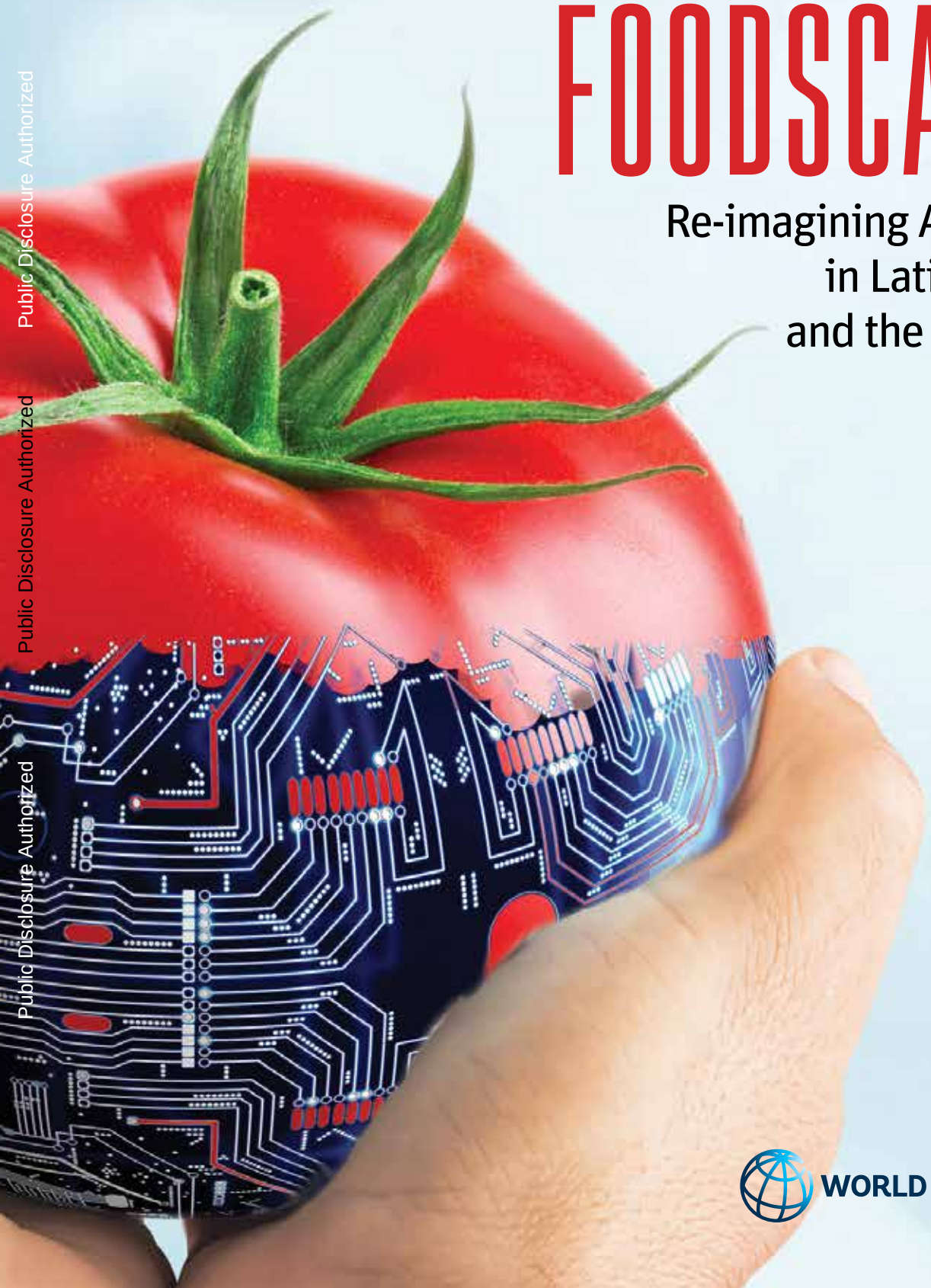
FUTURE FOODSCAPES

Re-imagining Agriculture in Latin America and the Caribbean



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Re-imagining Agriculture in Latin America and the Caribbean

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Foreword

What happens in Latin American and Caribbean farms, food processing facilities, supermarkets, and beyond has important implications both locally and globally. The region's agri-food systems make vital contributions to a diverse set of development objectives, including growth and trade promotion, poverty reduction, food and nutrition security, and climate resilience. Furthermore, because Latin America is the world's largest net food exporter, the region's agri-food systems can help lower and stabilize international food prices, bringing benefits to consumers everywhere. And because the region is home to vast forests and extensive savannahs, it plays a critical role in shaping global weather patterns and mitigating climate change. In a sense, Latin America and the Caribbean region are the world's breadbasket and lungs.

The region will continue to produce these benefits, however, only if its agri-food systems evolve in ways that avoid threats and capitalize on opportunities. In the past, the role of agriculture was seen mainly as producing enough food, feed, and fiber to meet the consumption needs of people and animals. Today, agri-food systems are expected to contribute to multiple objectives. If the complex trade-offs between growing the economy, reducing poverty, feeding the population, and preserving vital ecosystems are not managed successfully in Latin America and the Caribbean, the cost to the world will be extremely high.

With the population of LAC projected to grow from around 625 million in 2010 to around 750 million by 2030, demand for food, particularly animal-based food, is expected rise significantly. Rising food demand within the region will be accompanied by rising food demand in export markets. Meeting this demand in a sustainable way will be a huge challenge. Countries in the region will need to observe ongoing trends carefully, consider the many drivers that could influence future outcomes, anticipate possible future scenarios, and take appropriate actions to seize emerging opportunities and ward off potential challenges.

Up until now, the region has been slow to respond to changes in the global environment. Many food system actors continue to rely on centuries-old production methods that were appropriate in the past but that today are outdated, inefficient, and harmful to people and to the environment. Clearly, business as usual is not an option. This report seeks to enhance understanding of how agri-food systems in Latin America and the Caribbean region can contribute to growth, employment, and food and nutrition security, while sustaining global and regional natural capital endowments. The report is forward looking, examining what is apparent in the road ahead and anticipating also what may be waiting over the horizon. It explores how long-term trends and short-term disruptors could affect the future performance of the sector, and it identifies 20 proposed actions that can be taken to facilitate the emergence of a dynamic, productive, and sustainable food future.

Fortunately, there is still time to change the current paradigm. Demand for agricultural commodities, within the region and beyond, is growing, providing a reliable market for future generations of producers. At the same time, it is becoming clear that the agri-food sector can and must help stem greenhouse gas emissions to help slow global warming. This will mean increasing productivity—rather than expanding farmland—in order to preserve the vital role of forest landscapes. Meanwhile, technological advances are ushering in new, more efficient, and more environmentally friendly ways to produce, process, distribute, consume, and recycle food. The tectonic shifts taking place also hold the potential for creating a new generation of better quality jobs in agri-food systems.

So what is needed to ensure economically remunerative and resilient future foodscapes in Latin America and the Caribbean region? Answering this question is not easy. This report identifies impactful drivers and describes key actions that countries in the region can take to help ensure adequate food for all, without destroying the planet.

Carlos Felipe Jaramillo
Vice President, Latin America and the Caribbean Region

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Abbreviations

ABC	agricultura baixo carbono (low-carbon agriculture)
AOI	Agricultural Orientation Index
ASF	animal-source foods
BT	budget transfer
CARDI	Caribbean Agricultural Research and Development Institute
CATIE	Agronomic Center for Research and Education
CFS	Committee on World Food Security, United Nations
CGE	computable general equilibrium
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
Cread	Climate Resilient Execution Agency (Dominica)
CSA	climate-smart agriculture
CSE	Consumer Support Estimate
DFID	Department for International Development (United Kingdom)
DLT	distributed ledger technologies
ESI	Export Similarity Index
FAFH	food consumed away from home
FAO	Food and Agriculture Organization, United Nations
FLW	food loss and waste
FTE	full-time equivalents
GAP	good agricultural practices
GDP	gross domestic product
GEF	Global Environmental Facility
GHG	greenhouse gas
GMP	good manufacturing practices
GSSE	General Services Support Estimate
HLPE	High Level Panel of Experts on Food Security and Nutrition
ICT	information and communication technology
IDB	Inter-American Development Bank
IFPRI	International Food Policy Research Institute
IICA	Inter-American Institute for Cooperation on Agriculture
INIAF	National Institute for Agricultural and Forestry Research Innovation (Bolivia)
INSP	National Institute of Public Health (Mexico)

IoT	internet of things
IPCC	Intergovernmental Panel on Climate Change
ITPS	Intergovernmental Technical Panel on Soils
IUCN	International Union for Conservation of Nature
LAC	Latin America and the Caribbean
LUCF	land use changes and forestry
M&A	merger and acquisitions
MAD	minimum acceptable diet
MCP	marginal cost pricing
MDD	minimum dietary diversity
MFD	Mobilizing Finance for Development
MIRAGE	modeling international relations under applied general equilibrium
MPS	market price support
NBS	nature-based solutions
NDC	nationally determined contributions
NPC	nominal protection coefficient
OECD	Organization for Economic Co-operation and Development
PPP	public-private partnership
PROCI	Cooperative Technology Development Programs
PSE	Producer Support Estimate
PTA	preferential trade agreements
R&D	research and development
SDG	Sustainable Development Goals
SME	small and medium enterprises
SOE	state-owned enterprises
SPEED	Statistics of Public Expenditure for Economic Development
SPS	sanitary and phytosanitary
SSP	shared socioeconomic pathways
TFP	total factor productivity
TNC	The Nature Conservancy
TSE	Total Support Estimate
UNDESA	United Nations Department of Economic and Social Affairs
UPA	urban and peri-urban agriculture
WTO	World Trade Organization

Photo: Brazil. Diego Sene.

Executive Summary

Agriculture and food systems in Latin America and the Caribbean Region (LAC) are rightfully recognized as among the most successful on the planet: they have fed a fast-growing population, facilitated economic development, enabled urbanization, generated substantial exports, and helped drive down global hunger and poverty. Yet despite these significant contributions, the public image of the region's agriculture and food systems as dynamic, productive, and efficient reflects only part of a more complicated reality. The impressive achievements have come at the expense of significant environmental and health costs. LAC agriculture uses over one-third of the region's land area, consumes nearly three-quarters of the region's fresh water resources, and generates almost one-half of the region's greenhouse gas emissions. And despite the consistent food production surpluses, millions of people in LAC regularly go hungry or suffer from malnutrition and related diseases. In short, the region's successes in feeding the population and exporting food to the rest of the world are exacting high costs on people and on the environment.

These challenges are very real, but convincing policy makers to address them will not be easy. The declining visibility of farming and ranching in a region that is rapidly urbanizing has contributed to the perception that agriculture has lost importance and that attention can safely shift to other priorities. This perception is misguided, because the role played by agriculture has not diminished. On the contrary, agriculture and food systems make vital contributions to a diverse set of development objectives, including growth, poverty reduction, food and nutrition security, and climate resilience. If agriculture and food systems in LAC continue to underperform, it will not be possible to meet the region's development goals.

What happens in LAC agriculture and food systems matters within the region, but it also matters worldwide, for two reasons. First, Latin America and the Caribbean is the world's largest food net exporting region, and LAC food exports help to lower and stabilize international food prices, bringing benefits to consumers everywhere. In early 2020, the novel coronavirus (COVID-19) pandemic sparked an unprecedented humanitarian and economic crisis that threatened lives and livelihoods around the world and highlighted the fragile nature of the relationship between the planet and those who inhabit it. Disruptions to global food supplies linked to the pandemic drew attention to the importance of LAC as a major net exporter of food and pointed to new opportunities for promoting greater intra-regional economic cooperation, in terms of production, trade and technology.

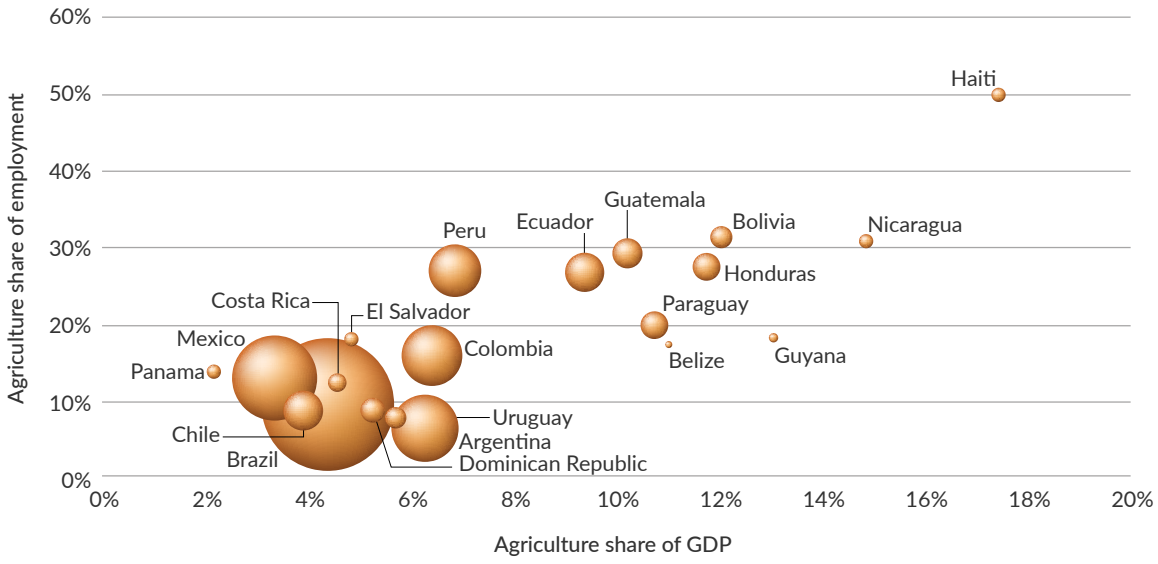
Second, LAC is the world's largest producer of ecosystem services, and its vast forests and extensive savannahs play a critical role in shaping global weather patterns and mitigating climate change. Latin America and the Caribbean will continue to produce these two global public goods only if the region's agriculture and food systems evolve in ways that avoid threats and capitalize on opportunities. Moreover, pursuing these two global public goods is likely to require trade-offs: feeding a larger and more affluent world population may require converting more natural habitats to agricultural production, and this will lead to additional carbon emissions, resource depletion, and biodiversity loss. While the actions needed to manage these trade-offs will vary from country to country, the tension between preserving vital ecosystem services and maintaining the stability of food supplies will demand attention at the national and global level. Failing to strike the right balance between ensuring economic growth, fighting poverty, combating hunger and malnutrition, and preserving resilient ecosystems will impose an unacceptably heavy cost and jeopardize achievement of the World Bank Group's twin goals of eliminating poverty and promoting shared prosperity.

Taking stock: How are Latin American and Caribbean agriculture and food systems performing?

Latin American and Caribbean agriculture and food systems are very diverse, and there is enormous variation among the region's countries in terms of their scale, sophistication, and economic importance. Conversations about agriculture in the region often distinguish between four groups of countries based on size, location, ecological and climatic characteristics, and agricultural economies: (1) Mexico and Central America, (2) the Caribbean States, (3) the Andean Zone, and (4) the Southern Cone (including Brazil). These groupings may be intuitive, but they gloss over many important features. The heterogeneity that exists among LAC countries in terms of size, location, agro-ecology, and stage of economic development is paralleled by equally pronounced heterogeneity among these countries' agriculture and food systems. While the food system in every LAC country is in some respects unique, almost all food systems tend to pass through similar developmental stages. Three types of food systems are distinguished in this report: (1) traditional, (2) transitional, and (3) integrated. In most LAC countries, all three types are present, although their relative importance varies.

In the past, the role of agriculture in Latin America and the Caribbean was seen mainly as producing enough food, feed, fiber, and fuel to meet the consumption requirements of people and animals. That view is now outdated. Today, agriculture and food systems in the region are expected to contribute to multiple objectives that go far beyond the production of primary commodities. Among these multiple objectives, four stand out. Today, LAC's agriculture and food systems are expected to contribute to: (1) economic growth and diversification, (2) employment and poverty reduction, (3) food security and improved nutrition, and (4) climate-resilient ecosystem services.

Economic growth and diversification: The importance of agriculture as a driver of economic growth and a source of diversification depends on three factors: (1) the size of the agricultural sector within the larger economy, (2) the rate of growth of the agricultural sector, and (3) the extent to which



Size of the bubble = Agriculture GDP (US$ billions, 2010 constant dollars)

Figure ES1. Contribution of primary agriculture to GDP and employment, LAC countries

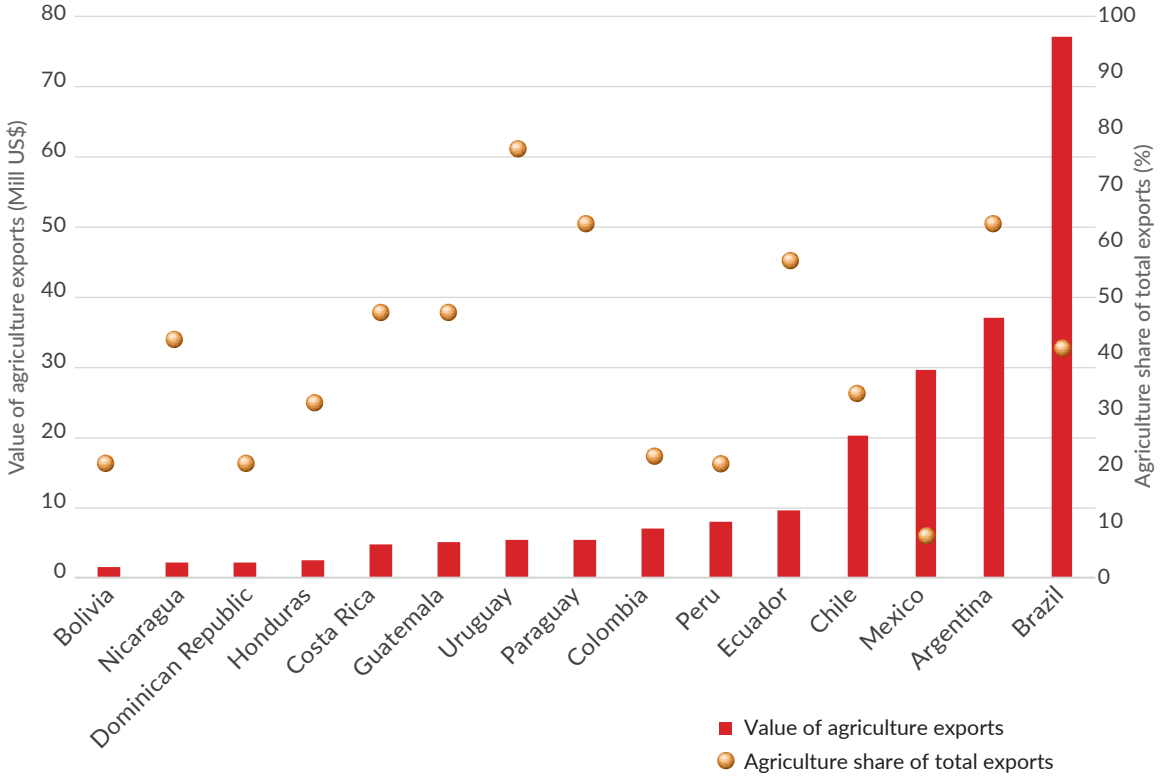
Source: World Development Indicators database, World Bank.

growth in agriculture stimulates growth in other sectors through linkages. The larger the sector as a share of the economy, the faster the growth in the sector, and the stronger the linkages, the larger the contribution to the overall economy. Agriculture remains important in the region, accounting for more than 5 percent of GDP in approximately 20 countries. The conventional way of measuring the sector's contribution results in an underestimate, however, because when forward and backward linkages and the associated multiplier effects are taken into account, the impact of the agricultural sector and its contribution to growth and poverty reduction are much larger. Studies on sectoral growth multipliers (designed to estimate how much overall GDP growth is generated by GDP growth in a particular sector) have consistently found large, positive linkages associated with primary agriculture. In LAC as in other regions, this is especially relevant for more developed economies. Recent studies have shown that in 2007, 2008, and 2012, the most recent years for which disaggregated input-output matrices are available, primary agriculture contributed 7.3, 3.8, and 2.9 percent, respectively, to overall value added of GDP in Peru, Chile, and Mexico (World Bank 2017c; Foster and Valdés 2015; World Bank 2017b). But when forward and backward linkages were taken into account, the share of value added of GDP accounted for in the three countries by the overall agri-food system rose to 11.3, 6.4, and 11.9 percent, respectively. This shows that agricultural development—normally accompanied by the emergence of dynamic and increasingly sophisticated integrated agri-food value chains—contributes significantly to the dynamism of the overall economy.

In the many LAC countries that are net exporters of agricultural products, the agriculture sector assumes additional importance through its role as an important source of foreign exchange. The absolute value of agriculture exports is highest in the super-exporters—Brazil, Argentina, Mexico, and Chile—but in many other countries even if the absolute value of agricultural exports is modest, agricultural exports still make up a significant share of total exports.

Figure ES2. Agriculture export value and share of total exports, selected LAC countries, 2016

Source: WTO Global Trade database.



Employment and poverty reduction: Agriculture contributes to poverty reduction by providing jobs for large numbers of people, many of them poor. Because LAC is more urbanized than other developing regions, the share of the total labor force employed in primary agriculture is lower there, but agriculture remains an important source of employment. Modernization of agri-food systems means less employment in primary production, but more—and often better quality—employment downstream in the value chain. When agricultural employment is calculated broadly by considering all jobs in the larger food industry, the contribution of agri-food increases substantially, accounting for an additional 10 to 15 percent of all jobs. Changes in the number of agriculture-linked jobs are accompanied by changes in the composition of those jobs. As the food system transforms and modernizes, jobs in primary agriculture decline in relative importance, while jobs in food services and agri-food manufacturing make up a growing share. The skills demanded from jobs in the food system also evolve as economies develop. Agri-manufacturing and food services jobs found in more developed countries are more likely to require non-routine cognitive labor (such as that performed by highly skilled professional service workers) and non-routine manual labor (performed by other service workers). Evidence presented in this report challenges the conventional view that other sectors offer more attractive income-generating opportunities for low-skill workers who leave agriculture. On average in LAC, when a worker decides to leave agriculture, moving to the service sector (e.g., hotels and restaurants) yields very little gain, and the rapidly growing service sector is actually the least lucrative sector to join. In the most developed LAC countries, the wage gains to workers leaving agriculture are very limited, and in the case of Brazil, where the flourishing agri-food sector provides many high paying employment opportunities, the opposite is usually true—workers who leave agriculture earn much less on average.

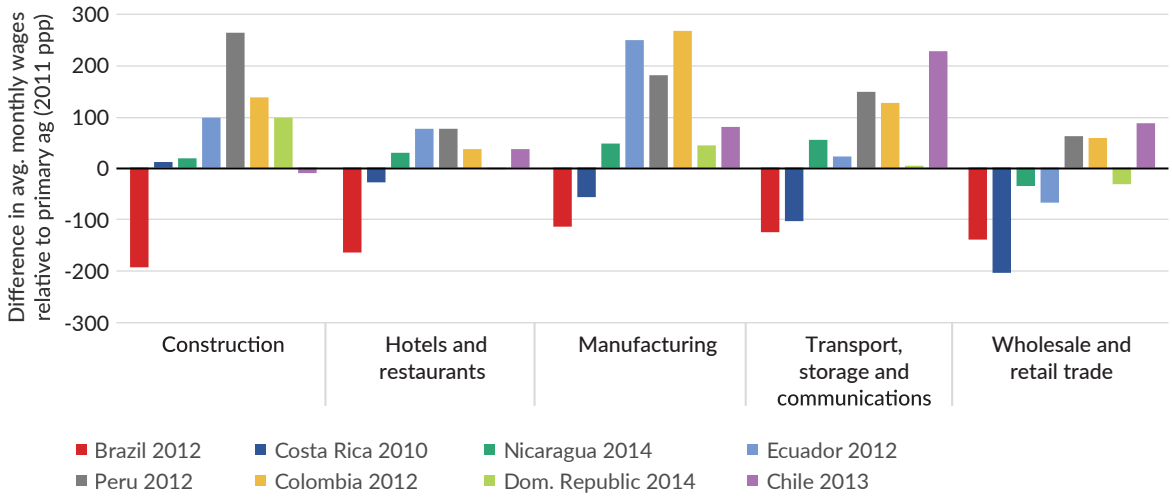


Figure ES3. Differences in average wages of low-skill workers, agriculture vs. other sectors

Source: SEDLAC Labor Force Surveys.

Food and nutrition security: Primary agriculture in Latin America and the Caribbean has grown rapidly over the past 25 years in response to rising domestic and foreign demand. Today, LAC accounts for a larger share of global agricultural production than the European Union or the United States plus Canada, and it has emerged as the world's leading net food-exporting region. Regional and global demand for food, feed, fiber, and fuel will continue to grow, propelled by growing populations, rising incomes, and shifting diets. In the face of these global demographic trends, the world's farmers and livestock producers will need to produce some 60 percent more food in 2050 than in 2006 (Alexandratos and Bruinsma 2012). LAC is expected to play an important role as the world's largest net food exporter, supplying food in a sustainable manner and contributing to lower global food prices. But just how well are food systems catering to the nutrition security of the population? While most people in the region are consuming adequate quantities of food, many are not consuming the right types of food. As a result, LAC suffers from the so-called triple burden of malnutrition, defined as the coexistence of undernutrition, overweight and obesity, and micronutrient deficiencies. LAC's populations are the most overweight in the world, and micronutrient deficiencies have contributed to a rise in diet-related health problems that often are reflected in noncommunicable diseases, including heart disease, stroke, type-2 diabetes, and site-specific cancers. Morbidity and mortality from diet-related diseases will continue to increase in LAC unless behavioral patterns shift toward healthy consumption. This will require not only changes in the choices made by consumers, but also in the actions of producers, because lack of availability of nutritious food also poses challenges to the adequacy of human diets in the region.

Addressing the nexus between agriculture, nutrition, and health is a key priority for LAC, but actions taken in LAC are likely to have global impacts. Worldwide, at least 88 percent of countries face multiple forms of malnutrition: the number of people going to bed hungry increased from 777 million in 2015 to 815 million in 2017, and more than 2 billion people are micronutrient deficient (Global Nutrition Report 2017; Foresight Report 2016). As the largest net food supplier to the world (including of fruits and vegetables), LAC has an imperative to continue supplying more nutritious, affordable food to help reach global nutrition targets, such as SDG 2.2[1] to end all forms of malnutrition globally by 2030.

[1] Sustainable Developent Goal 2.2: By 2030 end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons.

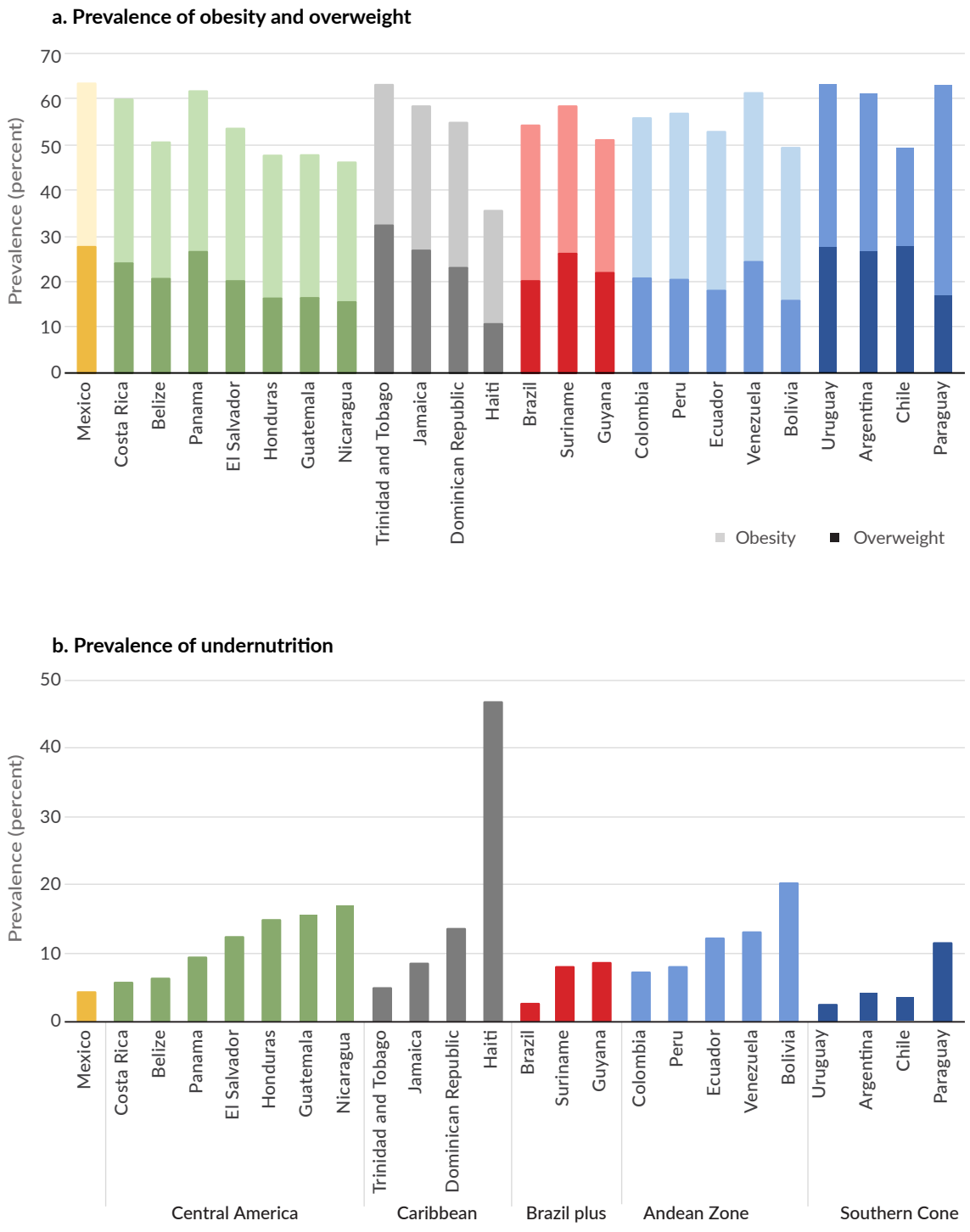


Figure ES4. Obesity, overweight, and undernutrition, LAC, 2016

Source: World Development Indicators database, World Bank, sourced from FAO undernourishment data.

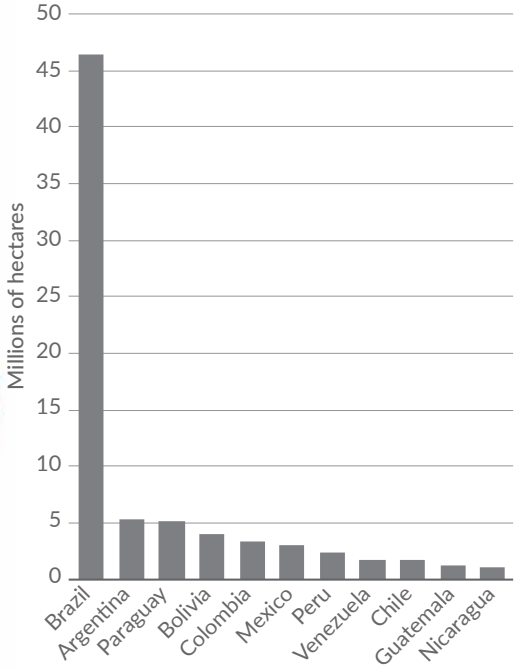
Climate-resilient ecosystem services: LAC is the world's largest provider of ecosystem services, and its ecosystems provide critical services not only for agriculture but also for human and animal well-being more broadly. The region is home to 57 percent of the world's remaining primary forests and one-third of all plant species. Almost one-half of the region's land surface is covered by forests, which store a massive estimated 104 gigatons of carbon. LAC is the source of between 40 and 50 percent of the world's biodiversity and is a major repository of agricultural biodiversity. The environmental footprint of agriculture and food systems in the region is very large, however, and the current rate of resource use poses a significant threat to the region's global public goods contribution. While some farmers and ranchers have been in the forefront of adopting green technology, agriculture and food systems in many LAC countries are dominated by production models based on unsustainable practices that undermine ecosystem services critical for human well-being, while generating greenhouse gas emissions that are a major contributor to climate change. These production models threaten the viability of LAC food production capacity and will need to be replaced with better models that ensure the sustainability of the natural resource base on which agriculture depends, increase the provision of ecosystem services, and enhance climate resilience. Improved environmental management can also generate tremendous domestic benefits even beyond ecosystem stewardship, including by sustaining, in the medium to longer term, LAC's dominant position in global food markets. If ecosystems fail to deliver key services such as water regulation, micro- and global climate stabilization, nutrient cycling, pollination, soil retention, and sedimentation control, agricultural productivity will be adversely affected, damaging the region's comparative advantage in world markets.

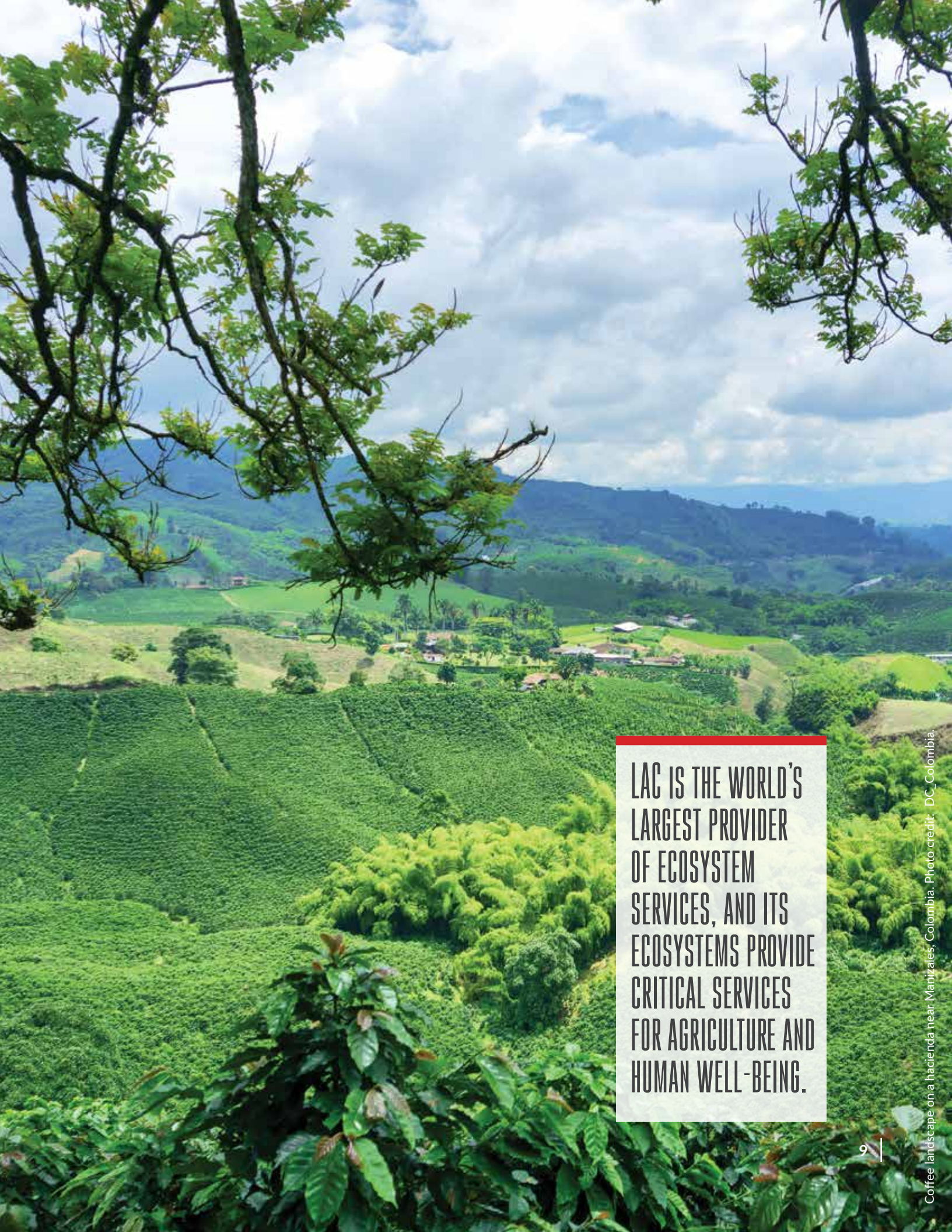
Figure ES5. Forest cover loss, 2000–2016

Source: WBG staff, using data from Hansen et al. 2013; FAOSTAT.

a. Forest cover loss, 2000–2012

b. Forest cover loss by country, 2000–2016





LAC IS THE WORLD'S LARGEST PROVIDER OF ECOSYSTEM SERVICES, AND ITS ECOSYSTEMS PROVIDE CRITICAL SERVICES FOR AGRICULTURE AND HUMAN WELL-BEING.

Coffee landscape on a hacienda near Manizales, Colombia. Photo credit: DC_Colombia.

Governance: Policies influencing the performance of LAC agriculture and food systems

Successful achievement of the multiple objectives to which LAC agriculture and food systems are expected to contribute will be influenced by a wide range of policies—not only policies specific to the agricultural sector, but also policies affecting trade and exchange rates; policies affecting the availability, quality, and cost of resources such as land and water; policies affecting human capital including education policies and labor laws; policies affecting the availability and cost of finance; and policies relating to human and animal health and safety.

Without pretending to be exhaustive, this report examines selected key elements of the policy environment affecting agriculture and food systems in the region. It concludes that ever since structural reforms were implemented in the 1980s and 1990s, incentives have remained fairly sector-neutral. With some exceptions (Argentina being the most prominent), explicit taxation of agriculture has been reversed. The heavy protection previously afforded to manufacturing was reduced and has remained constrained by domestic policies, as well as by commitments made by many governments under preferential trade agreements. The previously dominant role of state-owned enterprises in agricultural markets has been phased out in most countries, opening the way for private investment. This does not mean that no policy challenges remain, however. The level of support afforded to agricultural products has been reduced from earlier periods, but importables and exportables continue to be treated very differently in a number of LAC countries, implying that further reforms designed to level the playing field would improve performance. On the macroeconomic front, booming commodity sectors with the consequent risk of "Dutch Disease" effects can present challenges. And continuing efforts are needed, even in countries with flourishing agricultural sectors, such as Argentina, Brazil, Chile, Mexico, and Peru, to ensure that the benefits of sectoral growth are shared with vulnerable groups, who may include smallholders, the landless, women, and indigenous people.

Important insights into the incentives affecting LAC agriculture and food systems can be derived from analysis of the level and type of support provided to the agriculture sector, as well as from the examination of the quantity and quality of public spending on agriculture. According to the Producer Support Estimate (PSE) framework popularized by the OECD, support to agriculture is provided through two mechanisms: (i) market price supports, and (ii) budget transfers financed through public expenditure. Use of market price supports in LAC is widespread and relatively high by global standards, while use of budget transfers is less common and relatively low by global standards. Considering both mechanisms, the level and composition of public spending on agriculture varies considerably between LAC countries. Still, some commonalities can be observed at the subregional level. For example, Central American and Andean countries tend to rely on subsidies to private goods to support their agricultural sectors, with most of the subsidies affecting production decisions (such as input subsidies and other types of coupled payments).

While there are no one-size-fits-all recommendations for boosting the impacts of policy measures and increasing the payoffs from public spending, certain types of reforms clearly have potential to contribute across the board to the emergence of more efficient, more inclusive, less costly, more environmentally friendly, and more resilient agriculture and food systems. These include: (1) reducing use of market price support measures, (2) transitioning from input subsidies to decoupled payments,[2] and (3) increasing investments in public goods and services.

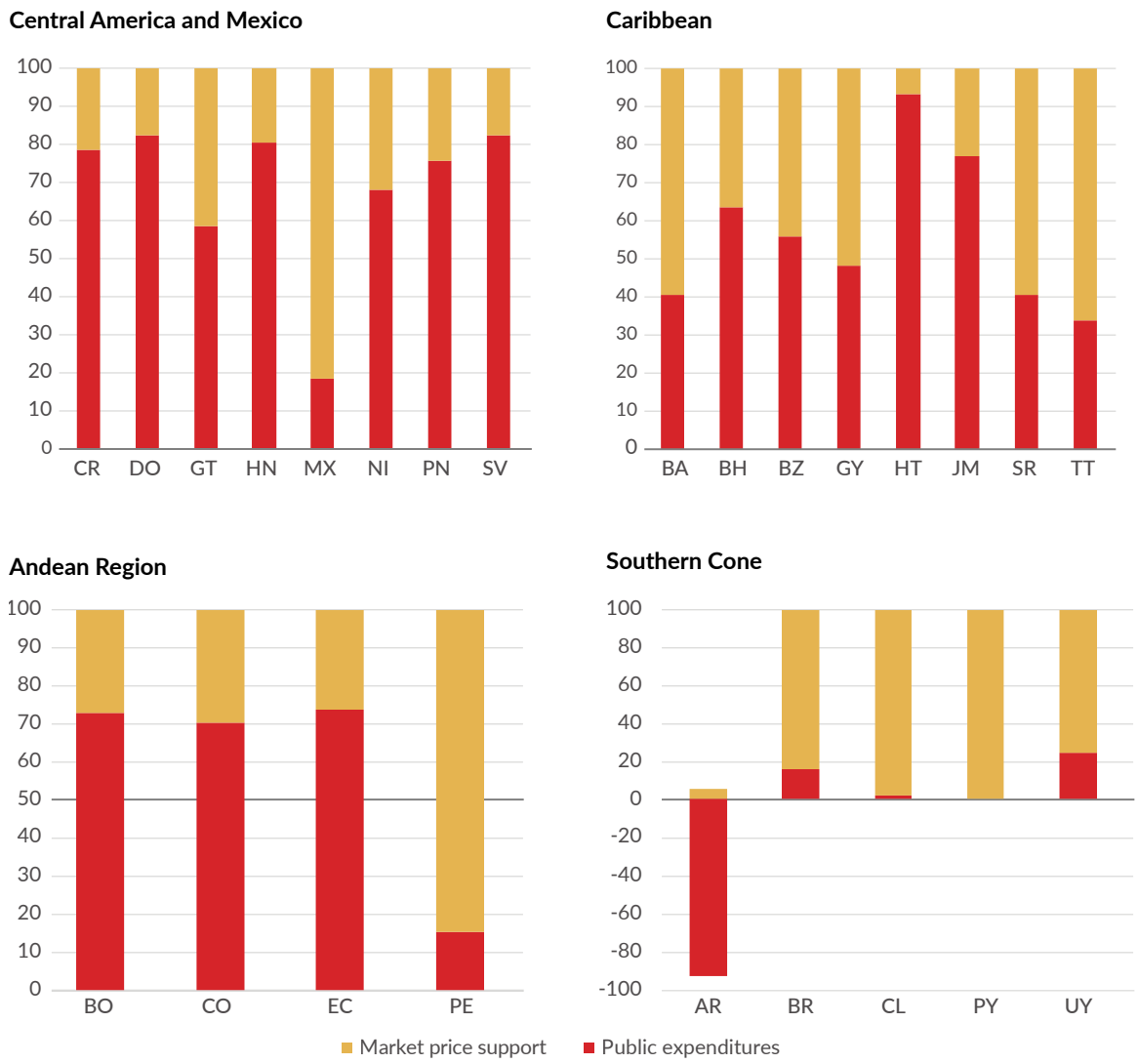


Figure ES6. Composition of support to agriculture: Market price support vs. public expenditure

Source: Agrimonitor Database, IDB 2018.

CR = Costa Rica, DO = Dominica, GT = Guatemala, HN = Honduras, MX = Mexico, NI = Nicaragua, PN = Panama, SV = El Salvador, BA = Bermuda, BH = Bahamas, BZ = Belize, GY = Guyana, HT = Haiti, JM = Jamaica, SR = Suriname, TT = Trinidad & Tobago, BO = Bolivia, CO = Colombia, EC = Ecuador, PE = Peru, AR = Argentina, BR = Brazil, CL = Chile, PY = Paraguay, UY = Uruguay

[2] Decoupled payments are budgetary payments paid to eligible recipients that are not linked to current production of specific commodities or livestock numbers or the use of specific factors of production.

Drivers: Trends and disruptors likely to affect Latin American and Caribbean agriculture and food systems

What does the future hold in store? Like all complex systems, agriculture and food systems in LAC will be influenced by a large number of forces acting in many different ways on multiple scales over a range of time frames. With that in mind, this report identifies a series of drivers that could be important in shaping the future trajectory of LAC agriculture and food systems. Depending on their level of uncertainty, the drivers are classified into two general categories: trends and disruptors.

Trends are gradual, long-run forces that have a great deal of inertia and are unlikely to change quickly, so their impacts are relatively certain and predictable through 2030. Trends are already having large impacts on LAC agriculture and food systems and will continue to have large impacts for the foreseeable future. Because trends are predictable, their future values through 2030 can be projected within a fairly narrow range with a relatively high level of confidence.

Disruptors are forces than can appear suddenly, without warning, and whose impacts on agriculture and food systems are difficult to predict. Disruptors by definition are associated with a high degree of uncertainty, so their identification involves a certain amount of subjectivity. Moreover, since the disruptors are subject to sudden, unpredictable changes,[3] their future values through 2030 cannot be projected with a relatively high level of confidence.

This report describes nine drivers that will be particularly relevant for LAC agriculture and food systems: (1) population growth, (2) urbanization, (3) migration, (4) income growth, (5) changing tastes and dietary preferences, (6) productivity growth, (7) emerging technologies, (8) climate change, and (9) policies.

Envisioning the future: How might the current trajectory change?

High-performing LAC agriculture and food systems will remain integral to the health and well-being of people and of the planet, but ensuring that they deliver sustainable growth, good jobs, food and nutrition security, and climate-resilient ecosystem services will not be easy. Action will be required by many actors working on multiple fronts to ensure that agriculture and food systems evolve in ways that lead to desired outcomes, taking advantage of emerging opportunities while avoiding risks that, if not properly managed, could in some cases prove catastrophic. Planning those actions and implementing them in a timely fashion poses daunting challenges, because while certain aspects of the future can be anticipated, others remain highly uncertain and some are completely unknowable.

Just because the future is uncertain and to some extent unknowable does not mean we cannot prepare ourselves for what lies ahead. On the contrary: successfully navigating the uncertainty associated with the evolution of LAC agriculture and food systems will require careful observation of ongoing trends, timely anticipation of emerging challenges and opportunities, and thoughtful consideration of the many drivers that could influence future outcomes. Scenario building takes advantage of tools that can be used to anticipate and explore potential futures and help inform policy choices and supporting investments.

[3] The COVID-19 pandemic, which appeared just as this report was going to press, is an example of a disruptor. It is expected to severely disrupt agri-food systems in the region and worldwide (see Box 19).

A scenario building exercise carried out for this report used a mix of quantitative and qualitative methods to generate insights as to what the future may bring and helped identify the actions needed to prepare LAC agriculture and food systems to better confront the challenges ahead.

The first part of the scenario building exercise used state-of-the-art modeling tools operated by the International Food Policy Research Institute (IFPRI) to explore how several key drivers might affect LAC agriculture and food systems in the years to come. In addition to capturing the likely effects of several long-term trends (e.g., population growth, income gains, productivity growth), the scenarios explored the likely impacts of two major disruptors: (1) climate change and (2) trade policy. An important insight emerging from the quantitative modeling work is that policy makers and others concerned with the future of LAC agriculture and food systems should not invest too heavily in strategies predicated on the assumption that a particular climate model is correct or that a certain trade policy will come to fruition. Rather, policy makers should develop investments that enhance resilience and provide broad menus of options for economic agents exposed to climate change and trade-policy uncertainties. Another insight emerging from the quantitative modeling work is that, while the high level of diversity found within LAC can pose a challenge when it comes to defining a collective agenda, the region's diversity can also be a valuable asset if used properly. To manage risks effectively, it is necessary to have a diversified portfolio.

The second part of the scenario building exercise used qualitative methods to explore how an expanded set of key drivers might affect agriculture and food systems in LAC. During a workshop held in February 2019 at the headquarters of the Inter-American Institute for Cooperation on Agriculture (IICA) in San José, Costa Rica, different combinations of disruptors were used to build a series of scenarios reflecting plausible agriculture and food systems outcomes by 2030. Building on the results of the workshop, the report identifies five scenarios that reflect a range of plausible configurations of LAC agriculture and food systems in 2030: (1) The Age of Exodus (main drivers: population displacement and climate change), (2) Healthy Diets Rule (main driver: shifting dietary

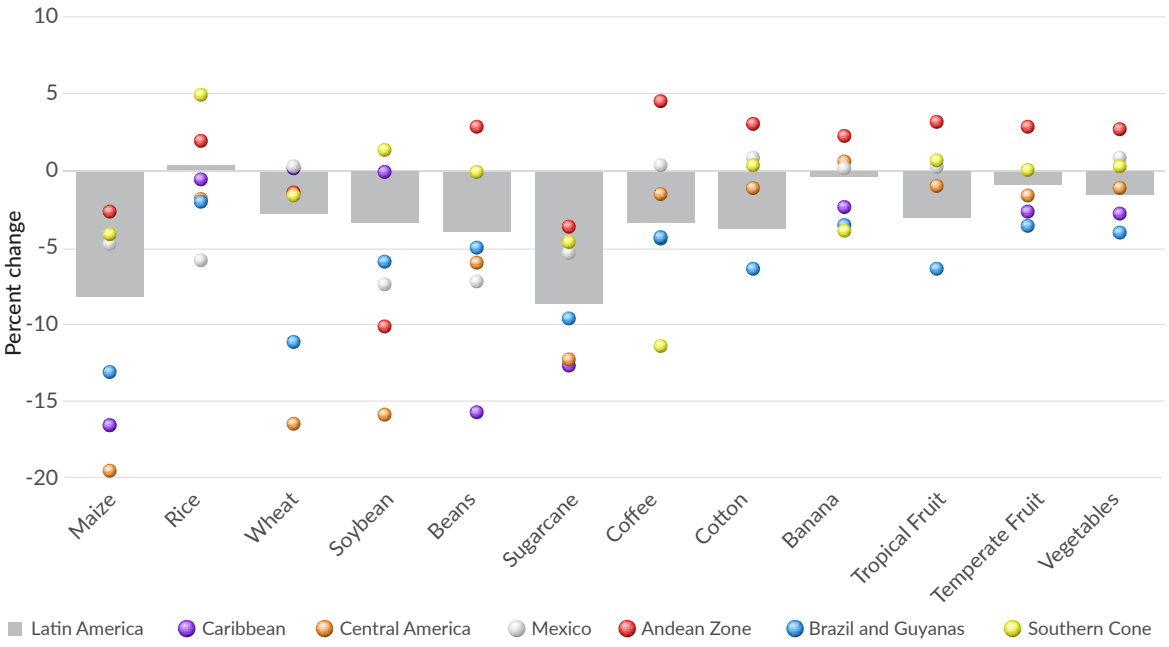


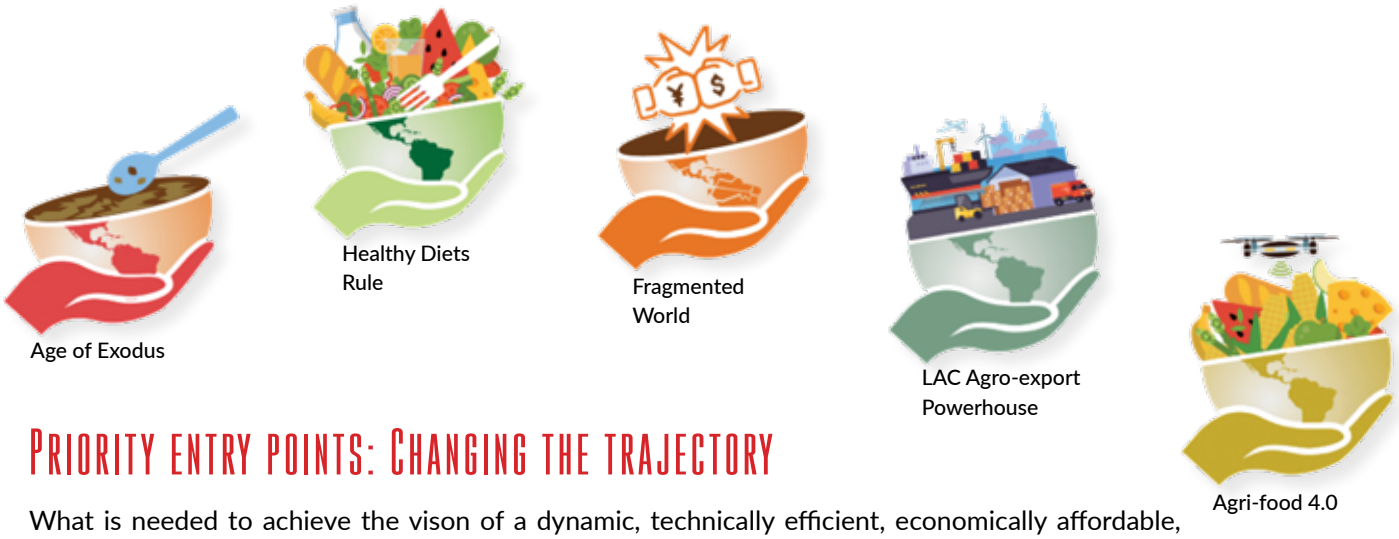
Figure ES7. Projected changes in yields due to climate change, LAC subregions, 2010 vs. 2030

Source: Sulser et al. 2015.

Figure ES8. **Changes in net trade under three trade war scenarios, LAC countries**

Source: Authors, MIRAGRODEP CGE simulations.

preferences), (3) Fragmented World (main driver: global trade disruptions), (4) LAC Agro-export Powerhouse (main drivers: surging growth in global food demand), and (5) Agri-food 4.0 (main driver: rapid technological change). These scenarios should not be understood as forecasts or projections: rather, they represent a series of alternative futures that could materialize if selected drivers evolve in plausible ways. By drawing attention to drivers that could be particularly influential, the scenarios point to areas in which actions may be needed to avoid undesirable outcomes or seize desirable opportunities. Four insights emerging from the qualitative scenarios building exercise stand out. First, supply-side factors and demand-side factors both have the potential to drive the trajectory of LAC agriculture and food systems, so it would be a mistake to focus exclusively on one or the other. Second, large, well-integrated markets have great power to cushion shocks, so the degree of openness of the global trading system matters. Third, even though technology can have a transformative effect on agriculture and food systems, it is a two-edged sword that could leave millions behind if some groups in the population are unable to gain access. Fourth, climate change is a wild card that could exact enormous damage on LAC agriculture and food systems.



Priority entry points: Changing the trajectory

What is needed to achieve the vison of a dynamic, technically efficient, economically affordable, socially inclusive, environmentally sustainable, and climate-resilient food future for Latin America and the Caribbean? Answering this question is not easy, due to the large amount of heterogeneity within the region, the complexity of LAC agriculture and food systems in all their dimensions, the fact that these systems are continuously evolving, and the difficulty of projecting the influence of the drivers noted above on the future course of events.

Taking into account that the drivers could affect system performance, as well as insights from the scenarios modeling exercises, the report identifies a set of 20 proposed actions that offer opportunities to unlock transformational change and contribute to the desired agriculture and food system outcomes.

The 20 proposed actions are classified into two categories: Imperatives and Strategic Choices. Each category in turn includes two types of proposed actions.

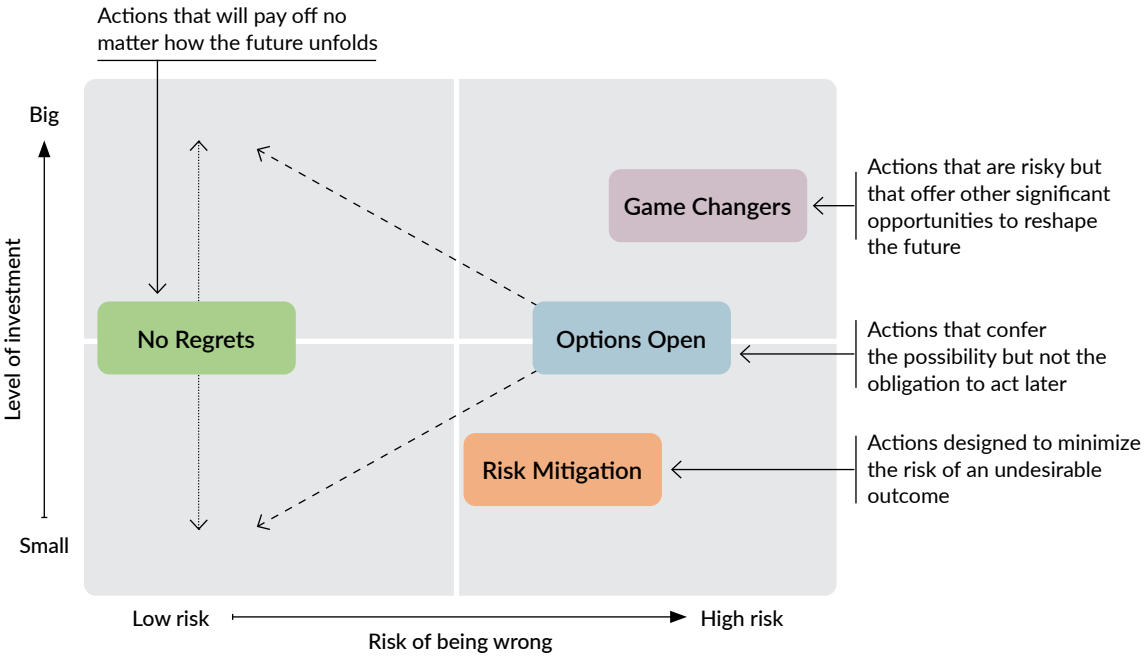


Figure ES9.
Types of actions: Building blocks of a flexible strategy

A. Imperatives

Imperatives are actions that can be considered essential, either because they are guaranteed to pay off or because they are needed to protect against risks that could be catastrophic.

1. No Regrets

These are actions that will pay off no matter what scenario materializes. Examples might be initiatives aimed at reducing market inefficiencies or building human or institutional capacity. Some No Regrets actions are relatively inexpensive to implement, while others can be pursued at a scale that requires significant investment. Even when the level of financial commitment is high, policy makers often focus on No Regrets actions because of their high probability of success.

- Strengthen agricultural research and extension systems
- Modernize agri-logistics infrastructure, including for ICT
- Up-skill agriculture and food system workers
- Promote healthy diets
- Reduce food loss and waste
- Make agriculture and food systems climate smart
- Deepen rural financial markets
- Improve land tenure security

2. Risk Mitigation

These are actions taken to reduce exposure to potential risks that could emerge under some scenarios. Examples might be putting in place early warning systems to guard against the effects of climate change or strengthening systems to ensure food safety. Risk Mitigation actions often require fairly modest investments that generate returns under all circumstances but are especially valuable when more optimistic scenarios fail to materialize.

- Step up climate monitoring
- Strengthen defenses against food-borne diseases
- Build social safety nets that can be activated quickly in times of crisis
- Promote the use of financial instruments for managing risk

B. Strategic Choices

Strategic choices are actions that can be considered discretionary, because they could lead to improved performance outcomes but are not guaranteed to pay off in every possible future scenario.

3. Options Open

These are actions taken to maintain the option to play in the future as scenarios develop and to secure the larger payoffs that could be realized under best-case scenarios. Most Options Open moves involve making relatively modest initial investments that will allow public or private actors to ramp up or scale back their level of engagement later as the scenario evolves. The desirability of implementing an Options Open action depends on the nature and scale of the benefits that would be realized and the cost of implementing the action.

- Maintain access to established and emerging markets
- Invest in irrigation where appropriate
- Support development of biofortified foods and nutraceuticals
- Facilitate the emergence of peri-urban and urban agriculture

4. Game Changers

These are large commitments designed to fundamentally change the trajectory of a complex system, in this case, LAC agriculture and food systems. Game Changers tend to require major capital investments that will result in extremely large payoffs under some scenarios, but no payoffs under others. The desirability of implementing Game Changers will depend on a country's level of ambition, resources, and implementation capacity.

- Decouple all agricultural production support
- Ensure that all agri-food system work is safe and fair
- Make agri-food systems carbon neutral
- Declare war on junk food

Principles for operationalizing the proposed actions

This report does not provide detailed guidance on how to operationalize the proposed actions. Operationalization strategies will have to be tailored to the needs of individual countries, based on the characteristics of their prevailing agri-food systems, the particular challenges present, the policy objectives being pursued, and the resources available. The operationalization challenge is further complicated by the fact that there are often important interactions between individual proposed actions—synergies, but sometimes also trade-offs—which means that a holistic, integrated approach usually will be needed to deliver desired outcomes.

This report does, however, lay out general principles that should be taken into account in developing implementation strategies for the various proposed actions.

Some proposed actions involve major regulatory or legislative reforms, trade agreements, or institutional changes, so implementation will require significant political commitment and strong implementation capacity. They will not necessarily be easy to accomplish and could involve direct or indirect costs in the short to medium run.

Other proposed actions will require significant expenditures. In considering how these expenditures should be financed, it is important to keep in mind the distinction between "public" and "private" goods. Many of the goods and services used to produce food and deliver it to consumers have characteristics (excludability, rivalry)[4] that make them quintessentially private, and the private sector will be willing to pay for them. But some goods and services have characteristics (nonexcludability, nonrivalry) that discourage the private sector from providing them at socially optimal levels. Goods and services with these characteristics are frequently labeled "public," and public resources are allocated to finance their provision. This does not necessarily mean that governments should produce such goods and services themselves; in some cases, private providers are more efficient producers, in which case, an efficient policy for the government can be to incentivize production by the private sector.

Many of the proposed actions do not fall neatly into one category or other. Extension services, for example, typically benefit mainly the farmers who actually receive the services. But in cases where there are demonstration effects that benefit other farmers, or where the extension is aimed at prevention of epidemic diseases, extension services have public-good characteristics. These cases are good candidates for consideration of some kind of partial subsidy or other form of public-private partnership.

Several proposed actions are aimed at objectives related to equity rather than growth and economic efficiency, in which case the private-public good distinction is less relevant. Social safety nets fall into this category. This would also include programs providing private goods but targeting poor farmers for purposes of poverty reduction.

