro-active fire suppression or pro-active enclosure/exclosure of livestock—could then be implemented. One concrete intervention would be to create national Fences for Farmers and Forests programmes. Another possible intervention would be to create national programs focusing on assisted natural regeneration on public lands.
 - Governments should develop a combination of national land-use plans, restoration strategies, and incentives to enable large-scale national and landscape-level restoration investment and implementation.** These plans can facilitate national governments' progress on a variety of
- international commitments and protect and maximise the many benefits that restored forests and lands provide. Restoration successes in China, in the Loess Plateau and in the nationwide Grain for Green programme have converted several million ha of degraded agricultural land back into agriculture or agroforestry on slopes.⁷⁵⁷ Costa Rica has also seen large areas of the country reforested, in part as the result of the government reducing subsidies to the cattle sector in the mid-1980s.⁷⁵⁸ Lessons from these and other successful examples should be replicated and scaled up elsewhere.
- Governments should establish public procurement policies (as well as public building codes) that favour sustainably-sourced wood from restored areas to stimulate market demand.** Accelerating the use of responsibly-sourced wood from restored areas to replace more carbon-intensive materials in building construction (for example concrete, steel, see Section 5.A), packaging (for example, plastic, see Section 5.B), and other uses would result in additional market demand for sustainable forest products. (See also Box 51).
 - Private and non-profit sectors can build capacity and accelerate restoration through multi-faceted 'outgrower schemes'.** Outgrower schemes achieve multiple restoration objectives all in one package: They provide seeds/seedlings, technical assistance, financing, champions/leadership, aggregation, and market access to smallholder farmers that, when combined, can make restoration in the economic interest of land managers. Some outgrower programmes are already demonstrating success. Komaza in coastal Kenya is a company enabling small-scale farmers to participate in industrial wood markets. It partners with rural farmers to plant woodlots that are collectively managed as a 'virtual plantations'. Farmers contribute land and labour, and are paid a fair price for harvested trees, while Komaza provides training, planting inputs, maintenance support, harvesting services, and a guaranteed market in wood processing and sales operations.⁷⁵⁹ Komaza's model offers a new income stream to smallholder farmers, while reducing pressure on virgin forest and increasing the area of reforested land. To date, Komaza has 4,000 ha planted with 14,000 farmers—with aims to scale to 30,000 ha by 2019.⁷⁶⁰

- **National governments should create investment environments that encourage large-scale private investment in reforestation and forest landscape restoration.** This will allow private landowners to invest with confidence in restoring the landscapes they own and complement public finance flows. The right investment framework and public policies should include measures to clarify land tenure. Governments can also provide the right enabling environment—tax incentives, regulatory reforms and public support measures such as nurseries, seed banks and extension services—to encourage these and similar green (infrastructure) investments.⁷⁶¹
- **Financial intermediaries, including DFIs and commercial banks, should use blended finance vehicles to facilitate the scaling up of private investment into restoration.** Financial structures and investments that blend capital can reduce investment risk, making sustainable land use more investable. Such instruments might include first loss capital, partial risk guarantees, insurance, technical assistance facilities, currency hedging, and payment-for-performance schemes. For example, The Tropical Landscape Finance Facility (TLFF) in Indonesia, established by ADM Capital and BNP Paribas, uses long-term loans for rural project investments (Box 35).⁷⁶² The blended finance vehicles that have worked so far are one-offs and need to be scaled.
- **Companies, governments, and entrepreneurs should accelerate innovation, R&D, and early phase project development to accelerate new and profitable technological solutions to enable restoration.** There are many entrepreneurs around the world already making forest restoration their business. UK-based company Biocarbon Engineering operates a fleet of drones reforesting areas that are difficult to access. The Dutch firm Land Life Company is the maker of the Cocoon technology, a biodegradable pod designed to increase seedling survival rates by providing water and shelter (see Figure 21). Restoration entrepreneurs need public and investor support, including dedicated incubator funds and innovation prizes, to test their ideas and encourage rapid scale-up of the best models.

Box 35

Tropical Landscapes Finance Facility (TLFF) mobilises private capital to restore degraded land in Indonesia

The Tropical Landscape Finance Facility (TLFF) leverages public funding to unlock private finance in both renewable energy production and sustainable land use, including agriculture and restoration projects. TLFF consists of a lending platform managed by ADM Capital with BNP Paribas as structuring adviser, and a grant fund managed by the UN Office for Project Services.⁷⁶³ TLFF's first transaction in February 2018 was a US\$95 million sustainable land-use bond—a world first. This will help finance a sustainable natural rubber plantation on heavily degraded land in two provinces in Indonesia. The main income underpinning the bond will come from rubber produced from the plantation. Planted areas of project land will serve as a buffer zone to protect the Bukit Tiga Puluh national park from encroachment. Roughly half of the project area is to be set aside for community partnership programmes and well-enforced conservation measures to support forest conservation and protect biodiversity corridors. The production company, PT Royal Lestari Utama, an Indonesian joint venture between France's Michelin and Indonesia's Barito Pacific Group, will employ and train several thousand employees in its plantations and give them stable incomes.⁷⁶⁴

Figure 21

A Cocoon from LandLife and a BioCarbon Engineering Drone at Work Planting Trees.



Sources: Land Life Company, n.d. The COCOON.⁷⁶⁵

3.C. Farm Smarter: Sustainably Increasing Agricultural Productivity

In 2016, agriculture accounted for less than 5% of global GDP⁷⁶⁶ and almost 70% of total employment in low-income countries worldwide.⁷⁶⁷ Global demand for food crops is expected to increase by 56% between 2010 and 2050.⁷⁶⁸ While the effects of climate change will make it more difficult to meet this demand, commodity agriculture itself poses significant threats to the climate as just four commodities—palm oil, soy, beef, and wood products—account for more than 40% of tropical deforestation.⁷⁶⁹ Sustainably raising agricultural productivity on existing agricultural land is a critical solution to the interrelated challenges of feeding the world and addressing climate change⁷⁷⁰ (see, for instance, Box 36, on innovative technology solutions to this challenge). Ensuring climate mitigation and adaptation, as well as better soil health and resilience, through the widespread adoption of better agronomic practices is a win-win for the climate and the economy. Achieving greater adaptation and resilience is also an urgent necessity, given the scale of climate change already locked in.