Regardless of the legislative requirements and budgetary implications, implementation of most of the proposed actions will pose political economy challenges. Any significant change to the status quo inevitably raises the prospects of winners and losers. Progress in implementing the proposed actions consequently may depend less on whether they are technically feasible or financialy affordable and more on whether sufficient political will exists to absorb potentially active resistance and reconcile what can be difficult trade-offs between different interest groups.

[4] In economics, *excludability* refers to the degree of difficulty in preventing consumers who have not paid for a good or service from having access to it. *Rivalry* refers to the degree to which consumption by one person of a good or service "uses it up" and therefore precludes use by another person.

Time for action

Latin American and Caribbean agriculture and food systems are underperforming. They have been slow to respond to changes in the global environment, and many continue to rely on centuries-old production methods that are outdated, inefficient, and harmful to people and to the environment. A growing body of evidence makes clear that the current trajectory is technically inefficient, socially inequitable, environmentally unsustainable, and fiscally irresponsible. Clearly, business as usual is not an option. Yet, looking forward, prospects for change remain uncertain. The needed characteristics of the future agriculture and food system are known, but realizing those characteristics will require fundamental changes, and many threats loom that could prevent those changes from happening.

Against the current backdrop of underperformance, awareness is growing that enormous opportunities are waiting to be seized. Demand for agricultural commodities, within the region and globally, is growing steadily, providing a market for future generations of producers. And with the steady escalation of global warming, it is becoming increasingly clear that agriculture as a sector can and must help stem and eventually reverse greenhouse gas (GHG) emissions. Meanwhile, technological advances are ushering in new, more efficient, and more environmentally friendly ways to produce, process, distribute, consume, and recycle food, magnifying the potential payoffs to adoption of improved technologies and practices.

Looking forward, Latin American and Caribbean agriculture and food systems will increasingly be called upon to perform multiple roles: contributing to rapid and stable growth, safeguarding food security, providing adequate and nutritious diets, generating high-quality jobs, overcoming inequality and promoting social inclusion, sustaining the natural resource base, and mitigating the impacts of climate change. Fulfilling these multiple roles will require appropriate strategies, well-crafted policies, robust investments, and strong institutions staffed by capable people. This report contributes to the knowledge base needed to seize the emerging opportunities by presenting information and analysis that can help advance the agricultural and rural development agenda and deliver positive outcomes. The central message of this report is that, contrary to the perception among many policy makers that agriculture in LAC has lost importance, the agriculture sector and the much larger agri-food system that it nourishes deserve significant policy attention and commitment of public resources. Today and in the years to come, the performance of LAC agriculture and food systems will have a decisive influence on the fortunes not only of the region but of the entire planet. The future of these systems is far too important to be left to chance. ●

Photo: © Morganeborzee | Dreamstime.com.

CHAPTER 1

Introduction: LAC agriculture and food systems deserve attention

Agriculture and food systems in Latin America and the Caribbean Region (LAC) stand at a crossroads. The declining visibility to public policy makers of farming and ranching in the rapidly urbanizing region has contributed to the perception that agriculture has diminished in importance and that attention can safely shift to other priorities.

This perception is misguided: the role played by agriculture has not diminished. On the contrary, agriculture and food systems make vital contributions to a diverse set of development objectives, including growth, poverty reduction, food and nutrition security, and climate resilience. As this report highlights, the forces shaping the evolution of agriculture and food systems in LAC are creating exciting opportunities to promote transformational changes, the effects of which will be felt at multiple levels: nationally, regionally, and globally.

What happens in LAC agriculture and food systems matters for economies within the region, but it also matters worldwide. LAC agriculture and food systems are the source of two important global public goods. First, LAC is the world's largest net food-exporting region, and LAC agricultural exports help to stabilize food supplies and reduce food price volatility worldwide. In early 2020, the novel coronavirus (COVID-19) pandemic sparked an unprecedented humanitarian and economic crisis that devastated lives and livelihoods worldwide. The crisis put more than a quarter of a billion people around the world at risk of suffering acute hunger within 12 months, including hundreds of millions in LAC who fell into poverty and suffered devastating socio-economic consequences. Disruptions to global food supplies linked to the COVID-19 pandemic drew attention to the importance of LAC as a major net exporter of food and pointed to new opportunities for promoting greater intra-regional economic cooperation, in terms of production, trade and technology.[5] Second, LAC is the world's largest provider of ecosystem services. The Amazon basin, the forests of Central America, and other biomes in the Andean region

[5] https://www.cepal.org/en/pressreleases/covid-19-pandemic-will-lead-biggest-contraction-economic-activity-regions-history-53

and in the Southern Cone host vast stores of biodiversity, sequester huge amounts of carbon, and perform atmospheric regulatory functions that affect weather patterns worldwide. LAC will continue to produce these two global public goods only if the region's agriculture and food systems evolve in ways that avoid threatening them and that capitalize on opportunities. If the complex trade-offs between growing the economy, reducing poverty, feeding the population, improving nutrition, safeguarding human health, and preserving natural capital are not managed successfully in LAC, the cost to humanity will be extremely high.

1.1 Objectives of the report

The purpose of this report is to improve understanding of the transformational opportunities offered by LAC's agriculture and food systems to contribute to growth, employment, and food and nutrition security while sustaining the region's natural capital endowments and helping to mitigate climate change. This will be achieved by describing how demand- and supply-side forces are transforming LAC's agriculture and food systems, exploring how long-term trends and short-term disruptors could affect future performance, and identifying measures that policy makers can take to facilitate the emergence of dynamic modern agriculture and food systems capable of performing the multiple functions that are expected of them.

The report is forward-looking: it adopts a long-term perspective and considers a time horizon up to 2030. The time line was chosen to extend far enough into the future to allow for the sector's potential transformation in the region, factoring in the impact of ongoing trends and potential disruptions, but not so far as to lie beyond the sight line of today's policy makers. The chosen horizon, furthermore, aligns with the Sustainable Development Goals (SDG) agenda set forth by the United Nations for the global community to meet in the coming decades, which identifies specific targets to be met by 2030. The alignment is appropriate, because the future performance of LAC agriculture and food systems will directly influence the achievement of (or failure to achieve) a number of SDGs, due to the impact of agriculture and food systems on growth, employment, food and nutrition security, and the environment.

1.2 Organization of the report

Including the introduction, the report contains six sections. Section 2 takes stock of the recent performance of LAC agriculture and food systems, briefly summarizing the contribution of these systems to a diverse set of development objectives including growth, job creation, food and nutrition security, and ecosystem sustainability. Section 3 considers the governance of LAC agriculture and food systems, assessing the effectiveness of public policies and supporting investments to achieve desired performance outcomes. Section 4 discusses the drivers that shape the evolution of agriculture and food systems, distinguishing between trends (slow-moving demographic, technological, and economic forces whose impacts will be felt gradually) and disruptors (fast-moving and often unexpected forces, such as technology breakthroughs or policy changes, that could lead to rapid change). Section 5 examines the road ahead, using scenario analysis to consider how future performance outcomes could be affected by the various drivers. Section 6 describes a series of proposed actions that can shape the transformation of agriculture and food systems to achieve outcomes that align with society's long-term goals and offers some final thoughts about the road ahead.

1.3 Methods and processes

The contents of this report are based on information derived from a wide range of sources. Preparation of the report involved literature reviews, original data analysis, crowdsourcing techniques to inform the identification of agriculture and food system drivers and disruptors, participatory scenarios building, and synthesis of diverse types of information. The report benefited greatly from collaboration with a number of institutions and organizations. Without the data and information contributed by many of them, important analyses would not have been possible.

Box 1. What is a foodscape?

A foodscape is a metaphorical landscape of foods and their production methods and cultural associations. As such, a foodscape can be best understood as a dynamic social construction that relates food not only to material processes but also, more broadly, to places, people, and meanings. A person's foodscape consists of the ensemble of places and spaces in which they produce or acquire food, prepare food, consume food, discuss food, and/or derive meaning from food. The concept originated in the field of geography and initially was used mainly to refer to urban food environments. More recently, the concept has been invoked in reference to the entire spectrum of urban and rural environments.

Foodscapes are not always proximate spaces. In many areas, people must use some form of transport to get to the nearest market, food store, or restaurant. With the emergence of the digital economy, foodscapes increasingly extend as well to online spaces that allow consumers to order food from distant locations through grocery and restaurant delivery services.

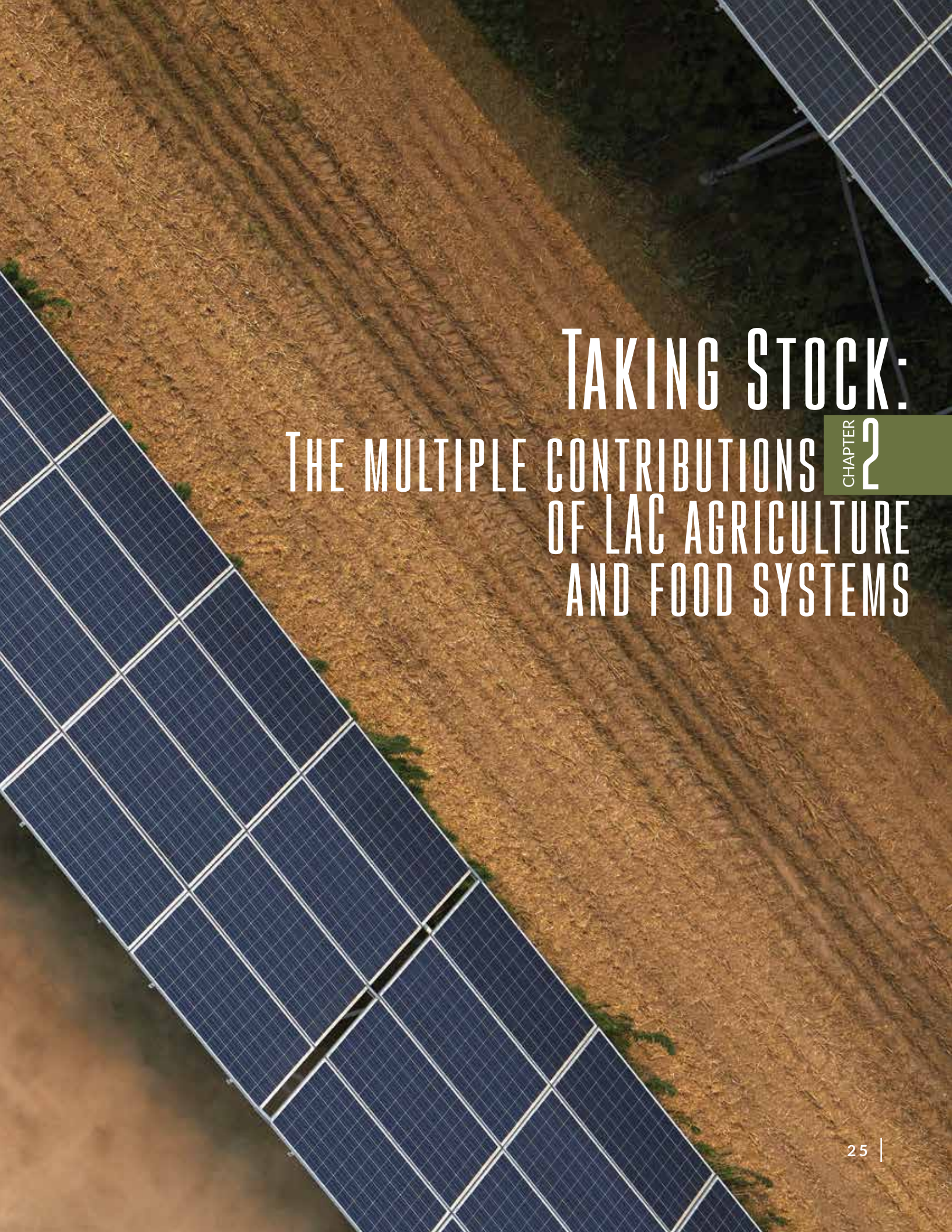
A foodscape is never fixed. The boundaries of a foodscape often shift depending on how the food environment expands and contracts, in part due to institutional dynamics among different types of actors. Institutions (e.g., schools, hospitals, and military bases), organizations (e.g., grocery stores and restaurants), and programs (e.g., food assistance programs) greatly influence food choices.

The contours of foodscapes are shaped not just by physical factors and institutional forces, but also by cultural and political perspectives about the meaning and significance of food. In recent years, growing awareness of the implications of different food choices on the health of humans, the welfare of animals, and the state of the environment have altered the foodscapes of many consumers, giving rise to the belief that food choices have transformative potential to make agriculture and food systems more ethical, healthy, resilient, and sustainable.

The foodscape framework is helpful for understanding how food, places, productive systems, and people are interconnected and how they interact. In this report, therefore, the concept of foodscape is used to speak to the multifunctionality of agriculture and food systems, as well as to the increasing importance attributed to these systems' economic, social, political, cultural, and environmental associations.

Sources: Mackendrick, 2014; Mikkelsen, 2011.

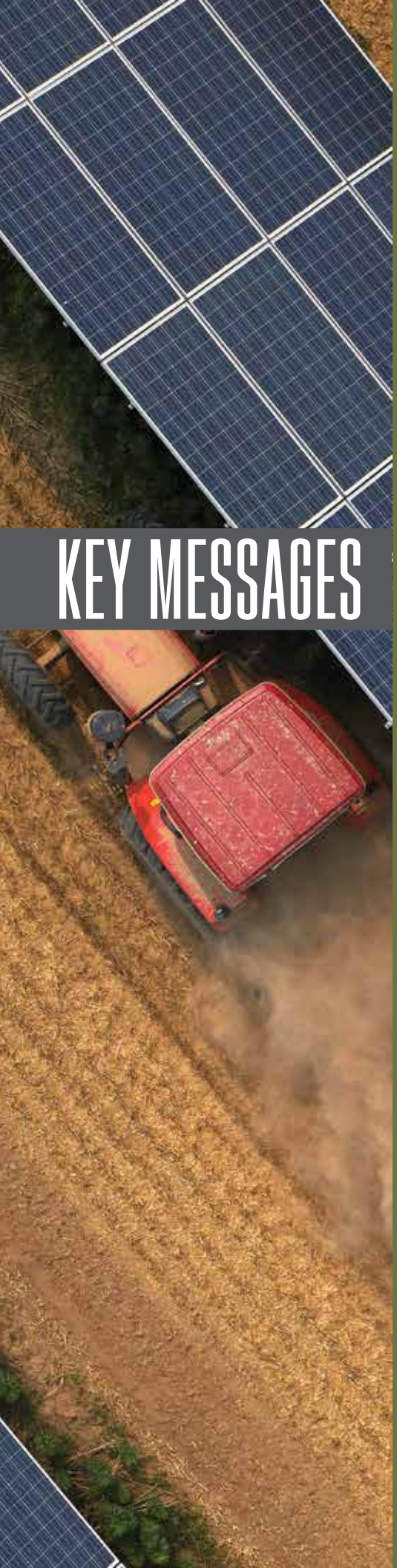
Photo: Jenson.



Taking Stock:

The multiple contributions of LAC agriculture and food systems

CHAPTER 2



KEY MESSAGES

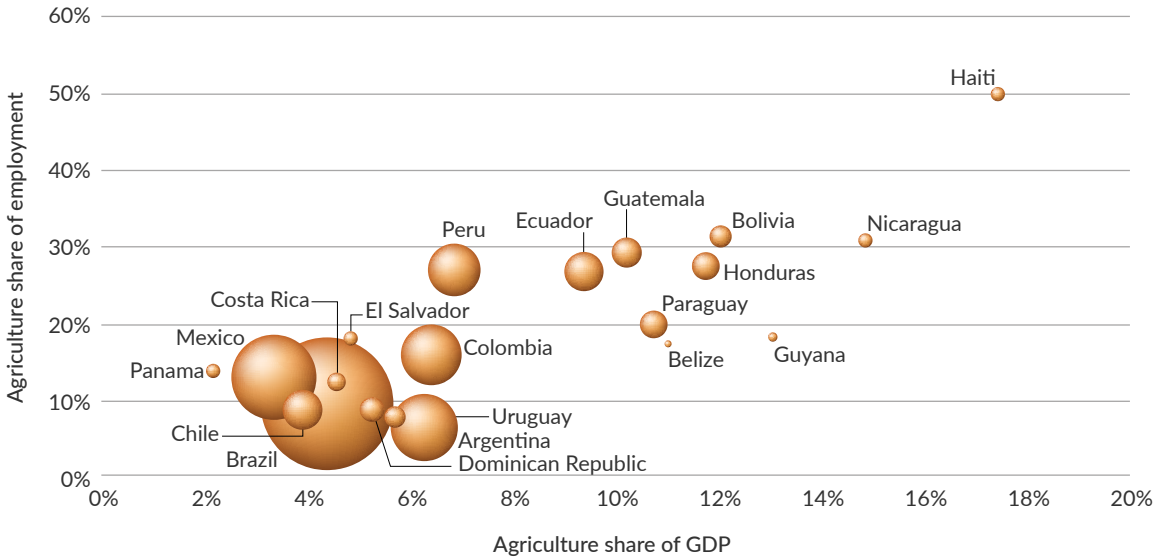
- LAC agriculture and food systems are important for meeting food, feed, fiber, and fuel needs within the region and beyond. They perform multiple functions: contribute to economic growth and diversification, generate poverty-reducing employment, help ensure food and nutrition security, and influence the health of the planet.
- LAC agriculture and food systems are diverse, reflecting regional variability in geographic features, biological endowments, agro-climatic conditions, and demographics, among other factors, and they feature a range of economic actors, both large and small.
- Regional averages mask important differences among and within countries: even though LAC as a region is often characterized as an agri-food export powerhouse, most LAC countries, including many that produce and export high-value agri-food products, are net importers of food staples.
- Global experience shows that as agriculture and food systems grow and mature, they pass through various developmental stages. In most LAC countries, different types of agriculture and food systems coexist, and their relative importance varies.
- The coexistence—even within the same country—of different types of agriculture and food systems means that one-size-fits-all strategies for improving performance are unlikely to be successful and points to the need for customized, context-specific interventions.

2.1 Importance of LAC agriculture and food systems

Agriculture and food systems are important for Latin America and the Caribbean. They account for a significant share of many national economies in the region, employ large numbers of people, and consume or affect significant amounts of natural resources, especially land and soils, water, forests, and biodiversity. At the same time, LAC is very important for food and agriculture globally, because the region is an important net exporter of food and agricultural commodities and because it generates ecosystem services with impacts felt worldwide (Díaz-Bonilla and del Campo 2010).

LAC agriculture is very diverse. Large farms account for much of the commercial agribusiness that dominates the agricultural powerhouses such as Brazil and Argentina, but more than 50 percent of the region's food production comes from smallholder farmers (Rabobank 2015). As these figures suggest, there is enormous variation among and within LAC countries in terms of the scale and sophistication of agriculture and in terms of its contribution to the economy. This is illustrated in Figure 1, which compares agriculture's share of GDP, agriculture's share of the workforce, and the absolute value of agricultural GDP across the region.

The diversity of LAC agriculture stems from a number of factors. The quality of land combined with the prevailing climate are important determinants of agricultural potential. Whether or not that potential is realized often depends on the land ownership arrangements. Many Latin American countries show a significant concentration of land holding in the hands of large private owners, a legacy of the colonial period in many countries' histories, and this influences their agricultural profile. The relatively low share of labor in agriculture, combined with relatively large land holdings in Argentina, Brazil, and Uruguay, reflect the importance in these countries' agricultural profiles of large holdings of savannah/cerrado/pampas land where the focus has been on highly mechanized large-scale production of field crops, including grains, oilseeds, sugarcane, and cotton, as well as



Size of the bubble = Agriculture GDP (US$ billions, 2010 constant dollars)

Figure 1.
Contribution of agriculture to GDP and employment, LAC countries

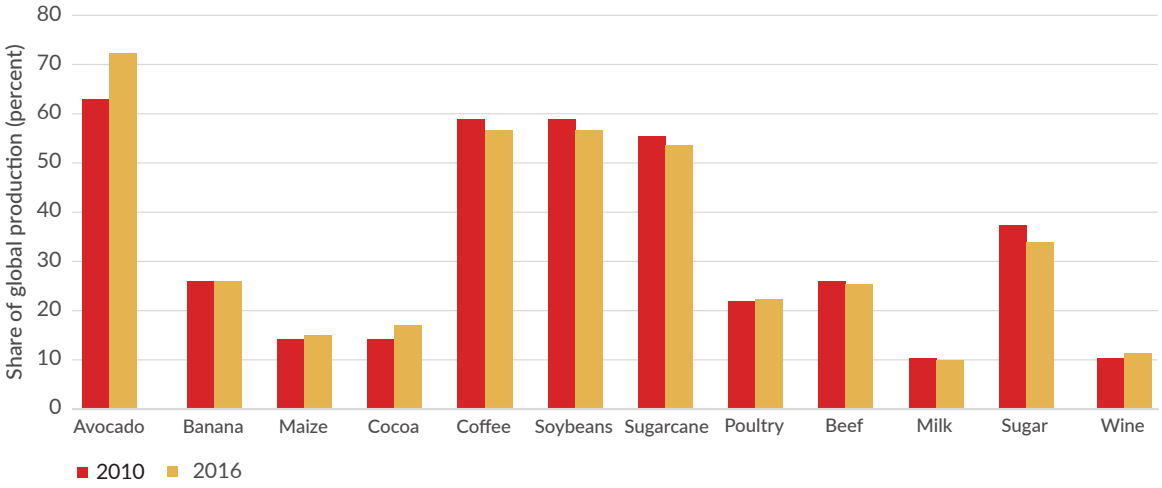
Source: World Development Indicators database, World Bank. 2018.

extensive livestock rearing. Elsewhere, irrigation contributes substantially to the productivity of drier land in regions of western Argentina, Chile, North and Central Mexico, and Peru. In the highlands of the Andes, coffee production—predominantly on small family farms—is concentrated in valleys and on lower slopes in Colombia and Peru. Throughout the Andes, land becomes progressively less productive as altitude increases, and poverty becomes correspondingly more prevalent.

LAC has long been associated with the production and export of agricultural commodities, which is why the region is sometimes referred to as "food supplier to the world." The moniker is justified; LAC accounts for a significant share of global agricultural production for many important commodities (FAO 2014) (Figure 2). Behind the aggregate statistics for exports is an impressive list of commodities for which the region is a leading supplier to the world market, including coffee from Colombia, soybeans from Brazil, wheat from Argentina, beef from Uruguay, bananas from Ecuador, tilapia from Honduras, wine from Chile, fruits from Haiti, quinoa from Peru, and vegetables from Guatemala. Summarizing across all products, LAC is the world's largest net food exporting region.

Figure 2.
LAC share of global production, selected commodities, 2010 and 2016

Source: FAOSTAT.

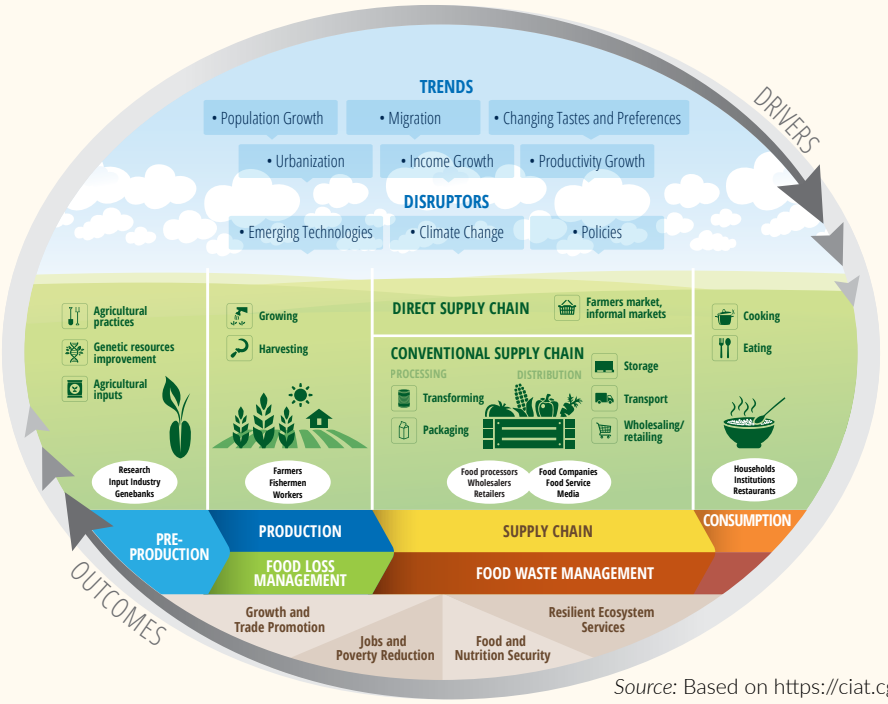


Many LAC countries are interested in capturing a share of the projected expansion in agri-food business that will accompany growth both domestically and in the global economy. LAC is one of the few regions with significant endowments of unexploited arable land that can be sustainably developed. While this suggests that LAC will continue to play a pivotal role in global food production and exports in the future, this potential comes with great responsibility for safeguarding and effectively managing the natural resource base on which all life depends. Any further expansion of the agricultural frontier in LAC will have to be informed by strong understanding of environmental impacts and unwavering attention to climate resilience. Given the often high costs of converting new land to agricultural uses, the production increases needed to meet the projected growth in demand for food, feed, fiber, and fuel will have to come increasingly from improvements in productivity and intensification of existing production systems.

Box 2. Agriculture and food systems: Conceptual elements

The definition of "agriculture and food systems" as used in this report is similar to the definition used by the United Nations Food and Agriculture Organization (FAO 2013; HLPE 2017). Agriculture and food systems encompass the entire range of actors, processes, and value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of agricultural and food products. Agriculture and food systems comprise all the products that originate from crop and livestock production, forestry, and fisheries and aquaculture, as well as the broader economic, societal, and natural environments in which they are produced. Activities in the food system also include the provision of inputs and services in the extended value chain, which support (or constrain) the flow of goods through the different stages of the core value chain.

Figure 3. Agriculture and food system conceptual elements



Source: Based on https://ciat.cgiar.org/

This report examines not only activities and actors, but also drivers that shape the organization, performance, and evolution of agriculture and food systems. Drivers are classified into two groups. Trends are ongoing, gradual, predictable processes with impacts on agriculture and food systems that are well recognized and can be anticipated and addressed in advance. Disruptors are sporadic, sudden, unpredictable shocks with impacts on agriculture and food systems that are usually unexpected, meaning that they cannot be anticipated and fully prepared for in advance. Policy makers are generally better equipped to deal with trends, but they can face major challenges in responding to disruptors, the effects of which will likely increase in the future as a growing population puts increasing demands on the world's resources and the rate of systemic change accelerates.

2.2 Agriculture and food system actors

In examining the organization and performance of agriculture and food systems in Latin America and the Caribbean—in the past and going forward—it is important to keep in mind the different actors. The structure of the region's agriculture has changed over time, both at the level of primary production and in the value chains that make up the broader agri-food system, with corresponding changes in the cast of characters. Fifty years ago, in the 1960s and 1970s, agriculture throughout much of LAC had a dual structure, with a small number of large enterprises (*latifundios*) operating alongside a large number of small holdings (*minifundios*). Fast forward to the present, and the structure of agriculture has undergone pronounced changes. The traditional dual structure has given way to a much more diversified structure featuring many new actors. While the precise configuration of actors and their relative importance varies from country to country depending on historical experience and current circumstances, the stage is usually populated by the same basic cast of characters.

Land owners

Land is a critical factor of production for farming and ranching, which means that the performance of LAC agriculture and food systems is greatly influenced by the forces that determine access to and use of land. Locally recognized ownership of land provides the greatest degree of land tenure security, so land ownership arrangements matter. Latin America is the world's most unequal region in terms of land distribution. The Gini coefficient for land—an indicator of between 0 and 1, where 1 represents the maximum inequality—is 0.79 for the region as a whole, 0.85 for South America, and 0.75 for Central America. Land in LAC is much more highly concentrated than in Europe (0.57), Africa (0.56) or Asia (0.55). Data from the national agricultural censuses of 15 Latin American countries show that across the region as a whole, one percent of farms control more than one-half of all agricultural land (Oxfam 2016).

Agricultural producers

Due to its enormous latitudinal range, varied topography, and rich biodiversity, LAC is home to a wide range of farming systems. FAO (2001) recognizes 16 distinct LAC farming systems, each characterized by a unique combination of agro-climatic circumstances and farming activities. The diverse structure of LAC agriculture is reflected in many different farm types. At one end of the spectrum, a small number of large, well-capitalized, technologically sophisticated farms and ranches operated as agribusiness enterprises account for a large share of the commercial agriculture that generates exports; such farms are particularly prevalent in Argentina, Brazil, Mexico, and Uruguay. At the other end of the spectrum, a vast number of much smaller, less well-capitalized, and technologically less sophisticated family farms account for an estimated 50 percent of LAC food production (Truitt Nakata and Zeigler, 2014).

In considering the potential of LAC agriculture and food systems to contribute to growth and poverty reduction, family farming merits special consideration because it represents a significant livelihood source for so many people. Definitions of family farming vary, but three key elements recur with great regularity: (i) small farm size, (ii) use primarily of unpaid family labor, and (iii) reliance on agriculture as a major livelihood source. These criteria are not definitive, however, and the size of an economically viable

family farm holding varies by region, production strategy, level of market integration, family structure, access to inputs, technology, infrastructure, and off-farm labor opportunities. Within the broader classification of family farms, different categories can be distinguished. For example, the Interamerican Institute for Agricultural Cooperation (IICA) recognizes three broad categories. *Subsistence family farms* produce mainly for home consumption, are poorly integrated into the commercial economy, and command limited amounts of land, capital, and knowledge. *Transitional family farms* produce both for home consumption and for the market and have some access to productive resources, but they struggle to remain sustainable. *Commercial family farms* produce mainly for the market, have access to significant amounts of productive resources, and consistently produce surpluses that allow them to increase the scale of their operations and accumulate further resources.

Statistics on family farming are surprisingly elusive. Lowder, Skoet, and Rainey (2016) estimate that currently there are about 21.5 million small-scale farms in LAC. Using a definition of family farms based not only on size but also on variables such as the level and sources of income, Berdegué and Fuentealba (2011) arrived at an estimate of 15 million family farms in LAC, which they classified into three groups: (i) about 10 million subsistence farms working roughly 100 million hectares (with a large proportion of their income coming from non-farm jobs, remittances and/or social subsidies); (ii) about 4 million farms working roughly 200 million hectares that are integrated in agricultural markets but face significant constraints; and (iii) about 1 million family farms working about 100 million highly productive hectares that hire some permanent labor.

Because many of the households that engage in family farming are poor, policies to support family farming have tended to focus on providing income support and safety nets. More recently, this has begun to change, as it has become evident that family farming is not synonymous with poverty. Depending on their asset base, access to markets and services, and other factors, small farms can be technically efficient and economically profitable, providing acceptable livelihoods for farming households. At the same time, in some places family farms have become too small, too unproductive, and too poorly linked to markets to be economically viable and to generate acceptable levels of income for farming families (IFAD 2015).

Complementing the family farming sector is a diverse group of farming and ranching enterprises that are commonly referred to as "large-scale commercial farms." If the total agricultural area in LAC is about 760 million hectares, and 400 million hectares are devoted to family farming, that leaves 360 million hectares controlled by large-scale commercial farms. While the category includes a range of farm types, what most large-scale commercial farms have in common is the ability to access investment capital, their use of cutting-edge technologies along with the required inputs and machinery, and their reliance on hired labor as opposed to just family labor. When well-managed, large-scale commercial farms are able to operate close to the technological frontier. These farms have generated the important advances in production and exports that turned LAC in the largest net food and agricultural exporter at the world level.

Agricultural input suppliers

The growth of commercial agriculture in LAC has fueled the emergence of a large agribusiness sector made up of a number of distinct industries that are economically important and politically

influential. Backward linkages from primary production have fueled rapid growth among LAC input suppliers. Seed companies, including many multinationals, have expanded their presence in the region, providing improved germplasm mainly for cereals and oilseeds. Companies selling fertilizers and crop chemicals, many of them multinationals, have also scaled up their operations. Machinery companies have grown their business significantly, although not at the same rate as seed, fertilizer, and crop chemicals. Brazil represents by far the largest market for input suppliers. During the past two decades, Brazil accounted for 65 percent of total regional sales of improved seed, 68 percent of total regional sales of fertilizers and nitrogen compounds, 65 percent of total regional sales of pesticides and other agro-chemical products, and 55 percent of total regional sales of agricultural machinery (FAOSTAT).

Feed manufacturers make up a second important group of input suppliers. While livestock production in LAC has traditionally been dominated by extensive production systems in which animals (notably cattle) are put out to graze on open pastures, rapid growth in intensive production, especially in the poultry and pork subsectors, has generated increased demand for feed. LAC now accounts for 16 percent of world feed production, with Brazil and Mexico ranking among the top five countries in the world in terms of feed manufacturing (IFAF 2019).

Agricultural traders

Similar to the way that the growth of commercial agriculture gave rise through backward linkages to emergence of a set of input suppliers, it also gave rise through forward linkages to a set of actors specialized in "post-farmgate" activities, including assembly, transportation, storage, processing, and distribution. In traditional food systems characterized by short, localized supply chains, very little value addition occurs in post-farm components of the supply chain. Farmers retain their production for home consumption, sell it directly to neighbors, or transport it to the market themselves. Consumers purchase raw products and process them at home. But as food systems have developed, supply chains have grown longer, market volumes have grown larger, and economies of scale have emerged, making specialization worthwhile in the midstream and downstream segments.

The transformation of LAC food systems has been accompanied by the emergence of a large number of specialized actors involved in the assembly, transportation, storage, and sale of agricultural products. Depending on the country and the commodity, these actors, who fall into the general category of traders, come in many different shapes and sizes with respect to geographic presence, business portfolio, degree of vertical integration, and ownership structure. Where traditional food systems persist, trading is often dominated by small-scale, informal market vendors who purchase directly from producers and sell directly to final consumers; these small-scale, informal market vendors are often women, so the disappearance of traditional food systems can mean disproportional losses in women's livelihood opportunities. As food systems develop and evolve through the transitional phase to the integrated phase, post-farmgate activities increasingly are carried out by specialized firms that concentrate on a single activity, such as assembly, storage, or transportation. Alternatively, firms involved in trading may choose to integrate vertically, performing several activities themselves to reduce market risk and/or achieve economies of scale.

Commodities importers and exporters

The large volume agricultural trade into and out of LAC has attracted the attention of the business community and given rise to a dynamic agricultural commodities trading industry. Traditionally consisting mainly of unprocessed cereals and oilseeds, LAC agricultural exports were long dominated by a handful of multinationals, including the so-called "Big Five" companies that account for much of the global grain trade (Archer Daniels Midland, Bunge, Cargill, Louis Dreyfus, and Glencore). More recently, the cast of characters has expanded with the diversification of LAC agricultural exports to include increased volumes of beef, fresh fruits and vegetables, fish and seafood products, and wine. In addition, with the development of greater food processing and manufacturing capacity, a greater proportion of agricultural products are being exported not as raw commodities but rather in the form of processed products.

Food processors and manufacturers

Rising incomes and changing lifestyles have been associated with rapid growth in the consumption of processed food in many LAC countries. This has created enormous opportunities for food manufacturers, who have expanded their presence in the region. Growth has been driven in part by the emergence and scaling up of domestic firms, as well as by the appearance of multinationals, many of whom are seeking to grow by expanding beyond their traditional presence in North American and European markets. Interestingly, the development of food processing and manufacturing capacity has been accompanied by a proliferation of actors. While large multinational corporations have expanded their market share in some subsectors, particularly bulk staples (e.g., wheat, maize, rice), small and medium enterprises (SMEs) and even micro enterprises have gained important footholds in markets for higher value speciality products, especially those sold under various certification regimes (e.g., organic, environmentally friendly, biodiversity preserving, ethically sourced, GMO-free).

Food service industry

Rising incomes and changing lifestyles also are fueling rapid growth in LAC's food service industry. As rising numbers of LAC consumers take an increasing proportion of their meals outside the home, the number of restaurants has proliferated, especially in the fast food sector. The result has been a proliferation in the number of food service establishments, both locally owned and international. A notable recent development has been the emergence of food delivery services in many major cities, catering to the growing number of households who have taken to using telephone and internet-based applications to order food delivery.

Food retailers

Latin America has led the way among developing regions in the growth of the supermarket sector. As described by Reardon et al. (2019), while a small number of supermarkets existed in most countries during and before the 1980s, they were primarily financed by domestic capital and tended to exist in major cities and wealthier neighborhoods. In other words, they were essentially a niche retail market providing at most 10 to 20 percent of national food retail sales. By 2000, supermarkets had risen to

occupy 50 to 60 percent of national food retail among the Latin American countries, almost approaching the 70 to 80 percent share of France and the United States. In a single decade, Latin America had the same development of supermarkets that the United States experienced in five decades.

Food retailers, especially the large supermarket chains, are having an important influence on LAC agriculture and food systems because of their ability to shape production decisions. The need to accommodate the demands of increasingly informed and increasingly discriminating consumers is forcing retailers to impose ever more stringent requirements on their suppliers, which profoundly affects the way farmers produce food and deliver it to market. Supermarkets have pioneered the introduction of sophisticated procurement systems, and supermarket buyers today make many of the production decisions that in past decades would have been taken by farmers: what to grow, when to plant, how to manage the crop, when to harvest, and when to deliver the crop to the market.

The rise of supermarkets notwithstanding, informal open air markets and "wet" markets remain important in many LAC countries, especially in rural areas. Some are efficiently organized and well managed, but many would benefit from additional investment in safety and sanitary standards, market protocols and efficient agri-logistic networks.

Consumers

For years, the perception in the food industry has been that consumer purchasing decisions are driven by three primary factors: taste, price, and convenience. These factors still affect consumer behavior, particularly among low-income consumers, but with the emergence in many LAC countries of a more prosperous and better-educated middle class, a broader set of food values plays a bigger role in the decisions made by consumers when they shop for food. As consumers become wealthier and better informed, they demand new qualities of food, and they are able to back up their changing preferences with effective purchasing power. In addition to considering taste, price, and convenience, LAC consumers are increasingly seeking out food that is nutritious, safe (in terms of being free of chemicals), sustainably produced, and/or ethically sourced. With the help of supermarket buyers who are highly attentive to changing market demand, their evolving preferences are transmitted rapidly back along increasingly integrated and highly responsive supply chains, inducing changes at every stage, even primary production.

2.3 Subregional differentiation: Countries

In recognition of the heterogeneity that exists within LAC, conversations about agriculture in the region often distinguish between four groups of countries based on their size, location, ecological and climatic characteristics, and agricultural economies: (1) Mexico and Central America, (2) the Caribbean States, (3) the Andean Zone, and (4) the Southern Cone. Sometimes the latter grouping is subdivided into one subregion containing mainly tropical and subtropical regions in northeastern South America (northeastern Brazil, Guyana, Suriname) and another subregion containing mainly temperate regions in Argentina, southern Brazil, Chile, Paraguay, and Uruguay. These groupings are intuitive, but as discussed below, they gloss over many characteristics of relevance to the current and likely future performance of agriculture and food systems. For this reason, this report examines different aspects of LAC's heterogeneity relevant to agriculture and food systems. The analysis will take note of

intercountry variability in factors such as national income, level of development, geographical features and connectivity, natural resource endowments, production of ecosystem services, importance of agriculture and food systems in the economy, structure of the agriculture sector, agricultural trade, and consumption patterns and nutritional outcomes. Where appropriate, the report makes differentiated recommendations based on the patterns of heterogeneity that have been identified.

2.4 Subregional differentiation: Food systems

The heterogeneity among LAC countries in terms of size, location, agro-ecology, and stage of economic development is paralleled by equally pronounced heterogeneity among these countries' food systems. The variability among food systems stems from the fact that in every country, the food system reflects the complex interplay of a unique constellation of geographical, agro-climatic, social, cultural, economic, and political factors that have given rise over time to particular food production systems and consumption patterns.

While the food system in every country is in some respects unique, almost all food systems tend to pass through similar developmental stages. Following McCullough et al. (2008) and Reardon (2016), three major types of food systems are distinguished for purposes of this report, characterized by their position along a developmental continuum: (1) traditional, (2) transitional, and (3) integrated.

Traditional food systems: Traditional food systems typically are found in the so-called agrarian economies in which income levels are still low and a large share of the population lives in rural areas and relies on agriculture as their primary livelihood source. Most rural households engage in subsistence-oriented agriculture, growing crops and raising animals destined mainly for home consumption, with occasional small surpluses sold in local markets to generate cash income. Food production methods involve few purchased inputs, rely heavily on family labor, and make limited use of capital. Traditional food systems tend to be spatially compact; because most transactions take place in spot markets, they often feature short supply chains with few coordination mechanisms. Transactions rarely are subject to quality and safety standards. Because consumers have limited purchasing power, diets are dominated by low value foods, chiefly cereals, roots, and tubers.

Transitional food systems: Transitional food systems abound in the so-called transitioning economies in which income levels have started to rise and a growing share of the population has migrated to towns and cities and relies on off-farm sources of income as their primary livelihood source. Food production methods are becoming increasingly sophisticated, making greater use of purchased inputs and replacing labor with capital through mechanization. Transitional food systems tend to be spatially expansive; because more and more people live at some distance from places where food is produced, longer supply chains are needed to deliver food from the countryside to urban centers. The longer supply chains give rise to large numbers of intermediaries, who rely increasingly on contracts to ensure coordination along the supply chain. As incomes rise, the purchasing power of consumers grows and consumption of high-value foods rises, including meat and fish, dairy products, and fruits and vegetables. While some consumers may want to know about the source of the food they buy, transactions are not always subject to quality and safety standards.

Integrated food systems: Integrated food systems are prevalent in highly urbanized economies in which a large share of the population has achieved middle-income status, lives in cities, and

no longer relies on agriculture as a major livelihood source. Food production methods become extremely sophisticated; in many cases, they are dominated by specialized agribusiness firms that have the resources and know-how to take advantage of cutting-edge global technologies. Integrated food systems tend to be spatially expansive, characterized by the long supply chains needed to deliver food to urban populations. The long supply chains can feature pronounced consolidation in certain segments, however, as seen at the retail level by the dramatic rise of supermarkets and more recently by the emergence of food home delivery services. At the same time, rising demand for fresher food, the desire to know the source of food, and a commitment to support local producers mean that some short supply chains continue to flourish as a way of serving consumers who want to "eat fresh" and/or "eat local". Diets tend to vary between different groups in the population; higher income, better-educated people favor high-value foods, including meat and fish, dairy products, and fruits and vegetables, whereas lower income, less-educated people consume large quantities of processed foods that may be more affordable but also are likely to be nutritionally incomplete. Lifestyle changes give rise to increased demand for convenience foods, leading to a shift in the location of consumption; a large share of meals are now taken outside the home. Out of a need to respond to ever more educated and demanding consumers, quality and safety control are increasingly demanded by the food industry.

Characteristics of these three types of food systems are summarized in Table 1. The characterizations should be taken with a grain of salt, however. While most food systems evolve in the same general way, the transformation process is not linear and deterministic, so the pathway can be quite divergent. Furthermore, the transformational process typically occurs at different times for different food groups; typically, the transformation affects cereals and grains first, livestock and dairy products second, and fresh fruits and vegetables last. For these reasons, in most LAC countries, multiple food systems coexist, usually with some more dominant than others.

2.5 Mapping food system types to LAC countries

The coexistence in most LAC countries of different types of food systems can pose a challenge for policy makers, because each type of food system tends to face its own set of constraints and enjoy its own set of opportunities. In thinking about the actions that may be needed to improve food system performance, it is useful to consider where individual LAC countries stand with respect to the typology of food systems, because the actions needed to improve performance in countries dominated by traditional food systems will likely differ from the actions needed in countries with predominantly integrated food systems. To the extent that food system types are linked to other features of the economy, this could provide valuable clues regarding the areas that should be the focus of policy attention.

With the goal of generating insights into the factors associated with the prevalence within individual countries of different food system types, LAC countries were classified into three groups using a three-dimension clustering procedure that took into consideration: (i) the relevance of agriculture in the economy (measured as agricultural value added as a share of GDP); (ii) the level of economic development (measured as GDP per capita in PPP, constant 2011 US$); and (iii) the degree of

Table 1. Food system typology and predominant characteristics

	Traditional food systems	Transitional food systems	Integrated food systems
Agriculture share of GDP	High	Medium	Low
Location of population	Mainly rural	Mix of rural and urban	Mainly urban
Income level	Low	Medium	High
Dietary pattern	Mainly unprocessed foods	Rising share of processed foods	Mainly high-value foods
Source of food consumed	Self-produced food	Self-produced and purchased food	Purchased food
Consumption location	Mainly at home	Mix of home and away from home	Mainly away from home
Production structure	Many small-scale producers	Emergence of agribusiness firms	Industrial firms, niche producers
Production technology	Labor intensive, low input use	Capital intensive, high input use	Capital intensive, sustainability focus
Product volumes	Small	Medium	Large
Supply seasonality	Highly seasonal	Somewhat seasonal	Deseasonalized
Direction of food flows	Rural-to-rural	Rural-to-urban	Rural-to-urban, urban-to-rural
Spatial orientation of markets	Short value chains	Long value chains	Mix of short and long value chains
Value chain organization	Fragmented	Consolidating	Integrated
Horizontal integration	Fragmented	Subnational	National
Vertical coordination	Relationships	Relationships, rules	Binding agreements
Intermediaries	Limited numbers of intermediaries	Many intermediaries	Limited numbers of intermediaries
Procurement arrangements	Spot markets (informal)	Producer contracts (semiformal)	Managed chains (extremely formal)
Retailing structure	Local markets	Local markets, small groceries	Supermarkets, niche markets
Food systems safety	No traceability	Some private standards emerging	Private standards, public accountability
Finance arrangements	Tied credit from traders	Self-finance	Commercial credit
Food system jobs	Mainly on-farm	Mix of on-farm, off-farm	Mainly off-farm

rurality (measured as rural population as a share of total population).[6] The anchors or centroids required by the clustering procedure were selected to include countries considered to be dominated by traditional food systems (Honduras), transitional food systems (Costa Rica), and integrated food systems (Brazil).

The results of the clustering exercise appear in Table 2. As expected, countries in which traditional food systems predominate (Cluster 1) generally have a higher share of agriculture value added in the economy, lower GDP per capita, and typically a significant share of the population living in rural areas (whose livelihoods will presumably be based on agriculture). Countries in which transitional food systems dominate (Cluster 2) include most of the Caribbean countries; in these countries, agriculture comprises a smaller share of the overall economy, income levels are higher, and the level of rurality varies. Countries in which integrated food systems dominate (Cluster 3) include those in which agriculture makes up a relatively small share of the economy, GDP per capita is relatively high, and the rural population is small.

In the absence of data on the relative importance of different food system types in individual countries, it is not possible to explore quantitatively the relationship between these clusters and the food system types. Still, the results of the clustering exercise support the intuition that different food system types are systematically associated with certain features of the overall economy and of the agricultural economy in particular. Traditional food systems are more prevalent in less-developed economies in which a large share of the population is rural and agriculture makes up a larger share of the overall economy—countries which tend to have much higher numbers of subsistence-oriented smallholders. Integrated food systems are more prevalent in more developed economies in which a small share of the population is rural and agriculture makes up a smaller share of the overall economy—countries which tend to be dominated by commercial farms and feature much more developed downstream agro-industries. Transitional food systems tend to dominate in countries that fall in between the two extremes.

While admittedly imperfect, this approach to classifying countries using a clustering procedure can be useful in characterizing the priority challenges facing individual countries and identifying the areas that may require priority attention from policy makers. Given the heterogeneity among LAC countries, it is not realistic to think in terms of one-size-fits-all-solutions; policy recommendations, technical solutions, and supporting investments must be tailored to particular types of food systems and to the differing circumstances of individual countries.

[6] *The World Development Report 2008: Agriculture for Development* used a two-dimension clustering method to group developing countries into three groups, using variables on the contribution of agriculture to growth and the level of rural poverty. For the present exercise, a three-dimension clustering method was used, in which an algorithm (i) generated sample means and standard deviations, (ii) standardized the data for each country with a z-score for each variable, and (iii) given selected centroids or anchors for each variable, went through an iterative process to minimize the squared Euclidean distance (minimizing the sum of squared errors) from each data point to the nearest centroid. The algorithm worked iteratively to assign each data point (country) to one of the k groups (clusters) based on the variables under consideration. Each country was assigned to a single cluster. All data are averages from 1990 to 2016, taken from the World Bank World Development Indicators database.

Table 2. Classification of LAC countries by predominant food system type – Clustering exercise results

Country	Ag. value added (% of GDP)	GDP per capita PPP (constant 2011 int$)	Rural population (% of total)
Group 1: Mainly traditional food systems			
Guyana	34.13	4,944	71
Nicaragua	19.44	3,692	44
Paraguay	18.92	6,748	44
Dominica	16.77	8,644	34
Honduras	16.41	3,653	52
Belize	16.13	7,130	54
Bolivia	14.79	4,831	37
Ecuador	14.59	8,614	39
Guatemala	12.54	6,226	54
El Salvador	12.38	6,557	40
Haiti	-	1,638	58
Group 2: Mainly transitional food systems			
Suriname	10.72	11,890	34
Costa Rica	9.83	11,052	37
St. Vincent and Grenadines	8.51	8,409	54
Dominican Republic	8.08	8,837	34
Jamaica	6.99	8,131	48
Grenada	6.65	9,899	65
Panama	5.69	12,807	38
Caribbean small states	5.35	12,139	59
St. Lucia	5.22	10,906	76
St. Kitts and Nevis	2.37	19,865	67
Barbados	2.36	15,344	67
Antigua and Barbuda	1.95	18,960	70
Trinidad and Tobago	1.33	22,603	91
Group 3: Mainly integrated food systems			
Colombia	10.42	9,613	27
Uruguay	8.69	14,130	07
Peru	8.20	7,938	26
Argentina	7.24	15,837	10
Brazil	5.99	12,424	19
Chile	5.68	16,101	13
Mexico	4.15	14,819	24
Bahamas	2.41	23,537	18
Aruba	0.47	35,973	54

Source: World Development Indicators database, World Bank.
Note: Several different combinations of alternative variables were tried with many iterations, and results were robust to alternative combinations.

Box 3. The Caribbean subregion — Unique challenges facing small economies

The Caribbean subregion, especially the small island states that make up many of the subregion's economies but also the larger non-island states of Belize, Guyana, and Suriname, face unique challenges that must be recognized and taken into account in building productive, inclusive, and sustainable agriculture and food systems for the future. These challenges may be structural, social, fiscal, or environmental.

Structural challenges: Many Caribbean economies are small, which prevents them from capturing economies of scale in research, extension, training, procurement and distribution of inputs, and marketing of outputs (this challenge may be less restricting in larger states, such as Dominican Republic, Guyana, Haiti, and Suriname). Many Caribbean economies are also nondiversified, which leaves them vulnerable to sudden changes in external supply and demand conditions. Finally, the physical dispersion of Caribbean states over a large area results in high logistics costs involved in transporting goods. All of these factors undermine the profitability of doing business, which is one reason why the private sector remains generally underdeveloped. Because of their small size, limited populations, and lack of access to natural resources, most Caribbean economies are heavily skewed towards the services sector, with primary and secondary production remaining underdeveloped. Many are heavily dependent on tourism: in some countries, almost three-quarters of total foreign exchange earnings come from tourism, and many other industries are linked to the tourism economy in one way or another. Dependence on tourism brings risks: the fortunes of the tourism industry vary depending on global economic cycles, and it is vulnerable to sudden severe disruptions from natural disasters and disease outbreaks. The weak domestic productive base, together with high import costs due to remoteness, often results in a consistently negative trade balance.

Social challenges: The Caribbean subregion in general suffers from an unskilled workforce, the legacy of decades of substandard education policies combined with extremely high rates of outmigration of tertiary-educated people. Unemployment is high in many Caribbean countries, especially youth unemployment, which has contributed to high rates of crime and rising insecurity. The fact that the Caribbean serves as a transit route for shipments of illegal drugs from South America gives further impetus to the insecurity. Gender inequality remains a problem in many Caribbean countries. Because of limited availability of land and water, high labor costs, and relative trade openness, the agri-food sector is not able to meet fully the food needs of the domestic population in many Caribbean countries, which as a result are heavily dependent on food imports. The increasing cost of food due to high import prices (further aggravated by the remoteness of some countries) limits the ability of poorer households to afford a nutritious and adequate diet. Nutritionally poor diets, combined with bad eating habits and lifestyle preferences (e.g., low exercise rates and high tobacco and alcohol consumption) lead to a high prevalence of obesity.

Fiscal challenges: The ability of many Caribbean governments to tackle pressing social problems is constrained by severe fiscal challenges. Because they are small, most Caribbean countries lack the large, diversified economic base needed to generate a consistent revenue stream, and the few countries that have developed extractive industries (e.g., Guyana, Suriname, and Trinidad and Tobago) face uncertainties about how long their nonrenewable resources will last. Almost all carry high debt burdens, which have resulted partly from imprudent policies but also have been inflated by the heavy dependence on imported fuel and food. Reducing the high debt burden has been made difficult by the middle-income status of many Caribbean countries, which has prevented them from securing access to concessional financing.

Environmental challenges: Last, but not least, the Caribbean subregion is extremely vulnerable to extreme weather events and natural disasters, not only the hurricanes that frequently impact the region but also periods of drought that affect agriculture (Figure 4). Climate change will likely increase the frequency and severity of extreme weather events and could also contribute to a rising sea level, which will threaten low-lying areas.

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Box 3. The Caribbean subregion — Unique challenges facing small economies (cont.)

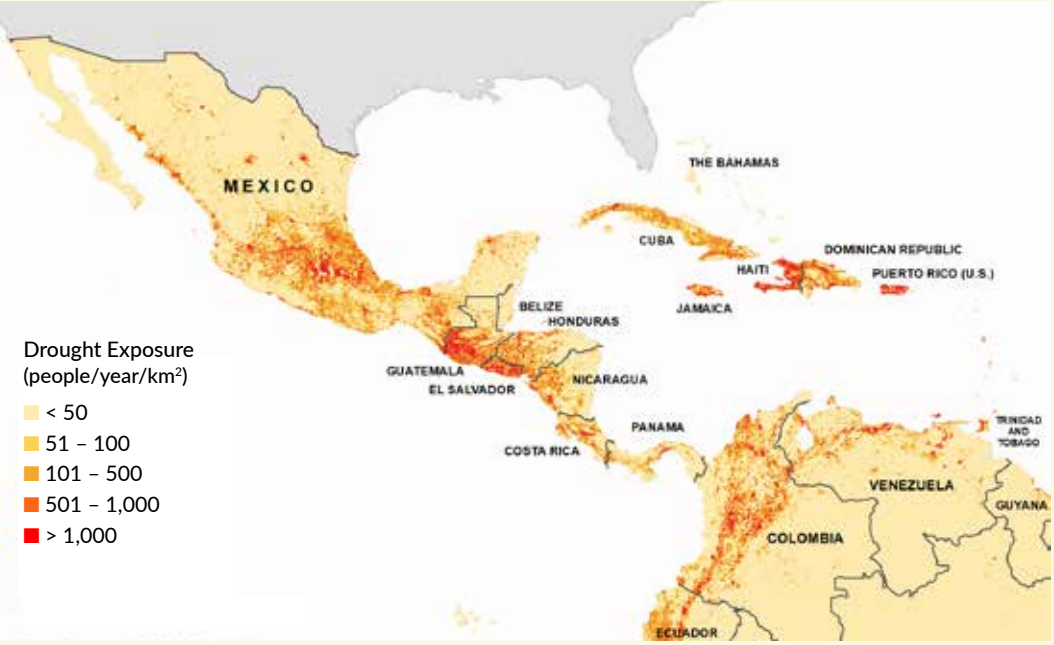


Figure 4.
Drought exposure, Caribbean subregion

Data Source: UNEP/GRID, 2019.

The challenges facing Caribbean countries are daunting, yet there are grounds for optimism. Global experience suggests that small economies are not necessarily prone to underdevelopment and can achieve very high income levels (Lederman and Lesniak 2018). Small economies, however, do tend to be highly open to international trade and foreign direct investment, to have highly specialized export structures, and to have large government expenditures relative to GDP. Because their export structures are so concentrated, their fiscal revenues are subject to terms of trade volatility. Still, small economies can compensate for their export concentration by being nimble, in the sense of changing their production and export structure quickly.

Agriculture and food systems in the Caribbean subregion have potential to contribute to growth, jobs, food and nutrition security, and climate resilience. The abundant productive resources present in the subregion are underutilized. Opportunities exist to promote exports of high-value products, especially to nearby North American markets, as well as to increase sales into the domestic tourism sector. Locally produced fruits and vegetables appear to have the greatest import substitution potential, given high demand, high perishability of these products, and their suitability for production even on small farms. The freshness of local produce, and reduced transport times and costs, represent major advantages and opportunities for local farmers in places where the tourism industry will pay a premium for freshness (Jansen, Stern, and Weiss 2015). To seize these opportunities, however, local farmers will not only have to increase the quantity and quality of their production, they will also have to ensure stability of supply, a critical consideration for the tourism sector. Development of the agricultural sector will free up resources that currently are used for food imports but that could be invested instead in health and education initiatives.

Realizing this potential will require strong policy support. The region as a whole needs to develop more integrated agricultural markets to lower costs and lay the groundwork for scale economies. Policies to counter short- and long-term weather and climate impacts need to be put in place, and infrastructure improvements are needed to offset the historical emphasis on export sales of tropical commodities and to pave the way for reliable delivery of high-value perishable products to the expanding tourism sector.

2.6 Contributions of LAC agriculture and food systems

In the past, the role of agriculture in LAC was seen mainly as producing enough food, feed, and fiber to meet the consumption requirements of people and animals. That view is now outdated. Today, agriculture and food systems in the region are expected to contribute to multiple objectives that go far beyond the production of food, feed, and fiber. Among these multiple objectives, four stand out. Today, agriculture and food systems in LAC are expected to contribute to (1) economic growth and diversification, (2) employment and poverty reduction, (3) food security and improved nutrition, and (4) ecosystem services, including climate change mitigation.[7] The rest of Section 2 reviews evidence on the multiple roles played by agriculture and food systems in the region, focusing particularly on the contributions made in these four areas.

2.7 Contribution of agriculture and food systems: Economic growth

What is the contribution of agriculture and food systems to economic growth and diversification? In LAC as elsewhere, the importance of agriculture as a driver of economic growth and a source of diversification depends on three factors: (1) the size of the agricultural sector within the larger economy, (2) the rate of growth of the agricultural sector, and (3) the extent to which growth in agriculture stimulates growth in other sectors through linkages. Put simply, the larger the sector as a share of the economy, the faster the growth in the sector, and the greater the linkages, the larger the contribution to the overall economy.

Size of the agricultural sector

Just how important is agriculture in the economies of Latin America and the Caribbean? Consistent with structural transformation processes that have been observed worldwide, primary agriculture as a share of the overall economy has declined in most LAC countries. Nevertheless, in many of the region's countries agriculture continues to account for a significant proportion of total GDP (Figure 5).

In thinking about the contribution of agriculture to economic growth, it is important to recognize that the size of the agricultural sector is often underestimated. The importance of agriculture in the economy of a country traditionally is measured as the direct contribution of primary production activities to overall GDP.[8] Value addition linked to agriculture-related activities other than primary production—upstream in the agri-inputs industry through what are commonly referred to as backward linkages and downstream in the agri-food industry through what are commonly referred to as forward linkages—is captured in the GDP share of other sectors, including manufacturing, trade, and services. This approach downplays the larger role of agriculture in the economy, especially in countries in which the overall agro-industrial system has become more sophisticated and more integrated.

The past century has witnessed profound changes in the way food is produced and consumed. For thousands of years after the emergence of agriculture, most food was produced and consumed

[7] PIADAL (2013) and Díaz-Bonilla (2015) argue that a fifth major dimension in which agriculture and food systems are expected to contribute relates to balanced territorial development. To keep the scope of the report more manageable, issues of balanced territorial development are not considered in detail here.

[8] What is generally referred to as "agriculture" often includes all of the natural resource sectors, i.e., crops, livestock, forestry, and fisheries.

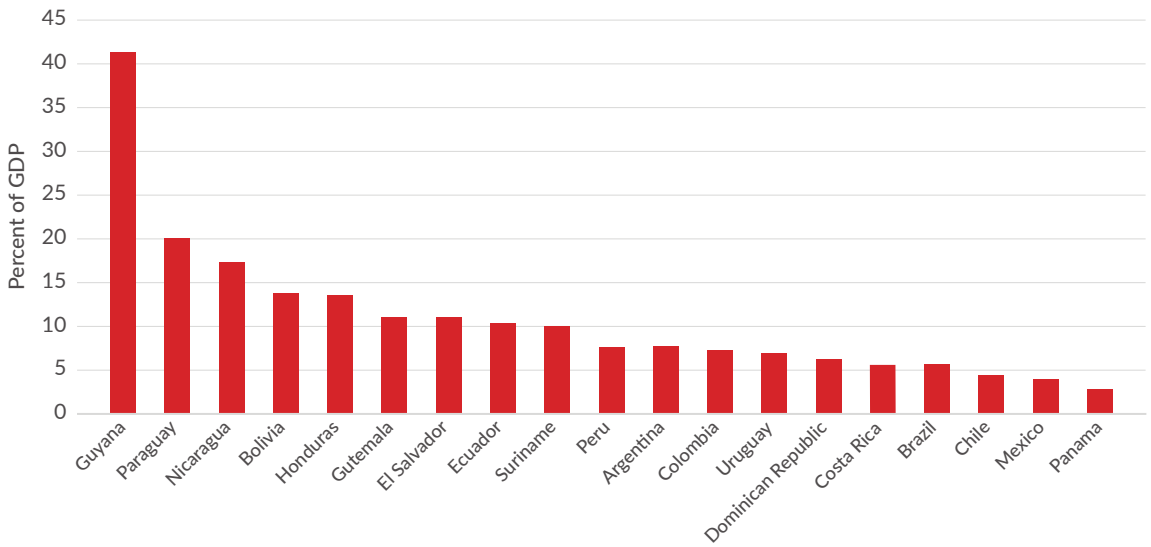


Figure 5.
Primary agriculture value added, by country, 2016 (% of GDP)

Source: FAOSTAT.

within the same household. Today, food moves from specialized surplus-producing farms to non-farming consumers. It is subjected to numerous value-adding activities such as transportation, storage, processing, packaging, and retailing, the importance of which has increased over the years in response to changing consumer demand. In industrialized countries, a large and growing share of food consumption expenditures now go to highly processed manufactured foods (including meals consumed outside the home), whose prices include a small share of primary product and a large share of non-farm value-adding activities. Yet when the time comes to compile national income accounts, most post-harvest value-adding activities are not considered agricultural activity; rather, they are classified as manufacturing or services, which obscures their link to the food system and their dependence on agriculture. Contributions both in labor and value terms of any productive activities occurring beyond the farm gate, for example in the food industry, are measured as non-farm labor and production in other sectors. Similarly, many products serving as inputs into agriculture, such as seed, fertilizer, insecticides and pesticides, and machinery are all listed as non-farm value added.

When forward and backward linkages and multiplier effects are taken into account, the impact of the agricultural sector and its contribution to growth and poverty reduction are considerably larger than is conventionally recognized. Studies on sectoral growth multipliers (designed to estimate how much overall GDP is generated by expanding GDP in a particular sector) usually have found large, positive multipliers associated with the agriculture sector. This shows that agricultural development—normally accompanied by the emergence of dynamic and increasingly sophisticated integrated agri-food value chains—contributes significantly to the dynamism of the overall economy (Haggblade, Hazell, and Brown 1989; Delgado 1999; Haggblade, Hazell, and Dorosh 2007).

The importance of this effect varies, however. In countries in which agriculture and food systems are relatively underdeveloped and a large share of agriculture value added still consists of primary production, the multiplier effects from linkages tend to be modest. In contrast, in countries in which agriculture and food systems are well developed and a large share of agriculture value addition takes place off the farm, the multiplier effects from linkages tend to be much larger (Table 3). For example

in Bolivia and Nicaragua, where (primary) agriculture continues to make up a significant share of the economy, multiplier effects are relatively small (World Bank 2019b; World Bank 2015). But in Chile and Peru, where (primary) agriculture accounts for a small share of overall GDP, for every dollar of value generated in primary agriculture, nearly 50 cents of value is generated downstream (Foster and Valdés 2015; World Bank 2017c). Mexico is an interesting case of a country in which agriculture, though representing only 2.90 percent of the overall economy, has extremely large multiplier effects: for every dollar of value generated in agriculture in Mexico, an additional US$2.40 of value is generated in the food industries downstream (World Bank 2017b).

Table 3. Value added from primary agriculture and downstream multiplier effects, selected countries

Country	Primary agriculture share (%)	Participation in forward sectors (%)	Multiplier effect* (per US $)
Nicaragua 2006 I-O matrix, 2006 VA[a]	23.47	2.46	0.10
Bolivia 2012 I-O matrix, 2012 VA[b]	12.93	4.61	0.36
Peru 2007 I-O matrix, 2007 VA[c]	7.31	3.60	0.49
Chile 2008 I-O matrix, 2008 VA[d]	3.82	1.82	0.48
Mexico 2012 I-O matrix, 2012 VA[e]	2.90	6.97	2.40

*Multiplier effect is defined as the ratio of the contribution of primary agriculture, via intermediate inputs, to downstream production relative to its value added to GDP.

Source: Authors' calculations, using: a. World Bank 2015; b. World Bank 2019b; c. World Bank 2017c; d. Foster and Valdés 2015.; World Bank 2017b.

If these multiplier effects are not recognized, the true contribution of agriculture and food systems to economic growth may not be apparent, and as a result the urgency to focus on agriculture and food systems as a development priority can be reduced. In deciding how much funding to allocate to individual sectors, policy makers often base their decisions on the relative size of the different sectors. In that context, when the size of the agriculture sector is based solely on the value of primary agriculture, ignoring the fact that what happens on the farm may be generating a lot of additional value-adding activity via multipliers, the result can be underinvestment in agriculture.

Rate of growth in the agricultural sector (primary agriculture)

The contribution of agriculture to overall economic growth depends not only on the size of the agricultural sector but also on the rate of growth within the sector. So just how fast is agriculture growing in LAC countries? Agricultural growth in LAC is quite robust. During the 10-year period 2007 to 2016, agricultural growth averaged 2.30 percent per year across the region,[9] with considerable variability among countries. By comparison, however, during the same period agricultural growth worldwide averaged 2.73 percent per year, meaning that LAC lagged behind many global competitors.

Agricultural growth in LAC has been quite robust, but the performance has been mixed compared to other sectors. Within LAC, the rate of growth recorded in agriculture exceeded the rate of growth recorded in manufacturing (2.03 percent per year), but it fell short of the rate of growth recorded in services (4.09 percent per year). Services are growing rapidly in LAC, far outpacing growth in agriculture and manufacturing. As the service sector has expanded, it has drawn labor out of rural

[9] Excluding small Caribbean states.

areas, including in many cases, the best-educated and most-skilled workers. The challenge for the agriculture sector is how to evolve technologically to boost productivity and accelerate growth, both on- and off-farm, so as to retain existing workers and/or draw additional workers back from other sectors—especially skilled and educated younger workers who can be more productive.

Agricultural growth not only has the potential to contribute to overall growth: it can also have a stabilizing effect on the economy. Primary agricultural production involves biological processes that are very sensitive to agro-climatic factors, so it tends to be highly variable, especially in countries in which rainfed production systems dominate. At the same time, performance in the agriculture sector does not always move in sync with performance in other sectors, such as manufacturing and services, which tend to be affected by different sets of factors. As a result, agriculture growth sometimes remains strong during periods when growth in other sectors falters, as illustrated in recent years by the experiences of Colombia and Mexico (Figure 6).

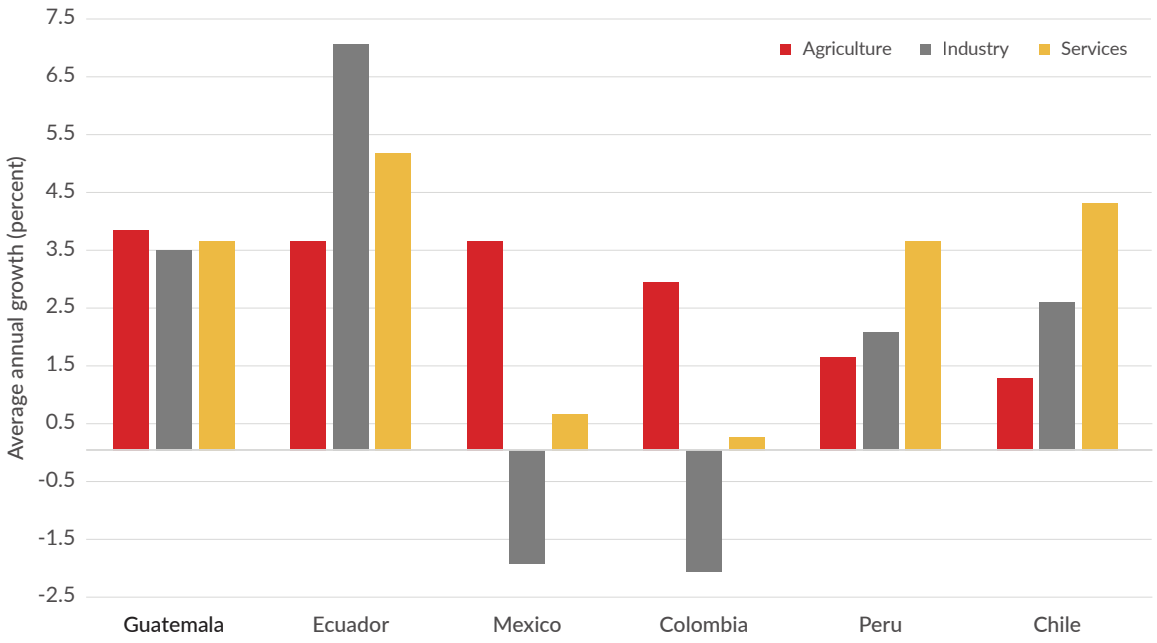


Figure 6.
Sectoral growth, selected countries, 2012–2016 (% average annual growth)

Source: World Development Indicators, World Bank.

Looking to the future, the contribution of agriculture to economic growth will depend critically on the rate of sectoral growth. In countries in which agricultural growth outpaces growth in other sectors, the agriculture sector will expand as a share of the overall economy, and the economic contribution of agriculture will increase. Conversely, in countries in which agricultural growth fails to keep pace with growth in other sectors, the agriculture sector will contract as a share of the overall economy, and the economic contribution of agriculture will decline.

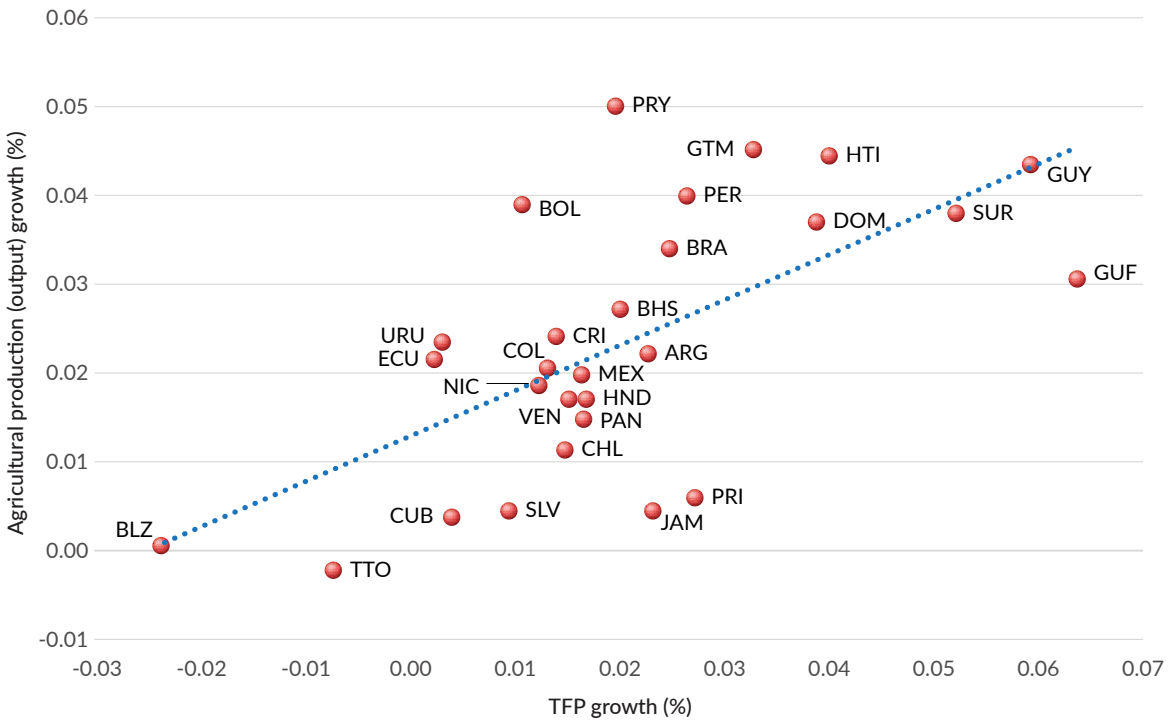
What will drive future agricultural growth in LAC? Two basic strategies are possible: (i) maintaining existing technologies and increasing the use of productive factors (especially land) and purchased inputs, and (ii) developing and applying new technologies to drive productivity gains that allow the same amount of outputs to be produced using fewer productive factors and purchased inputs. In

the past, agricultural growth in LAC has been driven mainly by the first strategy, as expansion of the land frontier has enabled ever greater areas to be converted to agricultural uses and application of increasing amounts of fertilizers and agri-chemicals have allowed steady increases in yields of crops and animals. More recently, however, attention has shifted increasingly to the second strategy, as more and more countries have either exhausted their supplies of unused arable land or realized that the current pace at which the agricultural frontier continues to expand and the rate at which inputs are being used on crops and animals are at odds with environmental, social, and other considerations. The conclusion is clear: going forward, establishing and sustaining high levels of agricultural growth in a climate-smart manner will not be possible without productivity gains. Opportunities to achieve productivity gains are discussed later in this report.

The importance of productivity growth as a driver of sectoral growth is illustrated in Figure 7, which shows that output growth in LAC agriculture is strongly and positively correlated with TFP growth. The relationship holds up not only in countries with modernized, technologically advanced commercial agriculture sectors (e.g., Argentina, Brazil, Chile, Mexico, and Peru), but also in countries that still feature large numbers of subsistence-oriented producers (e.g., Dominican Republic, Guatemala, Guyana, Haiti, Honduras, Nicaragua, and Suriname).

Figure 7. Correlation between agricultural production growth and TFP growth, 2006–2015

Source: Authors' calculations, using USDA Agricultural TFP growth indices database, Fuglie 2015.



2.8 Contribution of agriculture and food systems: Employment and poverty reduction

In addition to contributing to growth, agriculture contributes to poverty reduction by providing employment to large numbers of people, many of them poor. In LAC as in other regions, most primary agricultural workers live in rural areas, where poverty rates remain significantly higher than in urban areas. (Figure 8). For many of these workers, agriculture can provide a pathway out of poverty; as highlighted in *World Development Report 2008: Agriculture for Development*, growth originating from the agricultural sector has a larger impact in terms of reducing poverty than growth originating in other sectors.

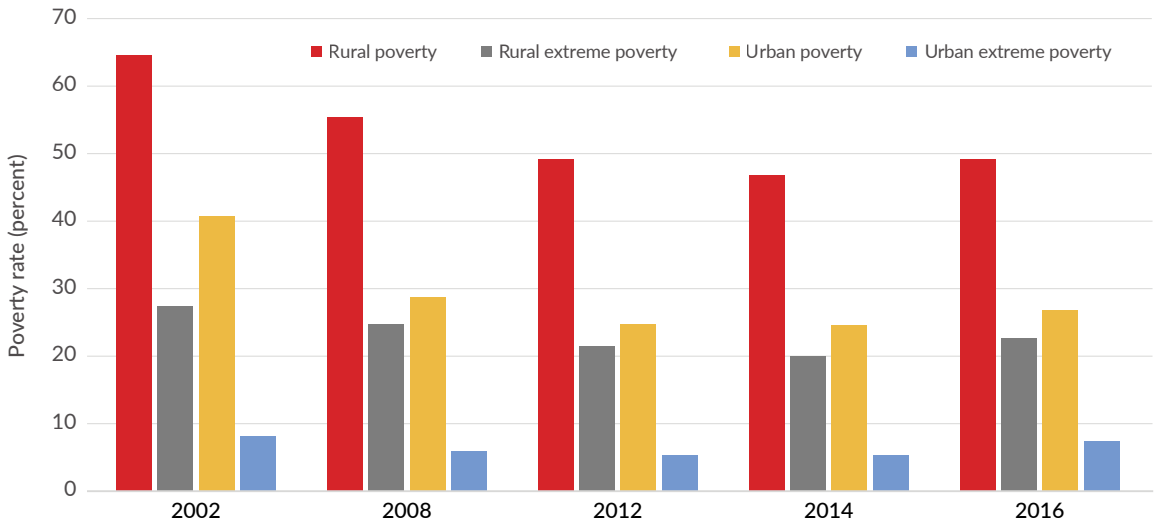


Figure 8.
Urban vs. rural poverty rates, Latin America, 2002–2016

Source: CEPAL 2017.

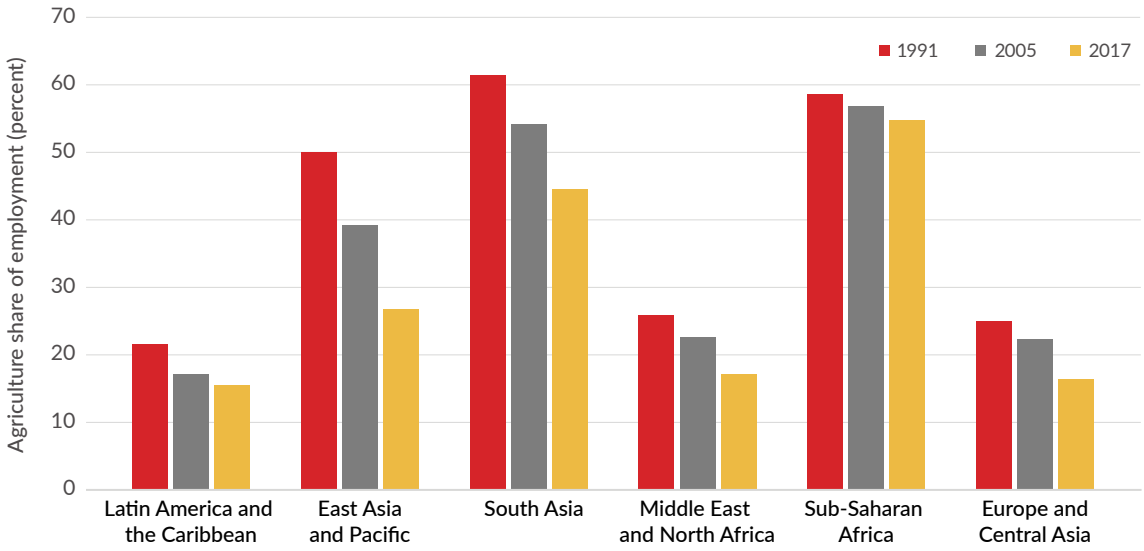
Note: Average of Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Uruguay, Venezuela.

Because many LAC countries are highly urbanized, and because primary agriculture in some of the biggest LAC countries is dominated by large-scale, mechanized production methods, the share of the total labor force employed in primary agriculture is lower in LAC than in other developing regions (Figure 9).

Agriculture nevertheless remains an important source of employment in many LAC countries. Despite the fact that the region is rapidly urbanizing and that large numbers of people are leaving rural areas and moving to cities, agriculture still accounts for a large share of jobs in many LAC countries. (Figure 10). One reason for this is that economic growth tends to have mixed impacts on agricultural employment. Under the process known as structural transformation, modernization of agriculture is usually accompanied by the adoption of labor-saving mechanization technologies, leading to less employment in primary production. At the same time, however, structural transformation typically also features the creation of more and often better-quality employment in other parts of the food system—for example in food manufacturing and food services. In national income accounts, this

Figure 9. Agriculture share of total employment, developing regions, selected years

Source: ILO.



growth in agri-food system employment tends to be recorded in the manufacturing and services sectors, however, so it is not always associated with agriculture.

In considering the role of agriculture in providing employment, it is important to keep in mind that traditional measures understate the ability of agriculture and food systems to provide jobs. Similar to the way that an expanded measure of agriculture GDP can be calculated by taking into account backward and forward linkages, an expanded measure of agricultural employment can be calculated by taking into account the jobs generated through backward and forward linkages from primary agriculture. When agricultural employment is calculated more broadly by considering all jobs in the larger food industry, the contribution of agri-food increases substantially, adding as much as 10 to 15 percent more jobs to the economy vis-à-vis food and agriculture (Figure 11).[10]

As economies grow and develop, changes occur in the number and composition of agriculture-linked jobs. These changes are evident across country income groups, providing evidence of structural transformation associated with economic development. As economies evolve, the number of agriculture-linked jobs may increase or decrease, depending on whether the rate of job growth in the sector is offset by adoption of labor-saving technology. Typically, however, the number of agriculture-linked jobs expressed as a share of all jobs in the economy declines, because job growth in other sectors is usually faster than in the agriculture sector.

Changes in the number of agriculture-linked jobs are accompanied by changes in the composition of those jobs. As the food system transforms and modernizes, jobs in primary agriculture decline in relative importance, while jobs in food services and agri-food manufacturing make up a growing share. In any given country, the configuration depends on the structure of production, consumption patterns, trade flows, and other factors (Figure 12). In Chile, a high-income country, over a 10-year

[10] A more inclusive measure of employment in the overall food system was generated using national labor force surveys from the harmonized SEDLAC database by considering employment in on-farm primary agriculture, food services (hotels and restaurants) and agri-food manufacturing (food, tobacco, and beverages).

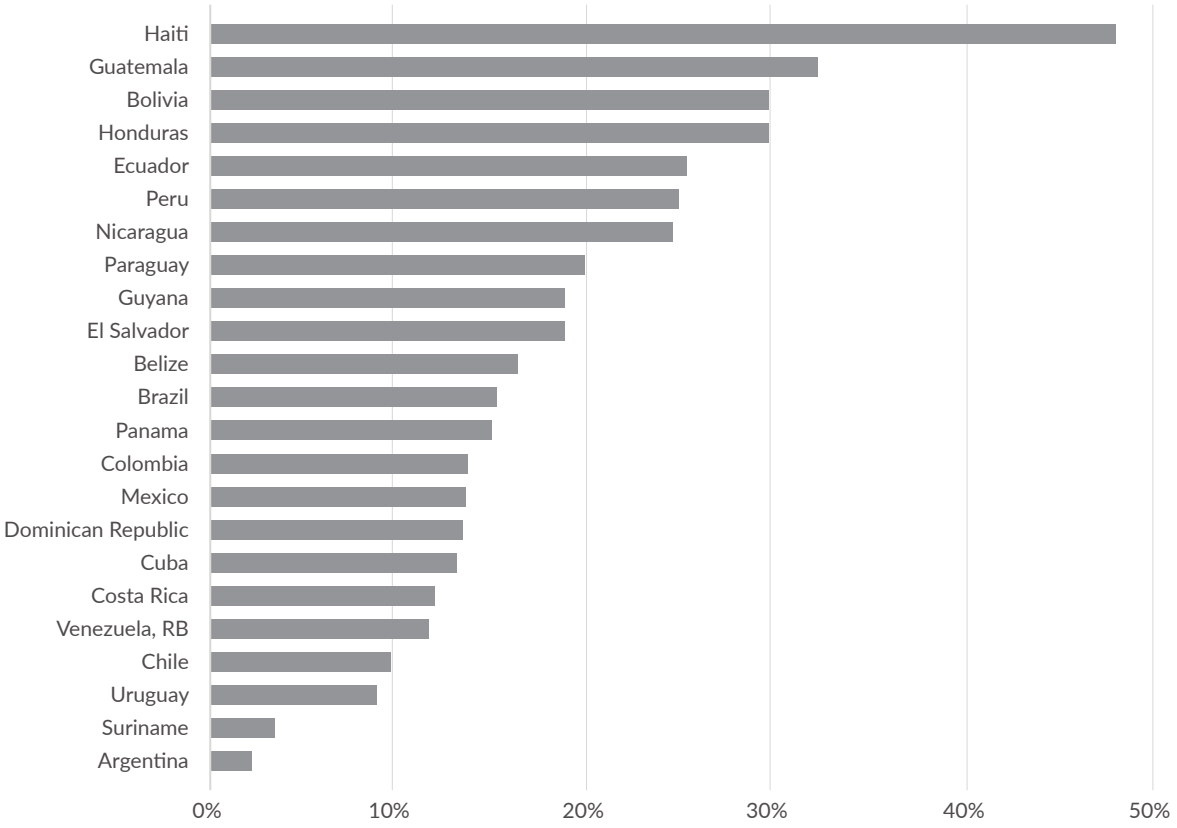


Figure 10. **Agricultural employment, LAC countries, 2018 (% of total employment)**

Source: World Development Indicators database, World Bank.

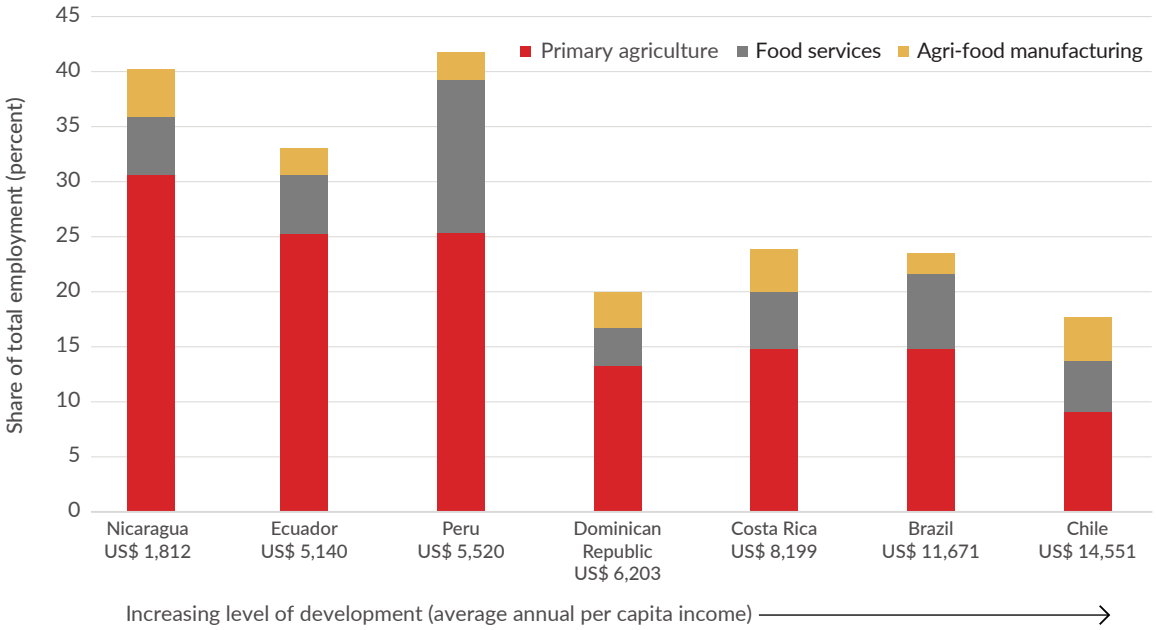
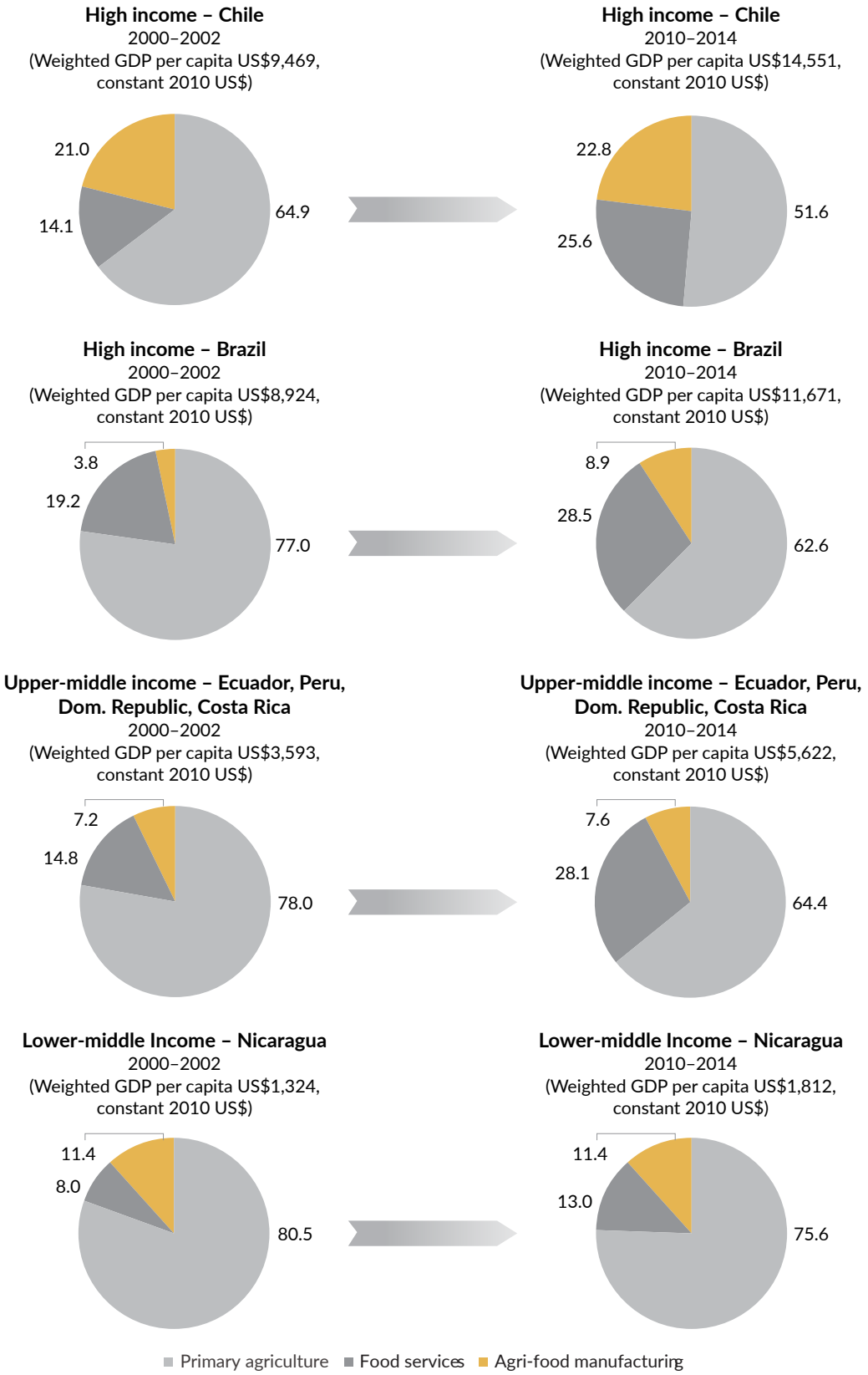


Figure 11. **Composition of food system jobs, by income group, selected countries 2010–2014**

Source: SEDLAC Labor Force Surveys.

Figure 12. **Evolution of composition of jobs in the food system (% of food system jobs)**

Source: Authors' illustrations.



period ending in 2013 the share of jobs in primary agriculture fell from 65 percent to 52 percent; meanwhile, jobs in manufacturing and food services increased from 35 percent to nearly 48 percent. In contrast, in Nicaragua, a lower-middle-income country, over a similar 13-year span ending in 2014 the number of jobs in primary agriculture fell from 81 percent to only 76 percent; meanwhile, the share of non-primary jobs in the food system increased only slightly from 19 percent to only 24 percent. The trends in Brazil and the block of upper-middle-income countries were similar, with the share composition of jobs reflecting the fact that incomes in these countries fall between those of Chile and Nicaragua.

In most LAC countries, important opportunities to increase value addition in the agriculture and food sector by converting raw materials into high-value products remain unexploited. Although policy makers in many countries continue to focus on increasing primary production, opportunities abound to invest in agri-logistical chains and to expand the agri-food manufacturing sector, as in Brazil and other upper-middle-income countries. Meanwhile, in high-income countries like Chile, as incomes rise and expenditure on food consumed outside the home rises, rapid growth is being seen in the food services sector. Finally, Peru stands out as a country that has distinguished itself as a gastronomy destination, which explains why 33 percent of food system jobs are found in the services sector.

As economies develop and the number and composition of agriculture-linked jobs changes, the labor force is affected, not only in rural areas where jobs in primary agriculture may be disappearing (or not), but also in peri-urban and urban areas where jobs in food services and agri-food manufacturing are often being created. If strategies can be found to ease the rural-urban transition by facilitating the reintegration into the formal economy of workers displaced from primary production activities, this could provide an entry point for attacking rural poverty. To understand the dynamics of labor markets related to LAC agriculture and food systems, it is necessary to look not only at the number of jobs associated with these systems but also at the nature of those jobs in terms of education requirements and the skills they demand (for example, occupations are often classified as routine, cognitive, or manual).[11]

Worldwide in the goods sector (defined as primary production plus manufacturing), associated service occupations (i.e., occupations not directly involved in production) are rising as a share of total occupations (Duernecker and Herrendorf 2018). But is this general trend also evident within the agricultural sector? How are jobs in primary agriculture evolving? Are they becoming less manual and more technical? And what about jobs in the rest of the food system? Answers to these questions can be found by examining the types of jobs found at different stages of agriculture and food systems and by following the shifting composition of those jobs as economies develop and incomes rise (Table 4).

[11] Occupations were categorized as follows: (i) professional service workers - legislators, senior officials and managers, professionals, technicians and associate professionals, (ii) other service workers - clerks, service workers and shop and market sales workers, (iii) industry workers - craft and related trades workers, and plant and machine operators and assemblers, and (iv) agriculture and elementary - elementary occupations and skilled agricultural and fishery workers.

Table 4.
Share of workers by occupation in each food sub-system, selected countries

Source: SEDLAC Labor Force Surveys

	GDP per capita constant 2010 US$ (2010–2014)		
	<5,000	5,000–10,000	10,000–15,000
Primary agriculture			
Professional service workers (%)	2.19	3.93	5.84
Other service workers (%)	0.61	1.32	0.52
Industry workers (%)	2.04	6.62	4.61
Agriculture and elementary (%)	95.16	88.13	89.04
Agri-food manufacturing			
Professional service workers (%)	14.30	15.51	21.68
Other service workers (%)	20.54	23.71	27.16
Industry workers (%)	17.59	18.65	22.75
Agriculture and elementary (%)	47.57	42.13	28.41
Food Services			
Professional service workers (%)	5.12	8.75	37.19
Other service workers (%)	85.70	52.66	48.33
Industry workers (%)	3.09	4.84	2.85
Agriculture and elementary (%)	6.09	33.75	11.63

Note: Lower-middle income (<US$5,000) includes Nicaragua (2014); upper-middle income (US$5,000–10,000) includes Costa Rica (2010), Dominican Republic (2014), Ecuador (2012), and Peru (2012); high income (US$10,000–15,000) includes Brazil (2012) and Chile (2013). Shares are weighted by number of workers in the food system.

In this sample of seven countries, several trends are evident. First, regardless of the income level of the country, as one moves downstream in the food system from primary agriculture to agri-food manufacturing and food services, demand increases for professional service workers with more education and greater cognitive skills. Second, regardless of the income level of the country, in primary agriculture most jobs remain in elementary and agriculture occupations; as the income level of the country rises, the composition of employment in primary agriculture shifts to encompass a larger share of professional service and industry workers, but the shift is minimal, suggesting that the importance of cognitive skills relative to routine manual skills does not increase significantly. Third, in agri-food manufacturing, not only is the distribution of jobs by skill level more even, but as the income level of the country rises, demand increases for professional service workers with more education and greater cognitive skills. Demand also increases for other service workers, such as clerks and retail workers. Fourth, a similar pattern is observed in food services: as the income level of the country rises, demand grows for professional service workers relative to other types of workers. Nonetheless, other service workers remain important for this industry.

While these results suggest that agricultural employment in LAC can no longer be thought of exclusively in terms of primary agriculture, at the same time most jobs in agriculture remain low-level jobs (i.e., classified as "agriculture and elementary occupations"). This leads to the question: what are the characteristics of workers employed in low-level jobs in the agriculture sector, compared to the characteristics of workers employed in similar low-level jobs in other sectors, such as manufacturing, construction, and transport? A commonly used measure of human capital is

educational achievement. Comparing the average years of schooling for agriculture and elementary workers found in different sectors, two trends are evident (Figure 13). First, as countries develop and GDP per capita rises, average years of schooling among primary agriculture and elementary workers has not increased systematically, indicating a lack of strengthening of human capital for this group of workers with low skill levels. In other words, although education level typically rises as countries become more developed, this may not be the case for farm workers. Second, low-level workers employed in primary agriculture have fewer years of schooling on average than the same category of workers employed in manufacturing, transport, storage, communication, wholesaling, and retailing, suggesting that the other sectors employ low-level workers with higher human capital or are more selective. The implication is that as economies develop and labor moves from primary agriculture to other sectors, low-level workers employed outside of agriculture, including most of those who have migrated to urban areas, are on average more educated than those who stay on the farm.

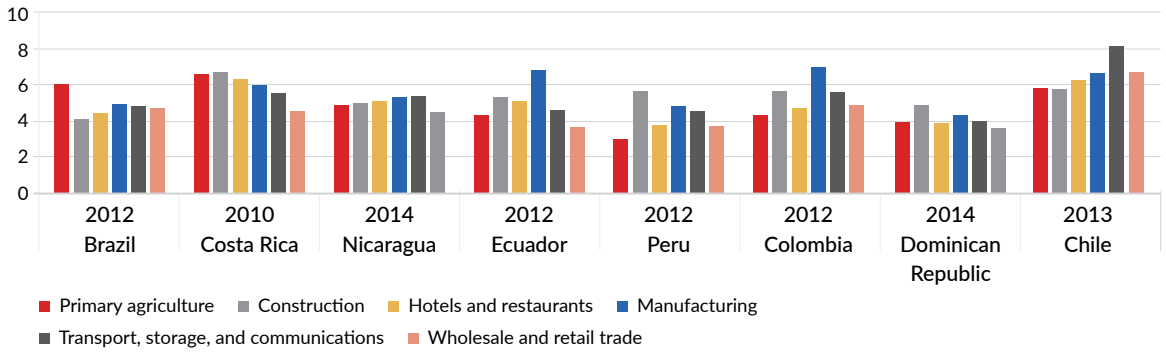


Figure 13.
Average years of schooling among agriculture and elementary workers, selected sectors

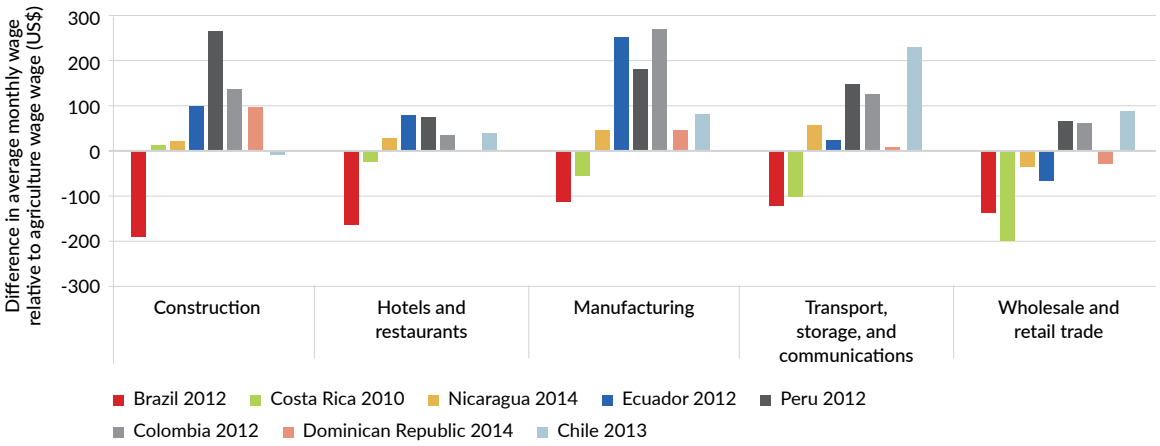
Source: SEDLAC Labor Force Surveys.

How do the earnings of low-level workers employed in agriculture compare to the earnings of low-level workers employed in other sectors? Consistent with the fact that they tend to have fewer years of education, low-level workers employed in agriculture tend to earn lower monthly wages than low-level workers employed in most other sectors (Figure 14). In our sample of nine LAC countries, the most attractive opportunities appear to be in construction and manufacturing. For example, low-level agriculture workers who leave the farm and take up construction work would earn US$20 to US$265 more in average monthly wages. In most cases, the differences between sectors are small, however, and if non-farm jobs are likely to be located in urban areas, then it may not be that advantageous to leave the farm once employment frictions and transactions costs are factored in.

Other sectors offer far less attractive opportunities for low-level workers who leave agriculture. For example, moving to the service sector (hotels and restaurants) yields limited gains and is the least lucrative sector to join, should a worker wish to leave agriculture. Furthermore, in the most developed countries, there are negative or very little gains to workers leaving agriculture. In our sample of nine countries, Brazil and Costa Rica are outliers; agriculture and elementary workers working in other sectors earn significantly less in all other sectors in Brazil and in most other sectors in Costa Rica, suggesting that it is not advantageous for low-skill workers to leave agriculture in pursuit of better income opportunities.

Figure 14. Differences in average wages of low-level workers, agriculture vs. other sectors

Source: SEDLAC Labor Force Surveys.



2.9 Contribution of agriculture and food systems: Food and nutrition security

What is the contribution of LAC agriculture and food systems to food and nutrition security? Primary agriculture in LAC has grown rapidly over the past 25 years in response to rising demand for food, feed, and fiber products—demand originating not only within the region, but also beyond it. Today the region's farmers and livestock producers not only meet the needs of local populations, they also produce exportable surpluses to help meet growing global demand. LAC accounts for a larger share of global agricultural production than the European Union or the United States plus Canada, and it has emerged as the world's leading net food-exporting region (Díaz-Bonilla et al. 2014), the exports of which serve to lower and stabilize global food prices (Glauber and Miranda 2016; Meyer and Glauber 2019). In the past, North America was the leading net exporter of agricultural products in the Western Hemisphere, but since 1997, Latin America has dominated as the largest net exporter, both in value and quantity terms.

Demand for food, feed, and fiber will continue to grow, not only within the region but also globally, fueled by a growing population, rising incomes, and shifting diets. The world population is projected to increase from 7.3 billion in 2015 to 8.5 billion by 2030 and 9.7 billion by 2050 (see World Bank population dashboard, 2017). Population growth within LAC is projected to increase at a slightly slower rate, rising from 631 million in 2015 to 717 million by 2030 and 778 million by 2050 (see World Bank population dashboard, 2017). In the face of this robust population growth, the world's farmers and livestock producers are projected to produce some 60 percent more food calories in 2050 than in 2005/2007 to meet demand, driven mainly by demand growth in Africa and Asia (Alexandratos and Bruinsma 2012).[12] Given the ever-increasing demand placed on the planet's food systems, LAC will be expected to continue to play an important role, supplying food in a sustainable manner and contributing to lower global food prices.

[12] In a widely cited study, FAO (2006) estimated that world food production would have to increase 70 percent between 2005/2007 and 2050 to keep pace with demand growth. The number was later revised downward by Alexandratos and Bruinsma (2012). For details of the projections, see: http://www.fao.org/3/ap106e/ ap106e.pdf.

Beginning in 2012, however, growth in agricultural net exports from the region appear to have plateaued at a time when agricultural net exports from Europe and Central Asia, as well as from North America, have risen (Figure 15). Nonetheless, LAC continues to supply an outsized share of the world's food, including high-value fruits and vegetables (Figure 16), and with rising demand there is a clear path for further increasing exports through productivity growth and reduced production costs, assuming these advances can be achieved with sustainable practices. In this way, LAC will continue to contribute to lower and more stable global food prices.

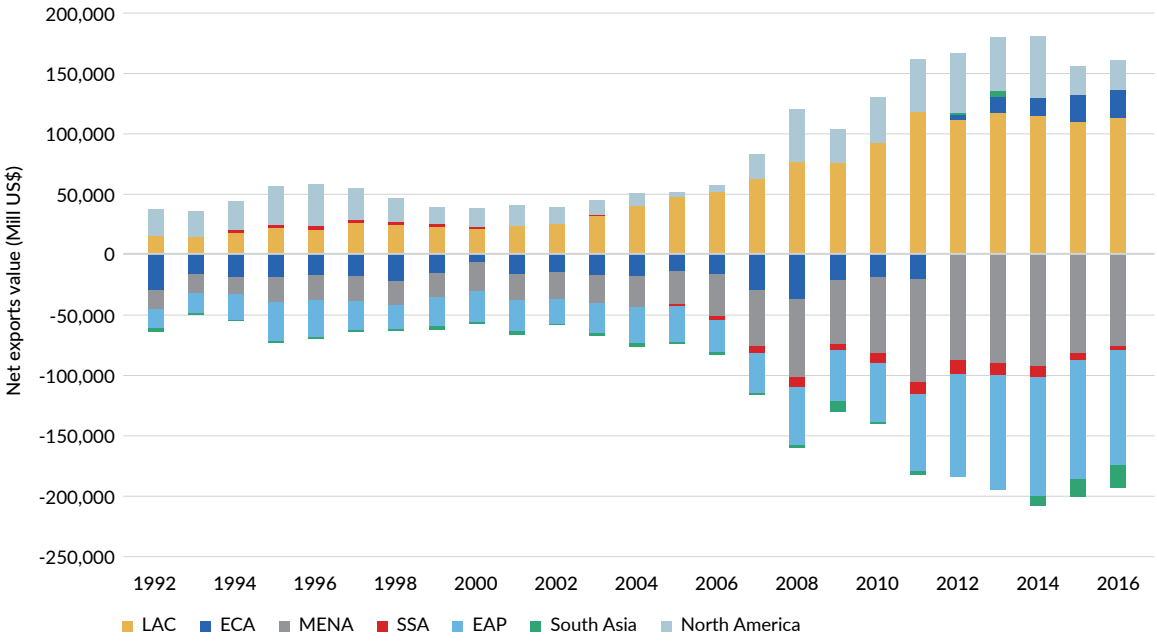


Figure 15.
Net exports of agriculture products by region, 1992–2016

Source: Authors' calculations, based on FAOSTAT data.

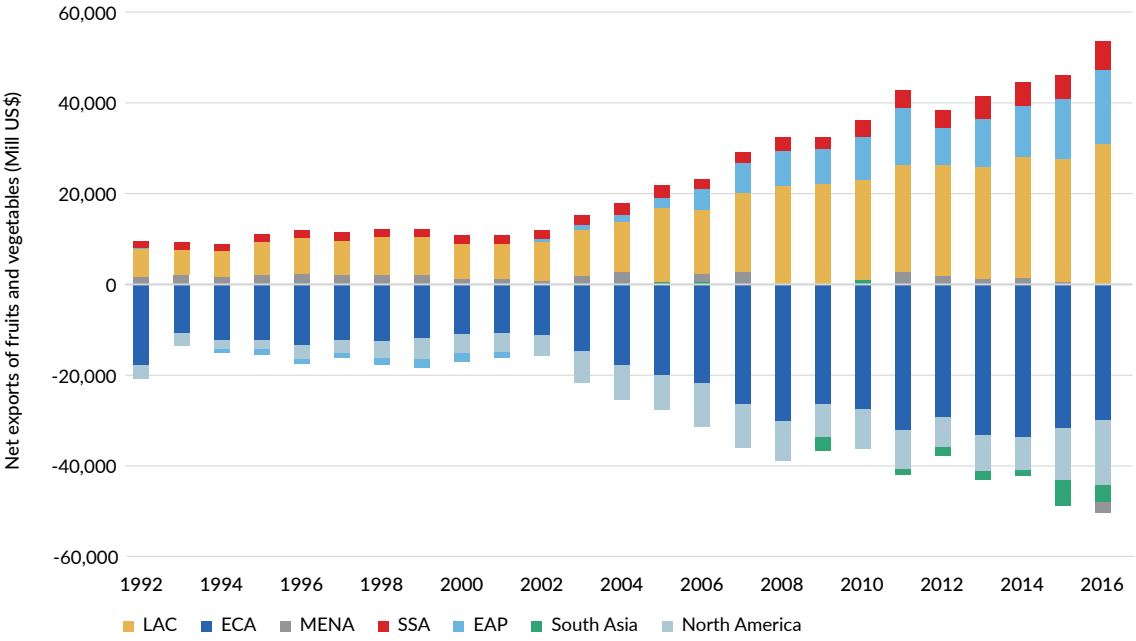


Figure 16.
Net exports of fruits and vegetables by region, 1992–2016

Source: Authors' calculations, based on FAOSTAT data.

LAC=Latin America and Caribbean, ECA=Europe and Central Asia, MENA=Middle East and North Africa, SSA=Sub-Saharan Africa, EAP=East Asia and the Pacific.

Compared to countries in other regions, countries in LAC are disproportionately reliant on agricultural exports. The share of agricultural exports in overall exports is much higher in LAC than the average for the world at large—a difference that has increased in recent years (Figure 17).

LAC is a net exporter of agricultural commodities and food products, yet the aggregate regional export numbers conceal large differences between countries (Figure 18). In some countries (e.g., Paraguay and Uruguay), agricultural exports make up a large share of total exports, but the value of agricultural exports is quite modest, usually because the country is small. In other countries (e.g., Chile and Mexico), agricultural exports make up a small share of total exports, but the value of agricultural exports is significant, usually because the country is large and sometimes because the agricultural sector is noticeably export-oriented. In Argentina and Brazil, agricultural exports make up a large share of total exports and the value of agricultural exports is significant, because both are large countries with large, export-oriented agricultural sectors.

Figure 17. Agriculture share of total exports, LAC vs. world

Source: WTO Global Trade Database.

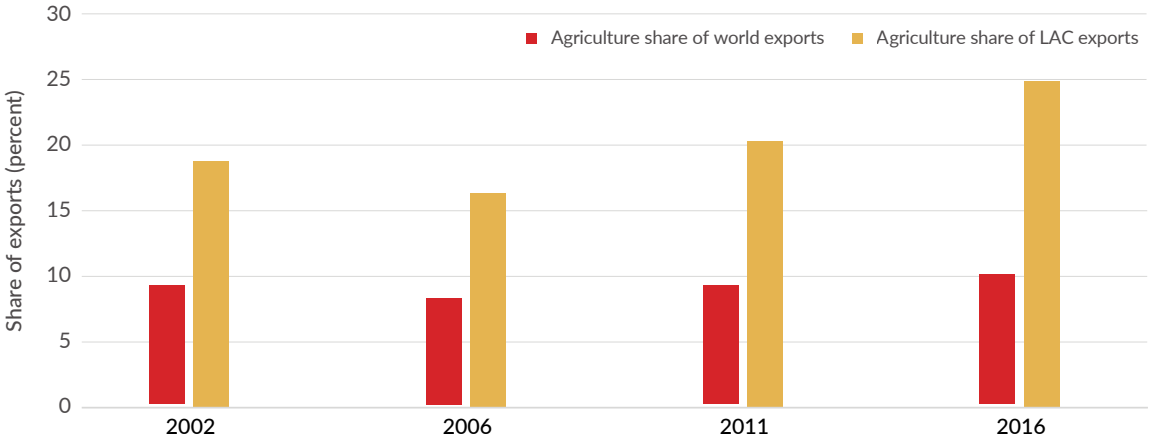
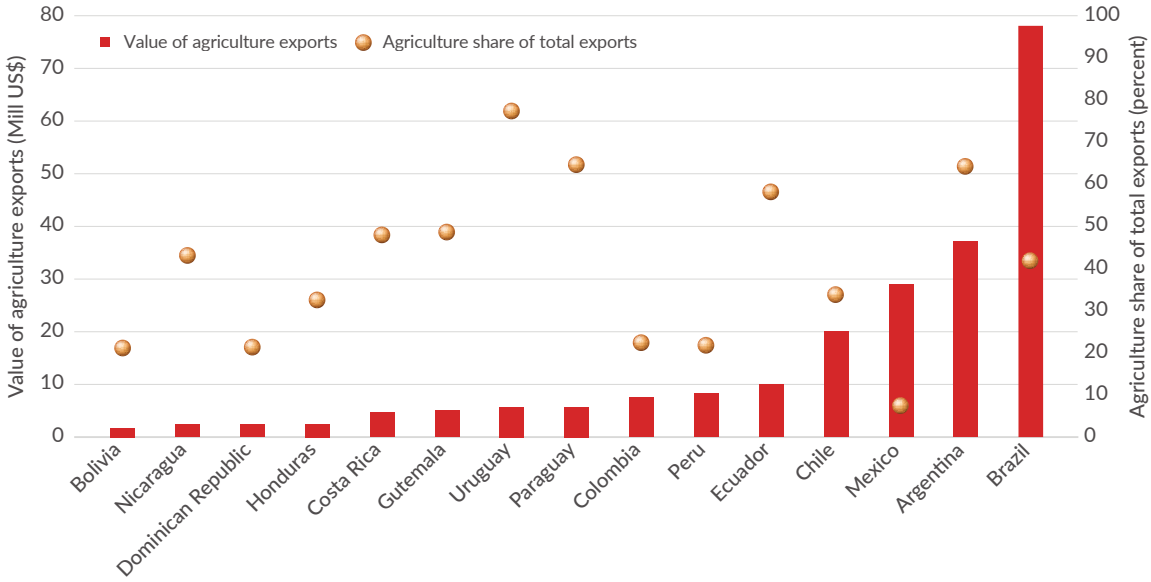


Figure 18. Agriculture share of total exports, selected LAC countries, 2016

Source: WTO Global Trade Database



The large differences between countries in terms of agricultural exports underlines an important reality: although LAC as a region is often thought of as an agricultural export powerhouse, most LAC countries are net buyers of food, not net sellers. This is particularly true when it comes to staples. For example, in the case of cereals, the region's exports come entirely from four Southern Cone countries (Argentina, Brazil, Paraguay, and Uruguay). All other countries are cereals net importers, including many countries that are highly dependent on cereals imports (Figure 19).

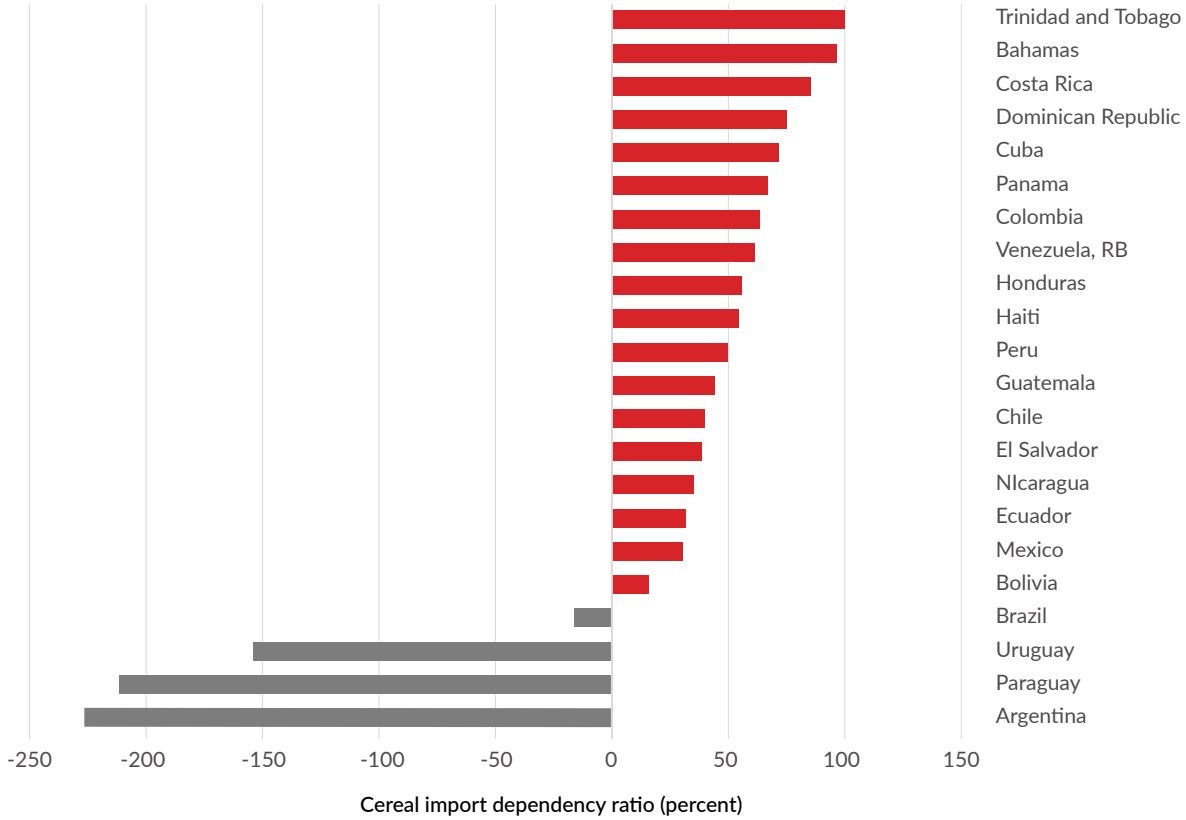


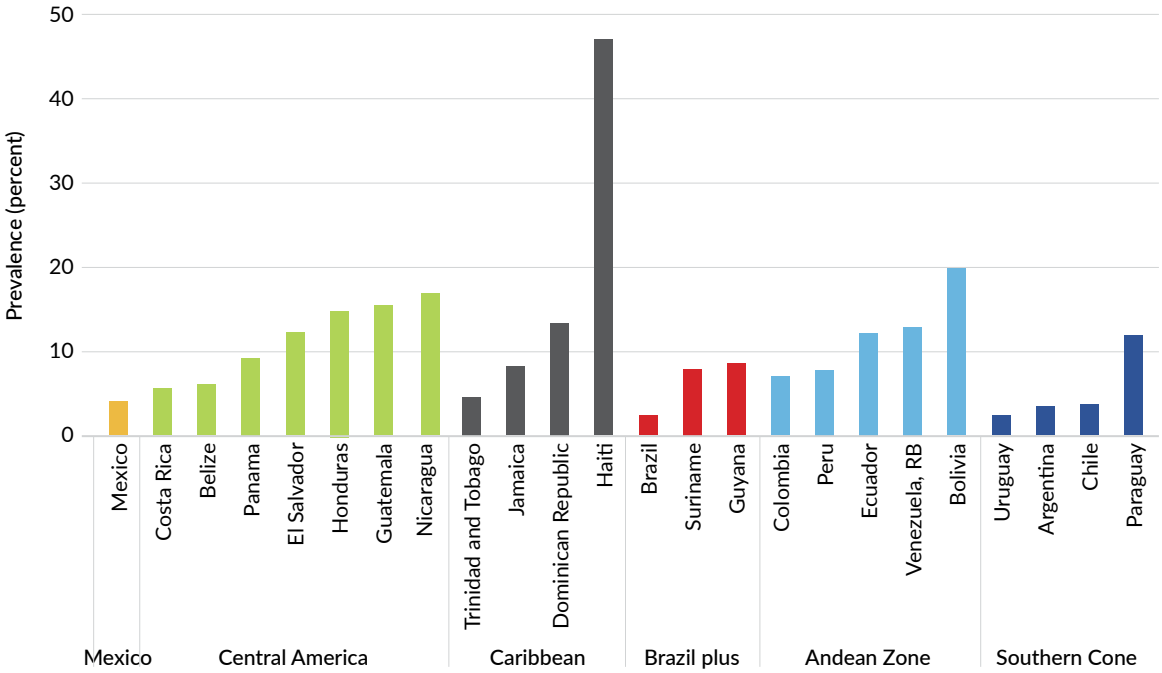
Figure 19. Cereal import dependency ratio, selected LAC countries (2011–2013 average)

Source: FAOSTAT.

LAC farmers and livestock producers have been very successful in feeding the growing population, both within the region and worldwide. But that does not mean problems of hunger and malnutrition have been eliminated in LAC. In 2016, approximately 5.5 percent of the region's population suffered from undernutrition; that is, they did not consume the minimum daily nutritional requirements. The share of the population suffering from undernourishment exceeded 10 percent in seven countries (Figure 20). Undernourishment is especially prevalent in Haiti, with one of the highest rates globally (49.0 percent). In Haiti, according to the most recent household survey (Enquête Mortalité, Morbidité et Utilisation des Services (EMMUS-VI), 2016–2017), 22 percent of children under age 5 are stunted, two-thirds of children suffer from anemia, and 49 percent of women aged 15–49 are anemic. In general, the prevalence of anemia among women of reproductive age (percentage of women ages 15–49) in LAC is 22.05 percent (2016), compared to about 18 percent in high income countries (although better than low income countries, at 38.4 percent, and the world, at 32.8 percent) (WDI/WB database).

Figure 20. Prevalence of undernourished population, selected LAC countries, 2016 (%)

Source: World Development Indicators, World Bank, sourced from FAO undernourishment data.



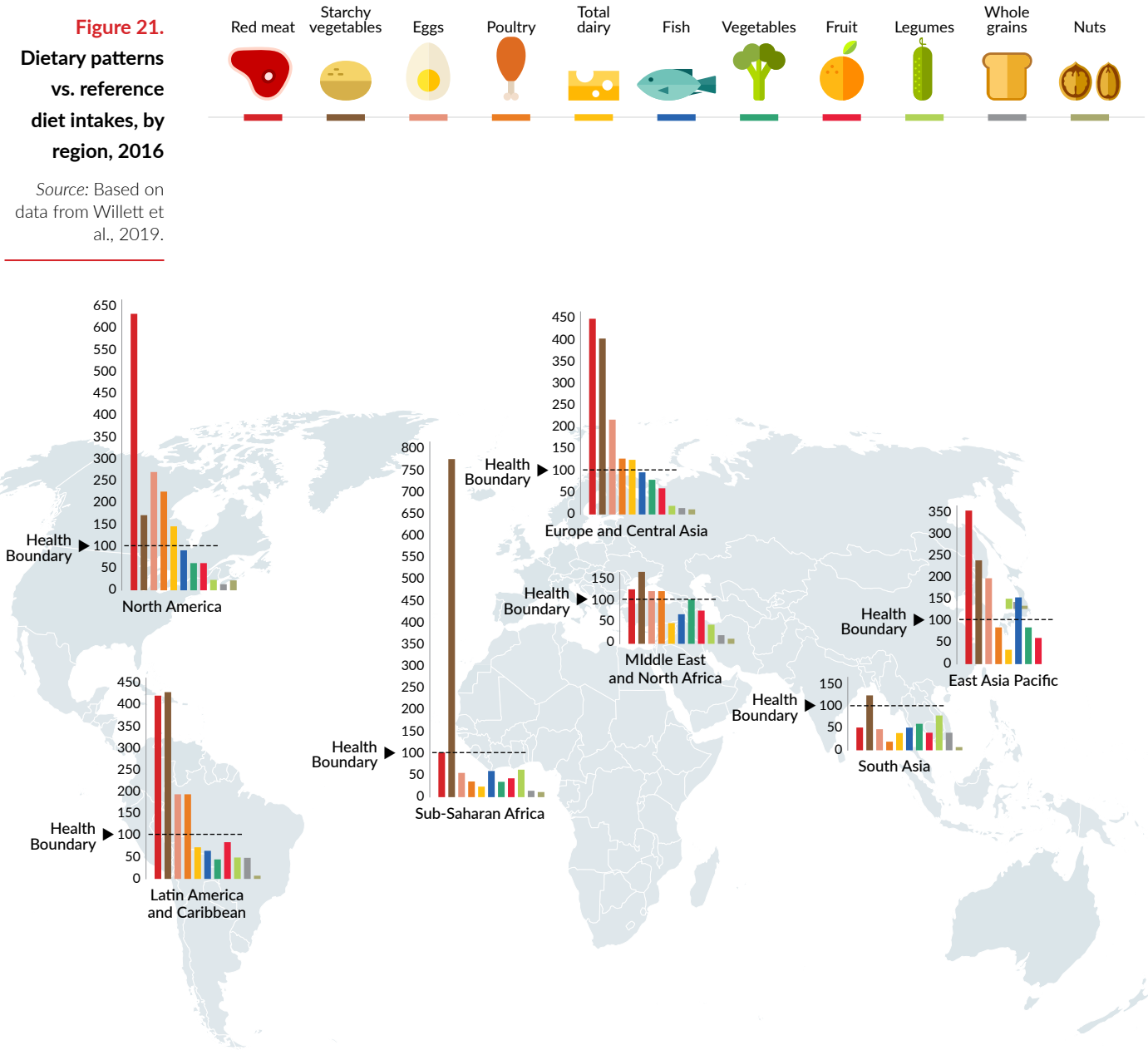
Separate from the question of whether people in LAC are consuming enough food is the question of whether they are consuming the right kinds of food. A growing body of evidence shows that while most people in the region meet minimum daily caloric intake requirements, many are consuming low-quality diets lacking in key micronutrients. The resulting micronutrient deficiencies have contributed to a rise in diet-related health problems that often become reflected in noncommunicable diseases. Micronutrient deficiencies are particularly prevalent among economically disadvantaged and vulnerable groups (Lopez de Romaña, Olivares, and Brito 2015; Nelson et al. 2018; Willett et al. 2019). Dietary intake of different food groups varies considerably between regions (Figure 21). In Latin America and the Caribbean, consumption of red meat and starchy vegetables is at least three times higher than the reference point (defined as the recommended average daily intake) and on par with consumption in Europe and Central Asia. Consumption of eggs and poultry is also above the reference point in LAC, while consumption of nutritionally critical vegetables, fruits, and whole grains remains well below the reference point.