Box 36 Tech Solutions to Improve Agricultural Practices in Sub-Saharan Africa

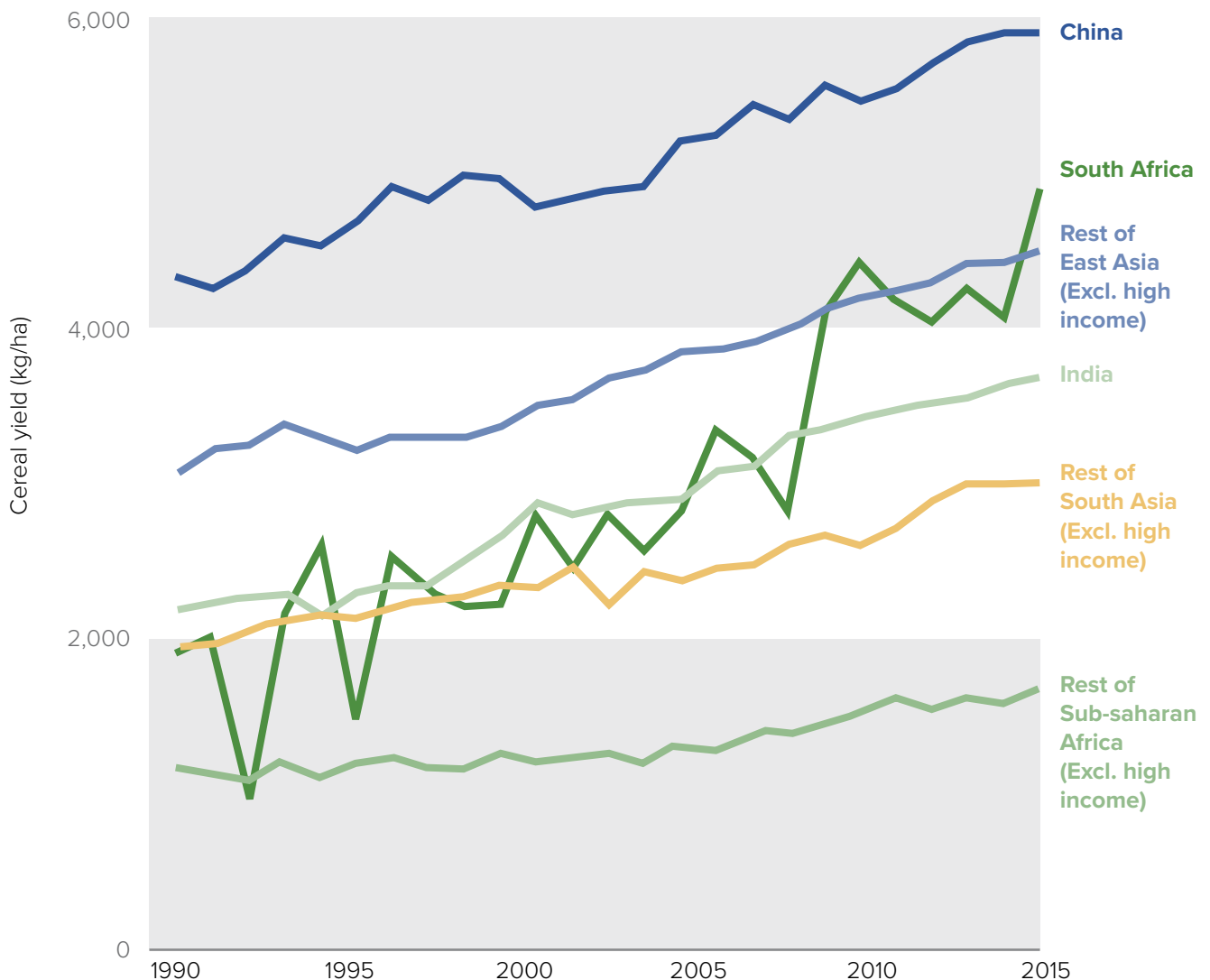
In Uganda, TechnoServe partnered with the Bill and Melinda Gates Foundation to pilot the use of drones in monitoring and optimizing agricultural interventions to improve practices, yields, and incomes. Through the partnership, TechnoServe helped seed company Equator Seeds Ltd. to monitor the farming practices of their 30,000 contractor smallholder farmers. The pilot delivered significant benefits for both farmers and Equator Seeds in terms of increased yields and decreased input costs. Pesticide use declined by 60%, and there was an average US\$2,150 increase in annual profits for the 270 pilot farms. Equator Seeds gained profits of US\$6.5 million, delivering a return of US\$20 for each US\$1 of program investment. A projected 100% increase in yields, coupled with the reduced spending on pesticides, means the 30,000 individual farmers in Equator Seeds' sourcing network can expect returns of over US\$3,000 and US\$1,500 in their first year of maize and soy seed production, respectively. This would equate to a US\$67 million increase in smallholder farmers' income and US\$300 million to Equator Seeds' profits in just one year.⁷⁷¹

Scaling up climate-smart agricultural approaches (CSA) is key to increasing agricultural productivity sustainably.⁷⁷² CSA covers a myriad of existing as well as new production systems, including landscape farming approaches and techniques ranging from intercropping and integrated crop-livestock management to improved water, soil, and nutrient management. If done effectively, CSA practices can produce the triple win of higher productivity that creates better jobs and income for farmers, climate mitigation through reduced GHG emissions, and increased resilience and adaptation to climate change in agriculture. If the right approaches are taken, CSA can also deliver important benefits for women farmers.

Agricultural productivity has increased significantly over the past 50 years, due to increasing use of fertilisers, water for irrigation, improved seeds, agricultural machinery, and pesticides (see Figure 22). However, these yield-increasing inputs have

also had damaging environmental impacts, such as increased emissions, nitrogen run-off, eutrophication, soil compaction, reduced water reserves and drainage capacity, and biodiversity loss.⁷⁷³ There is significant scope to achieve further increases in regional yields, especially in developing countries, while at the same time achieving greater adaptation and resilience. Methods such as crop diversification, agroforestry, and soil and water conservation have been shown to increase yields while avoiding the environmental impacts seen elsewhere. For example, an assessment of the impact of the use of fertiliser trees in farms in Malawi, Tanzania, and Zambia found that maize yields doubled, compared to unfertilised, mono-cropped maize plots.⁷⁷⁴ Another study found that the addition of woody legumes to maize crops in sub-Saharan Africa increased yields by an average of 1.3 to 1.6 tonnes per hectare.⁷⁷⁵ In Colombia, intensive silvo-pastoral systems have driven enhanced livestock productivity while conserving and restoring natural ecosystems.⁷⁷⁶

Figure 22
Cereal Yield Increases for Key Countries and Regions 1990 to 2015.



Source: Alliance for a Green Revolution in Africa (AGRA), 2017.⁷⁷⁷

Evidence of the Benefits

Yield improvements and CSA have generated significant economic growth and jobs for farming communities, including in Southeast Asia and sub-Saharan Africa. Among the benefits of CSA practices are the additional incomes generated by increased productivity, which generates greater economic security in the event of economic shocks, such as falling prices; greater availability of food for farmers and their dependents; and greater resilience to climatic shocks such as drought. In Niger, farmer-managed natural regeneration efforts generate US\$280 million per year in ecosystem benefits and yield increases, which provide food for 2.5 million people.⁷⁷⁸

A shift to CSA practices can also protect biodiversity and reduce soil erosion and fertiliser run-off. The relationship with freshwater is particularly significant: More effective allocation of permits for freshwater withdrawals can improve resilience and climate adaptation outcomes (see also Section 4.A). Payments for ecosystem services offer an opportunity for triple wins for investors, farmers and the landscape. For example, the Upper Tana-Nairobi Water Fund in Kenya deploys contributions from public and private donors to provide nearly 15,000 farmers with the training, tools, and resources they need to conserve water, protect the health of the Tana River, and enable higher crop yields and more stable incomes. Investors in the fund, such as the Kenya Electricity Generating Company and Coca Cola, recognise their dependence on the Tana River for their businesses. The fund found that a US\$10 million investment in water fund-led conservation interventions could return US\$21.5 million in economic benefits over 30 years (see also Section 4.A).⁷⁷⁹

Empowering rural women, who constitute over 40% of the global agriculture labour force, is also critical to feeding the world.⁷⁸⁰ Agricultural productivity improves when women have access to land, household welfare, and adequate finance. If women farmers had access to the same financial and technical resources as men, the resulting rise in output could rescue an estimated 150 million people from hunger.⁷⁸¹

Challenges

By 2050, without a global shift toward smarter practices, agriculture and associated changes in land use could consume 70% of the total GHG budget consistent with limiting global warming to 2°C.⁷⁸² Significant investments are needed to increase agricultural productivity, specifically in CSA, enhanced soil health, improved agricultural technology, enhanced access to finance for farmers, and better farm management.⁷⁸³ Practical obstacles hindering the adoption of CSA on a large scale need to be overcome, in particular the high initial investment it requires in areas where low-cost capital may not be available to farmers, as well as the costs of widespread dissemination thereafter. The political economy challenges of agricultural subsidy reform—with agricultural subsidies worth half a trillion US dollars per year—and better policy alignment also need to be addressed.

More than one-third of palm oil⁷⁸⁴ and two-thirds of the world's cocoa⁷⁸⁵ are produced by smallholder farmers who often lack access to credit, technology, and training. Providing finance and technical assistance to millions of smallholders, particularly women, would have a big impact on both their livelihoods and agricultural productivity. Innovative ways to reduce the transaction costs involved in reaching so many individual farmers also need to be urgently brought to scale.

Accelerators

- **All governments should reform economically inefficient and environmentally harmful agricultural subsidies.** Across the world, there is an urgent need to reform and redirect agricultural subsidies—which currently amount to an average of US\$519 billion annually⁷⁸⁶—in pursuit of stronger economic development, climate, and biodiversity outcomes. This includes a move to 'decoupled' subsidies, that do not depend on output, and a reduction in those that lower global market prices, making it harder for developing country producers to compete. The recent European Commission's (EC) budget proposal is an attempt to do this: By some calculations, it appears to have cut agricultural support by around 15% over the

past seven years.⁷⁸⁷ The EC also aims to introduce greater conditionality to direct payments to farmers, with a significant part of funding to be ring-fenced for actions beneficial to the climate, the environment, and rural development.⁷⁸⁸

- **National governments should align policy and fiscal incentives to promote CSA techniques and remove obstacles to their adoption.** Governments in both the developed and developing world should better align policies to reward CSA and incentivise better soil management. At both the national and sub-national level, targeted policies and incentives—such as those organising and funding farmer training and extension services—are needed to create enabling environments that incentivise, recognise and accelerate the adoption of proven climate smart approaches. In 2014, the Indian government implemented the first national agroforestry policy to improve farmer livelihoods and help deliver their ambitious goal of 33% tree cover (see Box 34).
- **Governments and private donors should increase public funding for national and global agricultural research and development.** This can include support for public-private collaborative agricultural research bodies like the Center for International Forestry Research (CGIAR) to strengthen efforts to improve soil health⁷⁸⁹ and to improve global understanding of the scope and limitations of soil

carbon sequestration. The CGIAR and other research efforts identify no regrets approaches to improved soil health and contribute to greater scientific consensus on the realistic long-term carbon storage potential of soils. Research efforts can also enable wider take-up of agricultural practices that are associated with improved soil health and resilience (such as reduced fertiliser and pesticide use and precision agriculture).

- **Governments and agricultural companies should invest in programmes that help smallholder farmers increase yields sustainably (coupled with integrated land-use planning to prevent further deforestation).**⁷⁹⁰ Increasing smallholder yields could spare millions of hectares from deforestation.⁷⁹¹ In Indonesia, new varieties of oil palm could achieve yields of between 10 and 13 tonnes per hectare, compared to historic yields of 3.6 to 3.8 tonnes per hectare.⁷⁹² In Uganda, Technoserve used drones to monitor and improve the agricultural practices of 30,000 smallholder farmers (see Box 36).⁷⁹³ Projects like these require investment to scale, and should be accompanied by rigorously enforced land-use planning and adequate clearing regulations to ensure that they lead to forest and ecosystem protection and restoration. A particular focus of investment should be on providing innovative, socially inclusive extension services and training.