The fact that many people in LAC regularly consume the wrong types of food has severe consequences. Excessive consumption of processed foods with added sugar and fat and of sweetened beverages is wreaking severe damage on human health. In 2016, about 58 percent of the population of LAC (close to 360 million people) were overweight, with the highest rates of overweight observed in Chile (64 percent) and Mexico and Uruguay (63 percent) (Figure 22). In all countries except Haiti, Nicaragua, and Paraguay, more than one-half of the population was overweight. Among those who were overweight, two out of every five people (140 million people in all) were obese.

To summarize, development of LAC agriculture and food systems has brought important benefits in the form of more abundant, reliable, and diversified food supplies, as well as in terms of lower

Figure 21.
Dietary patterns vs. reference diet intakes, by region, 2016

Source: Based on data from Willett et al., 2019.

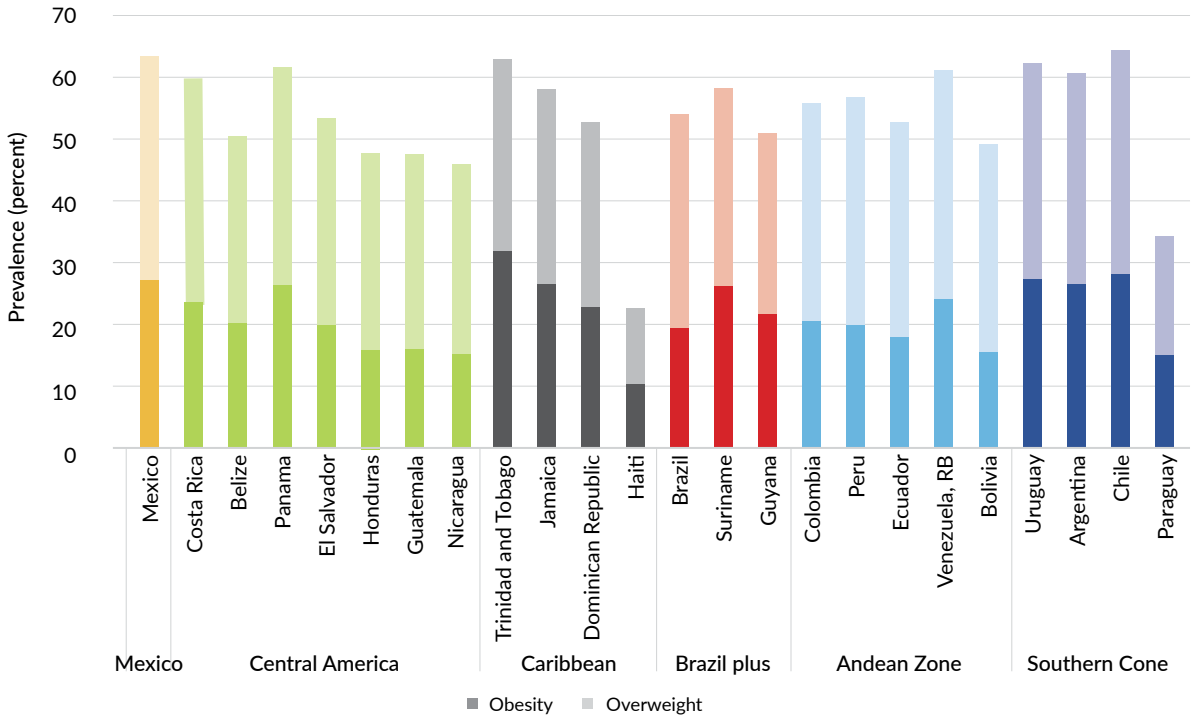


The **"reference diet"** is a notional universal healthy diet that includes targets based on extensive literature on food, dietary patterns, and health outcomes. It provides a basis for estimating the health and environmental effects of adopting an alternative diet to standard current diets, many of which are high in unhealthy foods.

(For details, see Willett et al., 2019)

Figure 22. Prevalence of overweight or obese population, selected LAC countries, 2016 (%)

Source: WHO country profiles.



food prices. But it has also given rise to new challenges. One of these challenges is to ensure that all people have access to and actually consume adequate amounts of nutritious food. Currently this is not happening, and as a result LAC suffers from the so-called "triple burden" of malnutrition, defined as the coexistence of undernutrition, overweight and obesity, and micronutrient deficiencies.

While the problem may be due in part to lack of consumer knowledge, inappropriate policies play a role as well. In many LAC countries, agricultural and food policies have failed to ensure the production of sufficient quantities of nutritious food, and at the same time they have been ineffective in discouraging the consumption of unhealthy food. Decreasing diversity in production has been mirrored in decreasing diversity in human diets, ushering in nutritional imbalances that have led, among other things, to a surge in health problems throughout the region.

Diet-related disease mortality will continue to increase in LAC unless policy actions can change behavioral patterns toward healthy consumption. The cost of failure is truly daunting. Using a global comparative risk assessment framework with agricultural production and consumption statistics, Willett et al. (2019) assess the potential effects of dietary change on diet-related disease mortality. Their findings provide a stark message for the region. Risk factors for mortality include high consumption of red meat (including beef, lamb, and pork); low consumption of fruits, vegetables, legumes, nuts, and fish; and being underweight, overweight, or obese. All of these hold true for average consumption in LAC. The consequences of unhealthy consumption habits include increased risk of heart disease, stroke, type-2 diabetes, and site-specific cancers, among others. The economic cost of these diet-related health problems, as reflected in the loss of human productivity and the burden imposed on health and education systems, is truly staggering. Recent estimates suggest that this cost per year amounts to US$500 million for Chile, US$4.3 billion for Ecuador, and

US$28.8 billion for Mexico, representing 0.2 percent, 4.3 percent, and 2.3 percent loss of annual GDP in these three countries (WFP 2017).

Recognizing the immensity of the problem, several LAC governments have taken action to promote consumption of healthier food. In Mexico, a tax is being levied on sugar-sweetened beverages and nonessential energy-dense food to disincentivize intake and reduce externalities associated with unhealthy diets; fiscal revenue generated by the tax is being used to support health interventions to reduce obesity (Pérez-Escamilla et al. 2017; Rivera-Dommarco et al. 2013). In Ecuador, regulations introduced in 2012 require that packaged food be labeled with information about fat, sugar, and salt content. In Chile, a National Law of Food Labelling and Advertising introduced in 2016 makes it easy for consumers to access information at the point of purchase about sugar, saturated fats, sodium, and calories. While some signs indicate that these initiatives are starting to change consumption patterns, additional time will be needed to evaluate their effectiveness.

2.10 Contribution of agriculture and food systems: Climate-resilient ecosystem services

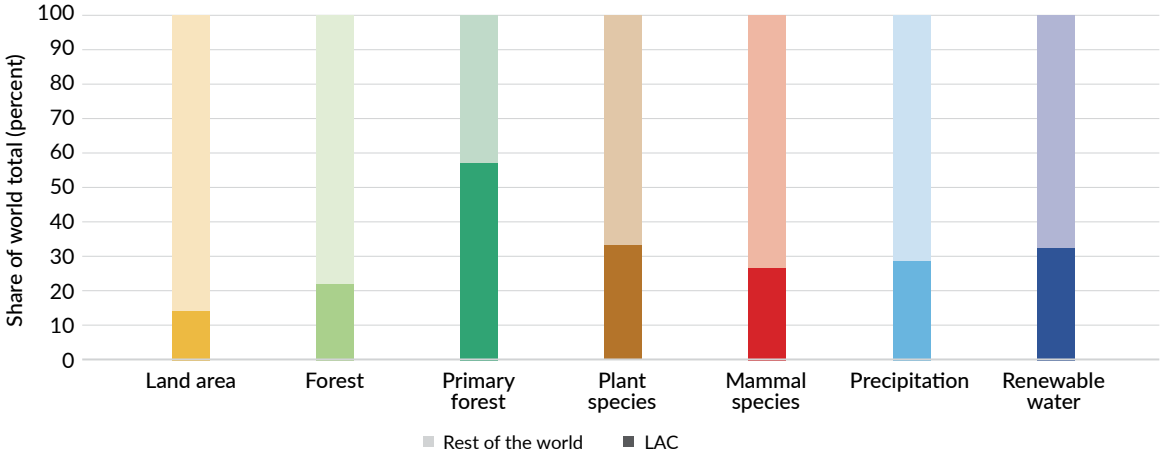
LAC is the world's largest provider of ecosystem services. LAC's diverse landscapes provide critical ecosystem services for agriculture and human well-being, at both local and global levels. The region is home to 57 percent of the world's remaining primary forests and one-third of all plant species. Almost one-half of the region's land surface is covered by forests, which store a massive estimated 104 gigatons of carbon. LAC is the source of between 40 and 50 percent of the world's biodiversity and is a major center of origin for agricultural biodiversity (UNEP 2016; IDB 2012; Riberiro et al. 2011; Keenan et al. 2015; Ray et al. 2006; Karr et al. 2015).[13] The region contains a high proportion of the earth's wetlands and tropical forests. The Amazon biome alone stores 10 percent of global carbon and releases seven trillion tons of water per year into the atmosphere, while helping to stabilize local and global climate and nurturing agriculture worldwide (Charity et al. 2016). Figure 23 shows the relative natural resource wealth of LAC compared to the rest of the world.

The environmental footprint of agriculture and food systems in LAC is very large, so mismanagement of those systems could pose a significant threat to the region's global public goods contribution. Natural ecosystems are not separate from agricultural systems, and protection of natural resources should not be seen as a barrier to agricultural production and economic growth. One-fifth of the region's territory has been set aside for the conservation of nature and ecosystem services, far surpassing the developing world average of 13 percent. Natural resource wealth contributes directly to the region's robust agricultural sector. Across the landscape, crop and pasture lands are intermingled with natural ecosystems (Kremen 2015). Together, they support an array of interrelated and interdependent relationships that underpin and sustain productivity. Agriculture is dependent on a wide range of ecosystem services, including water provision, soil health maintenance, plant pollination, biodiversity conservation, climate regulation, and more. There is increasing acceptance that agricultural practices that support ecosystem services—provided both to agriculture and to the

[13] Agrobiodiversity is the genetic diversity of crop species and noncrop species that support resilient food systems and ecosystems.

Figure 23. Natural resource endowments, LAC share of world total

Source: FAO 2018b.



surrounding communities—can sustain growth, create markets, reduce risk, lower production costs, support climate change mitigation and adaptation, and ensure efficient use of scarce resources (Bovarnick, Alpizar, and Schnell 2010; IDB 2012).

Agricultural production systems in LAC may be approaching a tipping point, one beyond which their own future viability may be threatened. Agricultural production systems in many parts of LAC are dominated by extractive models based on unsustainable extensification and intensification strategies that deplete ecosystem services critical for human well-being and environmental health (Bovarnick, Alpizar, and Schnell 2010). Regionally, agriculture and ranching are responsible for 70 percent of habitat conversion, with deforestation being three times the global rate (FAO 2016b). Beyond forest and habitat loss, agriculture and ranching account for over 70 percent of the region's freshwater resource withdrawals (FAO 2016b; Canales Dávila 2011), and they are among leading causes of land and soil degradation and biodiversity loss (UNEP 2010). Although estimates vary, GHG emissions from food production—especially livestock production—and agriculture-associated land-use change comprise up to one-half of all regional emissions (IPCC 2014; Bárcena et al. 2014).

Agriculture-driven ecosystem service loss trends underscore the need to transform the sector to protect the region's natural capital and contribute to global climate change mitigation efforts.

Land: Land degradation refers to the reduced capacity of land to provide goods and services for ecosystems and people. Food production has contributed significantly to land degradation in Latin America and the Caribbean. Degraded lands make up over 20 percent of forest and agricultural lands in the region, reducing productivity and ecosystem services across the landscape (Bai et al. 2008). Negative economic and social consequences to land degradation are both immediate and long term, including reductions in agricultural outputs, carbon sequestration, freshwater provisions, and forest products. The World Resources Institute estimates that land degradation negatively impacts regional annual agricultural GDP at a rate of 3 to 7 percent (Vergara et al. 2016). The most visible land degradation processes are native vegetation loss—especially contraction of globally significant tropical forest habitats—and soil degradation. Land clearing and agricultural practices that encourage soil erosion also accelerate land degradation while negatively impacting the region's freshwater and biodiversity resources.

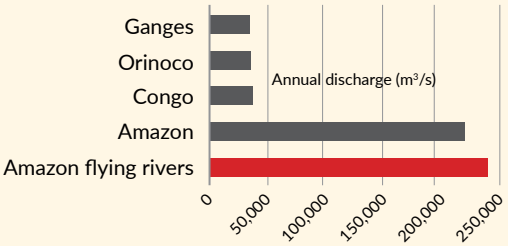
Box 4. Local and regional climate impacts of deforestation: The flying rivers of the Amazon

When water vapor in the atmosphere condenses, it falls to earth in the form of rain. The atmosphere absorbs water through two main processes: (i) evaporation from surface water (seas, lakes, and rivers), and (ii) transpiration through plants. Plants use their roots to extract water from the soil; after being used for various metabolic and physiologic functions, the water is then transported to small pores in leaves and stems, where it changes to vapor and is released to the atmosphere. Transpiration through vegetation represents 80 to 90 percent of terrestrial evapotranspiration. It can be very intense when expressed per unit land area: transpiration from trees in a forest can be larger than the evaporation from bodies of surface water, because of the multiple layers of leaves and shoots in forest canopies.

Water released into the atmosphere through evapotranspiration from the Amazonian forest—the largest rainforest in the world—is carried southward by wind currents, creating so-called "flying rivers" that carry large quantities of moisture from the Amazonian forest to eastern and southern Brazil and to parts of northern Argentina, Bolivia, and Paraguay. The water carried by these flying rivers is estimated to exceed the amount of water flowing in the Amazon River, the world's largest river in terms of discharge.

Figure 24.

World's largest rivers, by discharge



Source: http://riosvoadores.com.br/, http://www.ccst.inpe.br/.

Given the importance of these flying rivers, rainfall in many parts of South America would be dramatically different without the Amazonian forest. Many people in South America, including many policy makers and farmers, fail to appreciate how the flying rivers of the Amazon significantly influence weather patterns locally and across the region. They believe that benefits generated by protecting the Amazonian forest accrue globally, rather than locally. This belief may stem from the many advocacy campaigns that have sought to raise awareness about the role played by deforestation in contributing to global climate change.

The belief, widespread within the region, that protecting the Amazonian forest will benefit mainly people living in distant lands makes it difficult—especially in times of economic crisis—to resist the temptation to exploit forest resources to achieve immediate economic benefits. Overcoming this misperception with robust evidence will be fundamental for informed policy making.

Figure 25.

Path of flying rivers of the Amazon

Source: http://riosvoadores.com.br/, http://www.ccst.inpe.br/.

Soils. Agriculture has exacted a heavy toll on soils in Latin America and the Caribbean, affecting both soil structure and soil fertility. Farming activities that have contributed the most to soil degradation include mechanized land preparation and overgrazing (Gardi, Angelini, and Barceló 2014). Soil erosion challenges are widespread in the region, affecting an estimated one-half of all agricultural land (FAO and ITPS 2015). Erosion combined with unsustainable management practices has resulted in soil nutrient mining, which forces farmers to compensate by applying even more costly and potentially damaging amounts of fertilizers and other amendments like lime, thereby reinforcing negative feedback loops. With nitrogen fertilizer application rates on par with other regions, and with phosphate and potash fertilizer use among the highest in the world, current practices in LAC are unsustainable for water and soil quality (FAO 2014d; Mateo-Sagasta, Zadeh, and Turral 2018). Fertilizer use increase has been accompanied by crop chemical use, including pesticides and herbicides; with 11 percent of the world's arable land, LAC accounts for 20 percent of the world's agrochemical use, and the share continues to rise (IDB 2012). Growing awareness of the high cost of soil degradation led to widespread adoption—beginning in the Southern Cone countries in the 1980s and 1990s—of conservation agriculture, a method of farming characterized by the maintenance of continuous ground cover, reduced tillage, and regular crop rotations with green manure. Conservation agriculture has helped to significantly slow the rate of soil degradation in many LAC countries and is today considered one of the greatest agricultural success stories of the past century (Speratti et al. 2015).

Forest and habitat. LAC's tropical forests and other woodlands have faced tremendous losses from agricultural development, especially in recent decades (Figure 26a). The most visible example concerns the expansion of the agricultural frontier, a major driver of deforestation and an important contributor to greenhouse gas emissions at the global level. Agricultural extensification in this region is chiefly due to the growing global demand for products such as soybeans and beef. This commodity frontier expansion has largely removed or degraded natural habitat, particularly forests. Along with the iconic Amazon biome, expansion has escalated in biomes such as the Cerrado savannah in Brazil, the Chiquitano forests in Brazil and Bolivia, and the Gran Chaco forests in Argentina, Bolivia and Paraguay.

Over the period 2002–2012, Brazil lost about 34 percent of its forest cover (IDB 2012), and similar rates have been estimated in many other countries.[14] Figure 26b shows total forest cover loss for countries with more than 50,000 hectares of forest from 2000 to 2016. De Sy et al. (2015) estimate that between 1990 and 2005, 71 percent of the deforestation that occurred in Argentina, Bolivia, Brazil, Colombia, Paraguay, Peru, and Venezuela was due to increased demand for pasture and 14 percent to expansion of area planted in cash crops; less than 2 percent was attributable to construction of infrastructure (mainly roads) and expansion of urban areas. Numerous policies have sought to quell this trend, with only mixed success due to complexities in local, regional, and global factors (Garrett et al. 2018).

Unfortunately, agriculture-driven deforestation is far from being a thing of the past. Unless further concerted action is taken, LAC will continue to be the world's largest contributor to deforestation.

[14] Brazil encompasses the majority of the Amazon forest, which constitutes 12 percent of the world's forest area and 59 percent of Brazil's surface (de Figueiredo Silva, Perrin, and Fulginiti 2018). According to the National Institute for Space Research (INPE 2018), between 2010 and 2019, the Brazilian Amazon was being deforested at an average rate of approximately 7,500 square kilometers per year.

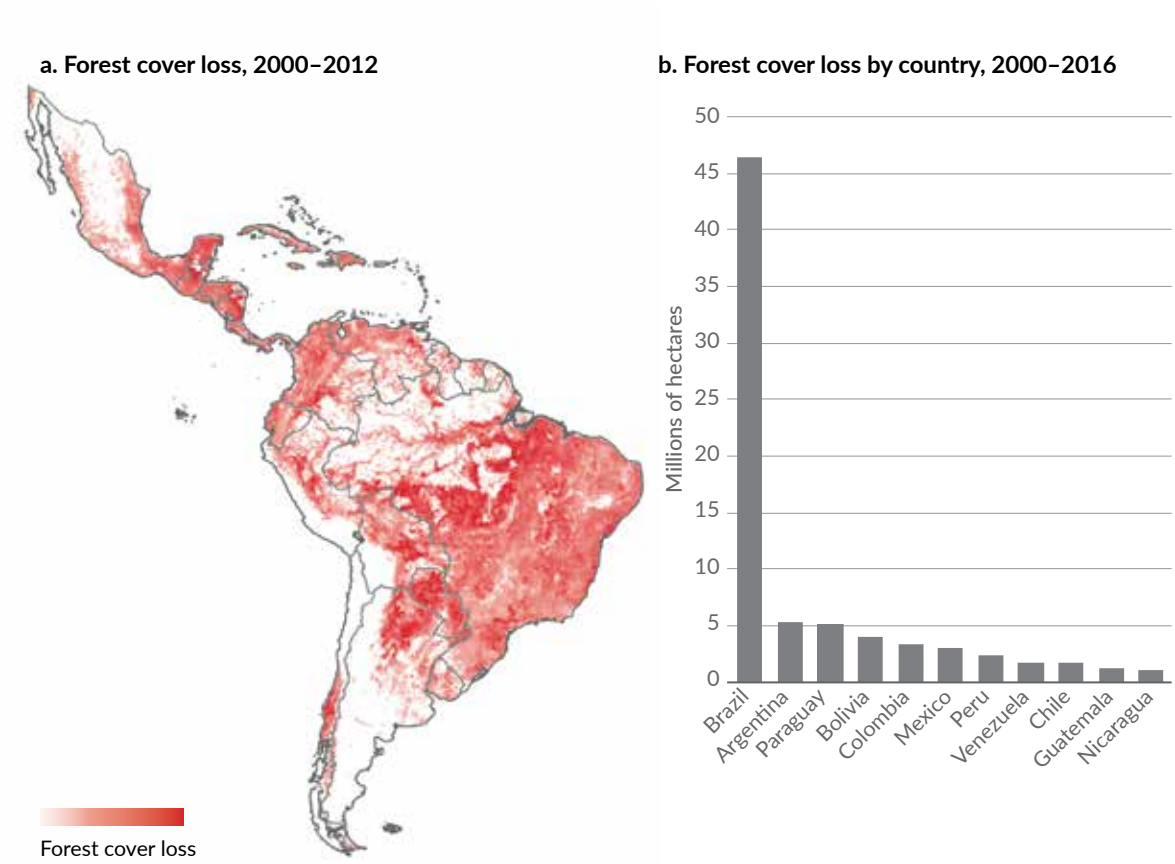


Figure 26.
Forest cover loss, 2000–2016

Source: WBG staff, using data from Hansen et al. 2013 FAOSTAT.

However, recent work by de Figueiredo Silva, Perrin, and Fulginiti (2018) provides a cautionary tale, indicating that, while it is clear that forest preservation brings many benefits to the global public good, in some cases, the opportunity cost of sequestering carbon in the Amazon may be borne disproportionately by local communities. In their work, de Figueiredo Silva, Perrin, and Fulginiti (2018) estimate that the preservation of the Brazilian Amazon costs local communities $797 per hectare in annual agricultural GDP in terms of forgone income. Stronger efforts are needed to strengthen corporate commitments to build responsible, deforestation-free supply chains, in ways that do not impose undue burdens on local communities. The Accountability Framework is one recent example of guidance for such initiatives.

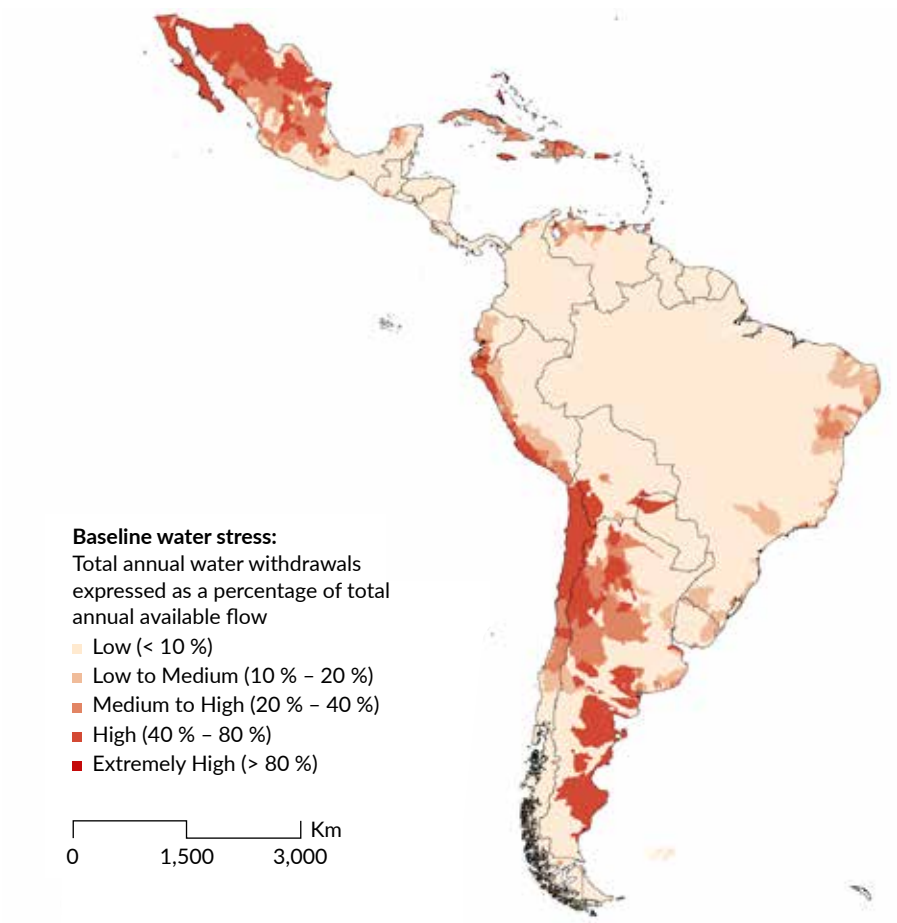
The challenge facing policy makers in Latin America and the Caribbean is daunting. Agricultural expansion will need to be replaced by sustainable intensification at the same time that the region is expected to contribute an increasing share of the food required to feed more than nine billion people by 2060. This will not be possible unless yield growth accelerates dramatically across the region. Opportunities exist to improve productivity, as a great deal of land is being used inefficiently, especially in the livestock sector. Intensification will need to be achieved using sustainable practices, however. In the past, intensification has gone hand in hand with increased and often excessive input use. Yield improvements depend on the adoption of various conventional and agro-ecological

management practices, including the use of high-yielding cultivars, and enhanced management practices to reduce abiotic and biotic plant stresses.

Freshwater resources. Latin America and the Caribbean is home to about one-third of the earth's freshwater resources (FAO 2014d), but existing agricultural and ranching practices threaten their quality and flows. Almost 20 percent of water used in agriculture is "exported" in the form of agricultural exports, a figure that will likely rise further (Mekonnen et al. 2015). Irrigation plays an important role in agricultural production depending on the sector and region, but across LAC almost 90 percent of the farmland is rainfed, which makes agricultural production very sensitive to changes in precipitation patterns and can place additional stressors on groundwater supplies during droughts (Wani et al. 2009; Spera et al. 2016). Overuse of groundwater and surface water reduce quality and provision of these resources for agriculture, human needs, and ecosystem biodiversity (Figure 27). Agricultural policies, regulations, and market forces may support or thwart efforts to protect water resources from overexploitation where they are less abundant, and alternatives must be sought to avoid crop or livestock production that is mismatched to locations with insufficient available rainfall or groundwater supplies.

Figure 27. Water stress hotspots, Central America, Caribbean, and South America

Source: WBG, using data from the World Resources Institute's Aquaduct Platform 1950–2010.



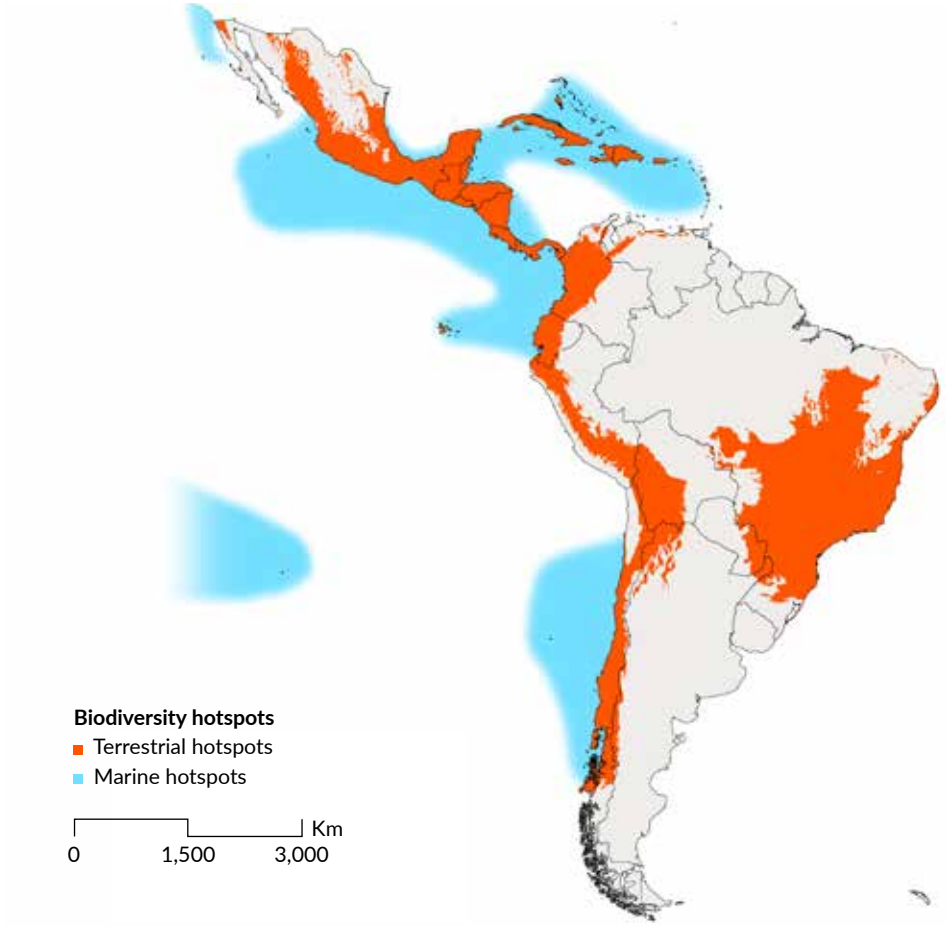


Figure 28. Biodiversity hotspots, Central America, Caribbean, and South America

Source: WBG, using data from Integrated Biodiversity Assessment Tool database and Conservation International 2011.

Biodiversity and agrobiodiversity: Latin America and the Caribbean's rich endowments of biodiversity (Figure 28) and agrobiodiversity have long been recognized by scientists, but only recently have policy makers and the general public started to recognize their value for agriculture. Biodiversity and agrobiodiversity underpin a multitude of services needed for agricultural production, including crop pollination, pest and disease control, soil health maintenance, and erosion control, among others (Bailey 2016; Klein et al. 2006). The region's biodiversity and agrobiodiversity are under severe pressure. Population declines have been considerable, and an estimated 12 percent of known wild plant and animal species are considered to be under threat of extinction (Pacheco Capella 2016; de Palma et al. 2016).

Agrobiodiversity results from millennia of interaction between natural and human systems and supports human well-being by enabling nutritious diets, helping to ensure that productivity can be maintained, strengthening resilience to climate change, and contributing to many ecosystem services, such as soil fertility and freshwater quality (Remans et al. 2017). While LAC is particularly rich in terms of its agrobiodiversity endowments, over the past century 75 percent of the genetic diversity of its agricultural crops has been lost, due in large part to the rise of monoculture cultivation and heavy reliance on a small number of crops and varieties that are highly responsive to fertilizer and

pesticides (WHO 2015; UNEP 2010). Efforts are underway to improve understanding and valuation of agrobiodiversity, in the hope of slowing and eventually reversing the ongoing decline.

Climate change: Globally, agriculture contributes between 19 and 29 percent of all GHG emissions; of the total, livestock contributes over 14 percent (Vermeulen, Campbell, and Ingram 2012; Gerber et al. 2013). Relative to the rest of the world, agriculture and ranching in Latin America and the Caribbean are significant contributors to GHG emissions. FAO (2014d) estimates that emissions of greenhouse gases from agricultural activities in LAC doubled from 1961 to 2010, with livestock-related emissions contributing 88 percent of the total. Agricultural emissions of GHG are attributable not only to on-farm agricultural practices, including enteric fermentation and fertilizer use, but also to clearing land for crop and livestock production.

Agriculture is a major source of GHG emissions, and it is also vulnerable to the effects of climate change. Although climate change mitigation efforts are underway and should be reinforced, it is accepted that climate change will continue to manifest in the form of abnormal weather featuring more frequent and more severe droughts, extreme precipitation events, sea level rise, extreme temperatures, and shifting ocean currents. As temperatures and rainfall trends shift, so too will crop and livestock suitability ranges. Areas that were once productive for certain crops or livestock species will no longer be so. Studies conducted for the World Bank and the Economic Commission for Latin America and the Caribbean (ECLAC) show that climate change will affect crop and livestock yields, impact local economies and jeopardize food security and nutrition across the region, especially in Northeast Brazil, the Andean zone, and Central America, where subsistence agriculture is more prevalent and poverty levels are higher (Oveido 2016). Climate shocks on yields of wheat, soybean, maize and rice could result in substantial negative economic impacts within LAC and worldwide. The Intergovernmental Panel on Climate Change (IPCC) has concluded that climate change is already affecting global food production. These findings represent a "red flag" for policy makers both in LAC and globally for future food and nutrition security, as well as the related economic and political insecurity that comes with it (Fernandes et al. 2012).

Business-as-usual food production systems will need to be replaced with better methods at scale. Ecosystem-supporting agricultural strategies can reinforce key functions such as pollinator habitats, freshwater infiltration, flood control, climate regulation, and carbon sequestration while also increasing profitability, nutrition, and access to food. There is strong science-based evidence showing the promise of agricultural and ranching practices that maintain or improve ecosystem services (Kremen and Miles 2012; Kremen 2015; TNC 2017; Lipper et al., 2014; Pretty and Bharucha 2014). These practices are often referred to as regenerative agricultural practices, biodiversity-friendly agricultural practices, or, more broadly, agroecological intensification. Their aim is to increase yields without adversely affecting ecosystem services or propelling habitat conversion (Kremen and Merenlender 2018).

A prevailing food production model based on unsustainable extraction and extensification, by threatening the ecosystem services we depend on, threatens the future capacity of agriculture itself: at the global level, for example, agricultural land degradation has reduced productivity in 23 percent of the global terrestrial area, and between US$235 billion and US$577 billion in annual global crop output is at risk as a result of pollinator loss (IPBES 2019b). Enhancing food production in LAC in the decades to come will require policy reforms and supporting investments that factor in the value of the environment and ecosystem services.

Box 5. The LAC livestock sector and climate change: Part of the problem, part of the solution

The livestock sector in LAC plays an important role in meeting local and global demand for animal source foods and contributes significantly to inclusive economic growth in the region. In the LAC region, about 21 percent of daily calories and about 50 percent of protein (about 175 kilograms of protein per capita per year) are consumed in the form of milk, meat, and eggs. Production of these animal source foods contributes an estimated annual US$126 billion to the region's total GDP, representing about 42 percent of the region's agricultural GDP. Livestock products also make up a significant portion of LAC exports, accounting for about 25 percent of global beef consumption and 26 percent of global poultry consumption. While much of this production and export comes from large, commercially-oriented operations in Argentina, Brazil, Mexico, and Uruguay, an estimated 80 percent of livestock keepers in LAC are smallholders, many of whom keep livestock using extensive, low-productivity systems and/or in areas unsuitable for livestock activities. Improving the productivity and sustainability of livestock systems is thus an important pathway out of poverty in the region (FAO 2018a).

The contributions made by livestock to growth and food and nutrition security are threatened by climate change. Higher temperatures and changing weather and seasonal patterns in LAC are adversely affecting the water, grazing, and other natural resources that underpin livestock production. Rainfall variability and drought result in lower productivity and higher levels of herd mortality, and about 70 percent of grazing areas in the region are considered to be in various stages of degradation (FAO 2018b). At the same time, livestock in LAC are also a leading contributor to climate change. Livestock account for more than one-third of total regional GHG emissions from all sectors (about 1.6 of total 4.6 gigatons annually). Most of these emissions are from specialized beef systems (LAC has the highest annual volume of beef emissions of any region worldwide), which in LAC historically have been based on grazing previously forested land and associated with deforestation and biodiversity loss. Across all livestock value chains in LAC, the greatest source of emissions is methane from enteric fermentation (44 percent of total livestock emissions), followed by carbon dioxide from land use change to expand pasture and cropland for cattle feed, especially soybeans in Argentina and Brazil (Gerber et al. 2013).

Emerging technologies show great promise for increasing productivity while reducing the environmental impacts of livestock production. In livestock production, higher animal yields generally correlate with lower emissions per unit of livestock product. Technologies and approaches that improve yields while also enhancing carbon sequestration can thus contribute significantly to climate change mitigation in LAC. One such approach is the "silvopastoral" system, which combines trees ("silvo") and managed pasture ("pastoral") in order to improve animal and grassland productivity and contribute to carbon capture and biodiversity recovery. In Colombia, for example, the Mainstreaming Sustainable Cattle Ranching project supported by DFID and the Global Environmental Facility (GEF) has over the last 10 years supported 4,100 family farms in their adoption of silvopastoral techniques, increasing milk productivity by an average of 36 percent and helping farmers sequester over 1.2 million tons of carbon. Another approach shows similar promise in Uruguay, where the government in 2019 began scaling up the implementation of low-carbon production technologies under the GEF-supported project Climate-Smart Livestock Production and Land Restoration in the Uruguayan Rangelands. The project will employ improved feeding, breeding, and other techniques, together with rangeland restoration and afforestation, to increase meat productivity in intervention areas by over 50 percent while sequestering over 5 million tons of carbon dioxide equivalent over 20 years.

Box 6. Tackling the environment-agriculture nexus in LAC

Agriculture and the environment are intricately interlinked in Latin America and the Caribbean. Agricultural production relies on healthy and biodiverse environments that provide key ecosystem services, such as the provision of fresh water, fiber, and genetic resources; the regulation of microclimates, pollination, and pest control; the contribution of supporting services, such as soil formation and nutrient cycling; and increasing resilience in facing the effects of climate change. The quantity and quality of ecosystem services availability is affected by agriculture expansion and unsustainable agricultural practices that degrade land.

Land use change from agricultural expansion replaces complex natural ecosystems and constitutes a major source of land degradation and threats to the provision of ecosystem services. The expansion of the agricultural frontier, either through the increase of cash or subsistence crops and of cattle grazing, remains the main driver of deforestation in the region. According to the World Bank's Natural Capital estimates, most countries in the region are reducing their forest capital and expanding their agricultural land capital. Natural capital patterns vary across the region, however; some countries, such as Costa Rica and Dominican Republic, have been able to expand both forest and agricultural land capital, while others, such as Argentina, Ecuador, and Paraguay, seem to have expanded agricultural capital at the expense of forest capital.

As lands degrade and become abandoned, new lands are occupied for production, leading to further deforestation. For example, in Brazil, more than 50 percent of the forest lands cleared for livestock have later been abandoned due to diminishing returns from raising cattle on soils that degrade constantly due to unsustainable cattle ranching practices. Combating land degradation and restoring degraded land is an urgent priority to protect the biodiversity and ecosystem services on which agriculture relies.

Ecosystem services cannot be easily replaced, and coping with their degradation imposes significant costs. Substituting ecosystem services may demand elevated capital investments (e.g., chemical, mechanical, and biological inputs) that can raise the costs of farming by diminishing agricultural productivity and impacting negatively returns in the medium and long run. In the meantime, evidence indicates that often investments in land restoration have positive economic returns, but that avoiding land degradation is always preferable to aiming at restoration once that land is degraded.

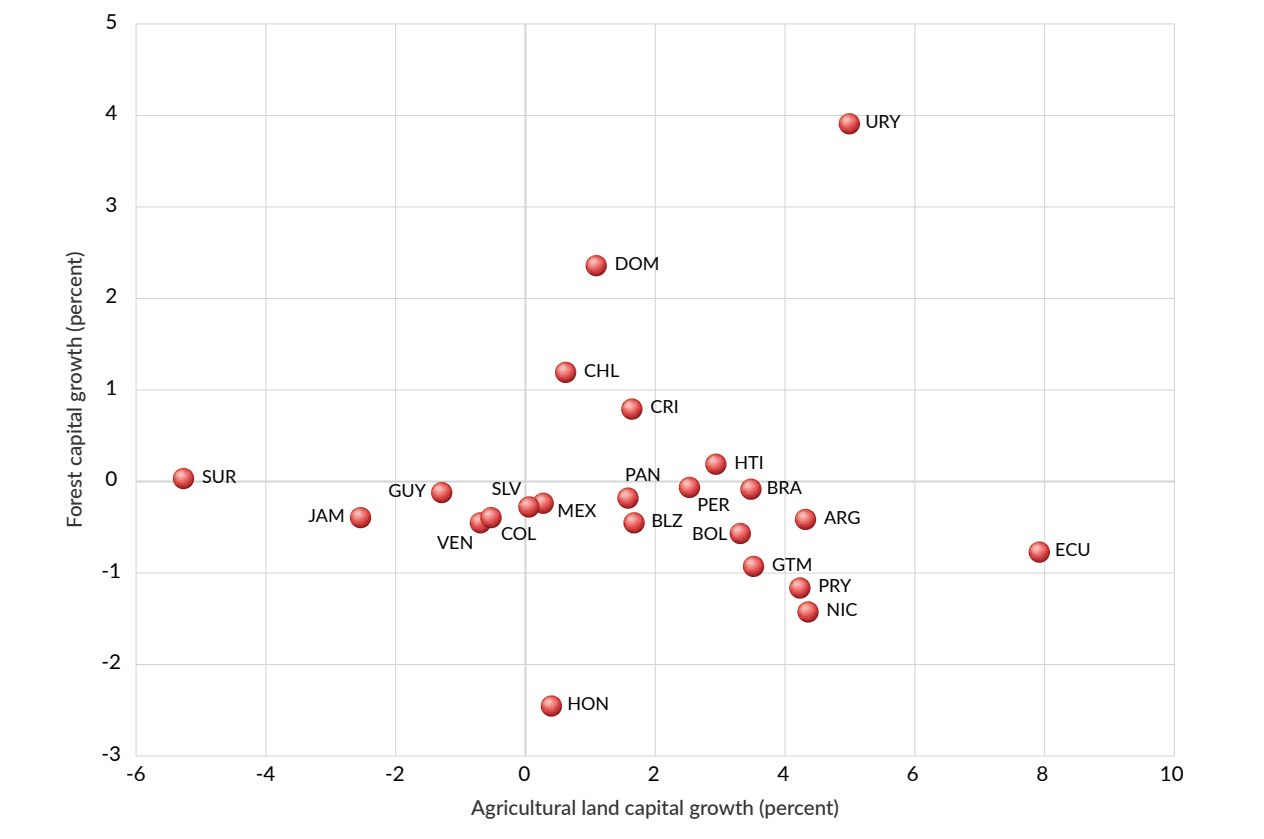
Proven agricultural practices can contribute to preserving or enhancing ecosystem services that can be more profitable and can increase agricultural production, and yet there are barriers that need to be overcome. For instance, agroforestry crops hosting biodiversity, regulating microclimate, and enhancing carbon stocks and increased crop rotations can help to reduce soil erosion. Switching production systems to more sustainable ones requires overcoming certain barriers, including high initial investments, lack of financing mechanisms, producers' low technical capacity (sustainable management practices require extension services), and distortionary policies that incentivize unsustainable practices.

Effective management of ecosystem services requires coordination across government agencies and a policy environment that deters unsustainable agricultural practices and incentivizes sustainable practices. Landscape approaches that mainstream biodiversity and ecosystem service provision and integrate the development of agricultural, forest, water, and infrastructure agendas are critical in this respect, and such policies are starting to be promoted and implemented in the region. Only through a landscape lens can the aggregated impacts and trade-offs that land use decisions entail be assessed. This requires strong institutional coordination and multi-stakeholder participation. >

Box 6. Tackling the environment-agriculture nexus in LAC (cont.)

Figure 29.

Forest vs. agricultural land capital average annual change, 1995-2014



Source: World Bank Environment, Natural Resources, and Blue Economy Global Practice.

Photo: © Seventyfourimages | Dreamstime.com

Governance: Key policies influencing the performance of LAC agriculture and food systems

CHAPTER 3

KEY MESSAGES

- Agriculture in LAC has performed well compared to agriculture in most other regions, in part because an overall policy bias against agriculture in many LAC countries dating back to the Second World War was largely corrected by structural reforms introduced in the 1980s and 1990s. Since then, incentives have remained fairly sector-neutral.
- The macroeconomic context can severely impact agri-food systems, especially in countries with significant agricultural trade. In the wake of the COVID-19 crisis, the exchange rate depreciation experienced by a number of LAC countries could hinder exports and disrupt critical imports.
- Going forward, as LAC countries seek to satisfy their agro-industrial needs, the risk of disruptions to far-flung global supply chains—highlighted during the COVID-19 pandemic—can be mitigated by leveraging existing strong intra-regional trade ties within the Americas
- Agricultural land in LAC is distributed unequally, and land ownership rights are often uncertain. Improving security of land tenure, creating functioning land markets, and achieving more equitable access to land remain major challenges.
- The level of public spending in support of agriculture has varied among LAC countries: on average, it has been higher than in other developing regions, and lower than in most high-income countries. In future, not only the quantity but especially the quality of public spending will have to increase in LAC for agri-food systems to thrive.

3.1 Agricultural policies in LAC in historical perspective

What is the role of policies in shaping the evolution of LAC agriculture and food systems? The reasons for a robust policy approach to the agricultural sector and the rural economy more generally were eloquently articulated in the World Bank flagship report *Beyond the City: The Rural Contribution to Development* (de Ferranti et al. 2005), which considered the contribution of agriculture and rural development to growth, poverty alleviation, and the environment. More than a decade has passed since the publication of that important work, and in the meantime agriculture and food systems in LAC have become significantly more complex and have extended far beyond the rural space. As emphasized throughout this report, agriculture and food systems today are expected to contribute in multiple dimensions that include but go beyond the three dimensions discussed in the flagship report, including growth, poverty reduction, food and nutrition security, and ecosystem services. (For additional discussion, see, for instance, PIADAL 2013 and Díaz-Bonilla 2015.)

Successful achievement of these multiple objectives will be influenced by a wide range of policies. This includes not only policies specific to the agriculture and food sector, but also policies affecting trade and exchange rates; policies affecting the availability, quality, and cost of resources such as land and water; policies affecting human capital, including education policies and labor laws; policies affecting the availability and cost of finance; and policies relating to human and animal health and safety. While a comprehensive analysis of all these policies is beyond the purview of this report, this chapter provides an overview of selected key elements of the agricultural policy environment.

In most LAC countries, agricultural policies are intended to improve productivity, increase producer incomes, reduce poverty, and achieve and maintain food and nutrition security for urban and rural populations. The mix of policies varies between countries, however, because of differences in the prevailing agricultural systems and also because policy design and implementation arrangements depend on many factors, including the availability of resources, the effectiveness of governance structures, and political economy considerations. This chapter focuses on two key features of this larger panorama. It begins with a brief synopsis of the historical evolution of policies, highlighting how policies in LAC have compared to policies in other regions. The chapter concludes with a discussion of what is probably the most significant determinant of the policy environment in most countries today: namely, how much public spending is devoted to agriculture in LAC and how that spending is distributed.

3.1.1 LAC led the reform movement

As described by Díaz-Bonilla (2015), one important reason why agriculture in LAC has performed well compared to agriculture in most other regions is that many countries in LAC were relatively quick to reverse the counterproductive policies that characterized the development paradigm common in the post–World War II era. Up until the 1970s, many developing countries pursued industrialization strategies that involved the use of trade and exchange rate policies to protect the manufacturing sector against competition from imports, targeted subsidies to reduce input costs, and controls to keep food prices low for workers. In this paradigm, agriculture was viewed as a source of cheap food, labor, and fiscal profits that could be siphoned off to finance industrialization with minimal adverse consequences

because agriculture had an inelastic supply schedule and very limited potential as an engine for growth. Policies of most countries in LAC were based on this type of industrialization strategy.

State-owned enterprises (SOEs) were an important instrument used to implement this paradigm. SOEs in many countries were actively involved in agricultural markets, participating in input supply as well as output procurement, processing, and marketing. Most SOEs required substantial subsidies, absorbing resources that might otherwise have been put to more productive purposes and preempting development of the private sector in those activities. Mexico was typical in this regard; in Mexico, the giant SOE Conasupo (and its affiliates) dominated the markets for grains, oilseeds, and dairy, requiring transfers of an average of 3.5 percent of the entire government budget in the period 1982–85 (van Blarcom, Knudsen, and Nash 1993). Together with other subsidies for agricultural credit, fertilizer, and electricity (all administered through government-operated companies), subsidies consumed around 85 percent of the budget of the Ministry of Agriculture, leaving only 15 percent for productive spending on research, extension, and irrigation investments. At one point in Venezuela more than one-half of the investment budget of the Ministry of Agriculture went to the construction of a single tractor factory (van Blarcom, Knudsen, and Nash 1993). Reforming these SOEs was a key component of the structural adjustment programs launched during the 1980s and 1990s. These reforms were generally carried out in conjunction with trade policy reforms, since the pricing and trade of the SOEs was closely connected to trade policies.

A recurring feature of the industrialization strategy was heavy taxation of agriculture. This came about to some extent through direct measures, such as taxes on agricultural exports. But even more important were the indirect effects on agriculture from the protection and subsidies to manufacturing (which competes with agriculture for resources, including labor and capital) and from overvalued exchange rates resulting from import protection and macroeconomic (particularly exchange rate) policies (Krueger, Schiff, and Valdés 1991). While agriculture ostensibly benefited from various subsidies (on agricultural credit, fertilizer, etc.), the subsidies only partially off-set the biases created by the protection of other sectors and the exchange rate policies. Within agriculture, import substituting products received much more favorable treatment than exportables, creating large distortions in relative production incentives and causing countries to overproduce goods that they could not produce efficiently. Other outcomes of the industrialization strategy were extreme macroeconomic imbalances, including deficits in the fiscal budget and balance of trade, as well as high inflation.

During the 1960s and 1970s, when many LAC countries were pursuing an industrialization strategy, agriculture in LAC was taxed at rates as high as or higher than in Africa and Asia. But beginning in the mid- to late 1980s (earlier in Chile), as the inadequacies and unsustainability of the strategy became increasingly clear, a number of LAC countries introduced the types of structural reforms that later were implemented in other regions as well. Chile was the earliest reformer, launching deep reforms in the mid-1970s. Other countries followed, to differing degrees. Reforms usually included macroeconomic stabilization, trade liberalization, deregulation, and privatization of SOEs. There was a considerable reassessment of the role of government in guiding economic development in general, and economy-wide reforms such as deregulation of service sectors like transport played a significant role in supporting the response of agriculture. Agricultural policies were an integral part of this reform process, although not the principal motivation of the reforms (Anderson and Valdés 2008). Improved

macroeconomic management reduced the implicit tax on agriculture from overvalued and otherwise distorted exchange rates. As a result of these structural reforms, the net taxation of agriculture in LAC began to diminish, and by the early 1990s it had almost disappeared (Figure 30).

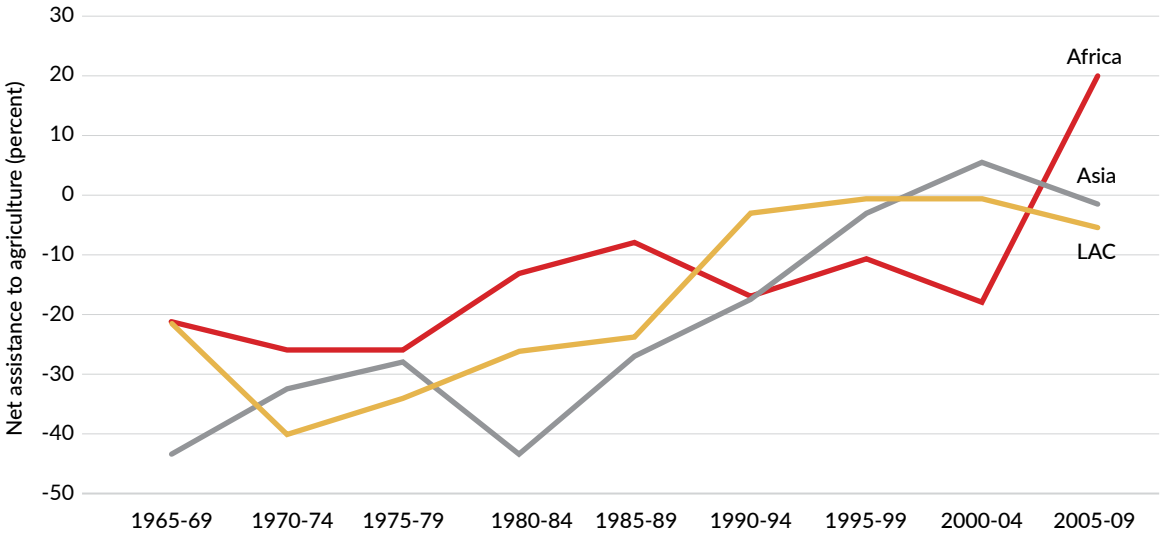


Figure 30. Relative rates of assistance to agriculture, by region, 1965–2009

Source: Anderson (2009) for 1965–2004; own calculations from Chaherli and Nash 2013 for 2005–2009, based on updated database for Anderson (2009) (http://go.worldbank.org/5XY7A7LH40).

Note: Five-year weighted averages with value of production at undistorted prices as weights. LAC countries in the study were Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua. The 2005–2009 relative rate of assistance for Africa was heavily influenced by several countries that provided high positive protection to agriculture (particularly Ethiopia), but this is not representative of the continent as a whole. A majority of countries had negative relative rates of assistance, as in earlier periods.

3.1.2 Dutch Disease and agriculture: Beyond booms and busts?

In addition to having to deal with overvalued and distorted exchange rates, a perennial issue for policy makers in a number of LAC countries has been how to manage potential so-called Dutch Disease effects caused by new hydrocarbon and mineral discoveries and/or instability in commodity prices—that is, volatile and highly appreciated exchange rates, which negatively affect tradeable sectors like agriculture. From the mid- to late 2000s, exchange rates appreciated in several important agricultural exporters, particularly Brazil and Colombia, reducing the sector's competitiveness in those countries. More recently, this trend has been reversed. Among countries that depend heavily on commodity exports, Chile has been a model of commodity cycle management. Following years of macroeconomic crisis in the 1980s, Chile has maintained macroeconomic policies—including policies specifically designed to offset the effects of commodity booms and busts—that have maintained a relatively stable real effective exchange rate and avoided overappreciation. Exchange rate stability has been critical in supporting the development of a high-value agricultural export sector. Going forward, management of cyclical market behavior will continue to be an important issue for agriculture in many LAC countries, particularly those with large hydrocarbon and mineral sectors.

3.1.3 Agricultural trade and trade policy: How LAC can continue to help feed the world

LAC has long played a disproportionately important role in global agricultural trade, mainly because the region enjoys a strong comparative advantage in food production. In their landmark study of the impacts of policies on agricultural incentives, Anderson and Valdés (2008) determined that the eight LAC countries in the sample (Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Mexico, and Nicaragua) displayed a revealed comparative advantage in agricultural production of 2.2 on average, well above the global average of 1.0.[15] The relative abundance of water and land resources in areas where agricultural production can be sustainably expanded indicates that LAC is well positioned to continue to be a major food exporting powerhouse. Not all LAC countries enjoy this potential, but it is not confined to Brazil and the Southern Cone (Deininger et al. 2011).

To take advantage of this opportunity to harness trade to help feed the world while also growing their own agro-industrial sectors, LAC countries have over time implemented policies designed to increase their integration with world markets. During the 1980s and 1990s, this was done mainly via unilateral trade reforms as part of the structural adjustment of their economies, as well as (in some cases) through commitments under the WTO. After the Uruguay Round negotiations bogged down, however, bilateral agreements became the most workable option for achieving trade liberalization, and for the past several decades many LAC countries have relied increasingly on preferential trade agreements (PTAs). Most PTAs have been intraregional: of the 441 bilateral agreements recorded by LAC countries between 1973 and 2017, only 71 have involved countries or groups of countries outside the region. PTAs with neighboring countries can have the advantage of encouraging trade in goods that are expensive to transport over long distances, such as live animals and dairy products, or bulky commodities such as potatoes (Antweiler and Trefler 2002). But a major disadvantage is that close neighbors are more likely to have comparative advantage in similar products, which reduces the benefits of trade and may simply result in trade diversion rather than trade creation (World Bank 2019c).

More recently, efforts by LAC countries to promote trade, including agricultural trade, have increasingly turned outward. In the wake of the signing of the 1994 North American Free Trade Agreement, many LAC countries have focused on negotiating extraregional PTAs, particularly with large, high-income economies where payoffs are likely to be more significant. Many of the extraregional PTAs go well beyond tariff reductions to embrace other trade issues, including some particularly relevant to agriculture, such as clarification of sanitary and phytosanitary (SPS) measures. Virtually all of these PTAs feature a phase-in period during which existing tariffs are progressively reduced and an expanded range of products is made eligible for tariff reductions or elimination. For various reasons, however, agricultural products have benefited less from PTAs than other types of products and services, and as a result agricultural trade remains less liberalized than nonagricultural trade.

Notwithstanding the spaghetti bowl of agreements among the LAC countries and with extraregional partners, barriers to agricultural exports remain relatively high (Chaherli and Nash 2013). Still, in some cases PTAs have had important positive effects, more so in processed and higher value-added

[15] Revealed comparative advantage (RCA) is an index, calculated based on trade flows, that is used to calculate a country's relative advantage or disadvantage in a class of goods or services. RCA = (Eij/Eit) / (Enj/Ent), where E = exports; i = country index; n = set of countries; j = commodity index; and t = set of commodities. A comparative advantage is "revealed" if RCA is greater than 1. If RCA is less than 1, the country is said to have a comparative disadvantage in the commodity or industry.

products than in bulk commodities. Analysis carried out using a gravity model that distinguishes among product groups shows that PTAs are positively associated with exports of all product groups, but the association is stronger for agro-industrial goods than for other types of goods. More recent PTAs appear to have had more significant impacts than earlier agreements, such as Mercosur, and these PTAs appear to have been more effective in reducing non-tariff barriers. And one thing is clear from theory and practice: PTAs yield larger benefits when member countries have lower trade barriers with partners outside the preferential area, because this reduces potential trade diversion (Chaherli and Nash 2013).

Agricultural trade policy reforms in LAC, whether implemented unilaterally or through PTAs, have been effective in promoting agricultural export growth. Historically, primary and processed products both have contributed meaningfully to export growth, but more recently LAC agricultural exporters have been tilting their specialization from upstream products (unprocessed bulk commodities) to downstream products (processed commodities and manufactured food products). LAC appears to be deepening trade in processed products more quickly than other regions. In addition, LAC has diversified its agricultural exports by country of destination (Chaherli and Nash 2013).

Reliance by LAC countries on PTAs continues, as evidenced by the recent negotiation of the US-Mexico-Canada Agreement (USMCA) and the EU-Mercosur Agreement. With respect to agriculture, USMCA is not significantly different from the North America Free Trade Agreement (NAFTA) that it replaces. The EU-Mercosur Agreement, on the other hand, does incorporate important new features that are relevant for agriculture. These include removal of tariffs on 95 percent of Mercosur countries' agricultural imports from the EU; liberalization of 82 percent of EU's imports from Mercosur countries; imposition by the EU of import quotas on beef, poultry, pork, sugar, and cheese; elimination of taxes on soybean exports to the EU; and strong provisions against export subsidies.

A recent World Bank (2019c) study based on computable general equilibrium (CGE) modeling concludes that neither of these two important new PTAs is likely to produce major structural transformation in the LAC signatory countries. In line with current patterns of comparative advantages, in Mercosur countries agriculture and livestock production will expand generally, while in Mexico and most Central American countries production growth will be concentrated in labor-intensive subsectors. All four Mercosur countries should see an increase in agricultural production, livestock, food processing, and related manufacturing activities. In Argentina, soy meals and oil products is the sector showing the largest expansion, followed by production of beef and vehicles. Brazil should see increases in the production of footwear, vegetables and fruit, beef, and vehicles. But except for a few activities, the changes in sectoral output and employment will not be dramatic. The expected overall effects on growth, on the other hand, could be substantial.

The increases in agricultural exports expected to result from the USMCA and the EU-Mercosur Agreement do raise some concerns, however, notably with respect to potential adverse ecosystem impacts. For example, the EU-Mercosur agreement is expected to lead to an increase of around 22.3 percent in livestock production by 2030. If the increase were to be achieved entirely through extensification, i.e., with no increase from current levels of productivity per unit land area, this would require an expansion in pasture land of 11.4 million hectares—an area equivalent to about one-third of the area that has been deforested in Brazil so far in this century.

Today, many LAC countries are working within the multilateral system to seek further reforms to promote increased agricultural trade. At the same time, most continue to look for opportunities provided by PTAs to address issues not handled well in WTO commitments. PTAs could be made especially impactful through several types of actions:

- Removing the exemption of agricultural products from the "general tolerance" or *de minimis* exceptions in rules of origin, so that producers of agricultural products (primary and processed) can take advantage of low-cost imported inputs, similar to producers in other sectors. A second-best alternative is to exclude only especially sensitive agricultural products, not the entire sector as many PTAs currently do.
- Improving the treatment of SPS issues in PTAs. This could include clarifying the rules under the multilateral SPS agreement to improve transparency or, even better, committing countries not to impose more stringent protection than that recommended by international scientific organizations. Harmonization and mutual recognition of standards would also enhance trade. Some of these issues might be handled through current committees and working groups.
- Harmonizing PTAs by gradually converging their commitments.
- Exploring agreements with countries with especially high trade barriers for LAC agricultural exports, especially in South Asia, the Middle East, and North Africa.

3.1.4 Land policy and agrarian reform

An enduring legacy of Latin America's colonial past is a highly skewed distribution of agricultural land. A relatively small number of large *latifundios* control most of the agriculturally active area—much of it taken from indigenous community lands—while the vast majority of farmers work "*mini-* or *micro-fundios*," and large numbers of rural workers remain landless. Even after numerous attempts at land redistribution and agrarian reform, the region still has the most unequal distribution of land in the world (von Bennewitz 2017). The Gini coefficient for land distribution in LAC is 0.79, compared to 0.57 in Europe, 0.56 in Africa, and 0.55 in Asia. The Gini coefficient for South America—0.85—is even higher than for the region as a whole (FAO 2017a). Access to land is an especially acute issue for women, who control between 8 and 30 percent of agricultural land, depending on the country. On average, women work smaller farms with lower quality soil, while having less access to credit and technical assistance (FAO 2017b).

The unequal distribution of land is particularly problematic because many of the numerous small-scale farmers lack security of land tenure. For example, in Colombia, while the cadastral record is incomplete, it is estimated that approximately 60 percent of land parcels are held informally (CONPES 2018b). In Guatemala, 95 percent of rural land parcels are not registered, and in Brazil estimates of tenure informality range from 40 to 50 percent. Insecurity of tenure produces many problems that reduce productivity of the sector and increase poverty. First, lacking secure tenure, many smallholders are largely locked out of credit markets, have limited incentives to invest in land improvements, and are forced to devote time and resources to protecting their claims. As a result, often the tenure insecurity correlates with spatial poverty, adding to the poverty trap. Lack of secure tenure also undermines the potential to improve efficiency through land consolidation by larger scale

investors. Lack of clarity on who owns what and the absence of centralized and complete cadaster databases makes finding land for investment difficult and expensive. In addition, governments—particularly local governments—lack data for land use planning, property tax administration, and other land management activities. These factors not only reduce land productivity, they also curtail the ability of many smallholders to participate in off-farm activities, thereby perpetuating a cycle of poverty (Deininger and Feder 2009; IDB 2012; Lopez, Salazar, and De Salvo, 2017). Indigenous peoples and women farmers tend to be doubly disadvantaged, having lower access to land, credit and other inputs to increase output and productivity.

Efforts to redistribute land and implement agrarian reforms have been undertaken in many LAC countries, but few if any can be characterized as having stimulated broad-based rural development or lifted large numbers of poor farmers and landless laborers out of poverty. One important reason for this failure is that they have not been successful in addressing the need to formalize titles, improve land administration, and enhance security of tenure. In some cases, agrarian reform programs have succeeded in transferring effective control over land to new groups, but the programs have stalled because the transfers were never legally codified. In other cases, land has been expropriated and reassigned to poor households, but the original owners were never paid the agreed compensation, so new titles could not be issued (de Janvry and Sadoulet 2002). In still other cases, agrarian reform programs succeeded in transferring legal ownership of land, but this was not accompanied by complementary measures to help the beneficiaries establish themselves as farmers, leaving them mired in poverty. Tensions around land issues remain high in some areas, although often they are more linked to new problems, such as guerrilla and drug-related rural violence (ECLAC/FAO/IICA, 2012). But conflicts related to ownership of ancestral lands have never disappeared, are still part of the political landscape, and will likely remain so for the foreseeable future.

One country in which the government has devoted substantial resources to supporting land reform beneficiaries is Mexico. In the 1930s, the Mexican government established a unique system of communal farms—the *ejidos*—and over the course of several decades invested significant sums in providing them with highly subsidized irrigation, inputs, marketing assistance, and other services (de Janvry and Sadoulet, 2002). The results were disappointing: many ejidos suffered from problems related to collective decision making and inadequate individual effort, similar to other collective farming models around the world, and most ejidatarios remained poor. In an effort to resolve these problems, in 1992 the government adopted a constitutional amendment allowing ejidos to privatize land and allocate it to individual members, upon approval of a super-majority of the ejido. The results have not lived up to expectations, however, as the new right has been exercised mainly by ejidos in peri-urban areas.

Attempts to regulate use of agricultural land have often had unintended consequences. Similar to what happened with the ejidos in Mexico, in a number of countries including Bolivia, Dominican Republic, and Peru, restrictions imposed on land use have sometimes prevented the consolidation of small, fragmented landholdings, slowing the uptake of improved technologies that are cost-effective only on larger farms. And in Brazil and Colombia, legal requirements that land must be put to productive use to facilitate adjudication or to avoid confiscation has contributed (along with poor forest governance) to deforestation. Land owners have been pressured into using forested land for agricultural purposes, with the land often ending up (after fertility was quickly depleted) in relatively low-value cattle ranching (Deininger and Byerlee 2011).

Box 7. Reducing inequality and improving land administration: The way forward

Improving security of land tenure and creating functioning land markets remain major challenges in LAC. Making progress on these fronts will require tackling the issues with multiple policy instruments.

Initiatives to improve land administration and enhance security of tenure must recognize the heterogeneity of land tenure systems and land issues throughout the region. From large commodity-based agriculture in the Southern Cone to the smallholder-led agriculture prevalent in Central America, from the Amazon to the Andes, there are no one-size-fits-all solutions. Still, certain reforms are needed across the region:

1. **Complete the reforms to secure tenure for all landholders:** Formalization, regularization, and land distribution programs that are community based and make use of administrative systems, rather than courts, are needed across the region. This requires simplification of policies and processes, fit-for-purpose approaches, and new technology. For example, in Nicaragua the World Bank has been supporting the recognition of indigenous peoples' land rights since 2002 through the Land Administration Project. The program, which has served as a model for similar programs elsewhere in the country, has supported the development of the institutional and legal framework and the demarcation of territories of indigenous peoples. Poor and marginalized indigenous communities in the Caribbean subregion of Nicaragua have received collective titles to 15 ancestral territories, comprising over 22,000 square kilometers, or close to 19 percent of the national territory. Legal recognition of land rights had the additional effect of strengthening the recognition by central, regional, and local authorities of the traditional forms of governance of these territories.
2. **Invest in modern systems of land administration** with complete and up-to-date maps and cadasters that provide information for all—owners, investors, local government—on who owns what. Good land administration supports land markets at all levels and provides incentives for putting land to its most productive use. In Colombia, the recently approved Multipurpose Cadaster Project will focus on developing an efficient cadaster and property registration system so that titles issued to land holders can be maintained, owners can access credit, and local authorities have up-to-date data for planning. In Nicaragua, greater tenure security through registered titles helped bring the level of households' investment close to the optimum and increased the value of land by almost 30 percent.
3. **Target investments to benefit women and indigenous peoples (where relevant).** According to FAO, women and girls have historically suffered from a lack of control and ownership of land in Latin America. Culturally speaking, women do not consider themselves the landowner, despite legal protection even in the event of informal marriages. Therefore, many World Bank land projects include targeted interventions for women and for indigenous and other ethnic communities to ensure that they benefit equally.
4. **Reform taxation policies and systems to tax underutilized land rather than production.** Moving to a more progressive level of land taxation should encourage more productive use of land and discourage accumulation of land for speculative purposes.

Source: World Bank Land and Geospatial Unit.

3.1.5 Evolution of the volume of agricultural spending

An important dimension of agricultural policy is the priority accorded to the agriculture sector in decisions on public expenditure. To control for differences in country and sector size, the importance of public expenditure on agriculture is appropriately measured using the Agricultural Orientation Index (AOI), calculated as the share of total public expenditure devoted to agriculture relative to the sector's share in the economy. This index for many countries globally can be computed using data

from the Statistics of Public Expenditure for Economic Development (SPEED) database, maintained by IFPRI for the period between 1980 and 2012.

How does public expenditure on agriculture by countries in LAC compare to public expenditure in other countries around the world, and how has this changed over time? On average, governments in LAC have historically spent somewhat more on agriculture than have governments in other developing regions, although this tendency has changed over time. During the 1980s, 1990s, and 2000s, countries in LAC gave higher priority to agricultural spending than did countries in the East Asia and Pacific, South Asia, and Sub-Saharan Africa regions. During the same period, however, the agricultural orientation of expenditure in the developing regions was much lower than in the high-income countries (Figure 31), although this was not universally true in 2010–2012. Of potential concern is the fact that AOI in LAC has been on a downward trend since the 1990s, whereas the opposite seems to be true—to varying degrees—in other developing regions.

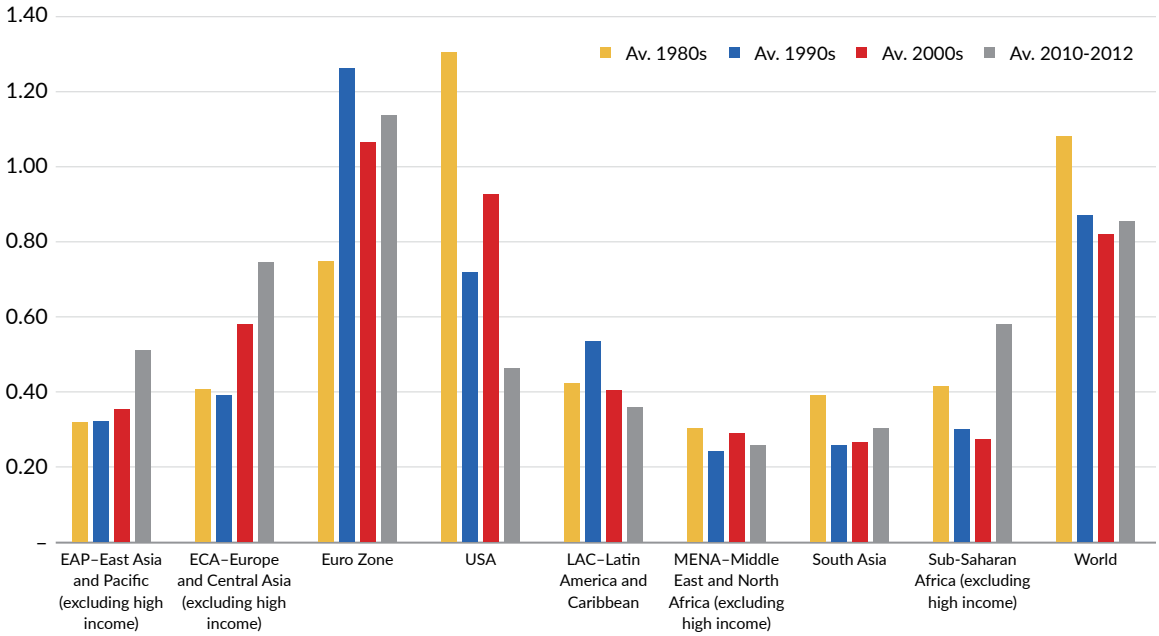


Figure 31. Agriculture Orientation Index (AOI): World and regional comparison

Source: Authors' calculations from IFPRI SPEED data set and World Development Indicators database, World Bank.

Note: Agriculture Orientation Index (AOI) methodology: AOI = (AG PE/Total PE) / (AG GDP/Total GDP). PE = Public Expenditure. AG PE/Total PE: The numerator of the index was from the IFPRI SPEED database, using the variable "totag ppp," the percentage of agriculture expenditure in total expenditure for the years 1980–2012. AG GDP/Total GDP: The denominator was built based on World Development Indicators (WDI) database. The Agricultural GDP of each country or region was divided by Total GDP of each country or region for the years 1980–2012.

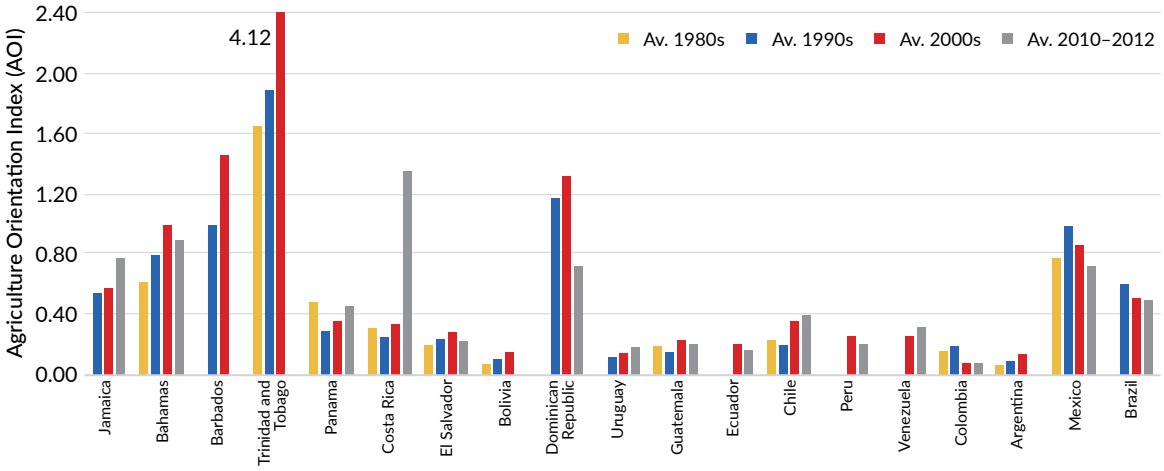
In interpreting these numbers, it is important to remember that a lot of the money spent in the 1980s and early 1990s was spent inefficiently on subsidies and SOEs. In that context, one could argue that lower spending in the decades following structural adjustment did not indicate a reduced priority for agriculture (relative to other sectors, as well as to other countries), but only a recognition by policy makers that less spending was needed because the money that was being spent was being spent more effectively. But this interpretation of the evidence seems dubious, because structural

adjustment affected other sectors as well as agriculture, and other countries, meaning that the efficiency of public expenditure increased in all sectors. This suggests that changes observed in AOI are a reasonable, though admittedly rough, measure of how the priority of agricultural expenditure in LAC changed over time and how it compared to other countries.

Within LAC, considerable diversity can be observed across countries with respect to both the level of the AOI and its evolution over time (Figure 32). The small Caribbean island nations have recorded higher levels of spending on agriculture than have other countries in the region. Even among the economies with large agricultural sectors, spending has varied widely and continues to do so. Argentina, one of the most important agricultural economies of the region, shows a very low (albeit increasing) AOI, while Brazil and Mexico have much higher AOIs, which declined over time from peak levels in the 1990s.

Figure 32. Agriculture Orientation Index (AOI): LAC countries

Source: Authors' calculations from IFPRI SPEED dataset and World Development Indicators database, World Bank.



Note: Figure includes all LAC countries for which data are available. Countries presented from left to right in ascending order of agricultural GDP.

To summarize, the overall policy bias against agriculture that prevailed in many LAC countries during the decades following World War II was largely corrected by the structural reforms of the 1980s and 1990s, and since then incentives have remained fairly sector-neutral. With some exceptions (Argentina being the most prominent), explicit taxation of the sector has been reversed. The heavy protection previously afforded to the manufacturing sector was greatly reduced and has remained constrained by domestic policies, as well as commitments made by many governments under multilateral and bilateral preferential trade agreements. The dominant role of SOEs in agricultural markets has been phased out in most countries, opening the way for private sector development.

This does not mean that no policy challenges remain. While differences in the type and level of support afforded to different types of agricultural products have been greatly reduced from previous periods, importables and exportables continue to be treated very differently in a number of LAC countries, implying that further reforms designed to level the playing field would improve performance (Anderson and Valdés 2008). On the macroeconomic front, booming commodity sectors with the consequent risk of Dutch Disease effects can present continuing challenges. Furthermore, a major challenge in sectoral

policy, even in countries with flourishing agricultural sectors such as Argentina, Brazil, and Chile, is how to ensure that the benefits of sectoral growth are shared with smallholders, the landless, and women.

Historical levels of public expenditure in support of the agriculture sector have varied among LAC countries, but on average for the region as a whole, spending on agriculture relative to agriculture's contribution to the economy has been higher than in other developing regions but lower than in high income countries. In addition, public spending on agriculture declined in LAC from the 1990s at least through 2012. To some extent, the decline in public spending likely was offset by increased private investment, fueled by an increasingly influential agribusiness sector. Of course, smaller budgets more efficiently spent can produce better results than larger budgets spent ineffectively. In that context, a critical question for government policy now is whether support for the sector is being provided in ways that will reap the largest rewards from public spending and promote inclusive growth. The following section turns to this question, looking at the current state of support policy across countries.

3.2 Recent public spending on agriculture: How much?

3.2.1 Introduction and context

Accurate information on the policy support to agriculture is necessary to evaluate and design public policies for the sector. Drawing on Egas and De Salvo (2018) and Díaz-Bonilla, De Salvo, and Egas (2019), the following sections explore the quantity and composition of this support and draw implications for policy. The main analytical tool used is the Producer Support Estimate methodology (PSE), developed originally by the Organization for Economic Cooperation and Development (OECD) and applied in Latin America and the Caribbean by the Agrimonitor initiative of the Inter-American Development Bank (IDB). The methodology is described more fully in Box 8.

3.2.2 Total support and the weight of market price support in the region

How much support do LAC governments provide to agriculture, and how is that support being provided? During the three most recent years for which data are available (the periods differ slightly by country), total support to agriculture in LAC averaged US$18.8 billion per year.[16] Excluding the data for Argentina, which provided net negative support to agriculture, total support to agriculture in LAC averaged US$28.8 billion per year.[17]

Support to agriculture expressed as a share of agriculture value added varied considerably, ranging from negative values in Argentina (which taxes its agricultural sector) to almost 90 percent of agricultural value added in some Caribbean island states (Figure 33). Support in Southern Cone countries (5 to 9 percent of agricultural GDP) was typically lower than in most Central American countries (22 percent on average) and Caribbean countries (38 percent on average). Excluding

[16] Most recent years with available data per country: Brazil, Chile, Colombia, Costa Rica, Dominica, Mexico (2015–2017); Argentina (2014–2016), Paraguay (2014–2016), Uruguay, Ecuador (2014–2016); Panama, Trinidad & Tobago (2013–2015); Barbados, Bahamas, Belize, Guyana, Jamaica, Suriname (2012–2014); Peru (2011–2013); Haiti, El Salvador (2010–2012); Guatemala (2009–2011); Nicaragua (2009–2010); Bolivia (2007–2009).

[17] In particular cases, such as Argentina, policy interventions reduce the prices farmers receive, through export taxes, fixed price mechanisms, or other border measures, providing a "negative support."

Box 8. Measuring agricultural support: OECD methodology

Since 1987, the Organization for Economic Cooperation and Development (OECD) has used the Producer Support Estimate (PSE) methodology to measure the support that governments provide to the agricultural sector. The PSE is a quantitative analytical tool that can measure not only the level but also the composition of policy support.

The PSE methodology incorporates a set of indicators that measure economic transfers to farmers and consumers resulting from the implementation of agricultural policy and programs. Transfers can originate from public expenditures or from price-distorting policies and regulations, such as tariffs, import quotas, export incentives, or administered prices, among others.

Transfers to individual producers or groups of producers are measured using the Producer Support Estimate (PSE) indicator. The PSE indicator includes two components: (i) market price support (MPS), which measures the support provided through price distortions, and (ii) budget transfers (BT), which represent the support financed through public expenditure.

In contrast to support provided to individual producers and groups of producers, transfers that benefit the agricultural sector as a whole (through the provision of public goods and services) are measured using the General Services Support Estimate (GSSE) indicator.

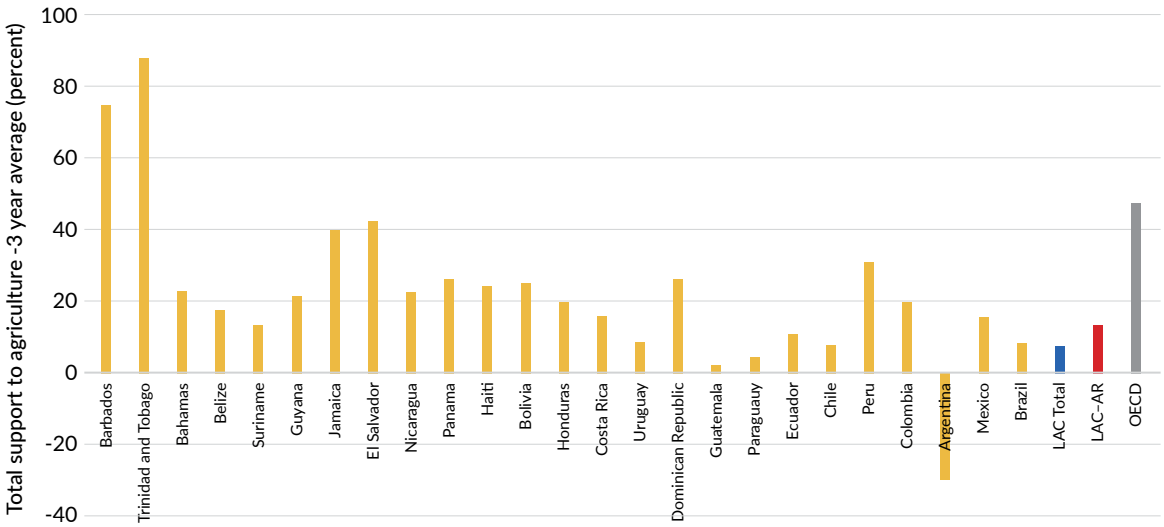
Transfers to agri-processors and other consumers of agricultural products are measured using the Consumer Support Estimate (CSE) indicator.

Last but not least, the Total Support Estimate (TSE) indicator, a measure of total policy transfers to the agricultural sector, is calculated as the sum of PSE, GSSE, and budget transfers included in CSE.

Source: //www.oecd.org/tad/agricultural-policies/psemanual.html.

Figure 33. Total support to agriculture, selected LAC countries (3-year average)

Sources: Agrimonitor database, IDB; OECD 2018.



Note: Includes both public expenditure and support given via MPS. Countries are arrayed from left to right according to the average size of their Agricultural Value Added for the three most recent years with available data.

Argentina, average total support to agriculture represented roughly 14 percent of the region's agricultural value added.

As reflected in the PSE methodology, support to agriculture is provided mainly through two mechanisms: (i) market price supports (e.g., import tariffs or restrictions), and (ii) budget transfers financed through public expenditure (see Box 8).

Use of market price support mechanisms in LAC is widespread. Across the entire region (again excluding Argentina which is an outlier), more than one-third of total support to agriculture (35.9 percent on average) is provided through market price support measures. This share varies widely between countries, however, depending on the country's trade openness, availability of fiscal resources, and political economy considerations (Figure 34).[18] Large countries with a tradition of following free-market policies, such as Brazil, Chile, Mexico, and Uruguay, tend to rely less on these types of market interventions; in these countries, the share of total support provided using market price support mechanisms ranges between 2 and 24 percent of total support. In contrast, most countries in the Andean region (with the exception of Peru), Central America (with the exception of Mexico), and in the Caribbean region make extensive use of market price interventions to support their farmers; in these counties, the share of the total support provided using market prices support mechanisms ranges from 34 to 93 percent.

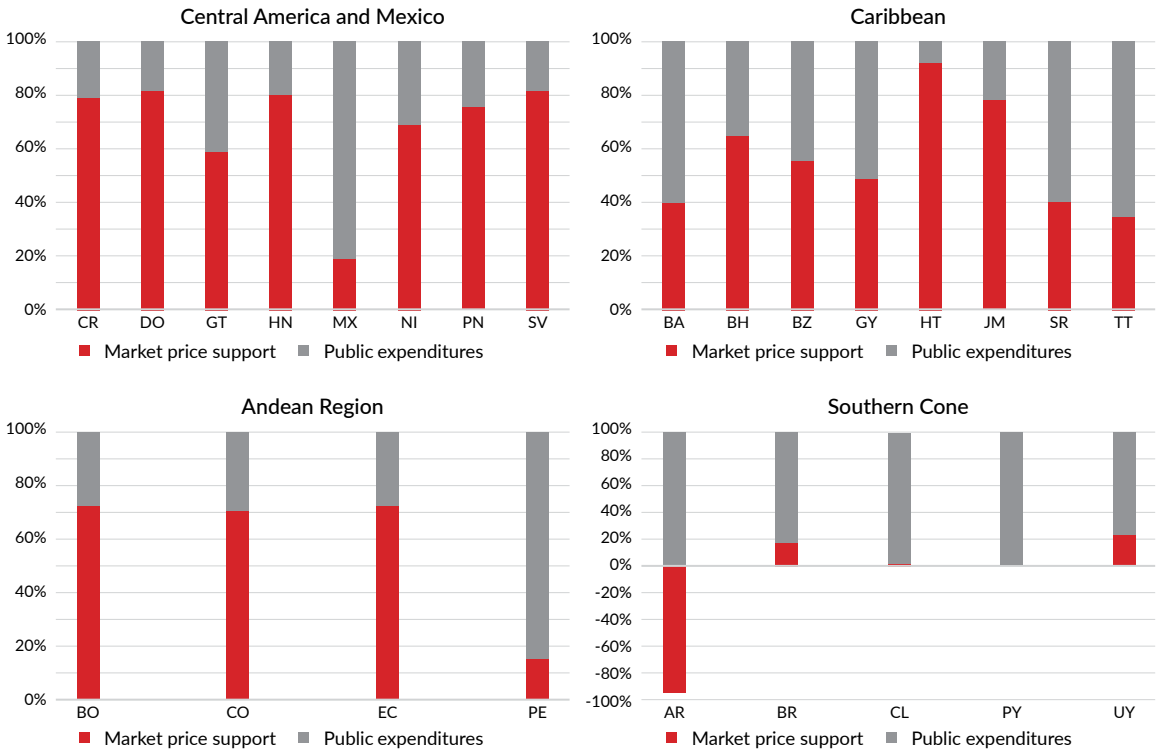


Figure 34. Composition of support to agriculture, market price support vs. public expenditure

Source: Agrimonitor database, IDB.

[18] A comprehensive review of the political economy of agricultural policies is provided by Swinnen (2018).

Reliance on market price support mechanisms in LAC is relatively high by global standards. For example, in OECD countries approximately 28 percent of total support to agriculture is provided through market price supports, a level exceeded by every LAC subregion with the exception of the Southern Cone.

In interpreting the information in Figure 34, it is important to note that the composition of support to agriculture not only varies between countries, but it can also change over time, not necessarily in the same direction. Egas and De Salvo (2018) tracked the nominal protection coefficient (NPC), from 1986 to 2016 for Brazil, Chile, Colombia, Costa Rica, and Mexico.[19] They concluded that Brazil, Chile, and Mexico over time reduced the use of border protection policies to support their agricultural sectors, showing more trade openness and more market transparency. In contrast, Colombia and Costa Rica continued to rely on border measures to protect farmers.

Economic theory and empirical evidence have shown that MPS interventions are highly distortive for the economy. Border measures that raise domestic prices give farmers incorrect market signals, preventing them from becoming more productive or switching to crops, livestock, or non-agricultural activities that would be more sustainably profitable. Moreover, this type of support usually raises prices for consumers as well, placing a special burden on the poor in a region in which millions of people are undernourished. It is of special concern that some of the countries with the greatest poverty rates (the Central American countries and Haiti) rely heavily on market price support policies.

3.2.3 Volume of recent public spending on agriculture in LAC

Complementing market price support mechanisms, budget transfers reflected in public expenditure are the principal instrument used by LAC governments to promote development of agriculture and food systems.

How much support to agriculture moves through budget transfers in LAC? During the most recent three years for which data are available, public expenditure in the agricultural sector in LAC amounted to an average of US$18.8 billion per year, representing roughly 8 percent of the region's agricultural value added.[20] The amount of public expenditure varied widely between countries, however: Guatemala and Haiti spent as little as 1.2 and 1.7 percent, respectively, of their agricultural GDP for their sector's development, while Peru, Barbados, and Trinidad and Tobago spent as much as 26.7, 44.7, and 58.0 percent, respectively (Figure 35).

Reliance on budget transfers in LAC to support agriculture is relatively low by global standards. Public expenditure in LAC accounts for only 8 percent of agricultural value added, compared to 31 percent on average in the OECD countries (Figure 35). Caribbean countries spent more on agriculture than the LAC average. In many cases this occurred not because spending on agriculture in those countries was so high, but rather because the agricultural sectors in those countries are very small (and it is difficult

[19] OECD (2016) defines the producer nominal protection coefficient (NPC) as "the ratio between the average price received by producers at the farm gate (including payments per ton of current output and excluding price levies per ton of current output), and the border price, measured at the farm gate."

[18] Public spending in support of agriculture totaled US$18.8 billion when data are included for Argentina, whose support to agriculture is "negative" due to export taxes and other price interventions. When data for Argentina are excluded, total public spending increases to US$28.8 billion, since the net effect of Argentina's policies during the period being analyzed was to generate US$10 billion annually.

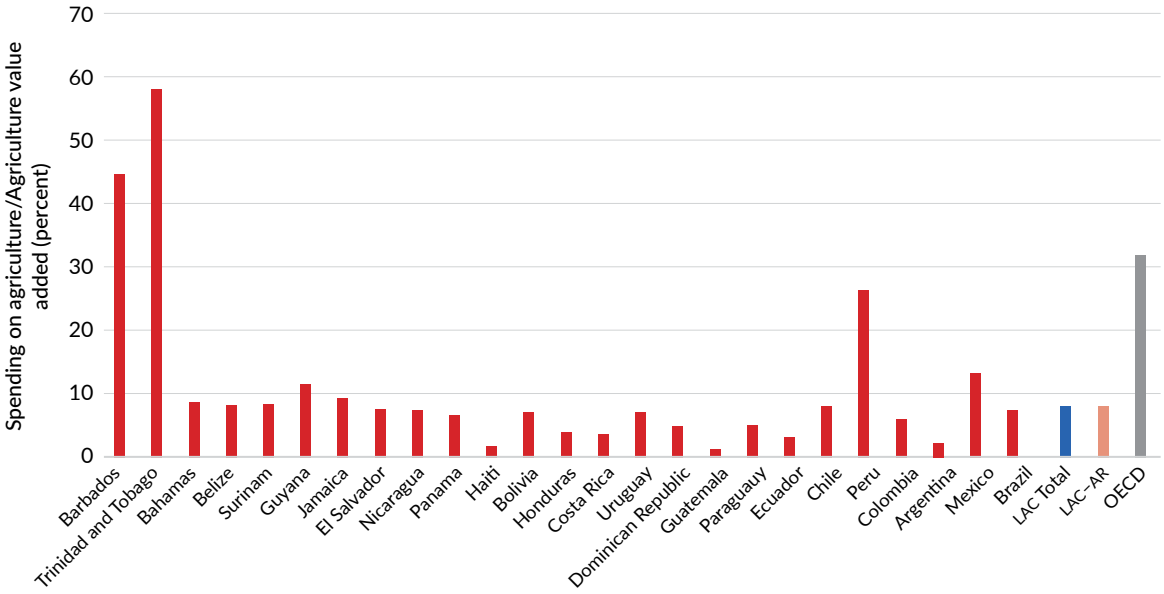


Figure 35. Public expenditure on agriculture, selected LAC countries

Source: Agrimonitor database, IDB; OECD 2018.

Note: Countries ranked from left to right in increasing order of agriculture value added.

to scale back public spending below some threshold level needed to cover minimum fixed costs). At the same time, some Caribbean countries are able to direct to their agricultural sectors resources earned in other sectors (e.g., tourism and/or natural resources). Outside the Caribbean region, differences in the level of public spending on agriculture can be attributed to diverse reasons. Generally speaking, however, public spending on agriculture in LAC is low, either because public budgets are very constrained (e.g., in Ecuador and Guatemala), or because the agricultural sector is very large and the government has other budgetary priorities (e.g., Argentina).

3.3 Public spending on agriculture: How effective?

The quantity of public spending on agriculture provides a measure of the support being provided to the sector, but it is an incomplete measure. Even very large amounts of public resources directed to agriculture will have little impact if they are spent ineffectively. For that reason, it is important to ensure that not only is the quantity of public spending adequate, but also that the quality of public spending is high, in the sense that resources transferred to the sector are generating the desired results.

3.3.1 Composition of public spending: Public goods and services vs. private subsidies

A starting point for understanding the effectiveness of public spending on agriculture in LAC is to understand the composition of that spending. Evidence from within the region and elsewhere suggests that the composition of public expenditure on agriculture affects its effectiveness in promoting agricultural development and boosting productivity (Anríquez et al. 2016; Lopez and Galinato 2007). A key aspect concerns the share of public spending used to support the production of public goods and services (such as R&D, extension services, and irrigation infrastructure), as opposed to subsidizing the provision of private goods and services (e.g., fertilizer subsidies or energy subsidies).

While total government expenditure on the farm sector positively impacts agriculture's performance, increasing the share of expenditures committed to public goods significantly raises rural income. Empirical evidence shows that a shift of 10 percentage points of total agricultural public spending from private to public goods—while keeping total expenditure constant—leads to a 5 percent increase in value added per capita. Alternatively, keeping the composition of expenditure constant, such an increase would require a corresponding agricultural expenditure increase of 25 percentage points. Likewise, at a more micro level, impact evaluations of specific types of expenditures show that these have important and diverse effects on agricultural productivity, income generation, and food and nutrition security in the region (Lopez, Salazar, and De Salvo 2017).

What is the composition of public spending on agriculture in LAC? The main agricultural support policies implemented in Latin American and Caribbean countries can be classified in five broad categories (Egas and De Salvo 2018). In addition to market price supports (discussed in the previous section of this report), the four other types of support involve budget transfers supported through public expenditure:

1. **Subsidies to variable or fixed inputs:** Subsidies are used in many LAC countries to increase access by farmers to production inputs (e.g., seed, fertilizer, energy, credit). These subsidies are generally classified as public spending on private goods, because they directly benefit individuals. Such subsidies have been implemented in numerous countries in the region and elsewhere, including Brazil, Chile, Mexico, and Nicaragua in Latin America and the Caribbean and many countries in Africa. Similarly, schemes offering subsidized advisory services and/or preferential interest rates to encourage agricultural investment are important policy tools in many countries, including Bolivia, Brazil, Colombia, Dominican Republic, Guatemala, Mexico, and Peru, among others. Subsidies to inputs, which have been commonly used in many developing countries because of their political appeal, have generally proven to be ineffective and/or counterproductive, with adverse unintended consequences (Lopez, Salazar, and De Salvo 2017; Jayne and Rashid 2013; Goyal and Nash 2017; World Bank 2008). Other kinds of subsidies, such as technology adoption programs, have shown mixed results in their attempt to increase productivity, possibly due to the limitations farmers face in adopting new technologies and the quality of extension and education services. There is, however, some evidence of positive impacts of incentives for technology adoption in Bolivia (Lopez, Salazar, and De Salvo 2017).

2. **Decoupled payments:** Decoupled payments are direct-to-farmer payments that do not depend on current input use or production. They are usually area-based and typically involve a predetermined payment to farmers, regardless of actual production levels achieved by the farmer or market prices received. Decoupled payment schemes have been implemented in Brazil, Chile, Guyana, Mexico, Paraguay, Peru, and Trinidad and Tobago. While they are a type of subsidy, they generally create less market distortion than do other forms of subsidies. For example, they do not encourage farmers to produce products that are worth less than they cost to produce, as do price supports and input subsidies. As a result, they provide a more cost-effective way to support farmer incomes. They also generate multiplier effects: every dollar spent by the government results in an increase of farmer incomes greater than one dollar. The income multiplier of Mexico's PROCAMPO program on participating households ranged from 1.5 to 2.6,

indicating that US$1 invested by the government of Mexico in PROCAMPO generated US$1.50 to US$2.60 additional income for the participating households (Sadoulet, de Janvry, and Davis 2001). Turkey's decoupled payment program had a similar impact.

3. **Supply of general services:** Public spending in support of agriculture in Argentina, Brazil, Chile, Costa Rica, Peru, and Uruguay has been focused on investments in the provision of general services. These usually take the form of public goods, such as agricultural research, extension services, plant and animal inspection services, and in some cases irrigation and drainage works. Empirical evaluations of spending on public goods—agricultural research, in particular—have consistently shown very high rates of return (Alston et al. 2000; Thirtle, Lin, and Piesse et al. 2003; Hurley, Rao, and Pardey 2014). Other spending on general services also has been found to be productive; animal and plant health initiatives, for example, show significant positive effects on productivity, sales, and prices (Lopez, Salazar, and De Salvo 2017). General service interventions such as land titling or land reform programs are ongoing in several LAC countries, but the aims and mechanisms often differ, ranging from providing titles to land that was previously state-owned (a type of subsidy) to strengthening and formalizing land rights for indigenous communities and historical users of land, in the framework of institutional modernization processes (general services).[21] Among other general service spending, programs to increase access to market information and investments in rural infrastructure also show promising results.

4. **Climate-smart agriculture initiatives:** Climate change is a cross-cutting issue that countries in the region have started to internalize in the design and application of their agricultural policies. Brazil, Colombia, Peru, and Uruguay have been leaders in this area. Two basic types of initiatives can be distinguished. One type is designed to produce global public goods; examples are programs that focus on reducing greenhouse gas emissions to mitigate climate change. Another type remains focused on producing benefits for private individuals and firms; examples are programs meant to help farmers adapt to the effects of global warming.

3.3.2 Composition of public spending: Intraregional variability

Not surprisingly, the composition of public spending on agriculture varies between LAC countries. At the subregional level, some commonalities can be observed, however (Figure 36). Geographic proximity, similarity in agricultural production patterns, and common trade relations allow for comparisons between (i) the Caribbean subregion, (ii) Central America including Mexico, (iii) the Andean Zone, and (iv) the Southern Cone. For example, Central American and Andean countries tend to rely heavily on subsidies to private goods to support their agricultural sectors, with most of the subsidies affecting production decisions (such as input subsidies and other types of coupled payments).[22] Meanwhile, countries in the Caribbean subregion and in the Southern Cone tend to make much greater use of other payments, mainly oriented towards provision of general services.

[21] Land titling programs can have significant impacts on investments made by farmers (Lopez, Salazar, and De Salvo 2017), but land titling is rarely included in the calculation of PSEs, because the nature of the service is in most cases not specifically targeted to the agricultural sector, but rather a general service provided to the entire population.

[20] Here, the notion of "coupled" and "decoupled" payments is used according to OECD (2016).

Box 9. Decoupled payments: Advantages compared to traditional subsidies

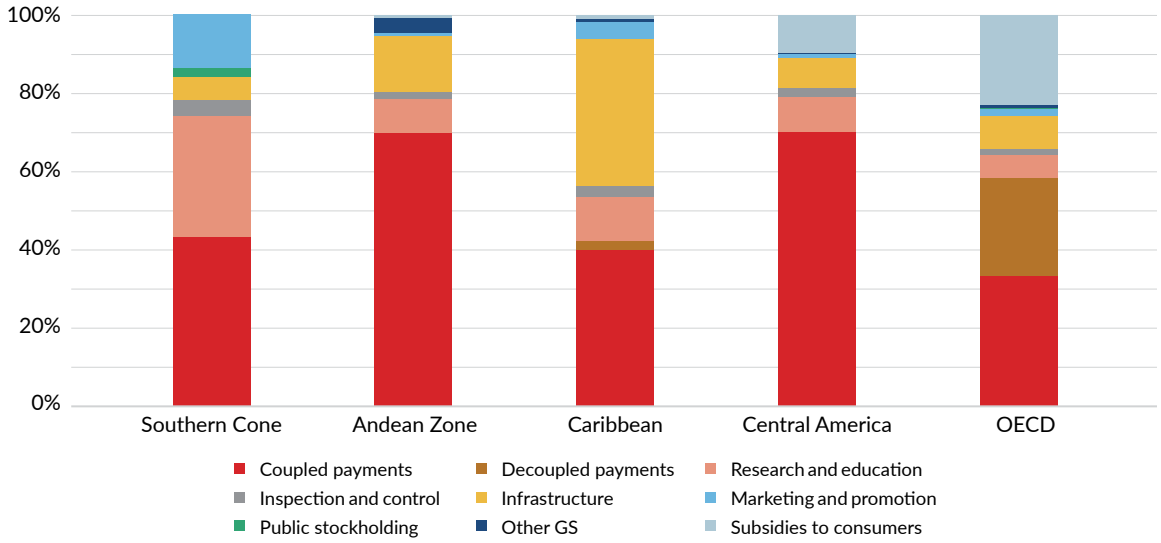
Decoupled support programs have several important advantages over other mechanisms that provide support through input subsidies, output price supports, or trade policy.

- They do not encourage farmers to grow products that they cannot grow at a competitive cost or for which there is no market. They thus promote much more efficient use of a country's limited resources of land, labor, capital, and other inputs.
- They provide a big bang for buck: ex-post analyses found income multipliers of 1.5 to 2.6 for PROCAMPO and similar benefits for DIS payments in Turkey.
- Since cash payments are more flexible than input subsidies, a given level of farmer welfare improvement requires a smaller subsidy.
- They assist in budget planning, since the budget needed is known in advance, and does not depend on factors that cannot be forecast with certainty, such as production or input purchases by farmers.
- They are "Green Box" under WTO rules, and are generally acceptable in free trade agreements.
- A co-benefit is that they provide a good opportunity to improve the land registration and cadastre systems on which they depend.
- They can reach small, poor farmers who benefit little if at all from traditional input and output based subsidies, who use few purchased inputs and/or do not market their output.
- They can be used to encourage good farming practices, for example, by being tied to actions by the farmer that have positive externalities, such as environmental benefits. In the United States and the European Union, some payments are conditional upon satisfying this kind of requirement.

Some lessons for designing and implementing decoupled support programs come from the experiences of Mexico and Turkey, and these can guide future efforts to implement this kind of program.

Figure 36. Composition of public spending in agriculture, LAC subregions vs. OECD

Sources: Agrimonitor database, IDB, and OECD 2018.

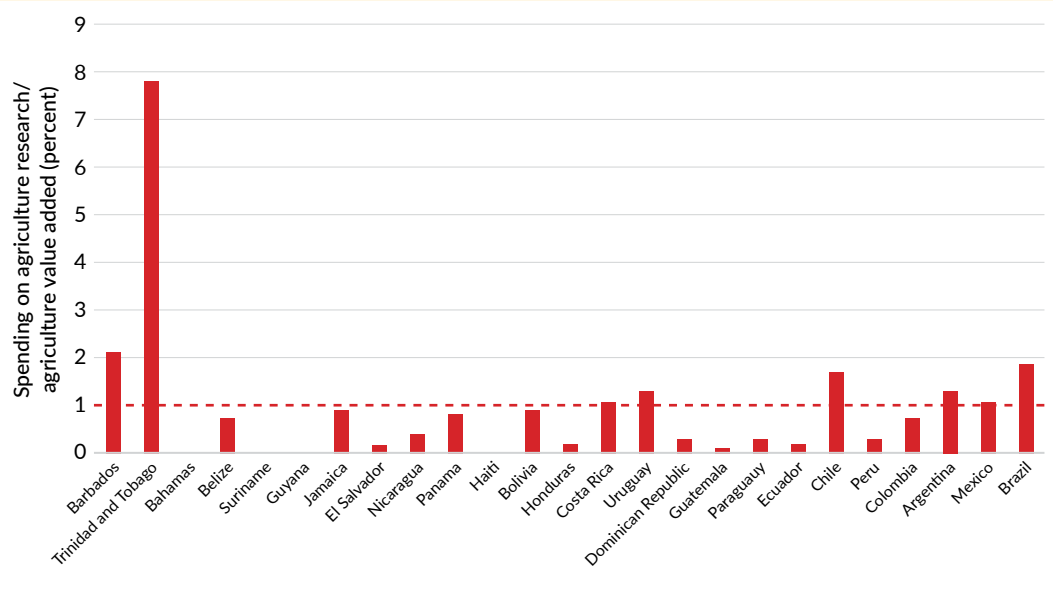


Box 10. Public spending in LAC on agricultural research and development (R&D)

Very few Latin American and Caribbean countries meet the United Nations recommendation to invest in agricultural R&D the equivalent of at least 1 percent of the country's agricultural value added. Most of these countries are located in the Southern Cone (Argentina, Brazil, Chile, and Uruguay), plus a handful of countries in the rest of the region (Barbados, Costa Rica, Mexico, and Trinidad and Tobago). These figures indicate that the allocation of financial resources to agricultural R&D, a typical public good item, should be increased in most countries of the region in order to contribute to agricultural productivity growth.

Figure 37.
Public spending on agricultural research, LAC

Source: Agricultural Science and Technology Indicators (ASTI) database, IFPRI.



3.3.3 Challenges and opportunities for public expenditure reform

LAC's agri-food system is still characterized by very unequal land distribution, as has been the case for centuries. It also shows a complex patchwork of modernizing commercial and family farms, struggling intermediate producers, and a substantial group of subsistence farmers. All of these are immersed in a geographically dense network of small and medium cities, with specific political and administrative functions, making local governments important actors in the policy making process. In terms of value chains, farmers are also part of even more sophisticated networks of suppliers of machinery and inputs, processors, traders and retailers, and food services, with multiple actors and interests. The advance of democracy since the 1980s has also added a variety of demands from civil society, mainly on environmental sustainability, consumer protection, and health issues. Public officials dealing with agri-food policies must be aware of this complex political economy and ensure analysis and consultation processes that help to align the variety of interests.

Policy making in LAC has always been complicated by the heterogeneity of the sector. Policy priorities have to be matched to the need, according to the structure of agricultural production. As a general rule, for large commercial farms the most important need is to ensure an adequate business

environment (Díaz-Bonilla et al. 2014). For small and family farms, policies should not only work to eliminate biases affecting small farmers in land, labor, inputs, and credit markets, but they should also make sure that value chains are sufficiently inclusive. In addition, public funding will be needed for R&D that will benefit the smallholder sector, the specific technology needs of which do not attract much interest from the private sector. Subsistence producers will benefit from the new wave of social safety networks combined with productive support and payment for ecosystem services.

While there are no one-size-fits-all recommendations to increase the impacts of policy measures and increase the payoffs from public spending, certain types of reforms clearly have potential to contribute across the board to the emergence of more efficient, more inclusive, less costly, and more environmentally friendly agriculture and food systems.

- **Reducing use of market price support measures:** Gradually reducing market price support measures and replacing them with a mix of targeted, decoupled, positive-externality-enhancing subsidies and spending on public goods and services, can help lift a burden now carried by low-income households who pay higher prices for food. This is especially critical in countries that have large poor populations and rely heavily on market price support measures.
- **Transitioning from input subsidies to decoupled payments:** Input subsidies have proven in many countries to be ineffective, expensive, and counterproductive. Replacing input subsidies with decoupled payments, without greatly reducing the overall payment level to farmers, should encounter much less political opposition than would eliminating the subsidies outright. Decoupled subsidies are superior policy instruments, for several reasons (see Box 9). Decoupled payments can be used to encourage environmental and agricultural good practices while raising farm revenues. Other subsidies could be used for these purposes if they are linked to well defined targets and minimize market distortions, but decoupled payments are likely to be more efficient.
- **Increasing investments in public goods and services:** The evidence is overwhelming that well targeted, well-managed investment in generating public goods and services generates enormous returns. Many LAC countries are underinvesting in public goods and services that can drive inclusive, sustainable growth in agriculture. Efforts should focus especially on agricultural R&D, innovation, agricultural education, and infrastructure, all of which have demonstrated their effectiveness for boosting productivity, raising rural incomes, and enhancing the resilience of food systems in the face of climate change.

3.4 Impacts of policies and public spending on private investment

In the future, policies will impact the performance of LAC agriculture and food systems by shaping incentives for private actors—not only through policies specific to the sector, but also through policies affecting trade and exchange rates; the availability, quality, and cost of resources such as land and water; human capital, including education policies and labor laws; the availability and cost of finance; and human and animal health and safety. These impacts will be all the more critical as the vast majority of value-adding activities associated with agriculture and food systems are carried out by private actors: input suppliers, financiers, farmers and ranchers, assemblers, transporters, processors, distributors, and consumers. In this sense, the agriculture and food sector differs from

Box 11. Policy support growing in LAC for climate smart agriculture

In recent years as the impacts of climate change on agriculture and food systems have become more evident, governments in many LAC countries have started to make commitments to building climate resilience and to operationalize those commitments through policy reforms and supporting investments.

The historic 2015 Paris Agreement ratified under UNFCCC COP 25 requires each party to the agreement to prepare, communicate, and maintain nationally determined contributions (NDCs) that it intends to achieve. NDCs reflect the efforts that each country plans to take to reduce national emissions and adapt to the impacts of climate change. Since 2015, 29 LAC countries have declared NDCs, all of which include adaptation commitments relating to agriculture. These agricultural adaptation commitments are wide-ranging and include measures like strengthening climate monitoring capacity and establishing early warning systems, investing in irrigation and agro-logistics infrastructure, promoting the use of climate-smart crop and livestock production practices, and promoting more diverse productions systems including agro-forestry systems.

Some LAC countries have also included mitigation commitments among their NDCs. To date, nine LAC countries have included agriculture in their mitigation targets, and an additional six countries have committed to economy-wide emission reduction goals that presumably include agriculture. To date, however, only five LAC countries have identified agriculture-specific actions under their mitigation commitments, suggesting that operationalization of the NDCs remains a challenge.

Throughout LAC, commitments embodied in NDCs are increasingly being translated into action. A good example is the Low-Carbon Agriculture Plan (Agricultura de Baixo Carbono - ABC) being implemented by Brazil. Among other measures, the ABC Plan includes the ABC Program, a credit initiative that provides low-interest loans to farmers who want to implement sustainable agriculture practices. These include no-till agriculture, restoration of degraded pasture, planting of commercial forests, biological nitrogen fixation, treatment of animal wastes, and the integration of crops, livestock, and forest. The ABC Program ambitious goals include rehabilitating 15 million hectares of degraded pastures and increasing the area under zero tillage from 25 million hectares to 33 million hectares by 2020. It also intends to reduce greenhouse gas emissions by 160 million tons of CO_2 equivalent annually, before 2020.

Several smaller countries in the region also are taking action at scale. For example, Dominica has set itself the ambitious goal of becoming the first resilient nation on earth. In the wake of the devastation caused by Hurricane Maria, the government established the Climate Resilient Execution Agency for Dominica (CREAD), conceived as a task force to hurricane-proof the entire island. CREAD's first mission will be to determine best practices across every sector—roads, building codes, energy grids, water management—before enforcing them island-wide.

UNFCCC COP 26, will provide an important opportunity to take stock of the progress made by individual countries toward meeting their NDCs. COP 26 will also provide an opening to explore more fully the concept of nature-based solutions (NBS), which are gaining traction as a guiding principle for the future development of LAC agriculture and food systems. NBS are defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al, 2016). If NBS can be firmly embedded in the design and management of agriculture and food systems, this will help to reinforce an important change in public understanding about what it means to be a farmer in the 21st century: not only a producer of agricultural commodities, but also a provider of ecosystem services and guardian of the natural resource base. One important implication of this expanded perspective will be the understanding that farmers and other agri-food system actors need to be remunerated for providing these services.

other sectors such as health, education, social protection, transport, energy, and defense, in which private actors may play a role but in which a much larger share of goods and services are generally provided by the state and financed using public funding. For this reason, it is especially important that policies relating to the agriculture and food system as well as the public investments supporting those policies create a favorable environment for private actors.

An enabling environment for agribusiness, conducive to private investment and resource mobilization, depends on the presence of a sound macroeconomic framework, reliable policies, well-functioning institutions, adequate infrastructure, and an educated labor force. The legal and regulatory framework, in particular, has been found to be of primary importance, as it governs competition and fair practices in agricultural value chains. Clear and accessible laws and regulations contribute to creating a safe and reliable environment for agricultural market players and investors: domestic and international investors are equally likely to expect certain rules and conditions before deciding to invest in the sector.

An inadequate legal and regulatory framework can lead to the distortion of market efficiency, increasing costs for participants and stunting the development of the sector. Regulatory uncertainty, unpredictable policy regimes, and cumbersome regulatory processes have been found to create a risky environment and raise major barriers for farmers, traders, exporters, and other value chain actors, impacting their investment decisions and the success of agro-enterprises (Staatz, Dione, and Dembele 1989; Jayne, Mather, and Mghenyi 2010; Nyameino, Kagira, and Njukia 2003). Other than influencing the size and behavior of firms and the ease of their entry and exit into markets, the regulatory framework establishes rules of the game, such as secure property rights; when it is inefficient, it imposes an administrative burden on doing business. These factors in turn determine costs and risks for firms and affect their ability to innovate. In addition to consuming time and financial resources, moreover, burdensome regulations and procedures can shift economic activity into the informal realm and contribute to a culture of corruption.

Recognizing the fundamental importance of the enabling environment, the World Bank's Doing Business in Agriculture (DBA) program (until recently known as Enabling the Business of Agriculture, or EBA) collects and disseminates data on countries' legal and regulatory framework for agribusiness by measuring and monitoring key elements underpinning private sector–driven agriculture. In this way, the DBA provides indicators that can be used to benchmark the regulatory environment of different countries and to inform policy dialogue and reform. The topical and country coverage vary slightly from one year to the next.

The EBA/DBA reports shed light on regulatory strengths and weaknesses of individual countries, highlight good practices that can be emulated, and point to areas with room for improvement that might merit attention. Beyond the results at a country level, indicator scores and data provide insights on regional trends that can be used to compare LAC to other regions. The 2017 EBA report covered nine LAC countries among the 62 countries covered worldwide, whereas the 2019 DBA report provided scores for 13 LAC countries among a total of 101 countries around the world.

In the 2017 EBA report, which covered seed, fertilizer, machinery, water, finance, markets, transport, and information and communication technology, LAC ranks third across global regions for water

and markets, fourth for seed, fifth for fertilizer, and last for machinery. While scores vary between individual countries, overall the results point to areas in which the majority of LAC countries can make improvements in the agribusiness regulatory environment (**Figure 38**).

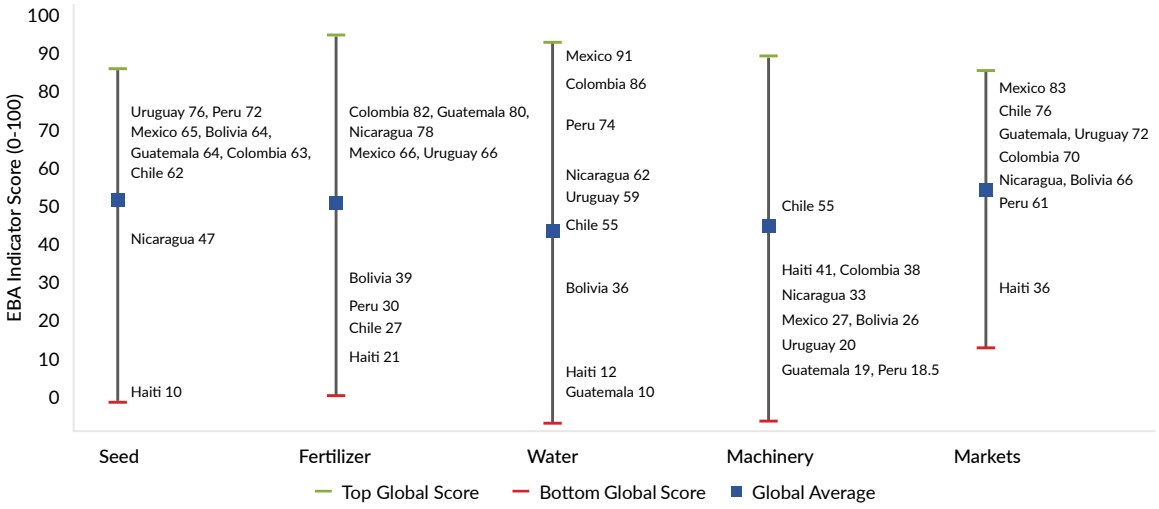


Figure 38.
Selected EBA scores for LAC countries, 2017

Source: World Bank 2019a.

In the 2019 EBA report, which publishes data on supplying seed, registering fertilizer, securing water, registering machinery, sustaining livestock, protecting plant health, trading food, and accessing finance, LAC displays overall strengths but also significant variation between countries. For instance, Colombia is in the first 30 percent of global performers on overall enabling environment in agriculture, with a strong regulation on finance, machinery, and plant protection. Uruguay, Brazil, and Peru are respectively the strongest performers worldwide on supplying seed, registering machinery, and accessing finance. Haiti, on the other hand, has major opportunities for improvement in most areas measured.

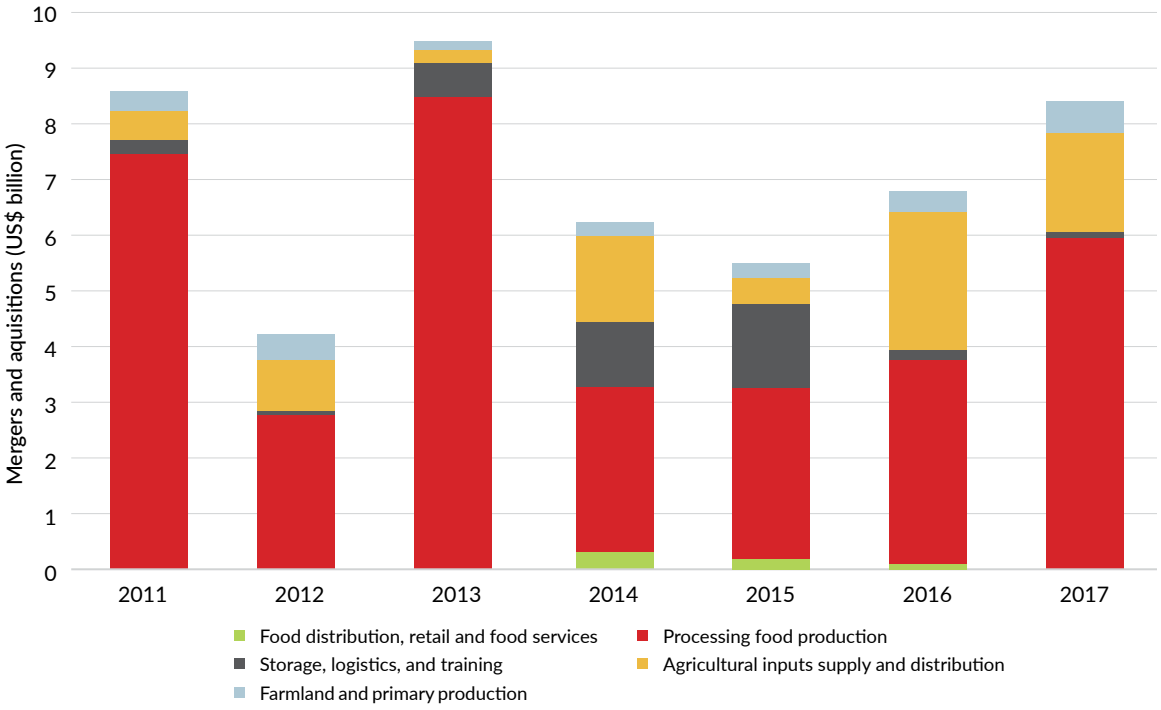
Crucially, laws and regulations influence the cost of production and determine the extent to which the private sector can benefit from investment and trade. In a region like LAC where agriculture and food systems are dominated by private actors, the effect of regulations on private entrepreneurship and investment is therefore particularly important to assess. Nevertheless, the total amount of private investment and the level of economic activity generated by that investment is surprisingly difficult to quantify. National income accounts data are often used to generate estimates of the agriculture share of GDP, and these estimates can be expanded through the addition of associated economic activity upstream and downstream in the value chain, but these approaches fail to capture an enormous amount of value, especially including the value of production factors that rarely pass through formal markets, such as privately held farm land and family labor.

As an indirect assessment of private investment in LAC agriculture and food systems, one can look at the level of interest in the sector as revealed by investment trends among institutional investors. In recent years, institutional investors have come to appreciate the features that make LAC fundamentally attractive for investors, including the increasingly favorable business climate. Rising interest among institutional investors has fueled a large number of merger and acquisition

(M&A) transactions in the LAC food and agribusiness sector (Valoral Associates 2018). Interest has been concentrated primarily in processing and food production, although agricultural inputs supply and distribution has also attracted considerable interest (Figure 39).

Figure 39. Food and agribusiness M&A transactions in South America by main sector

Source: Valoral Associates 2018.



Mergers and acquisitions in the food and agribusiness subsector in Latin American and Caribbean countries is being driven by both domestic and foreign investors (Valoral Assiciates 2018). Generally speaking, the industry is becoming increasingly internationalized, but the breakdown by segment reveals that foreign and domestic investors tend to have differing areas of focus (Figure 40). In the agricultural input supply and distribution segment, there is significant interest from foreign companies looking to expand their footprint in the region and to own local established brands and products. Domestic players, however, have fueled a wave of local consolidation as well. The storage, logistics, and trading segment features the highest number of foreign acquirers, including in recent years many Chinese and Japanese trading houses. In the processing and food production segment, the pattern is similar to the one seen in agricultural inputs, but at a much larger scale. Major subsectors involved include beef, poultry, pork, dairy, coffee, fruit juices, alcoholic beverages, and packaged foods. Finally, the food distribution, food retail, and food service segment remains predominantly a local play led by domestic companies.