Photo credit: Flickr: Patrick Sheperd/CIFOR



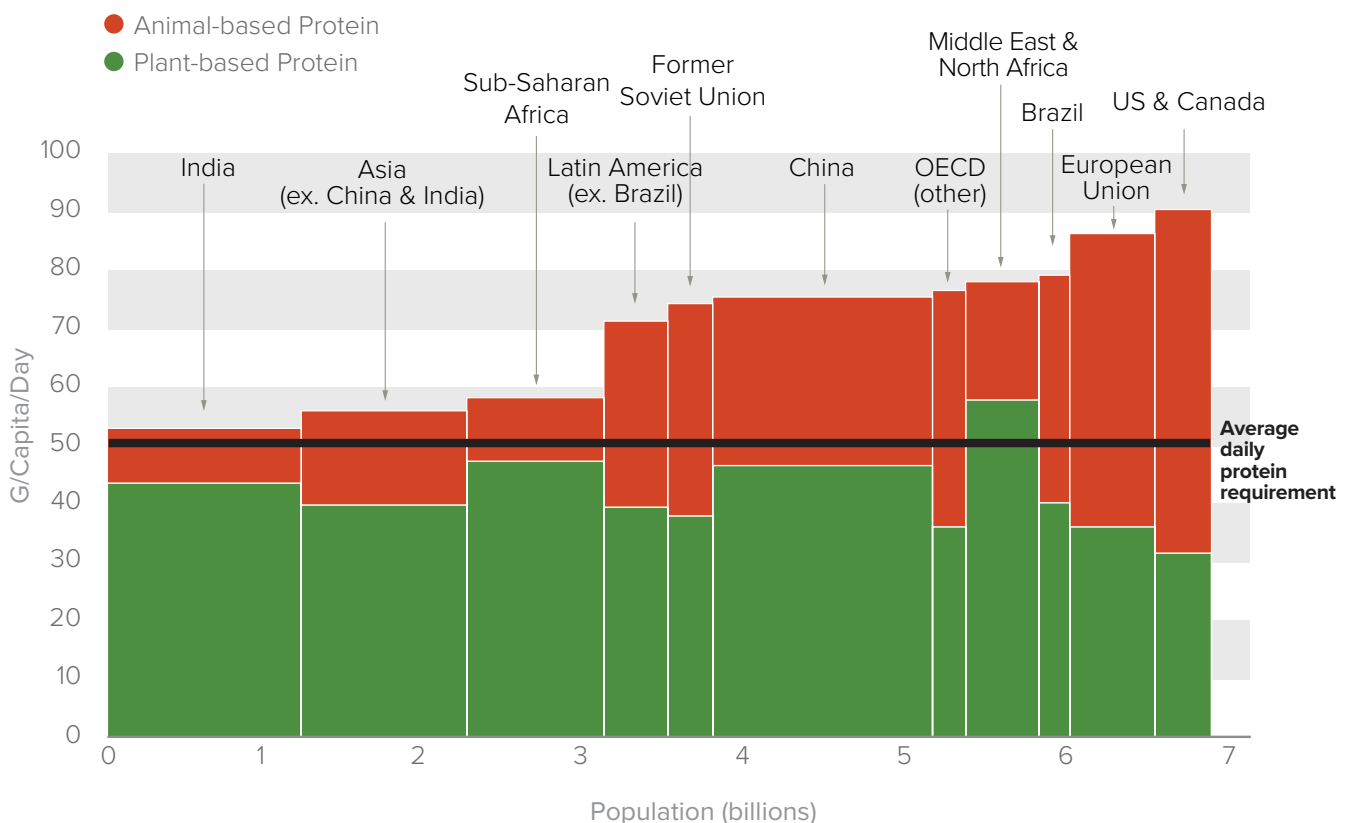
3.D. Setting a Sustainable Table: Advancing Better Food Consumption Patterns

Across the world, almost a billion people suffer from inadequate diets and insecure food supplies.⁷⁹⁴ At the same time, current trends towards diets high in processed foods, refined sugars, refined fats, oils, and meats have resulted in over 2.1 billion people becoming overweight or obese.⁷⁹⁵ This increase in collective body mass is strongly associated with the increased incidence worldwide of chronic non-communicable diseases, especially type II diabetes, coronary heart disease, and some cancers. If current trends continue, these chronic diseases are predicted to account for two thirds of the global burden of disease.⁷⁹⁶ The global economic cost of obesity was estimated to be around US\$2 trillion in 2012, roughly equivalent to the global cost of armed conflict or smoking.⁷⁹⁷

Dietary changes are also causing globally significant increases in GHG emissions and contributing to land

clearing. These dietary changes drive significant impacts in other sectors given the nature of the energy-food-water nexus. For example, animal-based food production takes up more than three quarters of global agricultural land and produces approximately two thirds of agricultural GHG emissions.⁷⁹⁸ The production of animal-based products uses one-third of the total water footprint of agriculture globally, with the average water footprint per calorie of beef 20 times higher than that of cereals and starchy roots.⁷⁹⁹ Livestock systems play an important role in many developing countries in nutrition, poverty alleviation and income diversification. Animal-based foods provide a concentrated source of some vitamins and minerals that are particularly valuable to young children in developing countries whose diet is otherwise poor.⁸⁰⁰ Furthermore, studies have demonstrated large benefits from modest increases in meat in the diets of the poor in sub-Saharan Africa.⁸⁰¹ However, among populations who consume high amounts of protein and animal-based foods, particularly in developed countries (see Figure 23), shifting to diets with a greater proportion of plants presents a huge opportunity to improve health and wealth and reduce the environmental impacts.

Figure 23
Protein Consumption Exceeds Average Estimated Daily Requirements in all the World's Regions and is Highest in Developed Countries.