These data on investment trends among institutional investors admittedly provide an incomplete picture—they show only the tip of a much larger iceberg that remains out of sight. Still, the rising interest in the food and agribusiness sector, coming from both domestic and foreign sources, provides evidence that the policy reforms enacted over the years, along with the supporting investments in

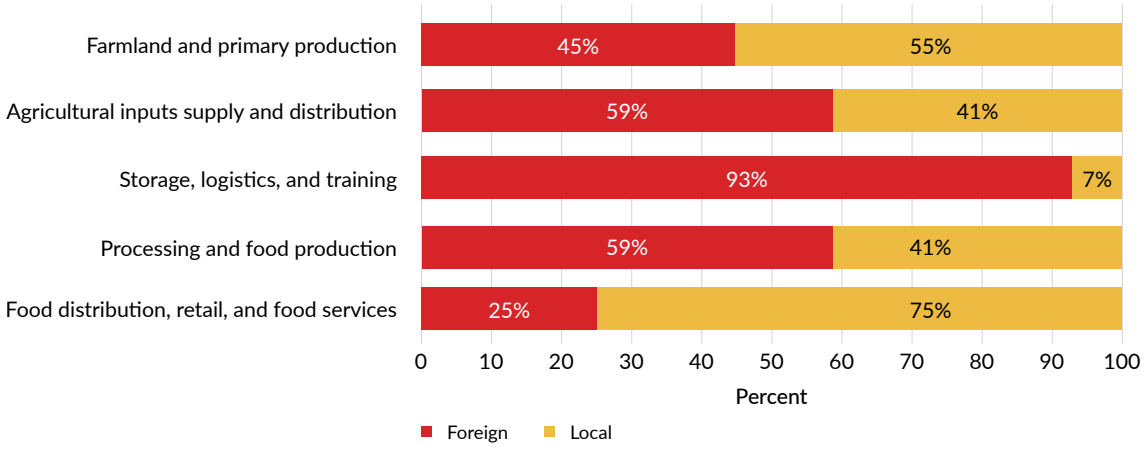


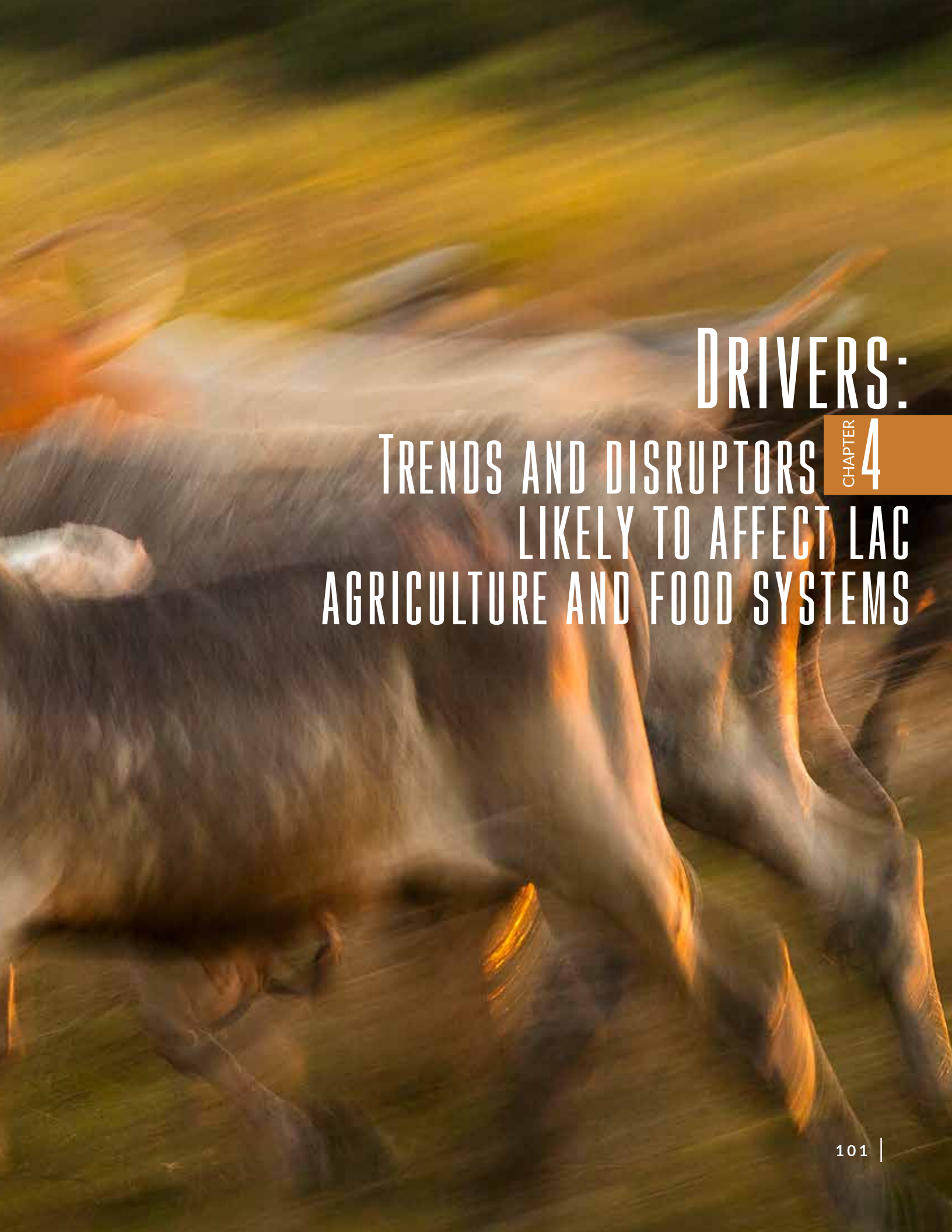
Figure 40. Breakdown of food and agribusiness M&A transactions in South America

Source: Valoral Associates 2018.

public goods and services, have been successful in removing many important obstacles to private investment and have cleared the way for much-needed resources to flow into the sector. But much change is still required. Even though policies in LAC have now become generally much less distortionary than in the past, regulatory and institutional reforms are still needed in many countries for agri-food systems to operate smoothly and provide a level playing field in which private initiative can flourish. This goal is ever more pressing to the extent that, in LAC as elsewhere, current levels of public investment in agriculture and food systems are insufficient to achieve key development goals, meaning that agribusiness will have to play an even greater role in advancing the larger agricultural development agenda.[23]

[21] Section 6.4 of this report discusses how the World Bank's Mobilizing Finance for Development (MFD) approach can be used to leverage private sector resources in pursuing the transformational opportunities offered by agriculture and food systems.

Samuel Betkowski



CHAPTER 4

Drivers: Trends and disruptors likely to affect LAC agriculture and food systems

KEY MESSAGES

- LAC agriculture and food systems will be influenced by many forces acting in different ways on multiple scales over a range of time frames. Based on multiple criteria, a set of drivers is identified that could be important in shaping the future of LAC agriculture and food systems.
- Drivers considered most likely to shape the trajectory of LAC agriculture and food systems include population growth, income growth, urbanization, changing tastes and preferences, productivity growth, emerging technologies, climate change, policies, and migration.
- Drivers include trends and disruptors. Trends are gradual, long-run forces with substantial inertia that are unlikely to change quickly, so their impacts on agriculture and food systems are relatively certain and predictable. Disruptors are shocks that can appear suddenly, without warning, and whose impacts on agriculture and food systems are difficult to predict. Some drivers do not fit neatly into one category or the other, but rather display characteristics of both.
- The COVID-19 pandemic illustrates the tremendous power of disruptors: the virus appeared unexpectedly and quickly posed supply- and demand-side threats to agri-food systems within LAC and worldwide, with effects that are likely to be enduring.

4.1 What could affect future LAC agriculture and food systems?

What actions are needed, today and in the years to come, to ensure that Latin American and Caribbean agriculture and food systems will be able to boost growth, create quality jobs, and enhance food and nutrition security within the region and worldwide while sustainably generating ecosystem services for the region and beyond?

Before addressing this central question, it is worthwhile to consider the forces that could shape future LAC agriculture and food systems, with the goal of identifying those that merit inclusion in a scenario building exercise. Like all complex systems, agriculture and food systems in LAC will be influenced by a large number of forces acting in many different ways on multiple scales over a wide range of time frames, and it would not be useful or even possible to consider all of them. Consistent with the central question articulated above, the decision was taken to focus on a set of forces with transformative potential—referred to here as drivers—having the following characteristics:

- **Time frame:** The influence of the driver will be felt on LAC agriculture and food systems by 2030. This time frame was chosen because it provides enough time for the driver to have significant impacts on agriculture and food systems, and the impacts are sufficiently close that they call for immediate or medium-run actions, including policy reforms and supporting investments.
- **Spatial coverage:** The influence of the driver on LAC agriculture and food systems will be felt throughout the region, or at least at the level of one or more of the four major geographically defined subregions (Mexico and Central America, the Caribbean states, the Andean Zone, and the Southern Cone). The reason for focusing on this degree of spatial coverage is to draw attention to drivers that are likely to call for collective responses by multiple governments.

Based on these criteria, a number of potential drivers were identified as likely to shape the performance of agriculture and food systems in LAC in the medium-long term. Next, an online survey in three languages was circulated to more than 20,000 stakeholders with an interest in agriculture and food systems in LAC, requesting that they rank the proposed drivers based on their perceived relevance in shaping the future of LAC agriculture and food systems (Figure 41).[24] More than 2,000 stakeholders responded, representing a wide range of public and private sector actors, civil society organizations, research institutions, and international organizations.

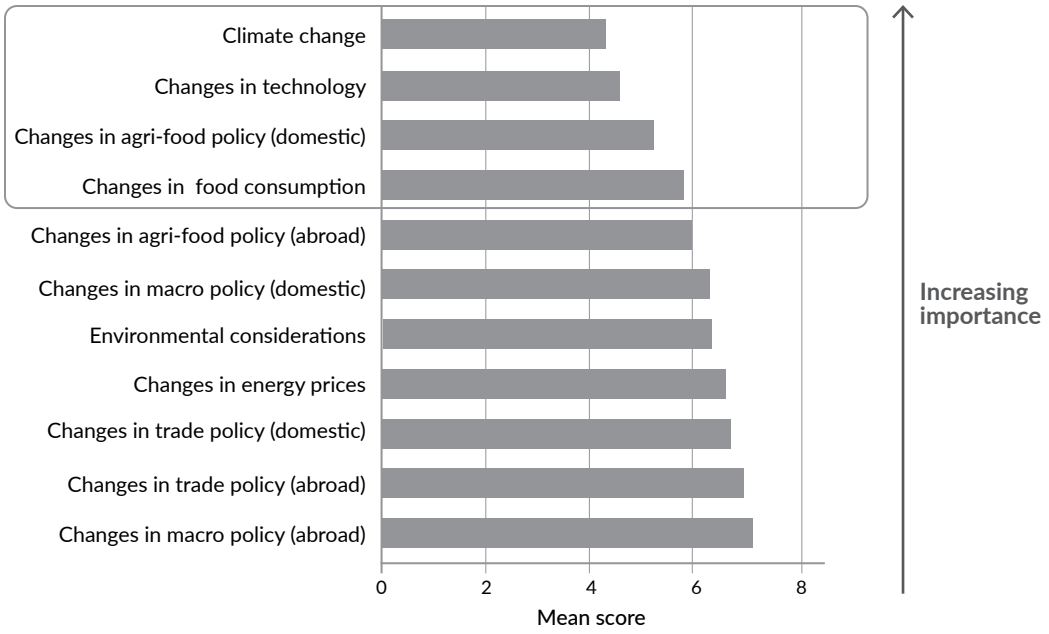
The drivers that respondents identified as top priorities for LAC agri-food systems are discussed in this section of the report. As will become apparent, the drivers can be classified into two general categories: (1) **trends**, and (2) **disruptors**. The key distinction between the two categories is the level of certainty associated with a given driver: whether it will occur, when it will occur, how quickly it will materialize, and what will be its impacts.

Trends are gradual, long-run forces that have a great deal of inertia and are unlikely to change quickly, so their impacts on agriculture and food systems are relatively certain and predictable. Trends are already having large impacts on LAC agriculture and food systems and will continue to do so for the foreseeable future. Because trends have a great deal of inertia, their future values through 2030 can be projected within a fairly narrow range with a relatively high level of confidence.

[24] The set of likely drivers was shared with the nearly 20,000 people included on the mailing list for *Agrimonitor*, published by the Inter-American Development Bank. Those listed were asked to rank the likely disruptors in order of perceived importance. Responses were received from around 10 percent of those contacted.

Figure 41. Selection of drivers from online stakeholder survey

Source: Authors' calculations, based on online survey results



Disruptors are forces that can appear suddenly, including without warning, and whose impacts on agriculture and food systems are difficult to predict. Because disruptors by definition are associated with a high degree of uncertainty, their identification involves a certain amount of subjectivity. For this report, a set of candidate disruptors was identified based on a review of the literature; this list was then validated through a survey of knowledgeable agriculture and food system actors. Because the disruptors are subject to sudden, unpredictable changes, their future values through 2030 cannot be projected with a relatively high level of confidence.

The distinction between trends and disruptors is to some extent blurred, because whether a driver is considered disruptive depends in part on the speed at which it materializes and the scale at which it produces its impacts. For example, introduction of a new crop variety targeted at a very small and specialized microenvironment may have a large and disruptive effect locally without having a measurable impact on yields measured at a national or regional level. Similarly, gradual changes in average temperatures and rainfall levels occurring over many years as a result of climate change will appear as trends, while the increased incidence of severe weather events and natural disasters linked to climate change will be disruptive. Consequently, some drivers do not fit neatly into one category or the other, but rather display characteristics of both.

4.2 Population growth

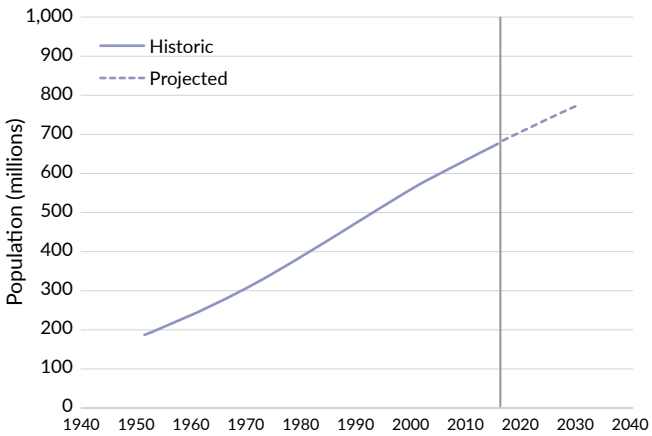
Population growth is a powerful long-term driver affecting the evolution of agriculture and food systems in Latin America and the Caribbean. Projections by the United Nations Department of Economic and Social Affairs (UNDESA) depict a future in which the region's population reaches almost 730 million by 2030, up from an estimated 653 million in 2018 (Figure 42a). Brazil and the Guyanas will continue to be the most populous subregion—home to almost 227 million people in

2030—but the speed with which the population in that subregion will grow is projected to slow significantly compared to other subregions (Figure 42b). While the populations in most of the other subregions are expected to grow by more than 10 percent between 2018 and 2030 (with Central America projected to record a staggering 20 percent growth rate during that period), the population of Brazil and the Guyanas will increase by a modest 7 percent, signaling the beginning of a demographic transition to a more mature population profile.

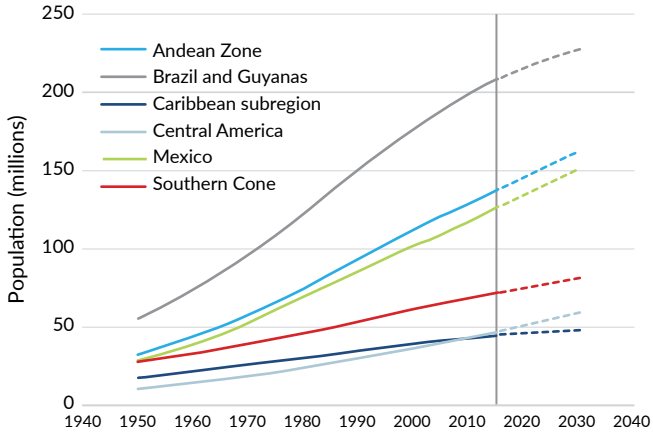
Figure 42. Projected population growth, Latin America and Caribbean Region, 1950-2030

Source: Authors' calculations, based on UNDESA Population Projections.

a. Latin America and Caribbean Region



b. Disaggregated by subregion



Population growth will place many new demands on LAC agriculture and food systems. Most obviously, larger quantities of food will have to be produced to feed the increased number of people. The additional amount of food that will be needed is not trivial. Even if per capita consumption levels were to remain unchanged (an unlikely scenario, for reasons that are discussed in the following sections), demand for food will increase about 22.5 percent by 2050.

As the population grows, changes in the demographic structure of the population will have additional implications. Age pyramids constructed for the Caribbean, Central America and Mexico, and South America in year 2015 and projected to 2030 indicate that throughout LAC, the population will grow older in the decades to come. These projected changes in demographic structure will bring new opportunities for the development of LAC agriculture and food systems, but they also bring challenges. More positively, as the population ages, the region will have an opportunity to exploit a demographic dividend: the boost in economic productivity that occurs when there are growing numbers of people in the workforce relative to the number of dependents. The region's working-age population will peak in the 2040s, with about 470 million potential workers (World Bank 2015). The extent to which the large labor force will translate into a boost for agriculture will depend, however, on the numbers and types of agricultural jobs that can be created, as well as on the ability of the labor force to perform those jobs.

On a less positive note, as the region's population continues to age, rising old-age dependency ratios (the number of those aged 65 and older, expressed as a share of the working-age population) will likely strain the economies of the region's countries. Elderly people are more vulnerable to both undernutrition and malnutrition, for reasons that may be biological (e.g., reduced ability to absorb nutrients, increased nutrient requirements), social (e.g., lack of income in old age to afford an adequate diet), or cultural (e.g., lack of nutritional knowledge) (WHO 2015). As their populations age, LAC countries consequently will be faced with the double burden of hunger and undernutrition on one hand and chronic diseases associated with malnutrition (e.g., obesity, diabetes, cancer) on the other. This will pose a challenge both for food systems and for the healthcare sector.

4.3 Urbanization

Urbanization is a second powerful driver affecting the evolution of agriculture and food systems in Latin America and the Caribbean. The population of LAC is not only growing; it is becoming more concentrated as increasing numbers of people leave the countryside and move to cities. Although definitions of urbanization can vary,[25] by any measure LAC is a highly urbanized region; indeed, standard classifications rank LAC as the world's most urbanized developing region (Table 5). Nearly four out of every five people in the region live in areas classified as urban; about 40 percent of these live in megacities exceeding one million people, while 60 percent live in smaller cities and towns. Recently, the region has witnessed the emergence of new urban expressions, where cities spill over their administrative boundaries and physically absorb other urban centres, giving rise to large urban territories, sometimes formalized in a single metropolitan area consisting of multiple municipalities with intense activity across all areas (UN-HABITAT 2012). Today, conurbations and big metropolitan areas are typical of many Latin American capitals and large cities such as Caracas, Fortaleza, Guayaquil, or Medellin, while an example of a megaregion is the urban corridor formed by the metropolitan areas of São Paulo, Campinas, and Baixada Santista in Brazil, home to 26 million inhabitants. Moreover, even single cities are physically expanding beyond what would be necessary to account for the growth in urban population, a phenomenon referred to as urban sprawl (UN-HABITAT 2012).

Table 5. Location of population, developing regions, 2016 (% of total)

Source: World Development Indicators, as cited in IFPRI, 2017.

Country	Urban population	Urban population in cities > 1 million	Urban population in cities < 1 million
Latin America & Caribbean	78.7	35.4	43.3
Middle East & North Africa	60.5	23.0	37.6
East Asia & Pacific	52.9	------	------
Sub-Saharan Africa	37.7	15.0	22.8
South Asia	33.0	14.5	18.6
High-income countries	81.1	------	------
World	53.9	22.0	31.8

[25] Government statistics on urbanization rely on national definitions of what constitutes an urban area, making comparisons across countries difficult. Using standardized measures consistent across countries, a recent World Bank report (Ferreyra and Roberts 2018) found that urbanization levels in LAC are very high by global standards (only the Middle East and North Africa appear to be more urbanized).

Urbanization in LAC is projected to continue; between 2018 and 2050, the urban population of the region will increase from 526 to 685 million, and by 2050 almost 88 percent of the total regional population will live in cities (United Nations, *World Urbanization Prospects* 2018). In many countries in Latin America, the area classified as "urban" is projected to expand by 10,000 to 50,000 square kilometers within the next 20 years (Figure 43). The trends in LAC are also occurring in other regions. Agriculture and food systems worldwide are being dramatically reshaped by the growth of cities. The Nature Conservancy (TNC 2018), describing the 2000s as the "urban century," estimates that by 2050 an area of 1.2 million square kilometers will be urbanized: this would be equivalent to building a new city with the population of London every seven weeks.

Figure 43. Urbanization level, LAC, 2015 and 2035

Source: WBG staff, using European Commission Joint Research Center's Global Human Settlement Layer, 2014.

Note: Based on EU population density definition.

As the region becomes increasingly urbanized, food systems will be called on to produce and deliver significantly larger quantities of food to growing urban populations. The scale of the challenge is sobering when one considers what food systems already deliver. For example, to serve the 21 million inhabitants of the greater Mexico City area, the Mexico City wholesale market already moves 11 million tons of food annually, equivalent to about six times all the maize produced in Ghana each year (Reardon 2016). By 2050, the Mexico City wholesale market will have to move nearly twice that much.

The growth in food demand from urban consumers will have strong implications for rural, peri-urban, and urban areas alike. To meet the increased demand, supply chains will have to penetrate further into rural areas, providing income opportunities for farmers, off-farm rural entrepreneurs, and the millions of rural wage earners working for them. In particular, as the midstream portions of food value chains (including processing, storage, wholesaling, and logistics) can contribute enormously to an increase in food produced, processed and distributed, large numbers of small- and medium-sized enterprises (SMEs) are now investing in trucking, wholesaling, warehousing, cold storage, first- and second-stage processing, local fast food, and retail trade (Reardon et al. 2014).

Urbanization will also change the look of the food system. As in other developing regions, LAC's urban food retail sector has undergone a "supermarket revolution": over the 1990s decade, the share of modern retail in total food retail went from roughly 5–10 to 50–60 percent in South America and to 20–50 percent in Mexico and Central America (Reardon 2016).[26] Large-scale retail and processing firms in the region are modernizing their marketing and procurement systems to cut costs and increase efficiency, as well as to improve quality, food safety, and phytosanitary standards. Relatedly, another recent trend among food industry firms is the consolidation of small businesses into larger ones, with the vertical integration of agribusiness firms and the consequent "dis-intermediation" of food systems (Berdegué and Proctor 2014). These developments in agri-food chains offer clear benefits to consumers, such as lower prices and improved food safety. A less desirable side effect, however, could be reduced market participation by smallholder producers and small-scale agro-processors; because they often have less capital and tend to be predominantly informal and unregulated, these actors may have difficulty meeting more rigorous food safety standards, as well as ensuring the quantity and frequency of product delivery demanded by large retailers in urban areas. To the extent that smallholders become crowded out of the market, this would have negative implications for farmers' livelihoods (FAO 2017a).

A significant challenge with urban food systems will be to ensure that nutritious, safe, sustainable food is available for *all* urban consumers, including the many urban poor. The LAC region features a high prevalence of urban slums, which account for around 25 percent of the regional population: even though this share represents an improvement over the last twenty years, the total number of people living in slums has actually increased over time, reaching 111 million in 2012 (UN-HABITAT 2012). Despite a high heterogeneity of experiences across the region (the urban population living

[26] Larger urban centers of higher-income countries in the region witnessed the "first wave" of the diffusion of supermarkets and the resultant transformation of their food system (FAO 2006), which began with processed foods and food staples (including canned, bottled, and dry packaged items such as rice, noodles, edible oils, and other food staples) to gradually include semiprocessed foods requiring extensive or minimal processing (such as dairy products) and minimal processing and packaging (such as poultry, pork, beef, and fruit). Currently, the biggest challenge for supermarkets is including fresh fruits and vegetables, especially leafy ones (Reardon, Henson, and Berdegué 2007).

in slums varies from 5 percent in Suriname to 70 percent in Haiti, according to UN-HABITAT estimates), these settlements are often totally or partially deprived of basic services and adequate access to food and are particularly vulnerable to environmental threats. Some cities in the region are devising programs to cater to the food needs of the urban poor. Belo Horizonte in Brazil and Mexico City, for example, have successfully implemented innovative rights-based programs and policies, which include direct farmer-to-consumer fresh produce sales at set low prices in poor neighborhoods and municipal markets, community dining rooms where nutritious meals prepared with locally sourced food are sold at subsidized prices, nutrition education, locally grown foods for school lunches, community gardens, and the dissemination of food price information (Tefft et al. 2017).

Box 12. Urban and peri-urban agriculture

Urban and peri-urban agriculture (UPA) is the practice of cultivating food and raising livestock within or in proximity to urban areas. Urban agriculture accounts for 15 percent of total agricultural land worldwide, a figure that extends to 40 percent of all cropland when considering peri-urban production areas within 20 kilometers of cities.

UPA systems can be characterized in multiple ways (Figure 44). UPA activities can range from household production in backyards, on rooftops, and in community plots to indoor commercial production in spaces as small as shipping containers or as large as warehouse facilities covering several hectares or more. Technological innovations have allowed UPA to evolve rapidly in response to increasing competition for resources, resulting in intensification that has addressed constraints related to the scarcity and the high cost of land and water in particular. In many cities around the world, vertical farms located in former factory buildings or skyscrapers now grow herbs, microgreens, and even vegetables, with the plants suspended in the spaces and sustained with LED lighting and hydroponics.

Location
Urban ot peri-urban, rooftop, balcony, underground, vacant plots, in buildings

System technology
Hydroponics, aeroponics, aquaponics, vertical

Growing space
Outdoor or indoor

Growing container
Shopping container, burlap bag, plastic bottles, reusable cloth, ground

Growing medium
Soil, soiless, pallets, gel-based

Water source
Rain-fed, irrigated, mist

Light source
Natural or artificial, LED, reflectors

Input use
Compost, fertilizer, pesticide, nutrient solution

Type of products
Type of crops grown or animal raised

Ownership
Individual, family, community, business

Scale of operation
Self-consumption, family business, big commercial production

Degree of environmental control
High, low

Figure 44.
Features of urban and peri-urban agriculture

Source: Authors.

>

Box 12. Urban and peri-urban agriculture (cont.)

Urban and peri-urban agriculture has a potentially important role to play in fulfilling many of the key outcomes expected of agriculture. In low- and middle-income countries, UPA systems produce a substantial amount of the food consumed in cities, especially by the urban poor, and in many parts of the world they help slum dwellers improve their food and nutrition security. An example is Kibera slum in Nairobi, Kenya, where farmers, with support from an initiative of the Kenyan Ministry of Agriculture, grow kale, spinach, onions, and other vegetables in "sack gardens." As well as providing the urban poor with nutritious food and extra income, UPA can help cities reduce their ecological footprint, contain urban sprawl, build resilience to climate change, and implement circular economy principles through the recycling of urban wastes.

UPA is widespread in the LAC region (Table 6). Peri-urban agriculture includes large farming areas that produce cereals, vegetables, and root crops; grazing land for goats and sheep; dairy farms; and intensive livestock production units. Urban agriculture, on the other hand, involves activities ranging from backyard horticulture to school gardening to intensive production of flowers and the raising of small animals for eggs and meat. Family gardens produce eggplant and okra in Antigua and Barbuda, carrots and coriander in Tegucigalpa, broccoli and quinoa in Quito, and spinach and strawberries on Bolivia's altiplano. In Bolivian cities, families also raise guinea pigs, which fit easily into small spaces and are a good source of protein. In Mexico City suburbs, residents keep rabbits, birds, and sheep, while in Kingston youths breed ornamental tropical fish for export to North America.

Table 6. Urban and peri-urban agriculture in LAC: Selected examples

Source: FAO, 2014b; Reardon, 2016; Tefft et al., 2017.

Country	UPA experience
Bolivia	50,000 families are food producers in the main cities and municipalities
Colombia	8,500 households produce food for home consumption in Bogotá
Cuba	40% of households practice UPA in La Habana, 90,000 residents are engaged in some form of agriculture
Ecuador	140 community gardens, 800 family gardens, and 128 school gardens in Quito
Guatemala	20% of households practice UPA
Haiti	260 ha of land in and around Port-au-Prince and other towns are cultivated by 25,500 families
Mexico	22,800 ha of farmland within the bounds of Mexico City produce annually 15,000 tons of vegetables
Peru	On the outskirts of Lima, short-cycle vegetables are grown on 5,000 ha of irrigated land for sale in the city
St. Lucia	20% of households practice UPA

4.4 Migration

Migration—both internal and external—is a third powerful driver affecting the evolution of agriculture and food systems in LAC. Every year, tens of thousands of people in LAC relocate, moving elsewhere within the same country or to another country. The decision to migrate can be driven by many factors, including both "push factors" (for example, deteriorating local economic conditions, disappearing jobs, increasingly precarious livelihoods resulting from environmental degradation or climate change, or rising crime and violence) and "pull factors" (for example, the prospect of a better life elsewhere).

In the past, the main forces driving internal migration in LAC were the economic and political changes that accompanied the transition to more open-market economic systems (Rodríguez-Vignoli and Rowe 2018). Internal migration involved mainly movements of people from rural to urban areas. This pattern was consistent with accepted macroeconomic theory. One of the most pervasive features of structural transformation and economic growth is the movement of people out of rural areas and the accompanying occupational shift out of farm labor (Charlton and Taylor 2016). To incentivize rural workers to supply labor for farm jobs, agricultural wages need to keep up with nonagricultural wages both in rural areas and urban areas. This is especially the case when implicit nonmonetary benefits are higher off farm, where physical labor demands are lower.

More recently, the historical pattern of internal migration has changed, and the significance of rural-to-urban migration as a source of population growth in urban areas has diminished in most LAC countries.[27] Today, two novel characteristics of internal migration stand out. First, rural-to-urban migration is not mainly to capital cities but to small and intermediate urban areas. Second, the main source of migration to urban areas is not rural-to-urban migration, but rather urban-to-urban migration. In terms of composition, most migrants are young, and selective migration of males and more educated individuals can be observed, generating an overrepresentation of these populations in the migration system (Murillo 2014).

Against this backdrop, rural labor markets in LAC are being reshaped. For example, as a result of rural-to-urban migration, women play an increasingly important role in agriculture. Women's agricultural wage employment has risen, particularly in activities linked to nontraditional exports, such as production and packaging of fresh vegetables, fruits, and flowers (Deere 2005). In many LAC countries, women and children make up more than one-half of the on-farm labor used to produce and process these crops, and there is evidence of increased feminization of smallholder production (Deere 2005). Similarly, young people are more likely to migrate out of rural areas, leaving behind an ageing and less skilled on-farm labor supply (Cazzuffi and Fernández 2018).

Distinct from internal migration is external migration: relocation to a neighboring country within the subregion or to a more distant country. In 2017, out of 258 million international migrants worldwide, roughly 38 million (14.7 percent) were from the LAC region, representing the third largest stock of migrants from a regional perspective (United Nations 2018). Mexico was the second largest country of origin of international migrants, accounting for 13 million of migrants. A large share of these

[27] Bolivia experienced the most significant reduction in the share of rural-to-urban migration to urban population growth, from 64 percent in 1980–1990 to 29 percent in 1990–2000; Mexico displayed the smallest drop, from 33 to 32 percent (Rodriquez Vignoli 2008; Bernard et al., 2017).

migrants are Mexicans providing agriculture labor to the United States. Interestingly, at the same time that Mexicans have been migrating to the United States in search of work, people in rural areas of Mexico are transitioning out of agriculture, with the result that the supply of farm labor has been declining by 150,000 workers per year (Charlton and Taylor 2016). This has resulted in heightened competition between the United States and Mexico for a diminishing supply of agricultural workers, driving up the cost of labor in two of the region's biggest agricultural producers.

Migration out of Central America has occurred in waves since the 1960s. While attention has recently focused on the large number of Central Americans seeking to gain entry into the United States, large numbers of Central Americans also have ended up settling in other Central American countries. Much of this migration has been driven by the increasing insecurity in many Central American countries, but another important factor has been the increased frequency of droughts, floods, hurricanes, and windstorms. LAC has not only experienced intense environmental problems, it is also a region in which a large proportion of the population continues to depend on livelihoods based on natural resources, particularly agriculture (Reuveny 2007). The large amount of "climate migration" in LAC has major consequences for the availability of labor, particularly labor employed in agriculture, adversely impacting agricultural productivity and slowing agricultural growth.

While many instances of migration constitute longer-term trends, some migration episodes can be viewed more as disruptors due to their suddenness, magnitude, and unpredictable outcomes. A case in point is the exodus of people from Venezuela precipitated by recent economic and political events in the country. According to the International Organization for Migration and the United Nations High Commission on Refugees, by December 2019, 4.77 million Venezuelans were living outside Venezuela, of whom around 3.9 million were located across the LAC region (Coordination Platform for Refugees and Migrants from Venezuela 2019). This unprecedented level of migration in the region is especially affecting Colombia, Ecuador, and Peru: in particular, Colombia has been reported to be facing one of the biggest international migration flows of the current century (Bahar, Dooley, and Huang 2018). Clearly, such inflows of people could have implications for agriculture and food systems by exerting pressure through demand for food in areas with high concentrations of migrants, creating a need for well-designed food social safety nets and food distribution systems to prevent food insecurity, food price fluctuations, and health and nutrition problems.

4.5 Income growth

Income growth is a fourth powerful driver affecting the evolution of agriculture and food systems in LAC. Over time, the region's population has not only been increasing in size and becoming more concentrated in urban areas, it has also been growing more prosperous. In 2017, PwC projected that annual global economic growth, then averaging around 3.5 percent per year, will slow to 2.7 percent from 2021–2030, 2.5 percent from 2031–2040, and 2.4 percent from 2041–2050. The slowdown is expected to occur as many maturing economies in high-income countries experience a decline in their working-age populations. Meanwhile, growth in emerging markets is projected to plateau as these economies mature. The IMF World Economic Outlook of October 2018 estimated that GDP per capita at constant prices in 2023 will be around US$16,000 for South America, up from US$14,000 in 2017, while for Mexico and Central America, and the Caribbean GDP per capita will rise from US$11,000 and US$17,000 in 2017 to US$13,000 and US$18,000 in 2023, respectively.

Longstanding projections of income growth prospects have had to be revisited following the emergence of the COVID-19 crisis, which represented a clear shock to the global economy. In LAC, the Economic Commission for Latin America and the Caribbean (ECLAC, 2020) is projecting GDP to fall by more than 5 percent due in the first few months of 2020; the decline is expected to be more pronounced in South America, and less pronounced in Central America and the Caribbean subregion. The slowdown is expected to be accompanied by a sharp increase in unemployment and a rise in poverty: by the end of 2020, the unemployment rate in LAC is expected to rise by more than 8 percent compared to a year earlier, pushing 29 million more people into poverty, and 16 million more people into extreme poverty.

These developments have profound implications for LAC agriculture and food systems, because changes in incomes—positive and negative—drive changes in food consumption patterns and affect nutritional outcomes. Incomes and nutrition are intimately related. Higher incomes are associated with less undernutrition and lower micronutrient deficiency rates. As incomes rise, not only do fewer people suffer from the challenges of undernutrition and hunger, but more people have access to better-quality food and more diversified diets. Worldwide, there is a strong positive correlation between a country's GDP per capita and the prevalence of two measures of children's nutritional quality: minimum dietary diversity (MDD)[28] and minimum acceptable diet (MAD) (Figure 45). Given the relationship between income and nutrition, the economic contraction sparked by COVID-19 will certainly result in declines in nutritional status.

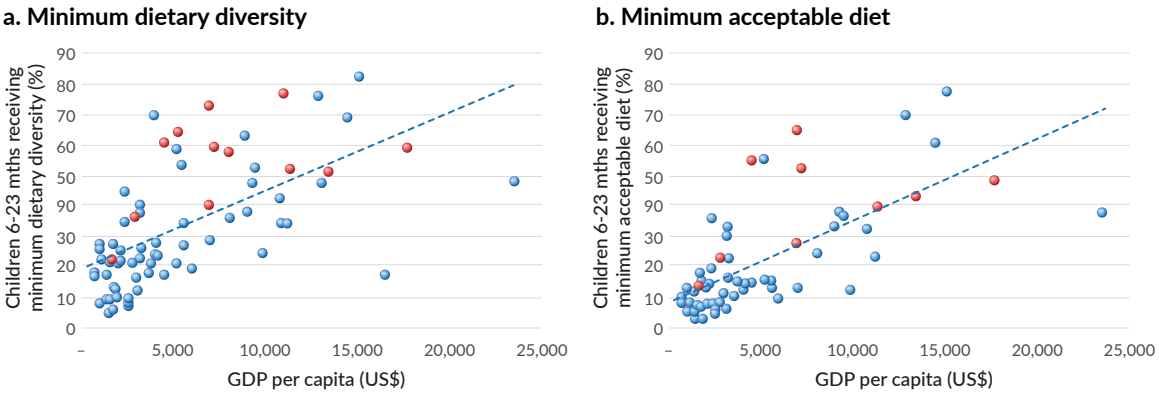


Figure 45. Dietary quantity and quality among children, LAC vs. world

Source: Authors' calculations, based on IMF (2018) and Unicef (2018).

Note: LAC countries are identified by red dots in the charts.

Whether or not the projected economic impacts of the pandemic are borne out, the income trends of the past few decades had already affected the outlook for agriculture and food systems in LAC. Whenever incomes rise, food consumption patterns change in a predictable way. The changes in diets associated with growth, which are often accompanied by changes in patterns of work and leisure, are referred to as the "nutrition transition." Low incomes are associated with carbohydrates as the main source of nutritional energy, a small contribution of fats and a negligible contribution

[28] A child is considered to have MDD when receiving foods from at least five out of eight food groups during the previous day. MAD is when a breastfed child had at least the minimum dietary diversity and the minimum meal frequency during the previous day or when a non-breastfed child received at least two milk feedings and had at least the minimum dietary diversity (not including milk feeds) and the minimum meal frequency during the previous day. Minimum meal frequency is two times solid, semisolid, or soft foods for breastfed infants 6 to 8 months of age; three times solid, semisolid, or soft foods for breastfed children 9 to 23 months of age; and four times solid, semisolid, or soft foods and/or milk feeds for non-breastfed children 6 to 23 months of age.

of meat and dairy. With higher incomes, countries start deriving nutritional energy mainly from carbohydrates and fat, and seeing a more substantial contribution of meat and dairy. Years of slow but steady growth in LAC have enabled the start of a nutrition transition. In contrast to the experience in Europe, where the nutrition transition happened gradually, enabling agriculture and trade to keep pace with demand growth, in LAC the nutrition transition had been happening much more rapidly, leading to changes in food demand that could exert significant pressure on natural resources.

The dietary changes associated with the nutrition transition typically include shifts in the structure of the diet towards higher energy density, a greater role for fat and added sugars in foods, greater saturated fat intake (mostly from animal sources), reduced intakes of complex carbohydrates and dietary fiber, and reduced intake of fruit and vegetables. These changes can have negative impacts on health, especially when they are combined with the reductions in physical activity that frequently accompany income growth (this is discussed in Section 4.5 below).

The dietary changes associated with the nutrition transition will continue to have important effects on LAC agriculture and food systems by altering the demand for different types of food. It is important to keep in mind that these changes in demand are originating not only within LAC countries but also in other regions that import food from LAC. An obvious example has been the dramatic growth in meat imports into China from the three largest meat exporters in South America (Argentina, Brazil, and Uruguay), which has been driven in large part by rising incomes in China (Figure 46).

After LAC economies recover from the impacts of the COVID-19 pandemic, dietary changes associated with income growth will resume impacting LAC agriculture and food systems in two main ways. First, increased demand for products such as fruits, vegetables, meat, eggs, and milk, production of which can generate increased employment while delivering attractive returns, will create opportunities for farmers to diversify production and participate in more lucrative value chains (Serraj, Krishnan, and Pingali 2019). Second, in a steadily globalizing economy, agriculture and food systems in LAC countries will face increasing pressure to produce competitively, regardless of whether they are targeting domestic markets or export markets. This will require increased investment on multiple fronts, including in innovation, agri-logistics, information systems, infrastructure, and market coordination mechanisms, among others.

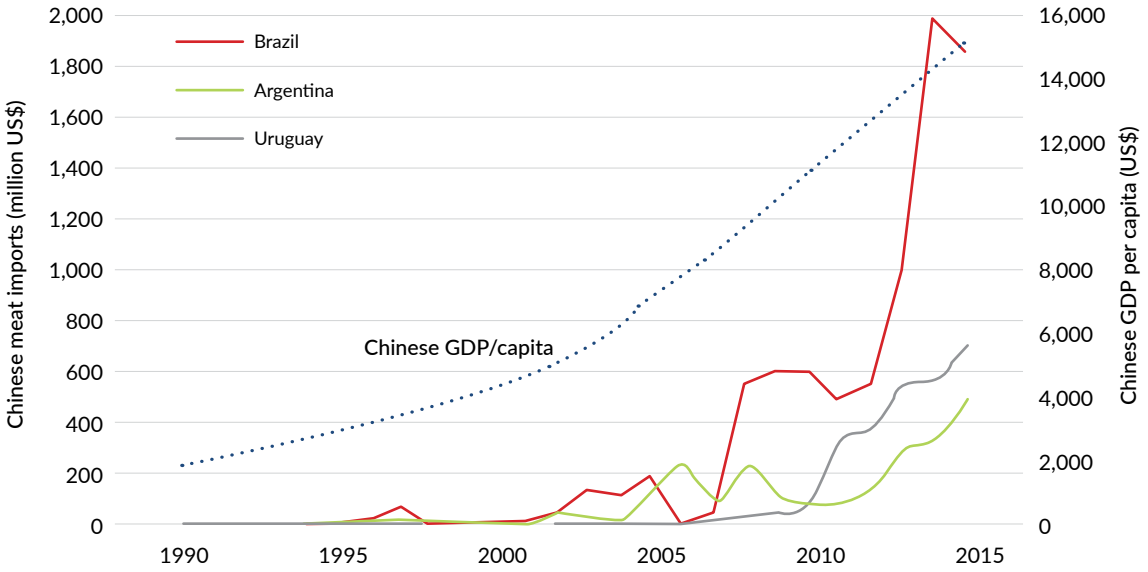


Figure 46. Growth in Chinese meat imports from LAC countries

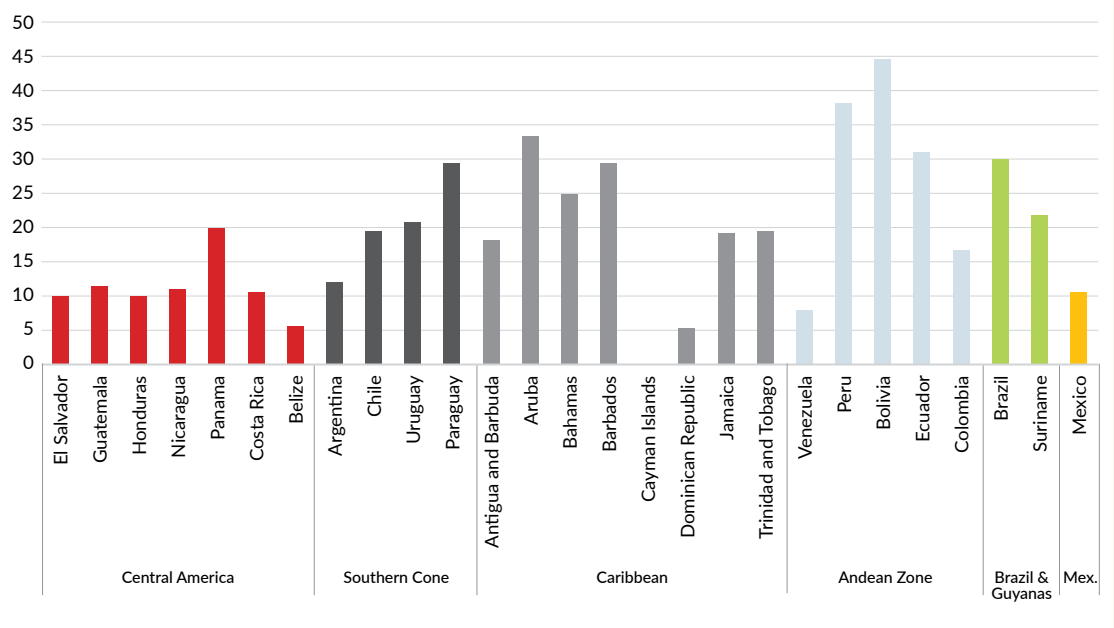
Source: Authors' calculations, based on IMF (2018) and UN ComTrade (2018).

Box 13. Women in LAC agriculture: Opportunities and challenges

In the face of population growth, LAC governments will be challenged to ensure that the fruits of development are distributed equitably. Across the entire LAC region, the gender composition of the overall population will remain relatively stable over time, but this stability will mask significant changes that are projected to affect the future evolution of agriculture and food systems. Crucially, a number of countries in the region, especially in the Caribbean region and in South America, are witnessing a gradual increase in the role played by women in agriculture, often because men are migrating in disproportional numbers to urban areas in search of employment. In Aruba, Barbados, Brazil, Ecuador, and Paraguay, women currently make up around 30 percent of the agricultural labor force, and in Bolivia and Peru the share approaches or exceeds 40 percent (Figure 47).

Figure 47. Women's share of agricultural employment, by country

Source: Authors' calculations, based on FAOSTAT data, years 2005–2014.



Note: Latest available year was used for each country.

If this trend continues, important new opportunities could open up for rural women, which in turn could translate into increased participation in the labor force, a more active role in decision making, better compensation, increased asset ownership, and social and political empowerment (FAO 2017b). At the same time, rural women in LAC have traditionally faced obstacles that have made it more difficult for them to own land, use machinery, acquire credit, and access markets for inputs and outputs, so these obstacles will have to be overcome. Gender differences tend to be especially pronounced when it comes to commercial agriculture: in many countries, women are less likely to work on commercial crops, or they get crowded out of traditionally female-intensive crops when these become more lucrative. Women engaged in agriculture also frequently suffer unequal treatment in the form of biased service delivery, for example, when the existing market structure sees women underrepresented in nonfood crops that are more often targeted by extension services, or when rural extension agents, who ostensibly are helping women, perpetuate traditional gender roles by focusing predominantly on household chores rather than productive activities. Absent significant policy and cultural changes that can serve to narrow these gender gaps, an increasing feminization of agriculture risks exacerbating the vulnerability of rural women and women-headed households if they remain trapped in low-productivity, subsistence-oriented agriculture.

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Box 13. Women in LAC agriculture: Opportunities and challenges (cont.)

Other than mattering in its own right, gender equality in agriculture is going to be crucial for development and poverty reduction (World Bank 2009, 2012). In agriculture and entrepreneurship, gender disparities in access to inputs (including land and credit) and in asset ownership have been found to be at the root of substantial gender productivity gaps (World Bank 2012). Equalizing access to productive resources between female and male farmers has been estimated to increase yields on women-run farms worldwide by 20 to 30 percent, which has the potential to raise total agricultural output in developing countries by between 2.5 and 4 percent (FAO 2011). Moreover, improving women's status has positive effects on many other development outcomes, including child nutrition and education. For these reasons, policies and programs that target women farmers, for example, by enabling them to serve as direct suppliers to modern food markets, have the potential to bring about transformative changes in LAC development.

4.6 Changing tastes and dietary preferences

Changing tastes and dietary preferences are a fifth powerful driver affecting the evolution of agriculture and food systems in Latin America and the Caribbean. Growing populations, rising incomes, and higher urbanization rates, in addition to affecting agri-food systems directly, will also drive significant changes in dietary choices and food consumption through their multi-faceted influence on consumer preferences and lifestyles. The nature and direction of the impact, however, are difficult to project and will depend on the interaction of various factors, among which public policies will play a nonnegligible role.

Income growth contributes to hunger reduction and dietary diversity and enables increased consumption of healthy food, such as fruits and vegetables, but it also enables excessive calorie intake, over-consumption of ultra-processed foods high in sugars, salt, and fats (Foresight Report 2016), and greater demand for meat, fish, and dairy products and other more resource-intensive foods (FAO 2017a). Income growth is also associated with the rise of a more aspirational middle class, whose dietary patterns may also be driven by motives related to health and/or social and ethical values (Tefft et al. 2017). Examples are concerns about animal welfare and health, the environmental footprint of food production, or food loss and waste, which result in a stronger request for organic and sustainable production and product traceability as well as lower demand for animal-source foods (ASF).

Changing consumer preferences will likely increase the need for LAC food systems to produce healthy, safe, and high-quality food products that satisfy adequate standards in terms of carbon footprint, energy use, impact on biodiversity, and fair-trade approaches (Díaz-Bonilla et al. 2014). This, in turn, is likely to influence the direction of future investment in agricultural R&D activities. What is arguably more difficult to predict are future patterns of meat consumption and their implications for the many economies in Latin America and the Caribbean that are major exporters of animal feed and livestock products. If as global incomes rise meat consumption levels converge toward those of today's richer countries, the spread of concerns about the environmental footprint of cattle raising and the health consequences of (especially red) meat consumption could produce an increase in vegetarian or flexitarian habits, thereby reducing global demand.[29]

[29] A "flexitarian" diet is a plant-based diet in which meat is typically eaten less than once a week (see IPCC 2018b).

Changes in consumer preferences associated with sustained urbanization also are likely to affect agri-food systems in the LAC region. The expansion of supermarkets improves year-round access to fresh foods and commercially fortified foods, leading to increased consumption of these food groups. At the same time, the greater availability of highly processed (and highly promoted) foods on supermarket shelves is also contributing to steer LAC diets towards fat, sugar, and salt. In parallel, the fact that more people work outside the home and, in many cases, have less home space to cook increases the popularity of food consumed away from home (FAFH) (Foresight Report 2016).[30] In Brazil and Peru, the share of household food expenditures on food consumed away from home is 31 and 28 percent, respectively, significantly higher than the 21 percent spent on similar consumption in China (Tefft et al. 2017). Growth in FAFH can provide significant employment opportunities in the restaurant, catering, and retail sector, but it also tends to translate into more frequent meals and snacking and a higher demand for packaged, processed, ultra-processed, and fried food. As a result, diets (especially those of the urban poor) risk being deficient in terms of calories, diversity, and nutrients.

Urban dwellers are typically more exposed to food marketing and advertising, which have a powerful influence over norms and preferences. To date, food promotion has been mostly directed towards cheaper, bigger, and tastier calorie-dense food and has been often pursued through sophisticated consumer-influencing practices such as brand association, portion size, and the shape of packages and serving containers (Chandon and Wansink 2012). Children in Latin America, similar to children in other highly urbanized regions of the world, are exposed to aggressive marketing of sugar-sweetened beverages, desserts, savory snacks, and other packaged foods high in sugars, salt, and fats. Data needed to make cross-country comparisons are scarce, but recent studies show, for example, that Argentinean children are exposed to 61 commercials for foods high in salt, sugars, and fats every week (Allemandi et al. 2018), and similar child-directed strategies have been found in Chile, Guatemala, and Uruguay (see, respectively, Mediano Stoltze et al. 2018; Perry, Chacon, and Barnoya 2018; Giménez et al. 2017).

Eating habits in LAC, already bad, are only getting worse. The highest levels of per capita consumption of sugar-sweetened beverages in the world are concentrated in LAC countries at middle-income levels (Masters 2016). Sales of ultra-processed food and drink products in the LAC region grew by 48 percent between 2000 and 2013, and the number of fast-food per capita purchases increased by 39 percent (Euromonitor Passport Database 2014). At the country level, the fastest rates of growth in sales of ultra-processed products occurred in Peru (107 percent), Bolivia (129.8 percent), and Uruguay (146.4 percent), whereas the fastest increase in fast food purchases was experienced in Peru and Bolivia (265 and 275 percent, respectively). Argentina, on the other hand, displayed a negative evolution of both indicators (by, respectively, 4 and 21 percent), but this seems to have been mostly due to the impact of the 2002–2003 economic crisis (PAHO 2015).

Because these changes in eating habits are combined in many instances with reduced physical activity (especially in urban areas), the nutrition transition in LAC is projected to bring an increase in the incidence of overweight, obesity, and nutrition-related noncommunicable diseases. The Pan American Health Organisation reports a positive association between sales per capita of ultra-processed products and adult obesity shares in a sample of 14 American countries, as well as a

[30] Food away from home (FAFH) refers to prepared food and beverages purchased for consumption outside the home (Tefft et al. 2017).

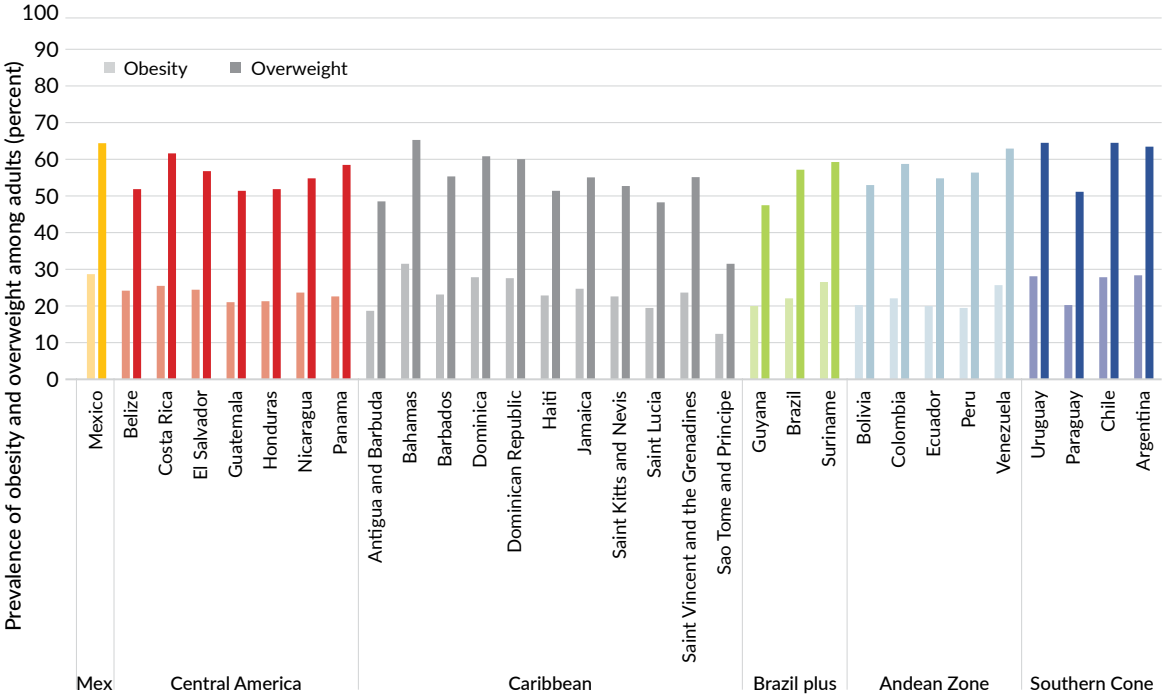


Figure 48. Overweight and obesity among adults, LAC, 2016

Source: Authors' calculations, based on WHO Global Health Observatory data.

strong, positive and significant correlation between changes in sales of ultra-processed products and changes in body mass in 12 Latin American countries (PAHO 2015). The negative impacts of unhealthy diets are proliferating rapidly. In 2000, the prevalence of obesity in the adult population was well below 20 percent for most countries in the region (with the exception of the Bahamas, Mexico, and countries in the Southern Cone excluding Chile), but by 2016 almost all countries exceeded that threshold, with shares even closer to 30 percent in Mexico, much of the Caribbean, and South America (Figure 48).

The link of obesity to diabetes, hypertension, and heart disease has led some LAC countries to to introduce mandatory or voluntary guidelines on front-of-pack nutrition labelling alongside the basic nutrient declaration. In Chile, Peru, and Uruguay, foods high in sugars, salt, fats and/or calories must carry a front-of-pack warning label, while Ecuador has adopted traffic light-style labels, which provide an indicator on the amount of sugar, fat, and salt in foods. Chile, Ecuador, Mexico, and Peru have also adopted tax designs with higher rates on beverages with greater sugar content per unit volume, to induce both production and consumption of lower-sugar options. Chile, moreover, has implemented mandatory restrictions on marketing food to children (Development Initiatives 2018).

4.7 Productivity growth

Productivity growth is a sixth driver affecting the evolution of agriculture and food systems in LAC. In the coming years, significant growth in agricultural production will be necessary to meet the increasing food demands of a larger, richer, older, and more urbanized population at the regional and global level. As environmental concerns spread and the scope for further increasing agricultural use of resources such as land and water narrows, steady increases in agricultural productivity will become ever more key to output growth.

In recent decades, productivity growth in LAC agriculture has been impressive by global standards. A widely used measure of productivity is total factor productivity (TFP), which is computed as the total value of crop and livestock outputs per unit value of inputs (land, labor, capital, and material resources) used in agriculture. Simply put, if total output grows faster than total input use, then productivity is improving, as fewer inputs are needed to produce each unit of output (Fuglie and Rada 2017). Over the past 35 years, the average annual TFP growth rate in LAC has almost quadrupled, rising from 0.5 percent in 1981–1990 (Nin-Pratt et al. 2015) to 1.92 percent in 2001–2015 (Fuglie et al. 2019). The productivity growth registered in Latin America and the Caribbean has been the fastest among all developing regions (Ludeña 2010) and has allowed countries in LAC to significantly narrow the productivity gap with OECD countries from 67 to 80 percent of TFP levels between 1980 and 2012 (Nin-Pratt et al. 2015).

TFP growth comes from two major sources: (i) efficiency gains, and (ii) technical change. Efficiency gains are reflected as increased output produced using any combination of inputs from a given technology. Technical change is an upgrade in technology enabling production of more output than was previously attainable, regardless of how efficiently the input mix was used. In the simplified two-input space in Figure 49, every point represents a combination of output per worker and output per unit of land, so that any move north or east of any given point represents an increase in, respectively, land or labor productivity given the available agricultural land and labor force. The blue curve in the figure is the technology frontier, which marks the boundary to how much productivity can be raised given existing technology and best practices. Efficiency is a move from point A below the technology frontier to point B on the frontier, whereas technology change is an outward shift of the technology curve itself to the dashed red curve, which allows the higher production levels represented by any point in the shaded area. Clearly, point C would be inefficient with respect to the new frontier, while point D would be efficient.

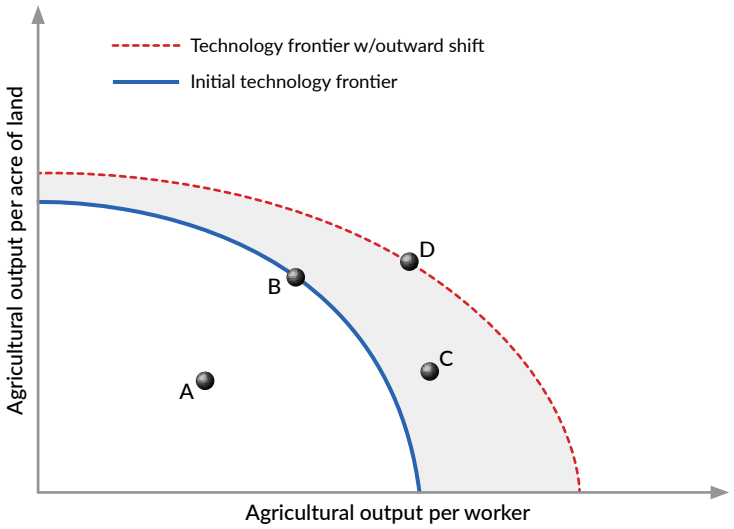


Figure 49. Agricultural land and labor productivity frontiers (conceptual illustration)

Source: Authors' illustration.

On balance, the empirical literature suggests that agricultural productivity growth in LAC has come mainly from technical change rather than from efficiency gains. The introduction of improved technologies (in many cases developed in high-income countries), such as modern crop varieties and improved livestock breeds, conservation agriculture including zero tillage, and agricultural machinery to allow mechanization of many cropping operations, has brought important benefits, leading to significant productivity gains and associated reductions in production unit costs in the LAC countries in which they have been adopted (Ludeña 2010).

The regional productivity growth figures mask significant variability, however, both across and within countries. Brazil displays an average annual TFP growth of 2.80 percent between 2001 and 2015,

TFP in the Andean countries and the Southern Cone grew on average at only 1.35 and 1.49 percent per year in the same period, and at an intermediate 1.86 percent in Central America (Fuglie et al. 2019). Brazil, in turn, has experienced more robust TFP growth in coastal areas and in some parts of the interior, such as Mato Grosso in the Cerrado, which is now the main soybean- and cotton-producing state in the country (Fuglie and Wang 2012). Crucially, efficiency and technical change (the latter in the form of catching up to the technological frontier) have both been significant drivers of TFP growth among the top performers in the region.

Productivity differences between countries are explained by many factors, including differences in agroecological conditions, production systems, average farm size, technology choice, and incentives, among others. Important differences in performance, for example, are associated with differences in agroecology. Generally speaking, countries with predominantly temperate production environments have recorded higher TFP growth rates than countries with predominantly tropical production environments. This pattern is mostly explained by higher growth rates of technical change in countries with predominantly temperate production environments, which can more easily adapt improved technologies generated by high-income countries for their own (overwhelmingly temperate) production conditions (Nin-Pratt et al. 2015). Meanwhile, several countries with predominantly tropical production environments (El Salvador, Nicaragua, and Venezuela) have recorded the lowest rates of productivity growth, a consequence of the technology frontier being lower for those environments and of lower productive efficiency achieved by farmers in those countries. On average, these countries produce 16 percent below the potential production feasible given the available technology for their agroecological zone (Nin-Pratt et al. 2015).

In future, converting new land to agricultural uses will be technically more difficult and environmentally more costly, so productivity growth will become increasingly important as a driver of agri-food systems development in the region. But where will that growth come from? As discussed above, increases in agricultural productivity can come from two basic sources: (i) improvements in technical efficiency given an existing technology ("moving to the frontier"), and (ii) technical change that pushes out the production possibilities frontier ("shifting out the frontier").

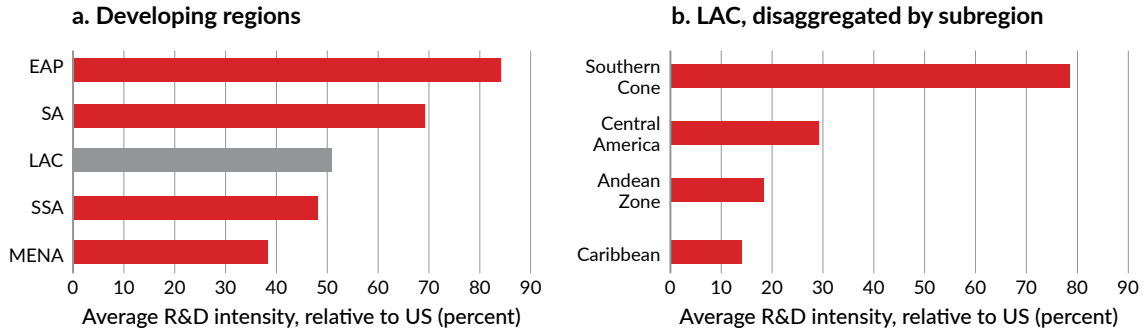
Moving to the frontier: Even in the absence of technological breakthroughs, opportunities to improve the technical efficiency of producers are manifold. At a basic level, education can boost technical efficiency by raising farmers' intellectual agility and improving their decision-making skills (Reimers and Klasen 2013). Specialized agricultural extension services can introduce farmers to more efficient practices and strengthen their capacity to use inputs effectively. Access to inputs being highly variable in Latin America (see, for example, Coelli and Rao 2005; Solís, Bravo-Ureta, and Quiroga 2009), measures that improve timely access to productive factors, such as improved plant varieties and animal breeds, fertilizer, crop chemicals, machinery, and irrigation, can also help farmers get closer to the production possibilities frontier. In situations where lack of secure access to land or extreme fragmentation of landholdings are discouraging use of improved technologies, measures to improve the functioning of land markets can also help to boost productivity. Similarly, measures undertaken to facilitate access to credit can make it easier for farmers to finance the purchase of productivity-enhancing inputs and machinery and/or contract laborers. Finally, since agricultural productivity is usually lower in remote, isolated areas (see, for LAC Calderón and Servén 2010; Goyal and González-Velosa 2013; Helfand and Levine 2004),

investments in rural roads, transportation facilities, and agri-logistics infrastructure can improve access to markets, improve the profitability of agriculture, and encourage productivity-enhancing investments.

Shifting out the frontier: Technical change that pushes out the production possibilities frontier comes mainly from innovation, which is a major factor driving TFP growth in agriculture. Innovation is difficult to define and measure, however, because successful innovation depends on multiple ingredients, including new technology, an effective technology transfer mechanism, a target population with the requisite knowledge and skills needed to take up the innovation, availability of associated inputs, and favorable economic incentives, among others. But even if innovation is inherently complex, it is clear that a major driver of innovation is research and development, so a lot of attention has focused on the ability of R&D to boost productivity in agriculture. A large body of empirical evidence makes clear that investments in productivity-enhancing public and private agricultural R&D have very high rates of return, often yielding double-digit benefit-cost ratios and benefits ranging from higher farm incomes and lower food production costs to reduced pressure on natural resources (Alston and Pardey 2014).

What has been the experience in LAC with respect to investment in agricultural R&D? The record across the region is far from uniform. Countries such as Argentina, Brazil, Colombia, Mexico, and Uruguay boast world-class research capacity, but this contrasts sharply with the situation in many Central American countries, Caribbean island nations, and some Andean countries, where agricultural research systems are suffering from underinvestment and increasingly falling behind in terms of infrastructure, human resources, and operating budgets.

In 2013, the last year for which data are available, the LAC region as a whole spent on agricultural R&D US$5.1 billion in 2011 PPP prices, up 75 percent from average annual investment during the 1980s. Research organizations in the region employed about 20,600 agricultural researchers (full-time equivalents (FTE)), twice as many as 30 years earlier (Stads et al. 2016). Nevertheless, given income, the size of the economy and of the agricultural sector, output diversification, and spill-over potential, R&D intensity in the region is still far below that in Asia and at similar levels as in Sub-Saharan Africa (Nin-Pratt and Falconi 2018). Benchmarking numbers to the United States, average R&D intensity in LAC is only one-half as high, lower than East and South Asia (where investment intensity stood at 84 and 69 percent of the US level, respectively) and slightly higher than Sub-Saharan Africa (48 percent of the US level) (Figure 50).



Note: Weighted averages use agricultural GDP as weight. The R&D intensity measure calculates R&D investment of a particular country relative to GDP, AgGDP, income per capita, agricultural specialization and potential spillovers.

Figure 50. Average R&D intensity values, 2008–2012, relative to the US in the same period

Source: Nin-Pratt and Falconi, 2018.

Funding for agricultural R&D in the LAC region comes from many sources, including national governments, donors, development banks, producer organizations, and the private sector, along with revenues generated internally through the sale of goods and services. Compared to other developing regions, in LAC donors and development banks play a comparatively small role in funding agricultural R&D (a notable exception is Bolivia, where donors account for 55 percent of all funding received by the National Institute for Agricultural and Forestry Research Innovation, INIAF). Governments are by far the dominant source of funding for the region's national agricultural research institutes, as well as the main employers of agricultural researchers (Stads et al. 2016). In Brazil, for example, agricultural research is conducted at both federal and state levels, through the Brazilian Agricultural Research Corporation (EMBRAPA) and through a number of state-operated agricultural research agencies that focus on local issues. Over time, the higher education sector has equally gained prominence in agricultural research, especially in Argentina, Bolivia, Costa Rica, Paraguay, and Uruguay, whereas in Colombia and Honduras the nonprofit sector (especially producer organizations) accounts for roughly 40 percent of the total number of researchers (Stads et al. 2016).

Private for-profit agricultural research also plays a significant role in LAC compared with other developing regions, especially in Argentina, Brazil, Chile, and Uruguay (Stads et al. 2016). Some countries provide tax exemptions for private R&D, while many private firms outsource their research needs to government agencies or universities or contribute to importing foreign technologies.

Regional and international organizations also conduct or promote agricultural research, leveraging cost-effective collaboration and technology spill-overs across geographical and national boundaries. Examples include the Inter-American Institute for Agricultural Cooperation (IICA), headquartered in Costa Rica, the Cooperative Technology Development Programs (PROCI), which comprise subregional mechanisms each formed by groups of national agricultural research institutes, and the Caribbean Agricultural Research and Development Institute (CARDI), the main agricultural R&D agency in the Anglophone Caribbean. The Agronomic Center for Research and Education (CATIE) is instead an autonomous non-profit institution, whose members include Bolivia, Colombia, Dominican Republic, Mexico, Paraguay, Venezuela, and all the Central American countries. With respect to international research, three centers that are members of the Consultative Group for International Agricultural Research (CGIAR) are headquartered in Latin America: the Alliance of Bioversity and the International Center for Tropical Agriculture (CIAT), in Colombia; the International Maize and Wheat Improvement Center (CIMMYT), in Mexico; and the International Potato Center (CIP), in Peru.

Most R&D spending in the region is concentrated in just a few countries. In 2013, Brazil accounted for more than 50 percent of all the resources allocated to R&D in the region, followed by Argentina and Mexico, which contributed 14 percent each to total regional expenditure. Investment in Colombia and Chile accounted for, respectively, 5 and 4 percent of the total, while the remaining LAC countries contributed much lower shares of agricultural R&D spending and operated smaller agricultural research systems (Stads et al. 2016).

According to a recent study on R&D intensity, Brazil again ranks first, reaching levels equivalent to the research intensity of the United States (Nin-Pratt and Falconi 2018). The same study then identifies a second group of countries with intensity levels between 90 and 25 percent of Brazil's: some of the Caribbean islands, including Trinidad and Tobago, St. Kitts and Nevis, and Antigua and Barbuda,

and Latin American countries such as Argentina, Bolivia, Chile, Colombia, Costa Rica, Mexico, and Uruguay. The remaining LAC countries display intensity levels below 25 percent of Brazil's, with Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Paraguay, and Venezuela even below 15 percent (Nin-Pratt and Falconi 2018).

4.8 Emerging technologies

Emerging technologies are a seventh powerful driver affecting the evolution of agriculture and food systems in LAC. What is often referred to as the Fourth Industrial Revolution is promising to transform virtually every sector of the economy, including agriculture and food systems.[31] Characterized by a fusion of tools that blurs the lines between the physical, digital, and biological spheres, emerging technologies encompass a wide range of new products as well as innovative process technologies that affect the production of traditional goods. These technologies are triggering momentous transformations in agriculture and food systems; by revolutionizing communications, operations, and transactions, they enable the creation of smarter farms, foster the emergence of more inclusive and transparent value chains, and empower a new generation of better informed and more engaged consumers.

The disruptive technology space is composed of digital and nondigital technologies (Bravi 2019). Digital technologies allow increasing numbers of food system actors to shift toward highly optimized, individualized, real-time, hyperconnected and data-driven practices, made possible by the use of highly interconnected and data-intensive computational technologies. At the farm level, precision agriculture techniques are being used to improve management of crop and livestock systems, while agricultural robots and auto-steering equipment accelerate operations while reducing labor requirements. At the distribution stage, e-commerce and digital marketplaces provide virtual spaces in which to match sellers and buyers, lowering marketing costs and facilitating trade in agriculture inputs and outputs. Distributed ledger technologies (DLT) such as blockchain show potential to dramatically improve the transparency of transactions and the inclusiveness of agri-food value chains. And financial digital technologies (FinTech) hold significant promise for modernizing and deepening rural finance.

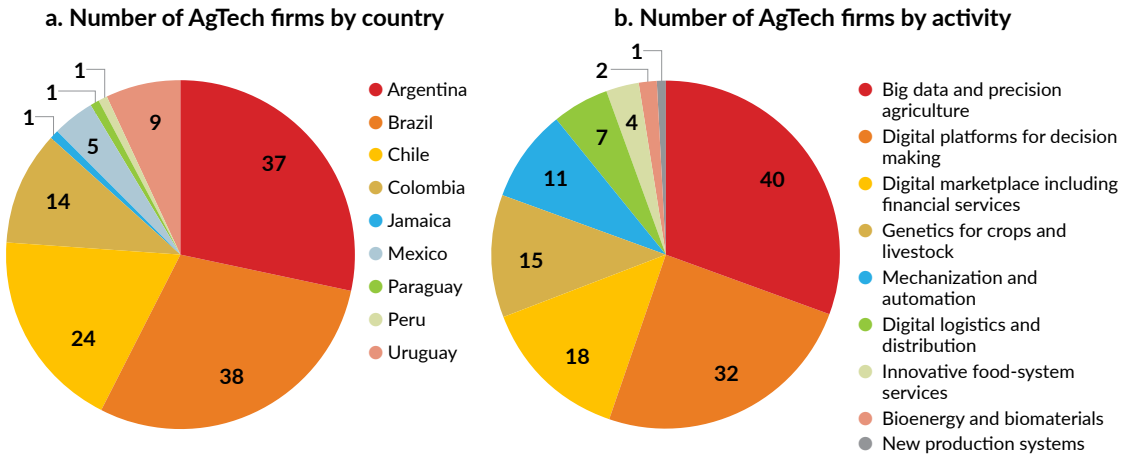
Nondigital disruptive technologies include a range of biological, health, and engineering innovations. Biological disruptors include genetically modified crops, whose DNA has been modified using genetic engineering methods, and bio-pesticides, biological or biologically derived agents able to achieve pest management in an environmentally friendly way. Disruptive health technologies with potential to radically affect agriculture and food systems are concentrated in the area of nutritional genomics (nutrigenomics), which is pioneering new products and processes designed to capitalize on the relationship between the human genome, nutrition, and health. Finally, engineering disruptors include technical breakthroughs in areas such as seawater desalinization, renewable energy generation, intensive farming, and 3D printing.

[31] The First Industrial Revolution followed the shift from reliance on animals, human effort and biomass as primary sources of energy to the use of fossil fuels and mechanical power. The Second Industrial Revolution was launched by major technological breakthroughs in the form of electricity distribution, wireless and wired communication, and new forms of power generation. The Third Industrial Revolution began with the development of digital systems, communication and rapid advances in computing power, which enabled new ways of generating, processing and sharing information.

Uptake of emerging technologies in agriculture and food systems has been uneven in LAC. Inadequate public investment and incentives, limited digital infrastructure in rural areas, and a general lack of awareness and familiarity among aging, poorly educated farmers have made technology adoption highly unequal, and still mostly driven by the commercial private sector. For example, mobile internet penetration in the region is limited: only about 50 percent of the population has access to the internet, and this figure is projected to grow to only 66 percent by 2025 (GSMA 2019). At the same time, research and development focusing on disruptive technologies for agriculture in LAC is carried out almost exclusively by the private sector, and advanced training, university curricula, and research programs are still catching up in building capacity and competence to support agriculture technology development. As a result, the industry that provides agricultural technologies (AgTech) is very young in the region. Sixty percent of all AgTech firms in LAC are less than five years old, and three-quarters are concentrated in Argentina, Brazil, and Chile. Most of these firms focus on activities such as big data and precision agriculture and digital platforms for decision making (Figure 51).[32]

Figure 51. Distribution of digital AgTech firms, selected LAC countries, 2015

Source: IDB 2017.



Change is coming, however. Countries such as Uruguay are betting on the adoption of digital solutions to sustainably intensify their agriculture, forestry, and livestock sectors, and they are piloting the adoption of blockchain and other DLTs in the food supply chain to improve traceability and facilitate commercial transactions. The region is seeing a proliferation of e-commerce platforms for products, inputs, machinery, and services for the entire agricultural supply chain, as well as of on-demand delivery startups that allow food and groceries to be ordered and delivered through smartphone applications. The governments of Brazil, Argentina, and several other countries are beginning to invest in the promotion of AgTech firms, mainly focusing on early-stage, domestic start-ups through programs offered by agricultural universities. At the same time, large corporate players have recently started investing in Brazil's start-up ecosystem in disruptive sectors such as FinTech, insurtech, edutech, mobility, internet of things (IoT), health, and telecom.

Emerging technologies show great potential to improve the ability of LAC agriculture and food systems to contribute to the desired outcomes of growth and diversification, employment generation and poverty reduction, food and nutrition security, and ecosystem sustainability.

[32] IDB (2017) identified 130 AgroTech ventures focused primarily on Latin America and the Caribbean whose main product or service is an agri-technology. These AgroTech ventures were identified through contacts with the industry, monitoring of incubator activities and business accelerators, and a review of sectoral media and publications.

Growth and diversification: Emerging technologies can improve productivity in agriculture and food systems by reducing guesswork, thus allowing economic agents all along the value chain to make faster and better management decisions. In primary production, digital applications used to support cropping decisions can help farmers increase yields and drive down production costs by optimizing the use of inputs and minimizing losses from pests and plant diseases, as well as reducing post-harvest losses thanks to smarter post-harvest technologies and practices. Livestock and aquaculture producers can take advantage of emerging disruptive technologies to increase productivity of their enterprises and reduce costs by improving nutrition management and enhancing animal and fish health. Data-sharing platforms, blockchain, and IoT can significantly improve the logistics of food value chains, while better traceability, smart contracts, and e-commerce reduce transaction costs and can contribute to more advantageous producer prices that better reflect product quality. More efficient and profitable agri-food chains can in turn crowd in private investment and FDI, with relevant spillovers on aggregate national GDP.

Employment generation and poverty reduction: Emerging technologies are likely to impact agricultural labor markets in diverse ways. More mechanized and automated production processes will likely supplant many low-quality, unskilled jobs in primary production, but at the same time the spread of technologies will foster the creation of higher-quality jobs downstream in the food system if the correct complementary actions and policies are put in place. Moreover, technological advancements can improve equality of opportunities in the labor market, boosting participation rates for certain categories of workers. For example, the increasing availability and falling cost of mobile devices will improve connectivity, enhance safety, and facilitate remote working, which will pave the way for greater participation by women in the work force. Similarly, the use of emerging technologies to promote agri-enterprise incubation and facilitate agribusiness start-ups will likely make agriculture more appealing to younger generations, boosting youth employment. Finally, tools that combine flexibility and transparency such as smart contracts can be used to reduce rates of labor informality and ensure job quality.

Food and nutrition security: To the extent that emerging technologies can help economic actors improve productivity and boost output in the agriculture, livestock, and fisheries sectors, they will have a positive impact on food and nutrition security. In addition to helping increase the quantity of food, emerging technologies can also enable improvements in the quality of food. Novel genetic engineering methods are expected to lead to the emergence of new generations of nutritionally enhanced superfoods and nutraceuticals, while the development of alternative proteins will further contribute to diversification of the food supply. Food systems can also be made more functional and more responsive to rapidly evolving consumer demands through the use of big data analytics to improve food demand prediction and the use of e-commerce services to better align food demand and supply. By facilitating food monitoring and tracking, technological advancements will enhance traceability and transparency, while sensing technologies (spectroscopy and image analysis) will enable better monitoring of food quality and safety. Finally, DNA-based personalized nutrition regimes can allow consumers to achieve significant health improvements through personalized diet management, reducing the burden of malnutrition and diet-related diseases.

Ecosystem sustainability: Emerging technologies have enormous potential to benefit the health of the planet. Precision agriculture can foster more sustainable use of soil, water, and natural resources, and reduce the quantity and lower the toxicity of chemicals used in primary production. Engineering

innovations can enable the establishment of environmentally benign circular production systems that rely minimally on external inputs. Further downstream in the value chain, emerging technologies will improve the efficiency of processing, storage, and transportation functions, lowering intermediation costs and reducing food loss and waste. Meanwhile, new opportunities will appear to strengthen climate change adaptation and mitigation, for example, through the dissemination of climate-smart agriculture practices via digital tools, or engineering innovations such as improved irrigation and desalinization systems, renewable energy, and vertical farming.

Emerging technologies have great potential to improve food system outcomes, but they should not be viewed as a panacea. If improperly managed, they could exact significant costs, especially in the areas of inequality, market power, and data privacy and cybersecurity (World Bank 2019a).

If access to emerging technologies is unequal, the benefits from using those technologies will also be unequal. Inequality of access could occur along several dimensions: spatial (due to differential connectivity resulting from uneven communication infrastructure); educational (if disruptive technology is skill-biased); economic (since substantial upfront investments are required to adopt certain technologies, especially hardware-heavy technology such as automation and robotization); and gender-based (men have traditionally had higher access to new technologies than women, who also on average display lower levels of digital literacy and knowledge).

The high upfront costs associated with software, data storage, analytics, and security, as well as network effects and switching costs for the consumers, are ideal ingredients that could lead to concentration of power in the market for technology service providers. Concentration of power would likely stifle competition and discourage innovation. Similarly, information asymmetries could enable some players to strengthen their market position due to their greater ability to access valuable data compared to other, less informed parties. The fact that information confers power could drive further vertical integration of agricultural value chains as players seek to exploit synergies along the data chain from the time the data are created to when they are used (Pesce et al. 2019).

Last, but not least, because digital technologies make the collection, storage, and use of information easier and cheaper, questions are being raised about the ownership and potential misuse of the personal and enterprise data of actors in the food system. Such data are being generated and collected at an ever-accelerating rate by new technologies, often in the absence of adequate privacy rules governing their ownership and use and of appropriate cybersecurity frameworks.

In the future, disruptive technologies have the potential to induce profound transformations of agriculture and food systems in LAC, the impacts of which would be felt across the region and worldwide. Depending on local socioeconomic dynamics, market structure, and the regulatory environment, these transformations could be highly beneficial and contribute to inclusive and sustainable growth, or they could perpetuate and even reinforce existing patterns of exclusion, privilege, and inefficiency.

Box 14. Emerging disruptive technologies: Five examples of relevance to agriculture and food systems

Precision agriculture

Precision agriculture involves the use of interconnected technologies to reduce uncertainty in agriculture. Typically these technologies include such things as remote sensing, big data analytics, artificial intelligence, GPS-based variable-rate technology, the internet of things (IoT), and cell phone platforms. Precision agriculture applications normally involve three steps: (i) data collection using sensing technology (e.g., satellites, drones, ground-based sensors, smartphones); (ii) production of technical advice tailored to specific producers through advanced computational techniques (big data processing powered by advanced cloud computing, artificial intelligence, machine learning); and (iii) delivery of advice to producers using digital delivery mechanisms, such as websites, tablets, or mobile phones. Applied to crop production, precision technologies provide highly specific directions for land operations, input applications, and irrigation management. In the livestock sector, sensors or smart ear tags and collars allow improved monitoring of diets, diseases, and fertility, while 3D cameras can be used to monitor livestock movements and track animal weight. In aquaculture, technical advice on feeding regimens or phytosanitary treatments is produced thanks to data collected by sensors in fish cages and ponds. In the capture fisheries sector, atmospheric, oceanic, and fisheries parameters data can be used to optimize catch operations, facilitate traceability, and improve marine safety.

Vertical farming

Vertical farming is the practice of producing food in vertically arrayed layers within a dedicated structure (such as a building, warehouse, or shipping container) using indoor farming techniques combined with technologies that allow for the control of environmental factors such as light, humidity, temperature, atmosphere, and nutrition. The main three types of vertical farming are hydroponics, aeroponics, and aquaponics. *Hydroponics* involves growing plants in nutrient solutions that are free of soil. *Aeroponics* involves growing plants in an air or mist environment, with no soil and very little water. *Aquaponics* combines plant and fish production in the same ecosystem: fish are grown in indoor ponds, producing nutrient-rich waste that is used as a feed source for the plants in a hydroponics farm, which in turn filter and purify wastewater from the ponds, which is recycled. Since vertical farming enclosures can be stacked vertically, and since much of the water used in vertical farming can be reused, vertical farming uses only a tiny fraction of the amount of land and water required for traditional farming. Furthermore, vertical farming enclosures provide a clean and controlled environment that can easily be isolated, allowing chemical-pesticides/herbicides-free production in a climate-resilient context. Finally, since vertical farming facilities can be located in urban areas, the products do not have to be transported long distances to reach the final consumer, which implies significant savings on agri-logistics costs as well as lower GHG emissions.

Alternative proteins

Alternative proteins include plant-based meat alternatives, products based on insects and other novel protein sources, and cultured meat and fish produced using biotechnology-based synthetization processes. Interest in alternative proteins has increased in recent years as the environmental impacts, health consequences, and ethical considerations associated with conventional livestock production have become more salient. Other than reducing GHG emissions produced by livestock and releasing land currently used to raise animals and grow feed, nutrient-fortified plant-based proteins could have positive health benefits on consumers thanks to a nutrient composition high in fiber and free of unhealthy components such as saturated fatty acids.

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Box 14. Emerging disruptive technologies: Five examples of relevance to agriculture and food systems (cont.)

Blockchain

Blockchain is a type of distributed ledger technology consisting of multiple "blocks" of information chained together sequentially. Each block stores new information about transactions (including anonymous information about transaction participants) that distinguishes it from other blocks. In order for a block to be added to the blockchain, after a transaction occurs it must be verified by a network of thousands or even millions of computers spread across the globe. Once the network verifies the accuracy of the transaction, the corresponding information is stored in a block that is given a "hash," a unique identifying code that allows users to distinguish that particular block from every other block. When the new block is added to the blockchain, it becomes publicly available for anyone to view. Crucially, users can connect their computers to the blockchain network, and they can receive a copy of the blockchain, updated automatically whenever a new block is added, making it virtually impossible to manipulate the information stored in the chain. Blockchain can benefit agriculture and food systems in a number of ways. Producers and buyers both stand to gain from more transparent transactions and more easily enforceable contracts; for example, producers can avoid intermediaries and connect directly with retailers, food service operators, and even consumers, thereby reducing marketing margins and receiving a fairer price for their products. Moreover, faster and easier transactions reduce the food losses that occur when, for lack of a buyer, perishable products remain too long in the field or in storage.

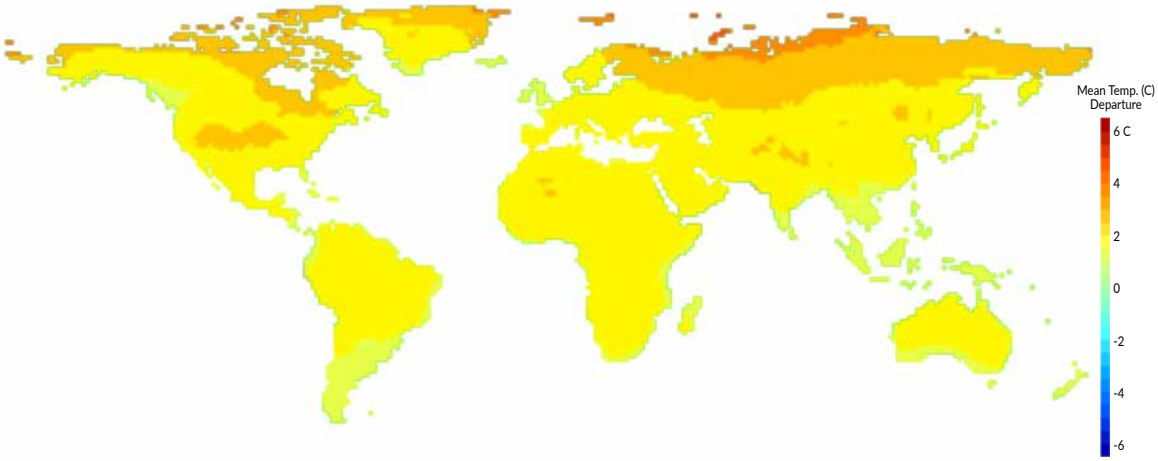
FinTech

FinTech refers to the use of digital technology to create and deliver financial services, typically with the help of mobile phones or internet-enabled devices. FinTech has the potential to disrupt agriculture and food systems in LAC by removing many barriers traditionally faced by smallholder farmers and people in rural areas in accessing credit and financial services. For example, internet and mobile banking eliminate the need to travel long distances to a financial institution. Moreover, while smallholder farmers are often unable to provide credit histories or business records, many now have digital records of their phone activity (airtime purchases, call records, social media and mobile money transactions), which can provide the basis for alternative credit scoring systems, reducing information gaps for lenders. FinTech also holds great promise to accelerate insurance take-up, improve access to productive inputs, and increase the efficiency of supply chains. Information generated by remote sensing devices, for example, can be used to design customized insurance products tailored to the risks faced by specific farmers, complemented by smart contracts that track weather conditions and pay out claims accordingly. Inventory management applications are being designed to boost efficiency along agricultural supply chains, for example by monitoring stocks and providing the just-in-time financing needed to ensure an uninterrupted flow of inputs to farmers and of produce to consumers. Direct digital leasing innovations are being used to increase farmers' access to borrowed farm equipment and tools through peer-to-peer digital networks that match farmers who need certain equipment with those who own equipment but do not use it on a full-time basis. Digital pay-as-you-go financing and efficient rental options are being deployed to streamline production processes and reduce costs, while the connectivity made possible by the internet of things is being applied to improve remote tracking and management of vehicle fleets.

4.9 Climate change

Climate change is an eighth powerful driver affecting the evolution of agriculture and food systems in Latin America and the Caribbean. Agriculture in LAC is highly vulnerable to climate change (IPCC 2014b). By the end of the 21st century, temperature increases are projected to range between 1.6°C and 4°C (Lachaud, Bravo-Ureta, and Ludeña 2015), with substantial variation across subregions: the Atlantic coast of Brazil, Uruguay, and Argentina will likely experience less warming than the global average, whereas parts of central South America, including Paraguay, northern Argentina, and southern Bolivia are expected to experience much more pronounced temperature increases (World Bank 2014) (Figure 52a). Changes in precipitation levels similarly will vary by subregion, ranging between -22 and 7 percent across Central American countries, with even greater heterogeneity in South America (Lachaud, Bravo-Ureta, and Ludeña 2015) (Figure 52b).

a. Temperature change



b. Precipitation change

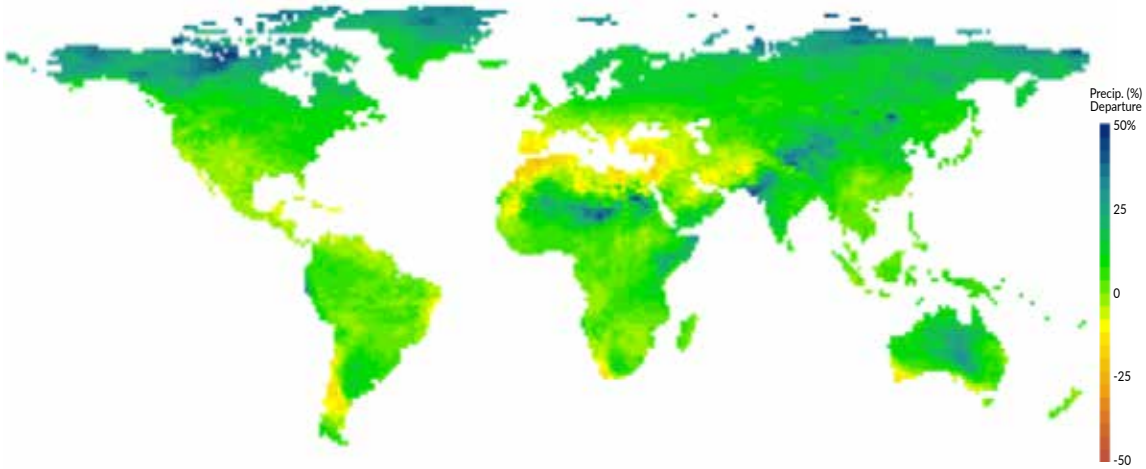


Figure 52. Projected change in temperature and precipitation, 2040-2069

Source: Built with World Bank Spatial Agent, using data from Climate Wizard.

Note: Projections under A2 Scenario, 60% ensemble model, annual season.

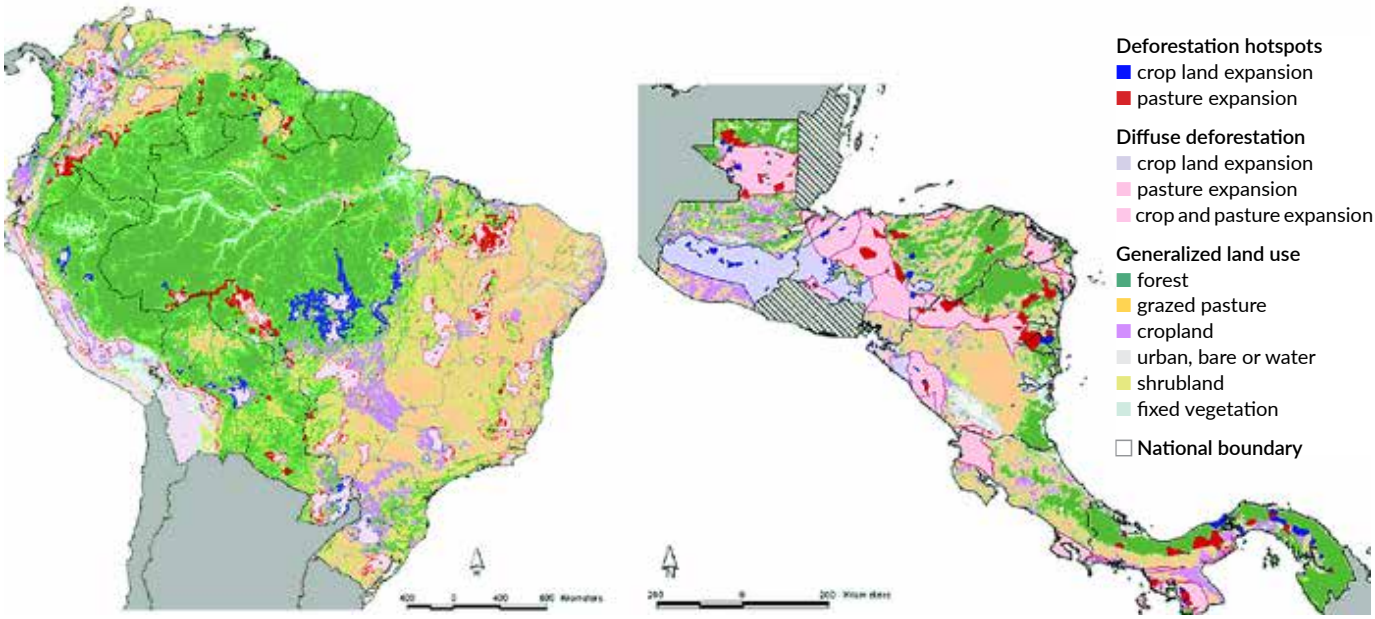
If global warming continues at the current rate, mean temperatures are likely to increase 1.5°C between 2030 and 2052 and show increasing variability (IPCC 2018a). Beyond the changes in temperatures, climate change will manifest itself in changes in precipitation levels and timing, availability of solar energy, carbon dioxide concentration rates, and sea levels—effects that in turn will lead to higher weather volatility, increased frequency of extreme weather events, and unconventional evolution of diseases and pests (Díaz-Bonilla et al. 2014). Particularly important for agriculture, by the mid-21st century climate change is projected to reduce renewable surface water and groundwater resources in most dry subtropical regions (IPCC 2014b).

An important contributor to climate change is carbon release due to destruction of natural habitat, especially forest loss. When natural habitat is cleared or burned, carbon stored in the form of biomass is released as carbon dioxide (CO_2). Destruction of natural habitat—epitomized by the deforestation occurring in the Amazon—is a major problem in LAC. Between 2000 and 2016, more than 5.54 percent of the region's forest was lost, or nearly 55 million hectares; this represented more than 91 percent of forest losses worldwide. Within the region, emissions attributable to land use changes and forestry (LUCF) made up the largest share of greenhouse gas (GHG) emissions (46 percent), far greater than in other developing countries (30 percent) and nearly three times the global average (17 percent) (de la Torre, Fajnzylber, and Nash 2009). GHG emissions attributable to LUCF are a particular concern in Brazil, home to more than 60 percent of the Amazon; expansion of the agricultural frontier combined with urban sprawl threaten to produce very high rates of forest loss, with potential impacts on global climate that extend far beyond the region's boundaries (The Nature Conservancy 2018) (Figure 53).

Climate change impacts agricultural systems directly by affecting plant growth, productivity, and nutritional content, among others. Climate change impacts agricultural systems indirectly when sea-level rises inundate low-lying coastal regions with saltwater, mean precipitation increases lead to destructive inland freshwater flooding, changes in precipitation reduce the availability of water resources for irrigation, and climatic changes alter the incidence and severity of agricultural pests,

Figure 53. Predicted deforestation hotspots, South America and Central America, 2010 – 2030

Source: IPCC Fourth Assessment Report (2007).



diseases, and weeds (Ruane and Rosenzweig 2019). These impacts are felt not only in cropping systems; livestock systems are also susceptible to damage and losses from weather-induced changes in the availability of forage and feeds, changes in the availability of water, and increases in the incidence and severity of diseases, among others. Last, but not least, climate change can also affect fisheries and aquaculture systems by reducing the productivity of wild fish stocks and undermining the productivity and the profitability of marine and freshwater aquaculture operations (Vermuelen, Campbell, and Ingram 2012).

Climate change will very likely depress the yields of many important food crops, including wheat, maize, and soybeans. Estimates of the likely impacts of climate change on crop yields in LAC vary substantially depending on the subregion, crop, and modeling method. Generally speaking, however, the impacts of rising temperatures are expected to be negative, even if mitigated by CO_2 fertilization. In Brazil, for example, in the absence of additional adaptive breeding, 2°C of warming would decrease yields of soybean and wheat by 30 to 70 percent and by 50 percent, respectively, compared to 1971–2000 levels (World Bank 2014).[33] Meanwhile, extreme weather events such as droughts and floods will cause significant water stress in many parts of the region, creating additional costs for producers. In Bolivia, for example, by 2050 the additional water storage needed to meet irrigation needs would imply costs of US$12 to US$60 million under a wet and dry climate scenario, respectively (World Bank 2010).

Livestock production in LAC is also projected to decline because of climate change. When subjected to heat stress, cattle, small ruminants, and camelids reduce their food intake, grow more slowly, and produce less milk, while also experiencing lower reproduction rates and higher mortality rates. In parallel, higher temperatures and increased CO_2 concentrations, combined with changes in precipitation patterns, change the composition of pastures, reducing their productivity and limiting the availability of nutrients, thus jeopardizing the quantity and quality of feed (World Bank 2014).

Capture fisheries off the coasts of LAC countries are projected to be adversely impacted by climate change as well. As ocean temperatures rise, many fish populations will migrate poleward toward colder waters, leading to projected reductions in the fish-catch potential of more than 50 percent off the coast of Uruguay, the southern tip of Baja California, and southern Brazil. Similarly, the Caribbean and parts of the Atlantic coast of Central America are expected to witness declines in catch potential ranging between 5 and 50 percent, and the Peruvian and Chilean coasts are projected to experience declines in catch potential of up to 30 percent (World Bank 2014).

The adverse impacts of climate change will be felt far beyond the primary production sectors. Changing climate patterns and extreme weather events are also likely to have severe and long-lasting impacts on downstream stages of the food system, affecting the processing, storage, transport, distribution, and disposal of food products. Agro-logistics infrastructure will be more susceptible to damage from extreme weather events, and increasing temperatures will generate increased need for electricity to power air conditioning and refrigeration, driving up storage costs. Higher temperatures will also impact the perishability and safety of fresh foods, because bacterial growth rates increase with temperature (Vermuelen, Campbell, and Ingram 2012).

[33] An exception is a potential 17 percent increase in yield of irrigated/flooded rice by 2050 in some regions, with the exception of Brazil, Mexico, and the Caribbean (Fernandes et al. 2012).

The overall effect of these impacts of climate change could be to undermine the stability of the region's food supplies, as more frequent and more pronounced cycles of under- and overproduction lead to greater variability in food prices. Climate change is likely to affect all four components of food and nutrition security: (1) availability, (2) access, (3) utilization, and (4) stability (see, e.g., Ingram 2011; Schmidhuber and Tubiello 2007; Ziervogel and Ericksen 2010). Populations located in remote areas, indigenous people, and communities dependent on agricultural or coastal livelihoods will be especially at risk (IPCC 2018b). In other words, the adverse impacts of climate change—lower incomes from agriculture-based livelihoods and reduced consumption due to higher food prices—will fall disproportionately on poor and disadvantaged groups that have low adaptive capacity because they have fewer assets and a more limited set of coping strategies (Vermuelen, Campbell, and Ingram 2012).

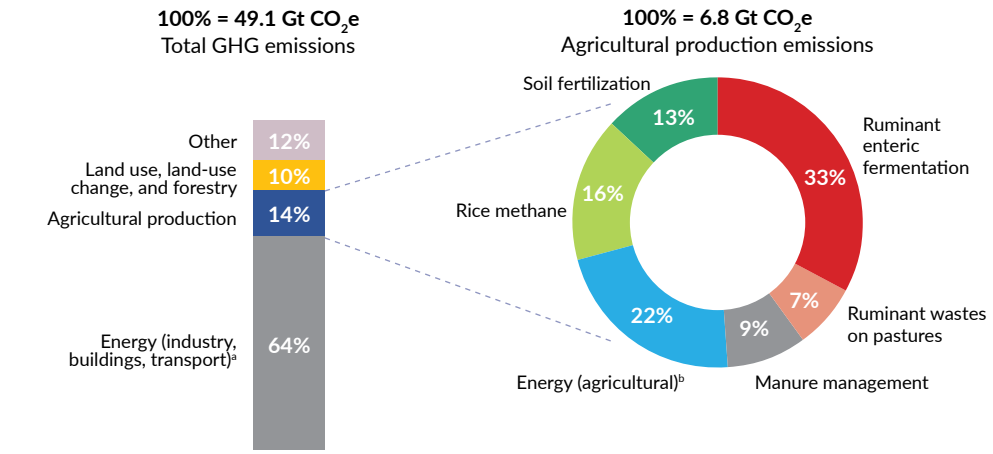
Box 15. Powering agricultural growth in LAC: The role of energy

Agriculture is a major consumer of energy: worldwide, the food system consumes about 30 percent of total energy consumption (FAO 2011). Energy is used upstream to produce inputs and manufacture agricultural machinery; on-farm to extract, pump, lift, collect, transport, and treat water; and downstream for processing, packing, transporting, and distributing food. The quantity, quality, and cost of energy inputs into agriculture influence the potential for agricultural productivity and post-harvest value addition and product transformation. Many LAC countries offer widespread access to grid electricity, but the high cost of electricity makes it unaffordable for farmers and agribusinesses and hinders the growth and sustainability of businesses, while impacting the quality of the production.

Energy used in agriculture provides both a challenge and an opportunity. As an input, energy accounts for a significant share of agriculture's contribution to GHG emissions. Energy used for agriculture, including on-farm consumption as well as energy from manufacturing of farm equipment and key inputs like fertilizer, is responsible for 22 percent of the total emissions from the agriculture sector (this is even before considering emissions from the transportation of food) (WRI 2018). However, new technologies including solar-powered and energy-efficient appliances present opportunities to introduce new and cleaner systems of agriculture production, with potentially significant reductions in GHG emissions.

Agriculture through its use of energy derived from nonrenewable fossil fuels contributes to GHG emissions, but agriculture also offers two potential ways to reduce GHG emissions by providing the feedstock for cleaner, renewable energy. First, agriculture residues can be converted into feedstock for clean energy systems, increasing energy access and creating on-farm circular economies of efficiency. Ruminant wastes on pastures and manure management together are responsible for 16 percent of agriculture's contribution to GHG (WRI 2018). The installation of simple technologies—such as on-farm biodigesters—has the potential to simultaneously improve manure management, reduce GHG emissions, and produce energy on-farm. Second, agriculture products can be produced for the express purpose of generating renewable fuels. This is the case, for example, with ethanol, which is most commonly made from maize, and charcoal, a black carbon residue produced by removing water and other volatile constituents from animal and plant materials. Production of crops as energy sources can give rise to food security and ecosystem trade-offs, however. Growing maize for ethanol production, for example, has raised the price of an important staple consumed by millions of the world's poor. Similarly, even though a regulated charcoal industry that requires replanting and sustainable use of forests can produce clean, efficient energy, illegal charcoal production causes deforestation and serious environmental concerns in many parts of the LAC region. >

Box 15. Powering agricultural growth in LAC: The role of energy (cont.)



Note:
[a] Excludes emissions from agricultural energy sources described above.
[b] Includes emissions from on-farm energy consumption as well as from manufacturing of farm tractors, irrigation pumps, other machinery, and key inputs such as fertilizer. It excludes emissions from the transport of food.

Figure 54. **Energy accounts for 22 percent of total agriculture emissions globally**

Source: GlobAgri-WRR model (agricultural production emissions); WRI analysis based on UNEP (2012); FAO (2012a); IEA (2012); and Houghton (2008) with adjustments.

In LAC, economic growth combined with changing food consumption patterns are impacting the demand for energy. As regional and global demand for food grows, so do agricultural energy requirements. Across the region as a whole, access to electricity is relatively high, but large disparities in electricity access rates remain between and within individual countries. Despite positive average growth rates for electricity production and consumption, some LAC countries face significant supply-demand imbalances (especially during dry years when production of hydroelectric energy falls), and large differences persist in connection rates and affordability. An estimated 34 million people in the LAC region have no access to electricity and many more unreliable access.

In *higher-income countries* where there are high levels of grid penetration even in rural areas, such as Chile, Mexico, and Uruguay, energy efficiency and renewable energy technologies (including biodigesters and solar) can help reduce GHG emissions, minimize environmental impacts, and help reduce energy subsidies and/or improve competitiveness in the agriculture sector.

In *lower-income countries* where farmers are largely without grid access, such as Haiti, farmers need access to energy for basic production, irrigation/pumping, cooling, storage, and processing. In these countries, renewable energy technologies (biodigesters, biogasification, solar, and solar thermal) can have the effect of replacing costly diesel generators, reducing diesel emissions, and injecting energy into value chains where it can help spur value addition and innovation.

Several LAC governments have made it a national priority to reduce GHG emissions in the agriculture sector, recognizing that there are significant opportunities to achieve emissions reduction by promoting the uptake of energy efficiency and renewable energy technologies.

> **Mexico:** A 2015 energy reform in Mexico has allowed private power producers to sell electricity to the grid. This means that agribusinesses can become power producers and sell excess energy to the grid, increasing the financial viability of technologies like solar and biodigesters. >

Box 15. Powering agricultural growth in LAC: The role of energy (cont.)

> **Uruguay:** Government policy for renewable energy and commitment to lowering emissions in the agriculture sector means that investments are prioritized that help to reduce GHG emissions in agriculture, like solar irrigation, solar pumping, and energy efficiency.

> **Nicaragua:** High costs of rural energy (nearly 40 cents per kilowatt-hour), combined with a large but inefficient livestock sector, strong markets, and poor-quality product, present many opportunities for interventions in the livestock sector to improve quality and storage, with priority given to solar milk chillers.

> **Haiti:** Low levels of energy access combined with high levels of produce losses present large opportunities for improved processing. Improving processing could help with food and nutrition security and value addition for products and could be accomplished through solar-powered dryers, solar refrigeration, and improvements in cold storage.

Increasing the reliability and affordability of the electricity input into agriculture has the potential to improve agricultural productivity both on- and off-farm, with important income effects through job creation and production increases for those engaged in agriculture. To the extent that remote communities tend to be the poorest and most vulnerable, off-grid solutions to provide electricity access is a critical component of any strategy to tackle extreme poverty and enhance shared prosperity.

The financial costs to the region's food systems caused by climate change could be enormous: as high as US$35 billion to US$100 billion by 2100 (Fernandes et al. 2012). And the costs will not be only financial. The impacts on human nutrition would also be exceedingly large. A recent simulation covering the period 2000 to 2050 concluded that in the absence of climate change, calorie availability per capita will likely increase by 3.7 percent, but climate change will reverse the trend, leading to a drop in calorie availability per capita by approximately 9 percent (Nelson et al. 2010).

4.10 Policies

Policies are a ninth powerful driver affecting the evolution of agriculture and food systems in Latin America and the Caribbean. Policies implemented by countries inside and outside of LAC set the institutional and incentive frameworks within which the effects of all the other drivers and disruptors play out. As such, policies can act as drivers by setting in motion long-term trends and as disruptors when they change suddenly and unexpectedly. While a comprehensive discussion of the policy environments prevailing in LAC countries is outside the purview of this report, the ability of policies to set in motion long-term economic trends or to trigger short-term market disruptions can be illustrated with two examples.

Over the course of many years, policy reforms—including both agricultural policy reforms that targeted the sector directly and broader macroeconomic policy reforms directed at the overall economy that affected the sector indirectly—laid the foundation for the agricultural booms of the region's two most dynamic agricultural producers and exporters, Argentina and Brazil.[34]

[34] This section is derived from Chaherli and Nash (2013), drawing on O'Connor (2012), Regunaga (2010, 2011), and Buainain, Ruiz, and Viera (2010).

In Argentina, a series of trade policy reforms introduced beginning in 1991 reduced taxes on agricultural exports and encouraged technology transfer by lowering barriers to importing technology embedded in inputs. In parallel, institutional restructuring reforms virtually eliminated the state grain marketing board and privatized ports, including the all-important grain loading facilities. Over time, these developments encouraged the emergence of a competitive farm services industry and attracted investment that improved the infrastructure used to move and store grain. Innovative commercial arrangements appeared, which attracted nontraditional financing into the sector and encouraged vertical integration in many value chains to increase efficiency and capture economies of scale.

Initially, the reforms had positive but modest impacts on production. But after 1996, the full effects became apparent as production of maize and soybeans took off (Figure 55). Aggregate factor productivity growth in the sector—1.1 percent per year in agriculture and 0.9 percent per year in livestock—was higher than in other sectors. Much more than is generally understood, the export-driven expansion of agricultural production after 1990 boosted employment and value addition in upstream and downstream industries, surpassing the employment and value addition generated in the import-substituting industries that had traditionally received high protection, such as the auto industry. Argentina's experience shows that both technical innovation and innovation in commercial organizations can be important drivers of competitiveness, given the right policy environment. In later years, some of the policy reforms—particularly those relating to trade policies—were partially reversed, shifting relative production incentives. The uncertainty and high export tax equivalent induced farmers to reduce the area planted in maize and wheat and expand the area planted in soybeans, undermining production sustainability. Export restrictions on beef and milk slowed the development of those two sectors. Agricultural growth continued, stimulated by high international prices, but the sector's full potential was not realized and remains unrealized to this day.

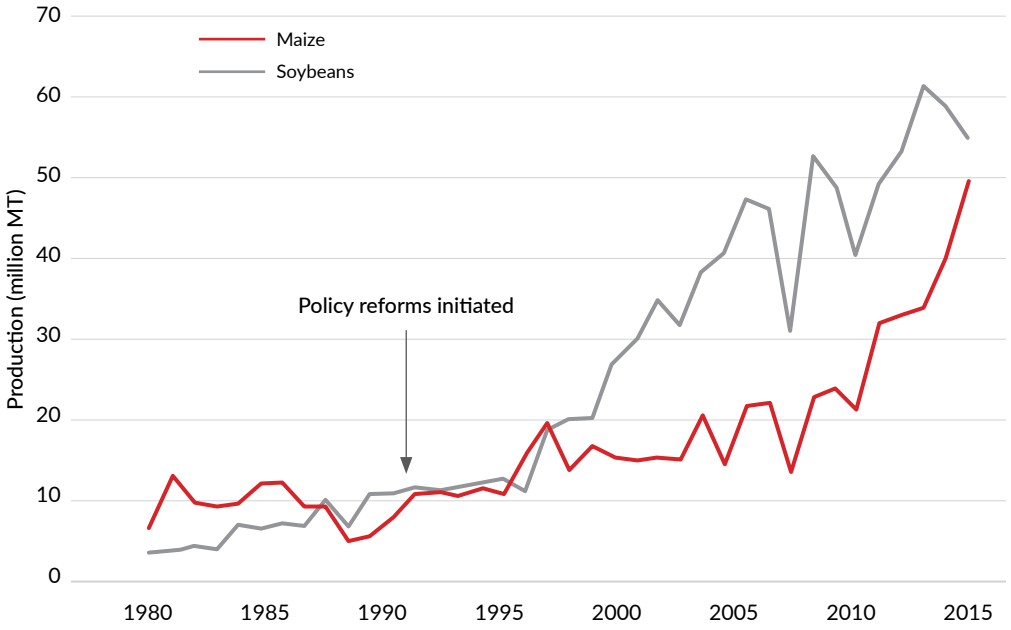


Figure 55.
Argentine grain production, 1979–2015 (millions of tons)

Source: FAOSTAT.

Recent developments in Argentina have only served to further emphasize the disruptive potential of policies on the region's agriculture and food systems. The severe fiscal crisis that gripped the country beginning in 2015, following a series of fiscal reforms and the freeing of the exchange rate, have buffeted the agricultural economy. Movements in the exchange rate that were generally favorable for export commodities were offset by increases in export taxes introduced by the government as it sought to close a widening fiscal deficit. In parallel, heightening trade tensions between the United States and China had a disruptive effect on global commodity markets, further heightening uncertainty and inducing many Argentine producers to scale back. While these developments have yet to play out fully, they illustrate well the enormous disruptive impact that policies can have on LAC agriculture and food systems.

In Brazil, rapid growth in agricultural production and exports similarly were stimulated by a series of policy reforms implemented during the early to mid-1990s. The reforms comprised trade liberalization (including the elimination of export taxes) to improve the incentive structure, virtual elimination of direct government purchasing (including through marketing boards), privatization of important state-owned enterprises (SOEs), and deregulation of markets for sugarcane, wheat, and coffee. Agriculture's share of public spending fell from 5.65 percent in the 1980s to 2.11 percent in 1995–99, but the composition of public spending on agriculture improved, with more funding going to research. The amount of subsidized public credit going to agriculture fell sharply, but innovative instruments (e.g., the "*cedula de producto real*") helped maintain the flow of credit going to medium and large-scale producers. Although considerably less interventionist than in the past, agricultural policy continued to be activist in some areas, including rural finance and price risk management.

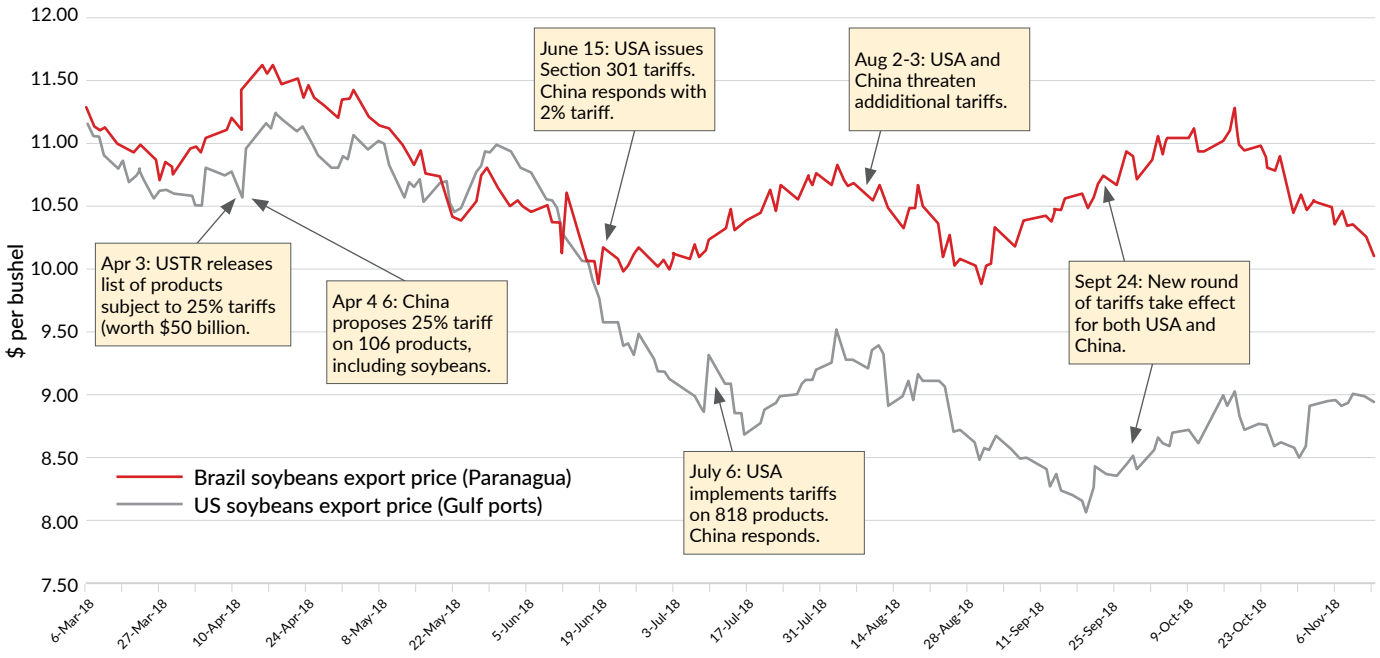
Complementing the policy reforms, technological innovation played an important role in Brazil in powering the agricultural boom. The federal research institute, EMBRAPA, has been the dominant actor, but many private companies, universities, and state-level research institutes have also made valuable contributions. EMBRAPA is credited with developing the soil enhancement technology that transformed the vast area of the Cerrado from an agricultural backwater into a leading production zone. During the 1960s and 1970s, agricultural growth was powered largely by expansion of the agricultural frontier, sustained by the continual incorporation of new land into production through deforestation, with cut-and-burn, shifting, and extensive production systems. As the environmental and social costs of this strategy became evident, however, research efforts were refocused on facilitating the transition to more sustainable intensification strategies, such as the innovative Low-Carbon Agriculture (*Agrciultura de Baixo Carbono*, ABC) Plan that today serves as a global benchmark for sustainable intensification.

Despite its record of success, Brazilian agriculture faces important challenges. The geographic diversification of Brazilian agriculture during the last 35 years—and the legacy of a closed economy that did not require efficient links to external markets—created agri-logistics bottlenecks that have undermined competitiveness in some areas, particularly in cereals and oilseeds. The efficiency of the national transport system remains low compared to the transport systems of Argentina and the United States, two major competitors, because of the large distances between production zones (many of them located in the Center-West) and export ports (many of them in the South-East), as well as infrastructure constraints and coordination difficulties constraints in the ports themselves.

In addition to supporting long-term economic trends, policy reforms can also act as disruptors by triggering sudden market changes. This is clearly illustrated by the impacts of the recent abrupt deterioration in trade policy relations between the United States and China. Soybean prices in the United States and Brazil have traditionally been very similar, with highly correlated movements. When trade tensions began to rise in early 2018 and it became likely that US soybean imports into China would be affected, the two price series began to diverge (Figure 56). As the event markers show, the more trade policy actions intervened, the wider became the wedge, to the benefit of Brazilian soybean producers.

Figure 56.
Soybean price, United States and Brazil (2018)

Source: Todd Hubbs, University of Illnois.



4.11 From agri-food drivers to agri-food futures in LAC

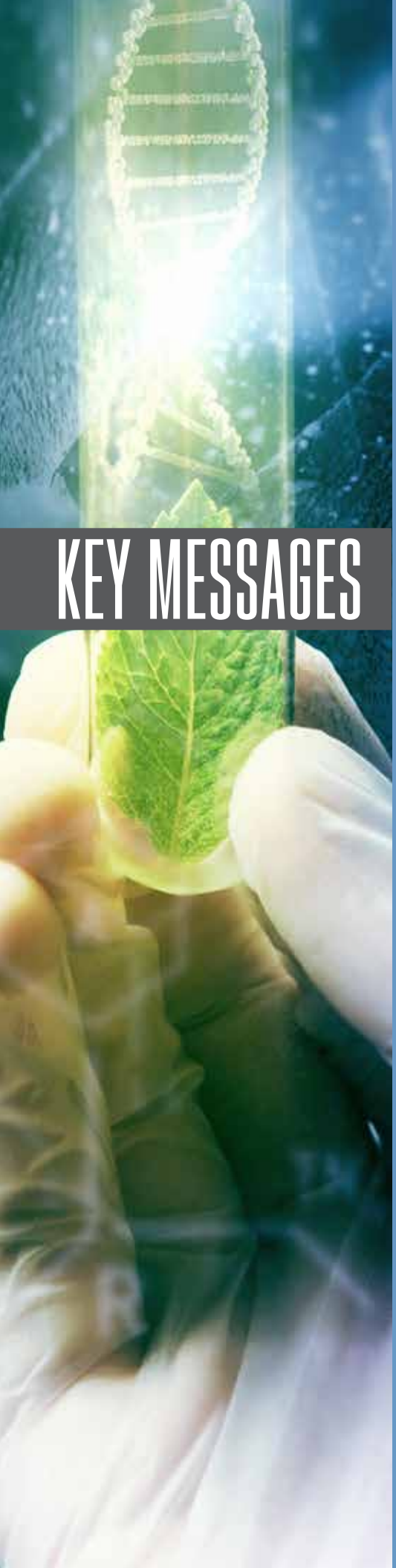
A set of powerful drivers will be paramount in shaping the future of LAC agriculture and food systems. Among these drivers, some consist of more gradual, long-run trends that can be considered more certain and to have relatively predictable impacts, while others will manifest themselves as disruptive forces that could appear suddenly and unexpectedly, with unpredictable impacts on agriculture and food systems.

Beyond the identification of the most significant drivers for LAC of the evolution of agriculture and food systems, a further challenge lies in assessing and quantifying the impact of the eventual joint manifestation of all or some of these forces in an integrated system, characterized by multiple interdependent actors and complex dynamics. The next chapter describes a range of plausible futures that could eventuate, depending on how various drivers materialize and combine in the years to come, and provides insights into the challenges and opportunities that these futures could generate for agriculture and food systems in LAC.

Photo: © Sergey Khakimullin | Dreamstime.com.

Envisioning the future: How might the current trajectory change?

CHAPTER 5



KEY MESSAGES

- Scenarios developed using quantitative and qualitative tools show how trends and disruptors might affect LAC agriculture and food systems in the future.
- Because the future is to some extent unknowable, policy makers should devise interventions that enhance resilience and provide a menu of options for economic agents who are likely to be exposed to multiple uncertainties.
- Large, well-integrated markets have enormous power to cushion shocks, so the degree of openness of the global trading system matters greatly.
- Technology can have a transformative effect on agriculture and food systems, but it is a two-edged sword: if properly leveraged, it can have enormous benefits, but if improperly managed, it can leave millions behind.
- Climate change is a wild card whose impacts on LAC agriculture and food systems could range from modest to severe.

5.1 Introduction to the scenarios modeling exercise

LAC agriculture and food systems have enormous potential to contribute to growth, employment, and food and nutrition security while sustaining global and local natural capital endowments. But while everybody agrees that high-performing agriculture and food systems will remain integral to the health and well-being of people and to the sustainability of the planet, developing efficient, inclusive, nutritious, and environmentally sustainable agriculture and food systems will not be easy. Efforts by many actors, working on numerous fronts, will be needed to ensure that agriculture and food systems evolve in ways that lead to desired outcomes, taking advantage of emerging opportunities while mitigating against risks that in some cases could prove catastrophic if not properly managed. Planning those actions and implementing them in timely fashion poses daunting challenges, because while certain aspects of the future can be anticipated, others remain highly uncertain, and some are completely unknowable.

The fact that the future is uncertain and to some extent unknowable does not mean we cannot prepare ourselves for what lies ahead. On the contrary: successfully navigating the uncertainty associated with the evolution of LAC agriculture and food systems will require careful observation of ongoing trends, timely anticipation of emerging challenges and opportunities, and thoughtful consideration of the many drivers that could influence future outcomes. Scenario building takes advantage of a useful set of tools that can be used to anticipate and explore potential futures and help inform policy choices and supporting investments. This section of the report summarizes the results of a scenario building exercise undertaken to broaden our perspectives on what the future may bring and to help identify actions that may be needed to prepare LAC agriculture and food systems to better confront the challenges that lie ahead.

The scenario building exercise carried out for this report used a mix of quantitative and qualitative methods to generate insights into some specific dimensions of potential futures. These are discussed in the next two sections.

5.2 Scenarios: Quantitative

In the first part of the scenario building exercise, state-of the-art modeling tools were used to explore how several key drivers might affect agriculture and food systems in Latin America. In addition to capturing the likely effects of several long-term trends (e.g., population growth, income gains, productivity growth), the scenarios explore likely impacts on LAC agriculture and food systems of two major disruptors: (1) climate change, and (2) trade policy. The simulations relating to climate change were done with the IMPACT partial equilibrium (PE) model, which can be used to explore the impacts of different climate change assumptions on cultivated area, yields, production, and consumption of agricultural commodities, among others. The simulations relating to trade policy were done using the MIRAGRODEP CGE model, which was used to explore the impacts of a series of disruptive trade policies (starting with trade tensions between the USA and China). The IMPACT and MIRAGRODEP models are maintained at and operated by the International Food Policy Research Institute (IFPRI).

Box 16. Scenario building: Methodological note

Porter (2004) defines a scenario as "an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome." Similarly, the Millennium Ecosystem Assessment (2005) characterizes scenarios as "plausible descriptions of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces."