Source: Ranganathan, J., et al., 2016.⁸⁰²

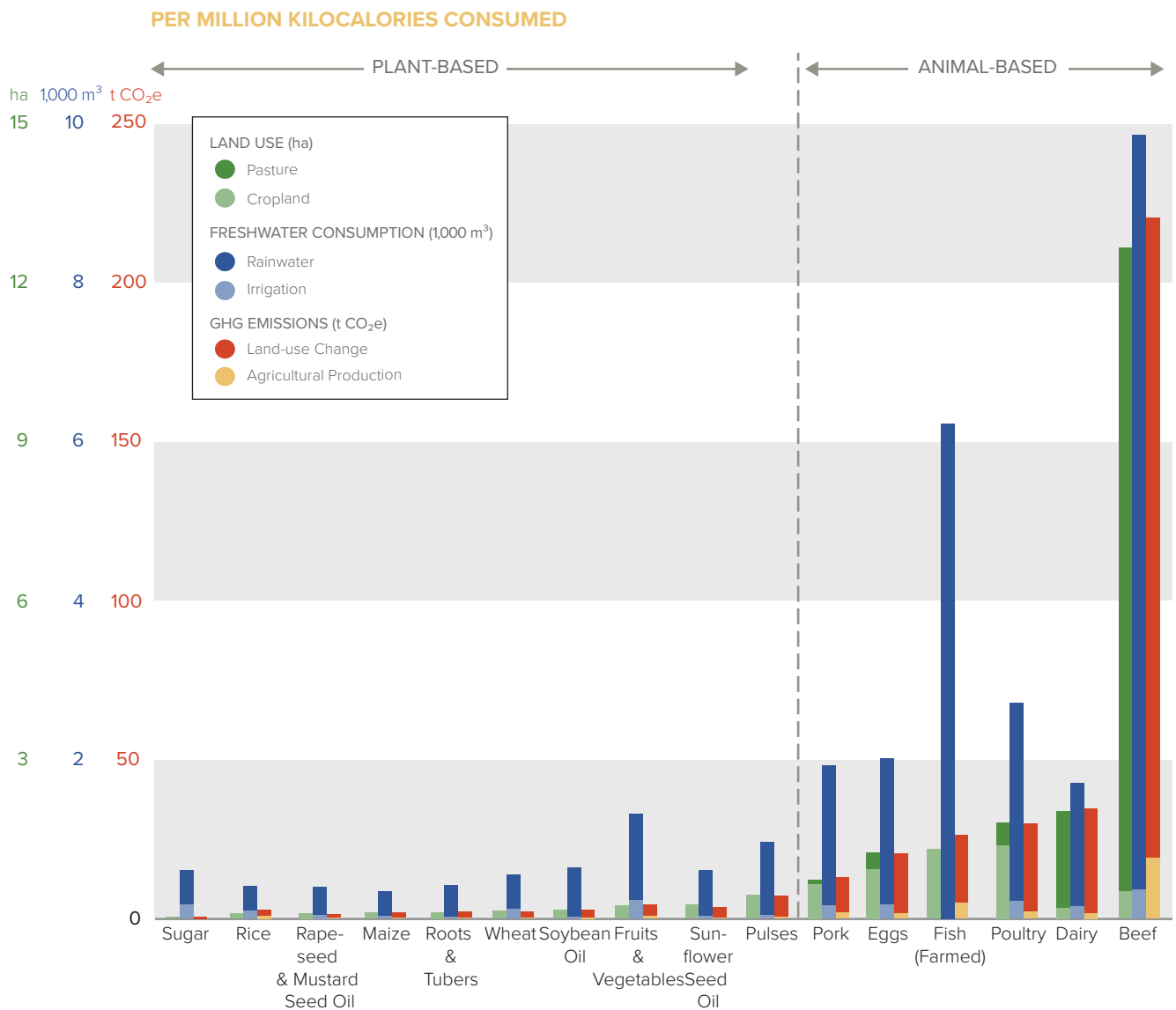
Evidence of the Benefits

Shifting the diets of populations who consume high amounts of animal-based foods toward plant-based foods—and especially away from beef—could result in global health-related cost savings of almost US\$1 trillion per year by 2050.⁸⁰³ Consumer shifts towards plant-based protein offer investors and companies significant market opportunities. Alternative protein could constitute a third of the global protein market by 2050,⁸⁰⁴ representing a huge new market opportunity.

Shifting diets could also release 150–640 million ha of agricultural land, avoiding future emissions related to changing land use of 37–168 GtCO₂e.⁸⁰⁵ Even

relatively small dietary shifts can have a big impact. Scenarios developed by WRI show that reducing an average American’s combined meat/dairy/fish/egg consumption by 50% nearly halves both the land needed to feed each person and agricultural GHG emissions—almost as big a reduction in both as the land and emissions reductions associated with a complete vegetarian scenario.⁸⁰⁶ This surprising result is due to two facts: First, production of animal-based foods accounts for more than 80% of the land use and GHG emissions associated with the average American diet; and second, that vegetarians tend to replace a significant amount of their foregone meat consumption with dairy, a relatively high-impact food.⁸⁰⁷

Figure 24
Comparative Resource Intensity of Animal Versus Plant Products.



Source: Ranganathan, J., et al., 2016.⁸⁰⁸

Challenges

As incomes rise between 2010 and 2050, demand for all animal-based food is expected to rise by 68%, and for beef and other ruminant meats by 88%.⁸⁰⁹ Typical strategies to shift diets rely on nutrition labelling or public health campaigns about the benefits of different food types or diets. However, evidence suggests that consumers do not regularly check labels when buying food.⁸¹⁰ Actual consumption shifts, for example from caged to free-range eggs and from higher- to lower-alcohol beer in the United Kingdom, or the shift away from shark fin in China, show that collective, collaborative efforts are needed, using tailored marketing approaches informed by behavioural economics. WRI's Better Buying Lab found that simple nudges, like the way vegetarian dishes are presented on a menu, could double sales of these dishes.⁸¹¹

Furthermore, government policies often conflict with each other, slowing progress towards better consumption patterns. For example, current agricultural subsidies that benefit beef production in Brazil include concessional loans, insurance for lost income, and tax exemptions. Similarly, US federal agricultural subsidies focus on corn, soybeans, wheat, rice, sorghum, dairy, and livestock, a large proportion of which are converted into high-fat meat and dairy products, refined grains, high-calorie beverages, and processed and packaged foods.⁸¹² Livestock subsidies in OECD countries amounted to US\$53 billion in 2013, and pork subsidies in China exceeded US\$22 billion in 2012.⁸¹³ Powerful lobby groups can at times be behind misaligned government policies. For example, the US government's 2015 Dietary Guidelines for Americans conspicuously lacked recommendations to reduce consumption of red and processed meat, which critics have blamed on powerful meat lobby groups.⁸¹⁴ Manufacturers, distributors, and retailers have powerful vested interests to sell the food that consumers want—including food high in sugar, processed meat, and saturated fats.

The issue of sustainable and healthy diets in the urban context is directly linked to broader concerns about urban poverty, food distribution, affordability, income, and governance (see also Section 2.B). Much of the world's food is sold, distributed and consumed through informal distribution systems. Slum dwellers face particular challenges in finding the time to secure access to and then prepare healthy food.⁸¹⁵ For example, 38% of Kenya's urban populations were found to be chronically food insecure.⁸¹⁶ Ultimately,

providing a better and healthier diet to the world's population will also require a concerted focus on the way that food is distributed to and packaged for consumers in cities, in order to ensure that nutritious food is affordable and available to all.

Accelerators

- **National governments' dietary guidance and public health campaigns should highlight health and sustainability and incorporate behavioural economics to encourage consumer choices.** Guidelines that set a clear recommended limit on meat consumption promote sustainability, even when health is the driver. As of 2016, Germany, Brazil, Sweden, and Qatar all included sustainability in their national dietary guidelines.⁸¹⁷ China's dietary guidelines advise individuals to limit meat consumption for their health.⁸¹⁸ More governments can follow suit in their dietary guidelines and support public health campaigns that are informed by marketing and behavioural economics to educate people about their protein requirements and the health benefits of switching, where appropriate, from red meat to other forms of protein or to more plant-based foods.
- **National and sub-national governments should use a combination of policies and collaborate with food chain stakeholders to positively influence population diet and health.** As a first step, policy measures may seek to encourage healthier food choices, for example by providing education on nutrition or subsidising specific food products. Government should also discourage unhealthy food choices and stimulate a food systems response to the problem of unhealthy diets using a wide range of techniques to improve the likelihood of success. This may take the form of voluntary collaboration with the industry regarding food labelling, formulation or portion size or of mandatory measures such as health-related taxes.⁸¹⁹ For example, this year, the US Food and Drug Administration implemented regulations requiring caloric information to be listed in all chain restaurant menus and vending machines.⁸²⁰
- **Food manufacturers, retailers, and service companies should increase investment in developing and marketing alternative protein products.** By increasing the number of vegetarian or plant-forward options among

their products, food companies can enter new markets. Pret-a-Manger has launched a “Not Just for Veggies” campaign and seen sales grow (see Box 31). Company menus in the United States at Google, Stanford University, Sodexo, and Sonic now include the blended burger patty: a mix of 70–75% beef and 25–30% mushroom.⁸²¹ This practice could be scaled to other countries and companies, as well as to publicly funded canteens (for example, in schools and offices for civil servants).

- **Shareholders and lobby groups should put pressure on companies to develop and offer more sustainable food products.** Investors and companies should be concerned about the investment opportunities in alternative proteins and financial risks associated with unsustainable food production. Investors are increasingly starting to factor these considerations into their investment decisions (see Box 37). For example, as a shareholder in Tyson Foods, investment manager Green Century Capital Management called for business plans from the company to meet growing demand for plant-based protein in 2016.⁸²² While many factors may have influenced investing decisions, Tyson subsequently invested in the plant-based protein producer Beyond Meat, which now has products in 19,000 supermarkets across America and plans to triple production.⁸²³ Valuable investment opportunities in disruptive technologies include synthetic leather, alternative protein production, aeroponics, vertical farming systems, and plant nutrient management and delivery.⁸²⁴

3.E. Waste Not, Want Not: Reducing Food Loss and Waste

One third of all food produced is lost or wasted along the food chain, costing the global economy an estimated US\$940 billion⁸²⁸ and causing about 8% of global GHG emissions.⁸²⁹ If food loss and waste were a country, it would rank as the third top emitter after the United States and China.⁸³⁰ Reducing food loss and waste offers a huge opportunity to generate economic savings for farmers, businesses, and consumers; improve food security; reduce GHG emissions; and improve climate resilience. Economic and social benefits include reducing the likelihood of smallholders becoming net food buyers, increasing the return on investment of time spent farming and the total time needed to work in fields, and raising overall productivity levels. Women are particularly critical to success: In addition to women constituting over 40% of the agricultural workforce,⁸³¹ surveys worldwide indicate that women are still responsible for 85–90% of the time spent on household food preparation.⁸³²

In 2015, the world committed to halve food loss and waste by 2030 (SDG12.3). The group Champions 12.3 is a coalition of executives from governments, businesses, international organisations, research institutions, and civil society dedicated to inspiring ambition, mobilising action, and accelerating progress toward achieving this goal. Their three-step approach—“target, measure, act”—provides a framework for governments and companies around the world to tackle food waste and loss reduction. In 2016, the first global food loss and waste accounting and

Box 37

FAIRR Helps Investors to Assess Risks and Opportunities in Intensive Livestock

Farm Animal Investment Risk and Return (FAIRR) is an investor network including groups such as AEGON Asset Management, AVIVA, and Green Century Funds. It works to put factory farming on the Environmental, Social, and Governance agenda by informing members of the material investment risks connected with intensive livestock farming and helping them to assess these as part of their investment processes. Risks range from potential regulations to price externalities (including deforestation) and shifts in consumer demand towards alternative, plant-based proteins.⁸²⁵ FAIRR also highlights investment opportunities in meat alternatives. The global plant-based protein market has been forecast to grow from US\$8.35 billion in 2016 to US\$14.22 billion by 2022.⁸²⁶ FAIRR’s 2018 report, “Plant-based Profits: Investment Risks and Opportunities in Sustainable Food Systems” evaluated 16 multinational companies (including General Mills, Kraft Heinz, Mondelez International, and others) on how well-prepared they were to profit from this hugely promising growth in demand for plant-based proteins.⁸²⁷ FAIRR contends that by equipping investors with the knowledge they need to better assess companies, they will make more successful—and sustainable—investment decisions.

reporting standard was created by the Food Loss and Waste Protocol partnership.⁸³³ Food loss and waste reduction efforts have been launched by the Consumer Goods Forum, the African Union, and Waste and Resources Action Programme (WRAP) in the United Kingdom, and they continue to create considerable momentum. However, rapid urbanisation and the growth of supermarket chains in low- and middle-income countries are fuelling food waste in their urban centres, while at the same time rates of food loss in production, handling, and storage remain high in these countries.⁸³⁴ Meanwhile, the factors driving household waste in developed countries continue to push it up: UK household food waste increased from 7 million tonnes to 7.3 million tonnes between 2012 and 2015.⁸³⁵

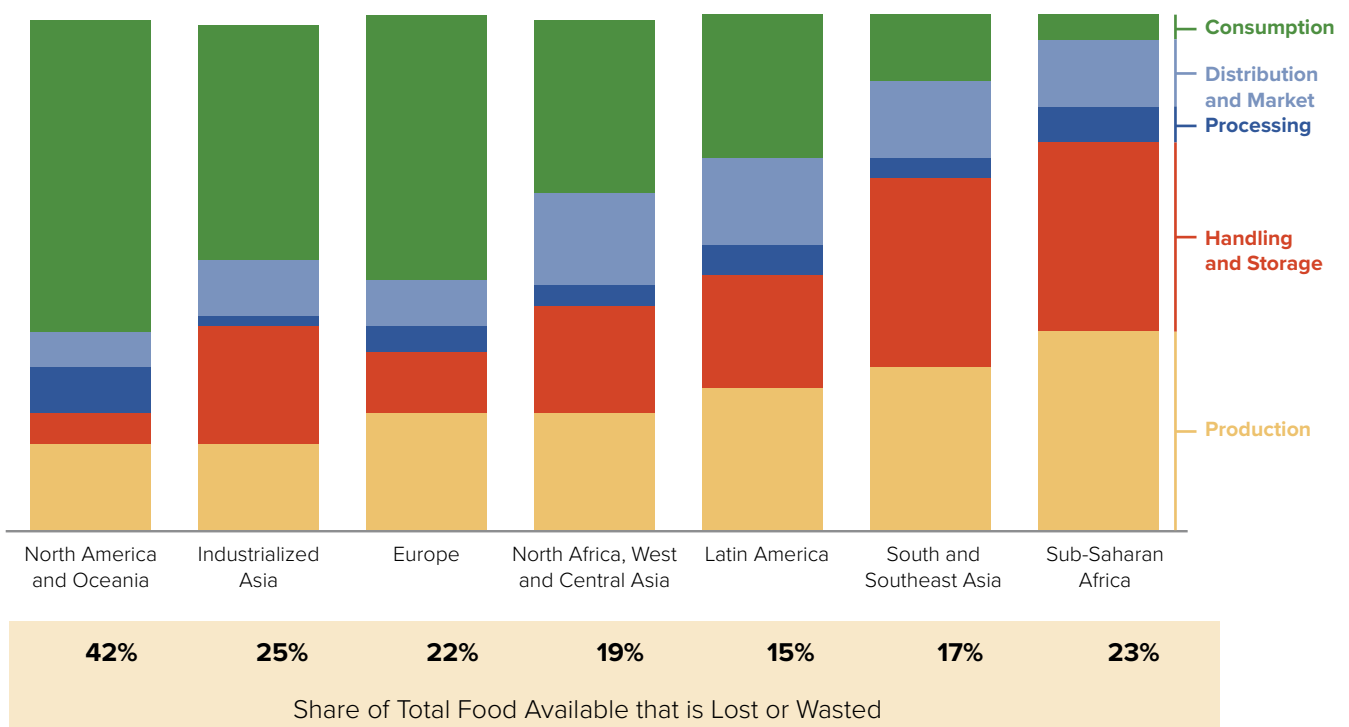
Evidence of the Benefits

In 2016, the Business and Sustainable Development Commission found that global opportunities to reduce food waste in the pre-consumer value chain could be worth US\$155 billion a year by 2030, and opportunities for reducing consumer food waste could be worth a further US\$175 billion.⁸³⁶ The Champions 12.3 review of nearly 1,200 business sites across 700 companies and 17 countries found that 99% of the sites earned a positive return on investment in activities to

reduce food loss and waste, with a median benefit-cost ratio of 14:1. The sectors showing the largest returns were hospitality and workplace canteens.⁸³⁷

Saving one quarter of the food currently lost or wasted would be an amount equivalent to enough to feed 870 million people annually— around 65 million more people than currently go hungry.⁸³⁸ Globally, the amount of crop calories needed to meet rising demand for food, animal feed, and bioenergy is expected to increase by 56% between 2010 and 2050.⁸³⁹ Halving food loss and waste would reduce the size of the gap between food availability in 2010 and projected need in 2050 by more than 20 percentage points.⁸⁴⁰ Losses near production are more prevalent in developing regions while food waste near consumption is more prevalent in developed regions (see Figure 25). In developing countries, increasing investment in processing, packaging, and distribution technologies would unlock considerable rewards on food security because many of these countries are net food importers rather than exporters.⁸⁴¹ For all countries, but particularly for developed countries, setting targets for national food waste reduction, educating consumers, improving retail forecasting, and standardising food labelling would increase resource efficiency and deliver savings for both consumers and companies.⁸⁴²

Figure 25
The Majority of Food Waste Occurs in Developed Countries, Whereas Food Loss is the Biggest Problem in Developing Economies.



Source: Champions 12.3, 2017.⁸⁴³

Reducing food waste also has clear benefits for climate change mitigation. WRAP estimated in 2015 that 7.3m tonnes of household food waste was thrown away each year. The avoidable food waste generated 19 million tonnes of GHG emissions over its lifetime—equivalent to taking one in four cars off UK roads.⁸⁴⁴ In developing countries, where climate change increasingly threatens the resilience of crops and food security, reducing food loss is an important lever to build resilience by securing the supply of food and thus adapting to climate change.⁸⁴⁵

Challenges

The key challenge to reducing food loss in developing countries is a lack of sufficient handling and storage. Lack of cold-chain storage is a critical cause of food perishing post-harvest: Most degradation processes leading to loss in colour, nutrients, and textural quality double their rate for each increase in 10°C.⁸⁴⁶ The lack of handling, packaging, and storage includes insufficient post-harvest storage facilities or basic

on-farm storage technologies. This challenge is compounded by limited training and availability of investment to build skills and infrastructure to develop the required infrastructure. Furthermore, unreliable access to markets, in part due to insufficient transport infrastructure, and weak government policy also exacerbate the challenge of reducing food loss and waste in developing countries.

A study of cassava processing in Nigeria, Ghana, and Vietnam suggests that investments in new machinery could reduce post-harvest losses by 44%.⁸⁴⁷ Some promising storage technology solutions are emerging but will require investment to go to scale (for example, see Mumbai's sustainable chillers, in Box 38).⁸⁴⁸ Introducing new service delivery models, such as centralised farmer managed facilities to better dry grain, weigh, pack, and store are being trialled for maize growers in Kenya. Motorised, movable driers are able to cover at least three to four neighbouring centres where storage sheds hold dried grain before it is sold.⁸⁴⁹

Photo credit: Flickr: Ollivier Girard/CIFOR



Box 38 Rolling Out Sustainable Chillers in India

Companies like Mumbai-based cold chain technology start-up TESSOL have developed solar-powered cold storage units to try to reduce the losses in storage and crop protection. US\$19.4 million is wasted in India on a daily basis only due to rejection at the farm and delays in the distribution process.⁸⁵⁰ These solutions reduce the running costs of these units by 60% and reduce diesel consumption by 1,000 litres per small vehicle per annum.⁸⁵¹

Over the last two years, TESSOL has implemented its fuel-free technology across poultry, horticulture, dairy, and frozen food sectors with some of the key players in India, including Godrej, Tyson, Abad Fisheries, Mother Dairy, Chitale, and Fortis hospitals.⁸⁵² Yet technologies like these are still nascent in India. Given that Indian farmers face a critical lack of access to suitable on-farm storage facilities and packaging materials, investing in a range of innovative technology companies has the potential to radically reduce post-harvest losses across India and strengthen supply-chain efficiency.⁸⁵³

A series of factors contribute to high levels of food waste in developed countries, where 56% of global food waste occurs.⁸⁵⁴ Relatively low food prices can mean there is little incentive to prevent waste: WRAP suggests that one cause of increased household waste in the United Kingdom between 2012 and 2015 was a decline in food prices in 2013.⁸⁵⁵ Confusing food labelling can also contribute to food waste. Without storage recommendations, consumers can miss opportunities to preserve their foods for longer. Consumers can mistake 'sell by' or 'best before' dates, which are measures of quality, with 'use by' dates, which are measures of safety. In doing so, consumers can waste food that is still safe and nutritious. In some countries, government regulations around health and liability can hinder food donation or other efforts to repurpose food before it is wasted.⁸⁵⁶ Another challenge is a culture of large portions, resulting in unnecessary leftovers.

Accelerators

- **National and local governments should set food loss and waste reduction targets and systematic measurement procedures, and then implement policies to reduce waste.** At its core, reducing food loss and waste is about efficiency. In developed countries, governments should also support entities and initiatives that educate consumers, such as WRAP in the United Kingdom. With the support of government funding, WRAP engages with governments, food and drink retailers, manufacturers and trade bodies to improve resource efficiency. Governments can make laws that encourage and enable companies to avoid throwing food away, engage with food industry initiatives to set targets and accelerate action, and work with partners to run consumer education campaigns. Governments can also consider policies like tax incentives (encouraging food donations and reducing recovery costs), liability protections, changing labelling and food safety, organic waste bans, and waste recycling laws.
- **Governments, DFIs, and the private sector should increase on-farm and food supply-chain infrastructures investment in developing countries.** Basic technologies, such as plastic storage bags, small metal silos, and plastic crates, can significantly reduce food losses and waste in storage and transport.⁸⁵⁷ Pilot efforts in Benin, Cape Verde, India, and Rwanda have documented reductions of food loss by more than 60% during field trials of a variety of low-cost storage techniques and handling practices.⁸⁵⁸ Increasing adoption of post-harvest loss technologies often depends on government-led investments to improve infrastructure (such as access roads), which also improves access to profitable storage technologies. However, private-sector companies are increasingly demonstrating that reducing post-harvest losses represents new market opportunities and viable parts of their business models.

- **Food retailers, manufacturers, and governments should standardise labelling practices by 2020 and inform consumers.**⁸⁵⁹ Consumer confusion about the meaning of date labels, or seeing multiple date labels on a product, can result in consumers throwing away food that they could safely eat. Standardising labelling could save consumers up to US\$29 billion annually in the United States alone.⁸⁶⁰ In 2017, the Board of Directors of the Consumer Goods Forum unanimously adopted a Call to Action to streamline and standardise food date labels worldwide by 2020. By meeting this commitment, companies (and consumers) can realise economic benefits at a global scale. Governments where date label rules are in place can further accelerate action by reforming regulations to support this Call to Action.
- **Governments, companies, and civil society groups should strengthen actions to increase public awareness and shift consumers' and companies' behaviour.** Increasing consumers' awareness and teaching them the skills to store and prepare their food better can help them reduce household waste. Connecting food producers with surplus food to charities and individuals in need is an important and efficient way of rebalancing local and national food systems. Advocacy campaigns are another important way for civil society to bring the issue of food loss and waste into mainstream conversation and encourage governments and businesses to lead in driving change (see Box 39). Supermarket TESCO was the first company to publicly disclose its supply chain waste and has received significant acclaim for its transparency in doing so.⁸⁶¹

Box 39 Surplus becomes Sustenance in Sydney and Beyond

After noticing the huge volume of food going to waste in the hospitality industry where she worked, Ronni Kahn founded OzHarvest in 2004. Starting with a truck in Sydney, Australia, Ronni delivered surplus food from shops and restaurants to charities supporting people in the area. Four thousand meals were donated in the first month. Today, OzHarvest works nationally, rescuing over 1,000 tonnes of food per week from over 3,000 food donors, including supermarkets, restaurants, catering companies, hotels, airports, farmers shopping centres, delis, cafes, film and TV sets, and board rooms.⁸⁶² OzHarvest aims to nourish the country and enable positive change, in particular among vulnerable people.

Since starting in 2004, OzHarvest has delivered 78 million meals, saved 26,000 tonnes of food and built a network of 1,000 charities that it serves.⁸⁶³ OzHarvest successfully advocated for changes in civil liability and health legislation that prevented food donors from giving away free food without fear of liability: The laws on food donation were changed in four of Australia's states. Training and education programs help to change the broader conversation around food loss and waste, as well as helping vulnerable people to improve their nutrition.