Scenario building exercises can be categorized according to various dimensions. One distinction is between exercises that start from the present and explore the future versus exercises that start from a vision of the future and then try to determine the paths to get there (if the future is desirable) or to avoid getting there (if the future is undesirable). The two approaches sometimes are called "exploratory" and "normative," respectively, but both may involve exploration, and both can include values and norms. A second distinction is between scenario building exercises that use known data and relations to project the future (which usually are less participatory and interactive than other foresight exercises) versus scenario building exercises that depend on the views of experts, who provide opinions and cite the evidence on which those opinions are based (e.g., Delphi methods) (UNIDO 2005). A third distinction is between scenario building exercises that use quantitative methods, relying on numerical variables and indicators to characterize events, versus scenario building exercises that use qualitative methods, which may be more suitable when data are not available on variables of interest or when it is difficult to define and quantify the variables of interest.

Quantitative models have several advantages: they require thinking through and clearly specifying the way parameters affect outcomes; they are internally consistent; they can be based on actual data; and they can be used to examine impacts of individual drivers as well as impacts of groups of drivers. At the same time, they also have some disadvantages: they can be difficult and costly to construct; they can require a large amount of data, which may be difficult to collect and subject to unrecognized sampling biases or other limitations; and the structural relationships reflected in the mathematical specification of the model can change over time.

Qualitative approaches to scenario building also have advantages and disadvantages. When the futures being explored involve complex socio-economic-physical-biological systems whose interrelationships are difficult to capture in a mathematical specification or for which adequate data may not be available, a qualitative approach based on creative thinking and brainstorming may be appropriate. But qualitative approaches also come with weaknesses: scenarios are often built based on assumptions about drivers (trends and disruptors), but because these drivers are not related functionally, the scenarios may be subject to internal inconsistencies. Also, because they are not grounded in actual numbers, qualitative scenarios do not lend themselves readily to exploring in detail the possible impacts of changes in the value of individual drivers or specific sets of drivers.

When thinking about foresighting methods, a point to keep in mind is that any type of forward-looking modeling of complex systems—in this case the world in its economic, social, and environmental dimensions—should not be understood as an unconditional forecast of the future, but simply as offering qualitative or quantitative scenarios that may develop if the postulated key relations, parameters, and driving forces evolve as defined.

Source: Piñeiro and Díaz Bonilla (unpublished background note).

5.2.1 Exploring impacts of climate change[35]

In the IMPACT model, population growth and/or income gains increase demand for food; the increased demand exerts upward pressure on food prices, triggering additional investment in agricultural production that raises yields and inducing a shift in area planted to more profitable crops. Meanwhile, yields also rise due to exogenous technical change. Before exploring the likely impacts of climate change, it was necessary to project what is likely to happen in the absence of climate change. Using one of the intermediate shared socioeconomic pathways (SSPs) defined by the IPCC Fifth Assessment Report, yields were projected for LAC countries for a set of major crops, including maize, rice, wheat, soybeans, beans, sugarcane, coffee, bananas, tropical fruit, temperate fruit, and vegetables. Even in the absence of climate change, crop yields will change in response to price signals reflecting changes in demand and supply conditions.

Yield changes projected to occur between 2010 and 2030 vary considerably by crop (Figure 57). Cotton and vegetables are projected to increase the most, while bananas and temperate fruits are projected to increase the least. Interestingly, the size of the projected increases differs significantly by subregion, reflecting differences in demand and supply conditions. Ignoring several outliers, the projected yield increases are often higher than average in Guayana and Brazil and the Southern Cone, and they are often smaller than average in Central America and the Caribbean.

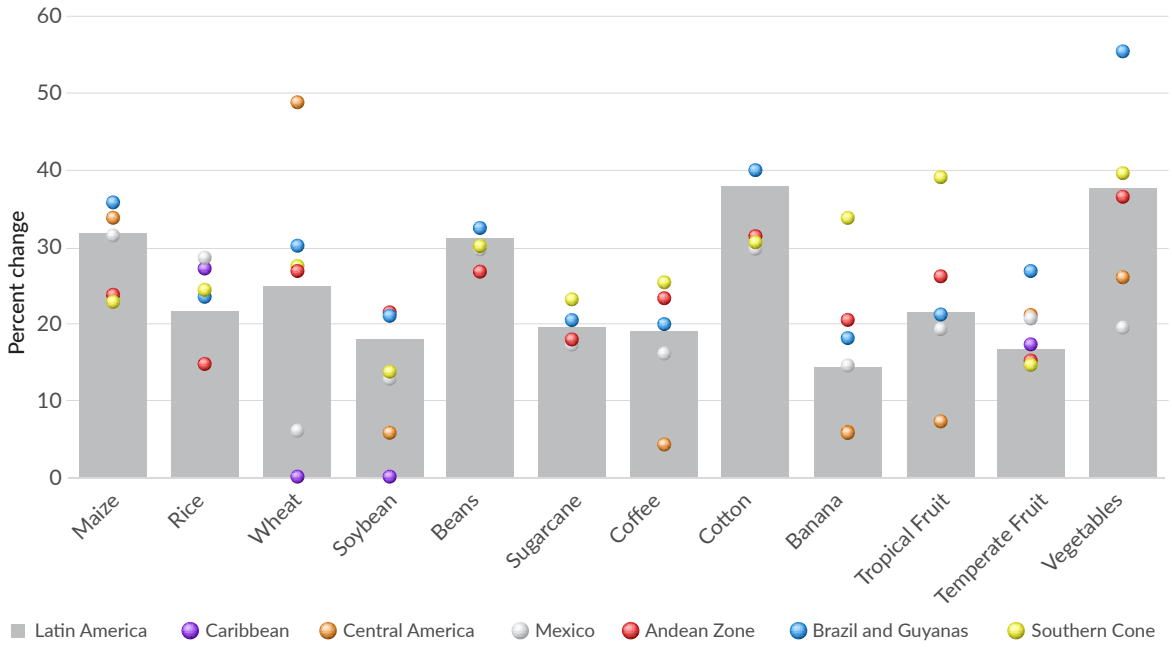


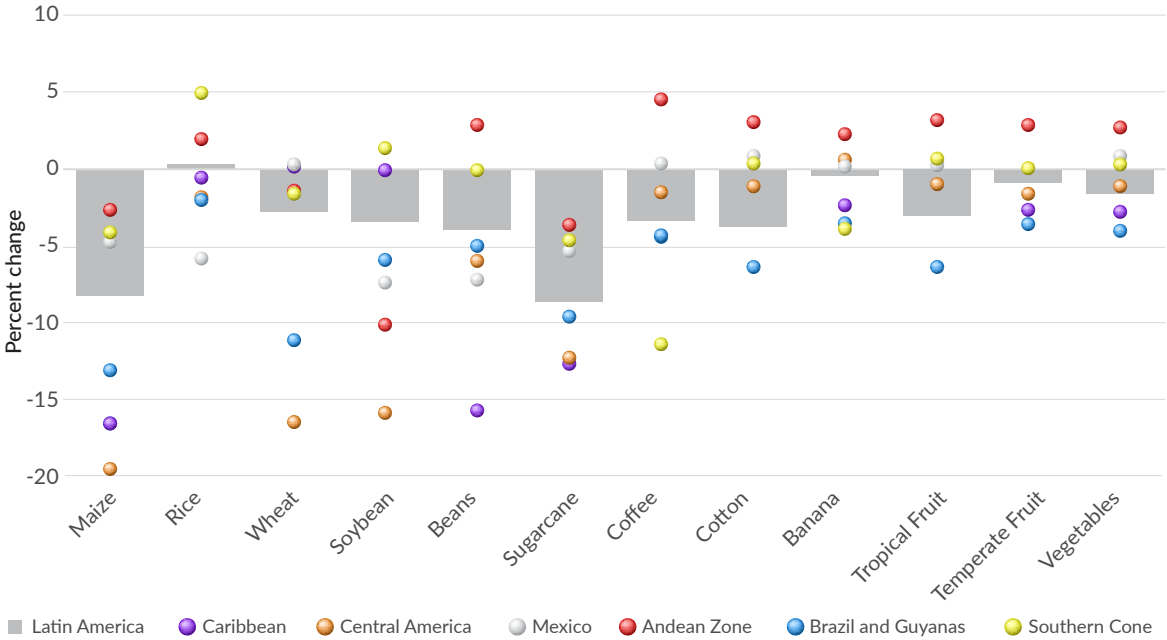
Figure 57. Projected increases in yields without climate change, LAC subregions, 2010 vs. 2030

Source: Sulser et al. 2015.

[35] Most of the projections reported in this section are based on median values calculated using results from four climate models. This approach does not always convey fully the level of uncertainty surrounding some of the estimates. Graphs and tables showing the variation among different climate models, as well as a more extensive discussion of the results presented here, can be found in a technical note produced by IFPRI as a separate output of the modeling work done for this report (see Thomas 2019).

Figure 58. Projected changes in yields due to climate change, LAC subregions, 2010 vs. 2030

Source: Sulser et al. 2015.



The impacts of climate change were simulated by shocking IMPACT with the results of crop models that used climate change projections generated by four leading climate change models.[36] Because every crop performs differently depending on agro-climatic conditions, temperature and precipitation changes generated by the climate change models will affect crop yields, sometimes positively but usually negatively.

The impact of climate change on crop yields in LAC is almost always negative, as reflected in the gray bars in Figure 58, which represent the median impact across the entire region of the four climate change models. One notable exception is rice, which on average is projected to experience a very slight increase in yields. For most crops, the projected yield decreases are modest on average (less that 5 percent). For maize and sugarcane, however, the projected yield decreases are more substantial (8 and 9 percent).

In addition to differing between crops, the projected impacts of climate change on crop yields also are projected to differ significantly by subregion. Central America will suffer particularly large yield decreases, especially in maize (-20 percent), wheat (-17 percent), and soybeans (-16 percent). The Caribbean subregion, along with Brazil and Guyanas, will also experience substantial yield decreases in some crops. In contrast, climate change is projected to boost average yields of some crops in some subregions. In the Andean subregion, milder temperatures and higher precipitation levels are projected to have a nonnegligible positive effect for many crops, including coffee, beans, rice, cotton, bananas, vegetables, tropical fruits, and temperate fruits. These differences are explained by the fact that different subregions will be affected differentially by climate change and that within those subregions the various crops typically differ in their ability to withstand changing agro-climatic

[36] Since there are dozens of global climate change models, all of which generate unique results, it was necessary to be selective. The work reported here used four of the five models selected for the AgMIP GGCMI study—namely, GFDL, HadGEM, IPSL, and MIROC (Rosenzweig et al. 2014). The fifth model was downscaled later than the other four and therefore was not included.

conditions related to changes in temperature levels, precipitation regimes, growing season lengths, and so on.

The IMPACT model results show not only the impacts of climate change on crop yields, but also the impacts on area harvested. The area harvested is affected in two ways: (i) directly through changes in temperatures and rainfall that make a given location more or less favorable for the production of a given crop, and (ii) indirectly through changes in prices (driven by changing demand and supply conditions) that influence the incentives to plant more or less of a given crop. The impact of climate change on area harvested varies by crop, as reflected in the gray bars in Figure 59, which represent the median impact of the four climate change models. Area harvested is projected to increase in most subregions for sugarcane, maize, soybeans, and rice, and it is expected to decrease in most subregions for wheat, beans, cotton, vegetables, and fruits. Area harvested for coffee and banana is projected to increase in some subregions and decrease in other subregions, resulting in a minimal net effect across the region as a whole.

The projected changes in crop yields and area harvested attributable to climate change can be combined to estimate the projected changes in overall production (Figure 60). Across the entire LAC region, production of all crops will be adversely affected, except for rice (which handles the temperature increase much better than the other crops and which currently is grown in areas of LAC with lower temperatures than the areas in which other crops are grown). The production declines will be most pronounced in wheat, cotton, beans, and maize; for all of these crops, both yield and area will be adversely affected by climate change.

Mirroring the regional heterogeneity in impacts on yields and area harvested, the impacts on overall production are projected to differ significantly by subregion. Central America will suffer particularly large production decreases, especially in wheat (-23 percent) and maize (-20 percent). Production

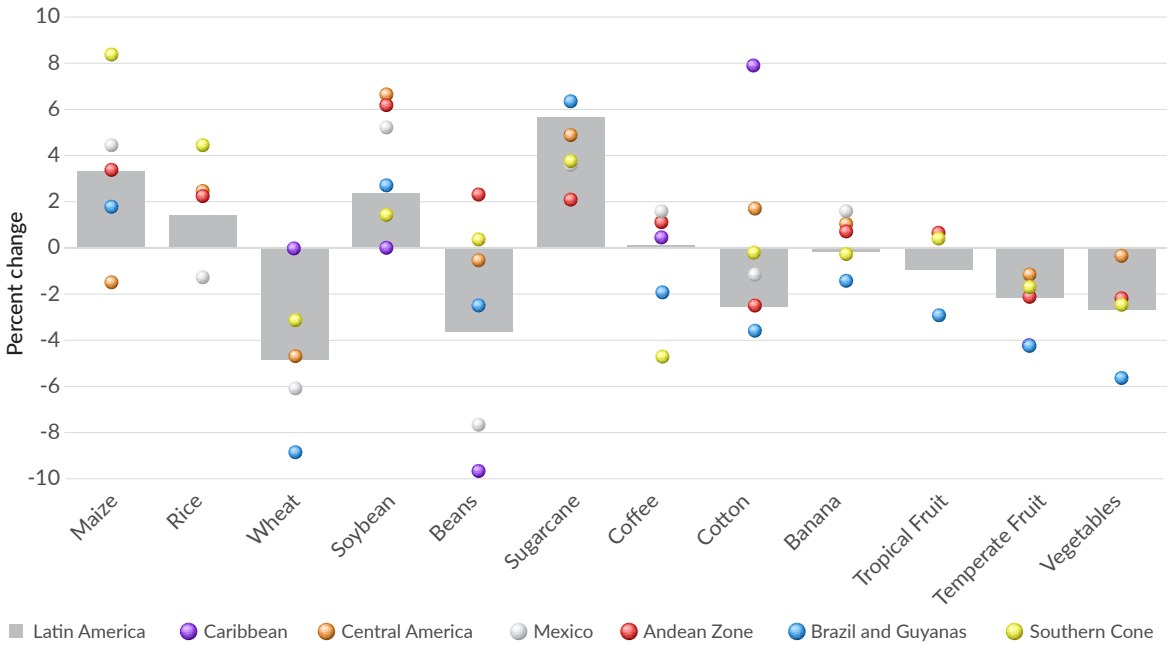
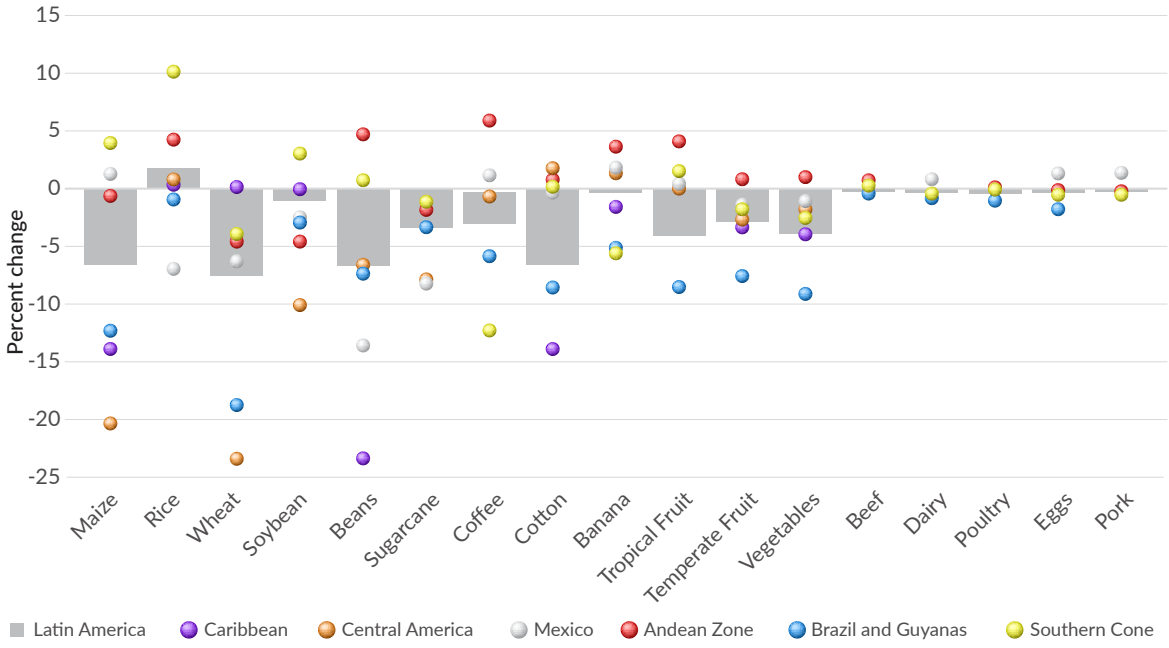


Figure 59. Projected changes in area harvested due to climate change, LAC subregions, 2010 vs. 2030

Source: Sulser et al. 2015.

Figure 60. Projected changes in production due to climate change, LAC subregions, 2010 vs. 2030

Source: Sulser et al. (2015).



decreases of this magnitude—especially considering that they affect leading staples—would significantly impact food supplies and quite possibly threaten food security for millions of households. Meanwhile, the Caribbean subregion will suffer particularly large production decreases in beans (-24 percent), maize (-14 percent), and cotton (-14 percent), raising similar concerns about threats to food security. In contrast, climate change is projected to boost production of some crops in some subregions. In the Andean subregion, changes in yields and area harvested are projected to have a non-negligible positive effect for many crops, including coffee, beans, rice, cotton, bananas, vegetables, tropical fruits, and temperate fruits, giving a potential boost to the agro-export sector in particular.

5.2.2 Exploring impacts of trade policy

LAC agriculture and food systems are well integrated into the world food economy, and many LAC countries are large net importers or large net exporters of agricultural commodities. Global trade policy therefore plays an important role in influencing production and consumption in the region. This has been very evident in recent years, which have featured dramatic changes in global agricultural trade flows as protectionism has resurfaced. Actions taken in 2018 and 2019 by the United States, China, and other countries are resulting in impacts being felt globally.

Latin America has been affected by the trade tensions between the United States and China. The two largest economies in the world are key partners for the region: they are both important importers and exporters, and their trade policies shape domestic markets in LAC as much as they affect global dynamics. To understand how LAC countries will be impacted by the trade tensions between the United States and China, one need only consider how the economies of the United States, China, and LAC countries are connected through trade (Figure 61). With respect to exports, both countries are important trading partners: China absorbs 13 percent of total agricultural exports from LAC, and

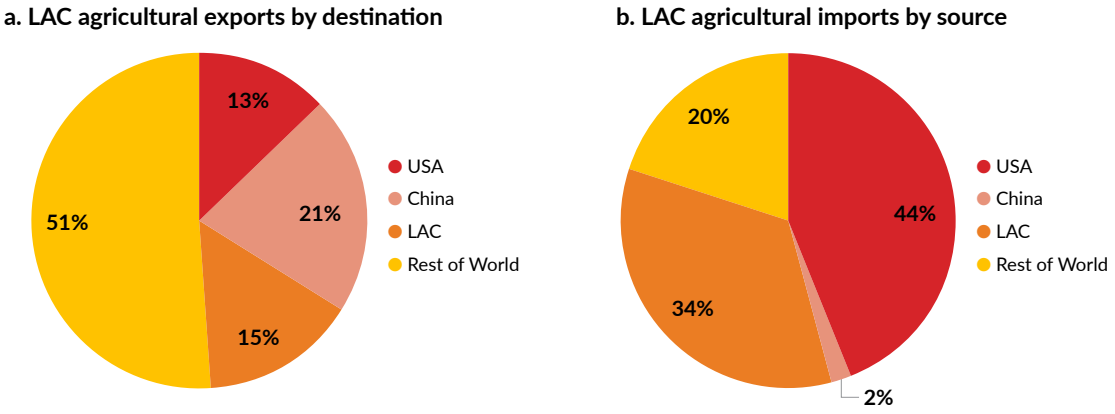


Figure 61.
LAC agricultural trade: Importance of key partners, 2014–2016

Source: Authors' computations, based on COMTRADE.

the United States absorbs 21 percent. With respect to imports, the importance of the two countries is very different: 44 percent of agricultural imports into LAC come from the United States, while the share coming from China is insignificant. It is important to note that intraregional trade within LAC is important, representing 21 percent of agricultural trade (imports plus exports).

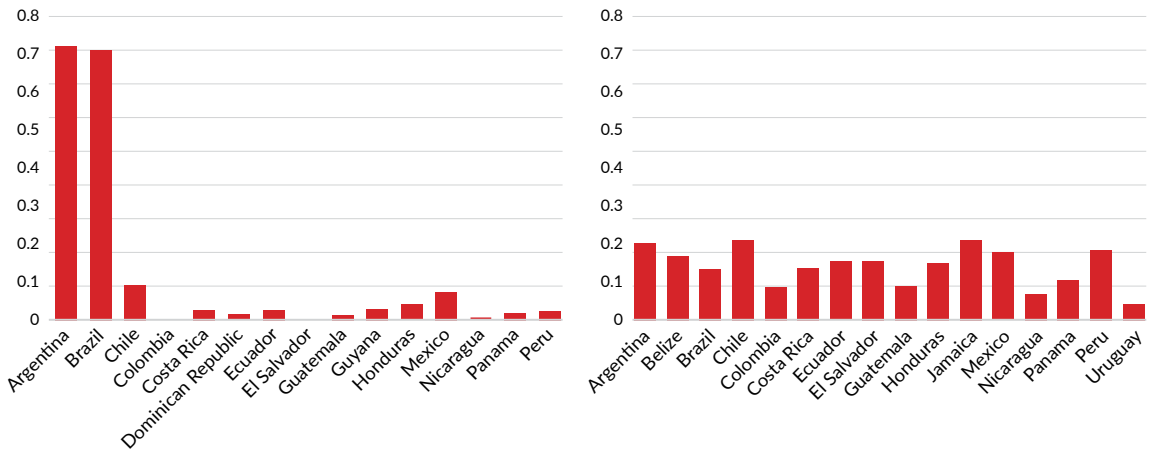
China and the United States are important trading partners for LAC, but due to the high level of heterogeneity within the region, the importance of China and the United States as trading partners varies from country to country. Different LAC countries have different degrees of engagement with China and the United States, and they also have very different patterns of product specialization. This means that individual LAC countries have very different degrees of exposure to changes in trade policies. To further complicate matters, the impacts of trade wars on individual countries are difficult to predict, because when targeted tariffs are increased as a result of a trade war, while this will negatively impact countries targeted by those tariffs, it can create opportunities for countries not targeted by the tariffs.

The degree to which individual LAC countries are likely to be affected—negatively or positively—by a change in trade policy depends on their export structure. LAC countries that are competitive in the goods being targeted in a trade war between other countries (in this case the United States and China) could potentially replace the countries whose exports are being targeted. The Export Similarity Index (ESI) developed by Finger and Kreinin (1979) measures the similarity between the exports of any two countries into a third country or market. The index is based on the share of each product in a country's total exports and is calculated as the sum of the minimum value for each product. An index value close to unity indicates that the two countries are competitors in the third market. An index value close to zero suggests little competition between the two countries in the third market.

Argentina and Brazil are very similar to the United States in the Chinese agricultural market (all three countries export large quantities of soybeans to China) (Figure 62). This implies that, to the extent the trade tensions between the United States and China disrupt US exports to China, Argentina and Brazil are well positioned to step in and fill the void. In contrast, when looking at the pattern of exports from LAC and China into the US agricultural market, the numbers are more homogeneous and smaller, showing less competition. This implies that, to the extent the trade tensions between the United States and China disrupt China's exports to the United States, it will have little impact on

Figure 62. Export Similarity Index (ESI) of LAC countries compared to United States and China

Source: Authors' computations by IFPRI, based on COMTRADE.



LAC trade prospects in the US market, with minor effects expected mainly in the markets for fruits and vegetables and fish products.

Future developments in trade policy are impossible to predict with certainty, making it difficult to predict how things will evolve going forward. Several scenarios can be envisioned, however, each of which could bring very different consequences for the global economy in general and LAC agriculture and food systems in particular. Three scenarios were explored for this report:

1. **United States versus China trade tensions continue.** This scenario focuses on the economic consequences of the trade tensions between the United States and China prevailing in mid-2019.

2. **United States versus China trade tensions escalate.** This scenario includes the measures listed in the first scenario and assumes as well the additional tariffs announced by the United States and China in January 2019. Included also are various tariff increases on steel and aluminum introduced in late 2018 by the United States, as well as the retaliatory actions taken by Canada, the European Union, India, Mexico, and Turkey.

3. **Trade wars break out worldwide.** This scenario explores the implications of an eventual escalation of the ongoing trade wars through tit-for-tat actions involving the United States, China, and other countries. This scenario mimics the noncooperative behavior seen during the global collapse episodes in the 1870s and 1930s. It represents a contagion scenario using the game theory approach developed in Bouët and Laborde (2017).

The MIRAGRODEP model was used to assess the impacts of the tariff changes associated with these three scenarios on a set of economic variables: exports, imports, production, GDP, household consumption, and adjustment costs through changes on labor markets. While the main focus of this report is on agricultural and food systems, it is important to remember that most trade wars will tend to affect both agriculture and non-agriculture sectors. Even when agricultural trade is not the primary focus of the trade war, tensions generated in non-agricultural sectors (e.g., steel tariffs) can lead to retaliation in the agriculture sector for the purpose of hurting a partner on its main exports. (Figure 63)

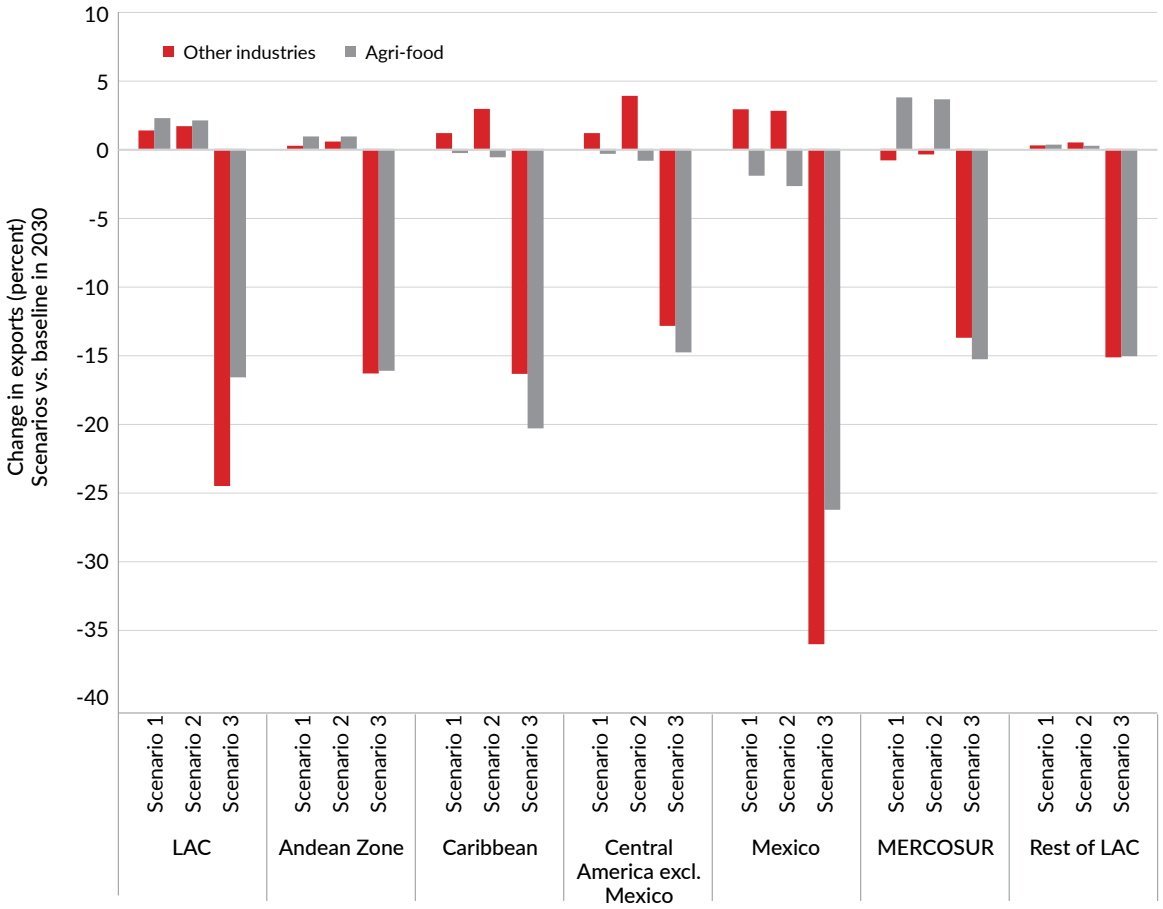


Figure 63. Changes in net trade under three trade war scenarios, LAC countries

Source: Authors, based on IFPRI MIRAGRODEP CGE simulations.

Note: Scenario 1 = **US vs. China;** Scenario 2 = **extended US-China trade tensions;** Scenario 3 = **escalating trade wars.**

United States versus trade tensions continue: If existing trade tensions continue through 2030, the rise in protectionism initially will benefit LAC as a whole, in the sense that net exports from the region will increase (agricultural exports will rise by 2.1 percent, and non-agricultural exports will rise by 1.2 percent). But these impacts will not be distributed equally throughout the region. MERCOSUR countries are likely to see their agricultural exports rise sharply to take advantage of attractive opportunities in Asia, but their industrial exports will fall. Central America, Mexico, and the Caribbean could see their non-agricultural exports increase as they move to fill the void in US markets created by import restrictions imposed on Chinese products in that market. The Andean subregion meanwhile is likely to remain relatively unaffected.

United States versus China trade tensions escalate. If existing trade tensions escalate, by 2030 some of these impacts will start to moderate. Under this scenario, net agricultural exports from the region will rise by less than 2 percent. Because LAC products will not be directly subject to tariff increases, LAC exporters will have opportunities to expand their market opportunities, replacing US products in third markets. At the same time, LAC exporters will be negatively impacted by the overall contraction in global demand.

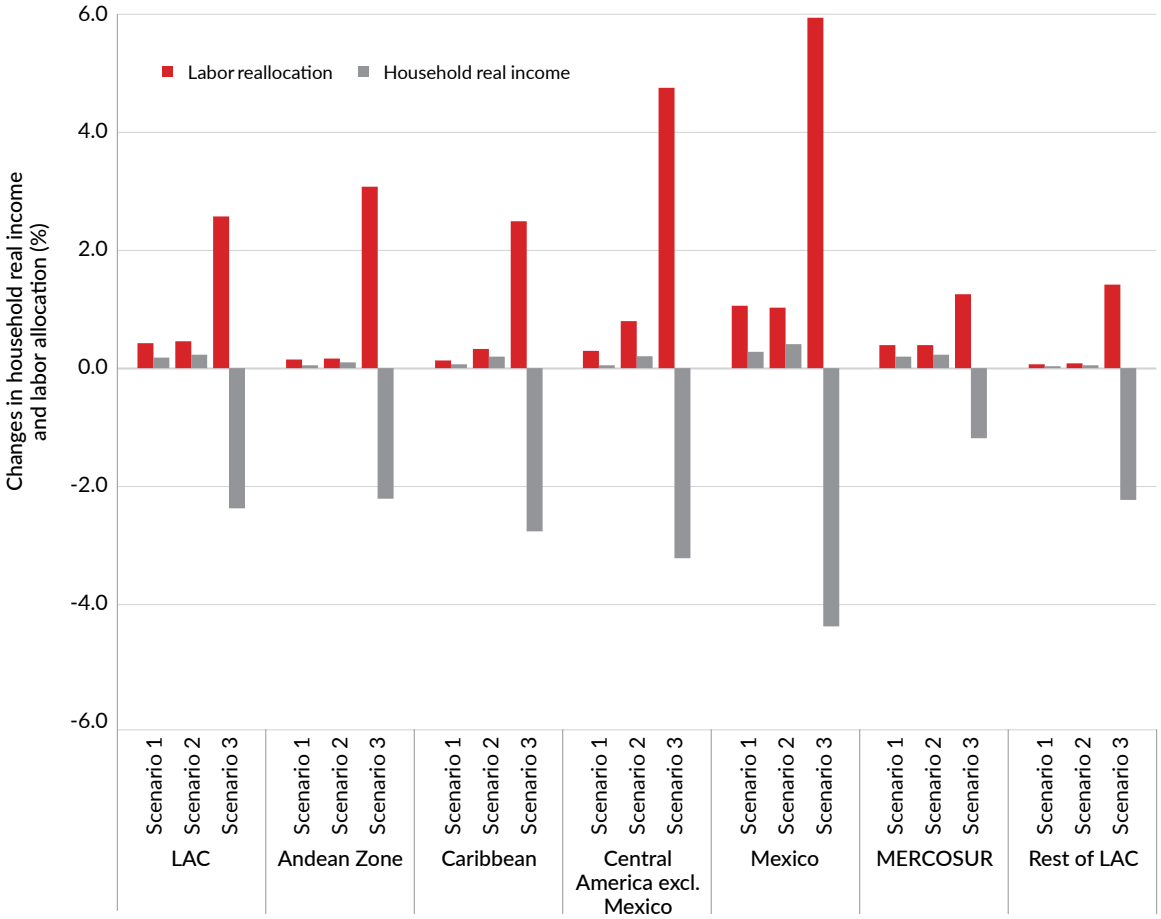
Trade wars break out worldwide: If trade tensions escalate to the point that full-blown tariff wars break out worldwide, the impacts would be devastating. Under this scenario, large tariff increases applied by all importing countries would have the effect of shrinking global trade in all goods by 27 percent. LAC countries will fare slightly better that the rest of the world; net exports of non-agricultural goods from LAC countries are projected to fall by 24 percent, and net exports of agricultural goods from LAC countries by only 16 percent. The resilience of agricultural exports to global trade shocks (an effect observed during the "Great Trade Collapse" of 2008) can be explained by the fact that food demand is far less elastic than non-food demand; consequently, even when food prices rise due to the imposition of tariffs, some food importing countries must continue to rely on purchasing in international markets.

The quantitative projections generated by the MIRAGRODEP model provide valuable insights about the direction and magnitude of changes in trade that would likely occur under three plausible trade scenarios involving changes in levels of tariffs. But changes in trading patterns are only one of the outcomes expected under the three scenarios. The model can be used as well to explore changes in two other variables of interest to policy makers: (i) household real income (a proxy for welfare), and (ii) allocation of labor to different sectors (a proxy for adjustment costs). (Figure 64)

With respect to household real income, all LAC subregions are likely to benefit under the first two scenarios, particularly the MERCOSUR countries (average increase of 0.19 percent) and Mexico

Figure 64. Income changes and labor reallocation under three trade war scenarios, LAC

Source: Authors, based on IFPRI MIRAGRODEP CGE simulations.



Note: Scenario 1 = **US vs. China;** Scenario 2 = **extended US-China trade tensions;** Scenario 3 = **escalating trade wars.**

(increase of 0.27 percent in the second scenario). Still, some countries are likely to suffer declines in household real income under the first two scenarios (e.g., Bolivia, Nicaragua, Paraguay, and some smaller Caribbean countries). But under the third scenario, the outcomes are very different: all subregions will experience declines in household real income.

With respect to changes in labor markets, the pattern is similar. Under the first two scenarios, all LAC subregions are likely to benefit, with the Central American subregion particularly well-positioned to seize opportunities to generate new jobs. Meanwhile, labor market reallocation will be more modest in the MERCOSUR countries and in the Andean subregion. Under the third scenario, however, labor market impacts are significant. Labor market adjustment costs will be particularly important in Mexico and Central America, where up to 6 percent of workers will lose their jobs and be forced to seek employment in another sector. Labor market adjustment costs will also be significant in the Andean subregion, where about 3 percent of workers will be forced to adjust.

The quantitative projections generated by the MIRAGRODEP model also can be used to explore the likely impacts of the three trade scenarios on GDP. GDP responds to the three scenarios in much the same way as household income: the first two scenarios bring some potential gains for some countries, while the third scenario brings an economic contraction in the region and within the region (Figure 65).

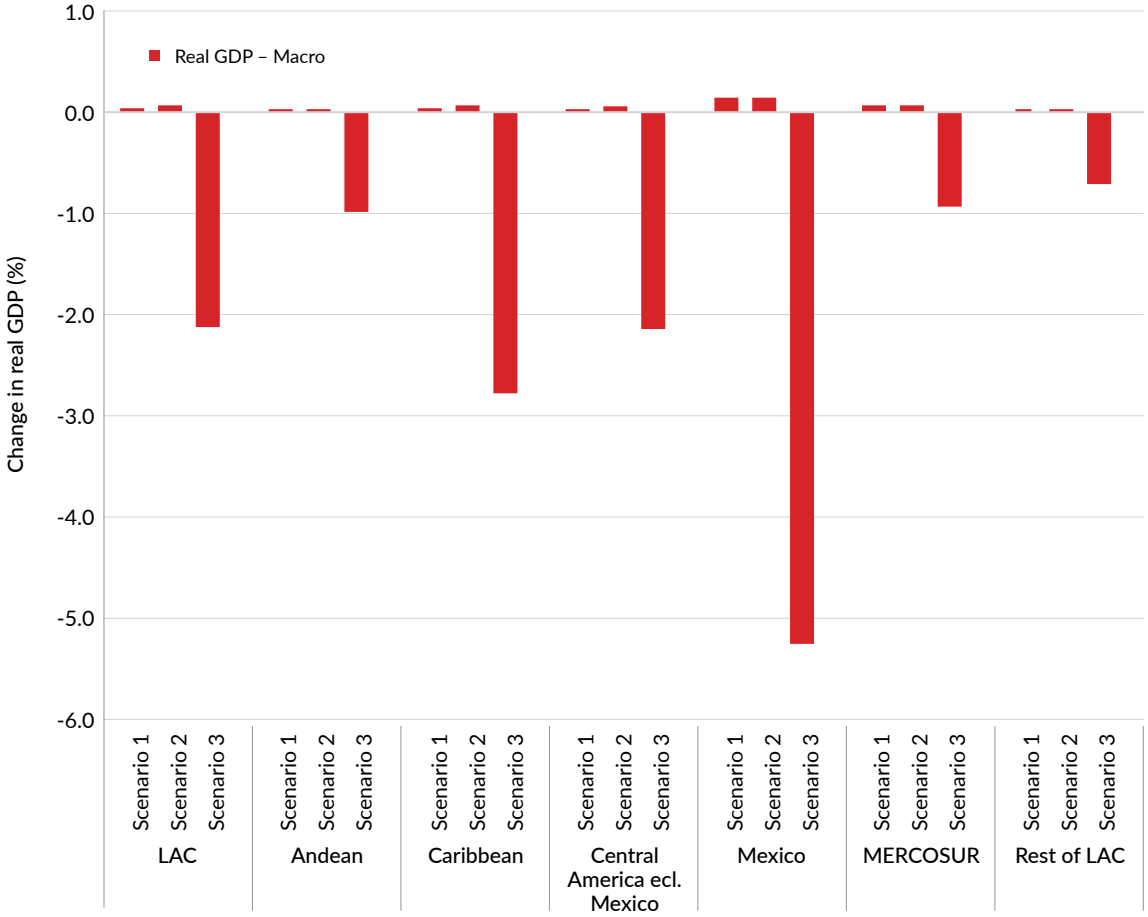


Figure 65. Real GDP changes under three trade war scenarios, LAC

Source: Authors, based on IFPRI MIRAGRODEP CGE simulations.

Note: Scenario 1 = **US vs. China;** Scenario 2 = **extended US-China trade tensions;** Scenario 3 = **escalating trade wars.**

5.2.3 Insights from the use of quantitative methods to build scenarios

The work done with the IMPACT and MIRAGRODEP models to explore the potential impacts of climate change and trade policies on LAC agriculture and food systems illustrates how quantitative modeling tools can capture complex mechanisms and provide estimates of changes in variables of interest under alternative scenarios. The quantitative modeling work can help to identify what should be policy priorities and highlight key issues on which decision makers should focus.

Like all models, IMPACT and MIRAGRODEP are necessarily stylized, yet they manage to capture the diversity of LAC, a region that is home to nearly 700 million people and that spans over 21 million square kilometers, combining a wide range of agro-climatic conditions and hosting a range of different food systems. Because the models manage to capture this diversity, when they are used to explore scenarios, they reveal that different LAC subregions and different LAC countries face unique combinations of challenges and are presented with unique sets of opportunities.

If there is one lesson that emerges from the quantitative modeling work, it is that policy makers and others concerned with future of LAC agriculture and food systems should not invest too heavily on strategies predicated on a particular climate model being correct or a certain trade policy coming to fruition. Rather, policy makers should develop investments that enhance resilience and provide broad menus of options for economic agents exposed to climate change and trade policy uncertainties.

A final point emerging from the quantitative modeling work is that, while the high level of diversity found within LAC could be seen as posing a major challenge when it comes to defining a collective agenda, the region's diversity can also become an extremely valuable asset if it can be used properly. To manage risks effectively, it is necessary to have a diversified portfolio. The extremely diverse agriculture and food systems found in LAC comprise a diversified portfolio.

5.3 Scenarios: Qualitative

In the second part of the exercise, qualitative methods were used to explore how an expanded set of key drivers might affect agriculture and food systems in LAC. During a workshop held in February 2019 at the Inter-American Institute for Cooperation on Agriculture (IICA) in San José, Costa Rica, different combinations of drivers were used to construct a series of scenarios reflecting plausible agriculture and food systems outcomes by 2030. The workshop participants were selected to represent a range of agriculture and food system constituencies; they included LAC policy makers, representatives of multinational and national agribusiness firms, representatives from the commercial banking sector, producers and representatives of producer organizations, civil society organizations interested in smallholder agriculture and environmental issues, researchers and academics, and officials from international financial institutions and development agencies.

To make the scenarios building exercise more useful, a reduced set of drivers was used. Many of the trends have transformative potential (e.g., population growth, income growth, urbanization), yet they are of limited interest for building scenarios because they are highly certain to occur and their impacts are quite predictable. Because the main value of scenarios building is to provoke thinking about the actions that need to be taken to deal with uncertainty, the scenarios building exercise therefore focused primarily on drivers having the potential to be disruptive.

Table 7. **Drivers considered in the scenarios building exercise**

Category	Specific potential disruptors	Likely impacts			
		Productivity	Jobs	Nutrition	Environment
1. Macroeconomic forces	Global agricultural commodity prices	Major	Major	Moderate	Moderate
	Global energy prices	Major	Major	Limited	Moderate
	Currency stability	Major	Major	Limited	Limited
2. Migration	Fragility (sudden displacement/ refugee crises)	Major	Major	Major	Major
3. Changes in demand for food	Demand for healthy/ nutritious food	Moderate	Moderate	Major	Limited
	Reduced meat consumption	Limited	Limited	Major	Major
	Demand for locally sourced food	Moderate	Major	Major	Major
	Demand for traceability	Limited	Limited	Major	Major
4. Supply-side structural changes	Water availability for agriculture	Major	Limited	Limited	Major
	Food loss and waste	Major	Limited	Moderate	Major
	Degree of adoption of improved technologies	Major	Moderate	Limited	Major
	Extent of land degradation	Major	Limited	Limited	Major
5. Climate change	Increased weather volatility/ natural disasters	Major	Major	Major	Moderate
6. Changes in technology	New genomic technologies (crops and livestock)	Major	Major	Moderate	Moderate
	Precision agriculture for higher productivity	Major	Major	Limited	Moderate
	Big-data-driven insurance for smallholders	Major	Major	Limited	Limited
	Alternative proteins	Major	Limited	Major	Limited
	Automation/robotics to save labor	Major	Major	Limited	Limited
	Blockchain for improved traceability	Major	Limited	Major	Major
7. Policies and regulations	Trade openness	Major	Major	Major	Major
	Acceptability of GMOs	Major	Major	Major	Major
	Fertilizer and pesticide restrictions	Major	Major	Major	Major

Expected impact: Major Moderate Limited

Figure 66.

Building scenarios to imagine plausible future worlds

Using a methodology developed by McKinsey and Company, the workshop participants built scenarios by selecting sets of disruptors, choosing one of two plausible extreme values that each disruptor could take on by 2030, and imagining the world that would arise given the particular combination of disruptors and plausible values. Aspects of each scenario considered included the likely impacts on the four performance objectives (growth and diversification, employment and incomes, food and nutrition security, and ecosystem sustainability); the implications for different constituencies (government, producers and producer organizations, agribusiness firms, consumers); and the net benefits for LAC agriculture and food systems. In addition, an effort was made to identify signposts that would foretell if a particular scenario is materializing, as well as the actions that would need to be taken by different actors to position themselves accordingly.

Building on the results of the workshop, five scenarios were identified as reflecting a range of plausible configurations of LAC foodscapes in 2030: (1) The Age of Exodus, (2) Healthy Diets Rule, (3) Fragmented World, (4) LAC Agro-export Powerhouse, and (5) Agri-food 4.0.

Foodscape Scenario 1: The Age of Exodus

Main drivers: Population displacement and climate change

Political turmoil combined with economic instability in several LAC countries has generated unexpected massive interregional migration. Some more stable countries receive migrants, while other countries serve as transit points for migrants who then move on. Migration is driven mainly by deteriorating economic and labor conditions in the unstable countries, along with dwindling access to food. Many of the migrants are considered vulnerable; they include women, youth, the elderly, and otherwise marginalized populations. Sudden, large-scale influxes of displaced populations have placed a heavy economic burden on migrant-receiving countries, imposing large negative shocks reflected in falling growth rates, rising employment, reduced food availability, and heightened insecurity. The economies of most migrant-sending countries have contracted severely, with GDP shrinking by double digits. Migrant-receiving countries also have seen their economies contract, by an average of 1 to 2 percent in larger countries and up to 5 percent in smaller countries.

Adding to the refugee crisis, most LAC countries are feeling the long-term effects of climate change: gradual warming, changes in precipitation patterns, and rising CO_2 emissions. These long-term effects have been reflected in short-term increased volatility in weather patterns and a higher incidence of natural disasters, which have negatively impacted food production and pushed up food prices. The food price increases have not fully compensated for lower production, and as a result many farmers have seen their income fall. Urban populations have suffered most, particularly the poor who spend a large share of their income on food. High levels of food insecurity have led to poor health and nutrition outcomes, especially among the vulnerable. In rural areas, this has adversely affected the supply of agricultural labor. Poverty rates have risen in many LAC countries, placing a greater burden on health systems and creating the need for social safety nets.

The disruptions have exacted a heavy cost on LAC food systems, not only in primary production but also downstream in the agri-food processing, food retail, and food services industries. After many decades of being a net food exporter, for the first time the region has had to import agricultural commodities to overcome structural food deficits. Food prices have risen, weakening demand for

processed foods and discouraging restaurant dining. The food services industry has contracted, boosting unemployment and depressing wages as a large pool of low-skill food services workers competes for increasingly scarce jobs. As many households have retreated into subsistence farming, pressure on land has intensified, accelerating land degradation processes and threatening the long-term health of the natural resource base on which agriculture depends.

How do we get here? Emergence story line

This scenario emerges following an extended period of economic stagnation during which growth in many LAC countries fails to keep up with population increases, lowering standards of living and leaving increasing numbers of people trapped in poverty. Government policies fail to address the needs of the poor, and wealth gradually accumulates in the hands of a few. A challenging business environment characterized by excessive regulations constrains commercial activity, leading to a slowdown in investment that adversely affects agriculture and food systems along with all other sectors. Periodic food shortages become commonplace in many countries. Meanwhile, accelerating inflation driven by irresponsible macroeconomic policies undermines the purchasing power of many citizens.

The long-term decline affecting the economy more generally is reflected in lagging performance of the agricultural sector. In the absence of attractive employment opportunities, many urban dwellers move back to rural areas and turn to farming in an effort to produce food for their families. As more land is brought under cultivation, deforestation rates accelerate, reducing biodiversity and increasing GHG emissions. Lacking technical skills and without financial resources, many farmers rely on low-input, extensive farming practices that often prove unsustainable. Yields decline over time in many areas as the result of soil nutrient mining that eventually leaves large areas degraded and unproductive.

The flagging fortunes of agriculture are reflected in rising levels of food and nutrition insecurity. Falling incomes combined with rising food prices lead to lower caloric intake and a shift to more affordable processed foods, many of which have reduced nutritional content or contain high levels of unhealthy oils, fats, sugar, and salt. Nutritionally rich fruits and vegetables, along with meat and fish, become less available in the market as the diminished purchasing power of many consumers undermines incentives to produce these relatively more expensive foods. The changes in dietary patterns lead to higher incidence of illness, especially among the poor.

The growing malaise among disenfranchised segments of the population is reflected in increasing levels of crime, heightened insecurity, and occasional outbreaks of social unrest. The rapidly deteriorating living conditions embolden opposition parties, sparking street protests and leading to calls for changes in government. Outmigration from affected countries accelerates as increasing numbers of people decide to leave in search of better opportunities.

Foodscape Scenario 2: Healthy Diets Rule

Main driver: Shifting dietary patterns

Changes in food demand spurred by the desire of better educated, more nutritionally aware consumers to improve their diets and “eat healthy” have brought about a radical transformation of LAC agriculture and food systems. Diets throughout the region have become more diversified: consumption of fruits and vegetables has increased, consumption of cereals and starchy tubers has

stabilized, and consumption of animal-based proteins has declined. Increased diet diversity has led to a proliferation in food sources. The shifts in consumer preferences have been facilitated by and further stimulated rapid technological change. With more and more consumers insisting on knowing the sources of the food they put into their mouths, food systems have been forced to become more transparent. The need for traceability has accelerated the uptake of blockchain, the internet of things, and food sensing technologies.

The demand for more nutritious diets and the resulting proliferation in food sources have raised incentives for farmers to diversify their production systems. For many, this has had the effect of reducing their dependency on a limited set of crops, bringing the added benefit of increased resilience in the face of climatic and economic shocks. New technologies have had a transformative impact, driving significant productivity increases on the farm and all along the value chain. Increased productivity has led to greater profits and increased incomes for all food system actors.

Meanwhile, trade barriers have fallen as the world economy has become increasingly globalized. The lowering of trade barriers is allowing food to move more freely between countries and regions. This has had the effect of lowering prices of imported food, benefiting consumers in LAC net importing countries. It has also had the effect of increasing the prices of agricultural exports, benefiting producers in LAC net exporting countries.

In response to these changes, the pace of technical change has accelerated. Actors all along the value chain have been quick to take up digital technologies such as blockchain, the internet of things, geo-location and food sensing, which provide the high levels of food system transparency and traceability being demanded by consumers. In parallel, producers and food manufacturers have adopted other emerging biological technologies, such as gene editing, biofortification, and biopesticides, that allow them to offer consumers a greater variety of safe and nutritious foods produced in environmentally sustainable ways.

How do we get here?

This scenario emerges after governments in many LAC countries decide the best way to tackle spiraling health care costs is to invest massively in educating consumers about the importance of nutrition. As consumers become more knowledgeable, they use their pocketbooks to signal their preferences, demanding foods with enhanced nutritional content. Actors throughout the food system respond to the changing economic signals, adjusting the mix of products on offer and greening the value chains that deliver them to consumers. Encouraged by rapidly evolving consumer demand that has given rise to government-stipulated labeling requirements for nutritional content, the agribusiness sector moves proactively to certify that food products not only meet nutritional requirements but also comply with social and environmental standards. Food that is healthy and produced in a green way becomes broadly available throughout the LAC region and is increasingly sold in supermarkets and retail shops even in smaller cities and commercial centers. The price of these products initially increases as demand rises, but it soon stabilizes as local production competes with imports and technology catches up.

Tariffs and other trade barriers are substantially reduced, initially through a proliferation of bilateral and regional agreements that gradually become wider in scope, and later by further progress in multilateral trade negotiations under the framework of the World Trade Organization (WTO). This

makes it easier to import food from outside the region. While LAC consumers become increasingly more demanding, imported foods remain competitive in many LAC countries, because sanitary and phytosanitary regulations worldwide strengthen and become more harmonized.

Changing dietary patterns are reflected in improved nutritional outcomes for many. Rates of obesity and overweight decline as people consume healthier diets. The benefits are less pronounced among the poorest groups, however, as the cost of healthy and nutritious food remains relatively high compared to ultraprocessed and nutritionally less dense options.

Foodscape Scenario 3: Fragmented World

Main driver: Global trade disruptions

Escalating political tensions worldwide have given rise to increased trade barriers, reducing trade in food and non-food items. With access to global markets restricted, export-oriented producers in LAC net exporting countries have scaled back production, precipitating a recession in rural parts of the MERCOSUR countries. At the same time, the farming sectors in many LAC net importing countries have revived as producers seize new opportunities to meet demand in domestic markets. In these countries, increased investment in agriculture has generated many new jobs. Agricultural markets throughout LAC have become increasingly fragmented, and disparities between markets have become more pronounced.

With imported food less available and more expensive, LAC consumers have turned to domestically produced food. This poses no problem for the relatively small group of more educated and more affluent consumers who are interested in eating healthy, nutritious foods and can afford the higher prices that those foods command. Over time, their ranks have expanded as they have been joined by other consumer groups with particular interests, including those who have developed new respect for local culinary traditions, those wishing to reduce the environmental impacts of their food choices, and those who place importance on providing livelihood opportunities for local farmers and revitalizing rural communities. A series of niche markets have sprung up to meet the diverse needs of these various constituencies. But the new realities are not favorable for all. Low-income consumers—especially the urban poor who formerly relied heavily on imported staples—are having difficulty affording the higher prices of locally produced food, and they have been forced to adjust their consumption patterns, leading to a reduction in the quantity and quality of their diets.

An unexpected consequence of the growing reliance on locally sourced food is a marked increase in supply volatility. Because food prices are less cushioned by international prices, which tend to be relatively stable, weather-induced production shortfalls are more directly reflected in unstable prices and more frequent episodes of food insecurity. In most cases, these disruptions are relatively short-lived, but in the countries facing large structural food deficits that continue to rely on imports, these local production shortfalls can trigger major crises.

Increased production in traditional net importing countries has led to rapid expansion of the agricultural frontier. In many LAC countries where unused arable land is scarce, agricultural activities have expanded into marginal environments not suited for farming or, even worse, into forested areas. In the absence of effective regulation, sharply increased use of crop chemicals has led to increased incidence of land and water pollution, with adverse impacts on human health.

How do we get here?

This scenario emerges following the imposition of trade barriers, which have an immediate effect on global trade in agricultural commodities. As international prices for cereals and oilseeds decline, export-oriented producers and agribusiness firms in MERCOSUR countries see a decline in their fortunes; many producers in these countries scale back their activities, and growing numbers of agribusiness firms declare bankruptcy. Prices for agricultural land in these countries fall.

In LAC net importing countries, the slowdown in global trade has very different impacts. Imported foods become scarce, and food prices in local markets rise. Rising food prices stimulate increased investment in agriculture, leading to a boom in the farming sector and generating many new jobs. Prices of agricultural land in these countries strengthen, and agriculture expands farther into forest lands.

The food retailing sector becomes increasingly fragmented. High-end supermarkets step up advertising of nutritious, healthy, locally sourced foods, and gourmet and specialty food retailers proliferate. Farmers' markets spring up in many wealthy urban neighborhoods, and increasing volumes of food move through these markets. At the same time, traditional supermarkets struggle as the higher cost of locally produced food forces them to raise their prices, causing middle- and low-income consumers to decrease consumption of high-value fruits and vegetables and livestock products and increase consumption of low-margin staples. Traditional open-air markets experience a revival, while the supermarket sector consolidates.

Foodscape Scenario 4: LAC Agro-export Powerhouse

Main driver: Surging growth in global food demand

As a result of rapid population growth in Sub-Saharan Africa and Asia, demand for food has outstripped supply. The growing structural food deficits in the rest of the world have increased demand for LAC food exports. In response to rising international commodity prices, producers in LAC net exporting countries have expanded their agricultural activities and intensified their production practices. Increased investment in production, concentrated mainly in the large-scale agribusiness sector, has fueled strong growth in the sector, especially in the Southern Cone subregion but also to a lesser extent in the Andean subregion and in Central America. Backward and forward linkages from the boom in primary production are fueling rapid growth in the number of food-related small and medium enterprises (SMEs), creating many new jobs, contributing to a revitalization of the rural economy, and narrowing the rural-urban poverty gap. Investment in research and development has increased as agribusiness firms race to increase efficiency in increasingly competitive markets.

The global agricultural boom has brought many benefits for LAC, but the sailing has not been completely smooth. The effects of climate change are becoming increasingly evident throughout the region, as more frequent extreme weather events and natural disasters now routinely impact production, driving food prices higher and making them more volatile. Thanks to the widespread use of new digital technologies, commercial farmers have access to an increasingly sophisticated set of insurance products that they can use to manage risk, but availing themselves of these instruments raises costs and undermines profits. Insurance products are much less available to smallholders, many of whom remain very exposed to climate shocks.

Furthermore, the LAC agricultural boom is exacting a heavy cost on the environment. Commercial farmers have responded to rising commodity prices by intensifying their production practices, accelerating the rate of crop rotations and increasing application rates of purchased inputs including chemical fertilizers and crop chemicals. The more intensive production practices are causing adverse environmental impacts, especially in marginal environments where the resource base on which agriculture depends is less resilient.

Strengthening international commodity prices have brought important benefits for LAC producers, but the same cannot be said for LAC consumers. Those whose incomes have grown as a result of the booming agricultural economy are able to afford higher-quality, more diversified and more nutritious diets. But at the same time, higher food prices in domestic markets have undermined the purchasing power of the poor, with the impacts being felt especially in urban areas that have not benefited from the agricultural boom. Changes in dietary patterns have led to poor nutritional outcomes among the poorer segments of the population, and food insecurity has increased, especially in urban areas. Governments in a number of LAC countries have responded to the deteriorating nutritional situation by stepping up feeding programs targeted at particularly vulnerable groups in the population.

How do we get here?

This scenario emerges as a result of developments outside of the region. As global population growth outstrips increases in food production, rising food prices trigger social unrest in the megacities of Asia and Africa. Faced with large structural food deficits, governments in those regions have no choice but to step up food imports, leading to increased agricultural trade and strengthening international commodity prices.

The impacts in LAC are immediate. The market for agricultural land in many LAC countries heats up, and private investment in the agribusiness sector increases dramatically. Backward linkages fuel record growth in the agricultural services industries, with firms that provide production inputs and services generating record profits. Agribusiness firms not only increase their production capacity, they also ramp up investment in research and development to remain competitive in an increasingly crowded market.

Rapid expansion of the agricultural frontier imposes a cost on the natural resource base. In many LAC countries, agricultural activities expand into marginal environments not suited for farming. It soon becomes clear that rates of deforestation are accelerating, imposing an environmental cost whose impacts will be felt only over the long term. In the absence of effective regulation, more intensive application of fertilizers and crop chemicals leads to increased incidence of land and water pollution.

Foodscape Scenario 5: Agri-food 4.0

Main driver: Rapid technical change

New technologies have had a transformative impact on LAC agriculture and food systems, driving significant productivity increases on the farm. New technologies also have led to significant efficiencies further down the value chain in transport, storage, processing, and distribution by improving coordination, enhancing transparency, and reducing transactions costs. Increased productivity made possible by the new technologies has led to greater profits and increased incomes

for all food system actors. Consistent with the desire of many governments to reduce poverty and promote shared prosperity, the new technologies have facilitated the integration of smallholders into commercial value chains, opening up new pathways for poverty alleviation in smallholder settings.

Large numbers of people have been able to find attractive employment in the larger food system. While technology has reduced the need for low-paid, unskilled labor, the expansion of post-harvest value-adding activities has created many new opportunities downstream in the value chain, including in a range of thriving food services industries.

The increased productivity made possible by the new technologies has helped to contain increases in food prices, benefiting many consumers. Dietary patterns have shifted, driven by the desire of more educated and more affluent consumers to eat healthy and to reduce the environmental impacts of their food choices. Interest has grown in personalized nutrition and healthcare, and more people use mobile apps to drive their shopping and eating habits. The strong global economy is enabling more consumers to purchase food priced at its "real" cost, as influenced by new technologies and policies that support sustainable choices and healthy diets. Consumption of alternative proteins has become widespread, with many consumers now avoiding consumption of animal-based proteins for environmental and ethical reasons.

The percentage of the LAC population that is malnourished has reached an all-time low. Synergistic policies, business practices, and social efforts have increased accessibility to nutritious food and decreased the affordability and desirability of animal-based protein and foods high in sugar, salt, and fat. Thanks to marketing campaigns implemented through social media, it has become cool among younger generations to eat a healthy diet.

An additional benefit of the new technologies is that they have enabled productivity gains to be realized without exacting a heavy cost on the environment. New-age genomics combined with precision agriculture techniques have significantly boosted yields, reducing pressure to expand the area used for agriculture and reversing decades of deforestation. At the same time, cutting-edge sensing technology has allowed precise calibration of input applications, which, combined with sustainable management practices, means that farming can actually improve land quality. Climate change has been partially mitigated thanks to strong commitments on the part of many LAC governments and a proliferation of shared best practices. These are guided by the Paris Agreement and measured through metrics. While climate shocks still occur, their impact is mostly absorbed by more resilient food systems. The "mutual benefit" philosophy underlying this world is stewarded by strong civil society institutions and international organizations.

While most people have benefited from the adoption of new technologies, the gains have been distributed unequally. Lacking the knowledge, skills, and resources needed to participate effectively in the new, more connected economy, some farmers—particularly the elderly—have been displaced and have not been able to take up viable alternative livelihoods. Similarly, some low-income consumers are struggling to pay for more expensive food, now priced to reflect its full cost.

How do we get here?

This scenario is driven by the proliferation and widespread adoption of transformative technologies, made possible by government policies that facilitated and encouraged massive private investment

in research and development, as well as the commercial application of the resulting technologies. A critical feature of those policies were regulations that ensured widespread access to socially beneficial technologies and prevented appropriation and restricted use to benefit narrow commercial interests.

Reversing a long-standing trend, the farming population becomes younger and more educated. Attracted by the prospect of remunerative and personally fulfilling employment, young people are drawn to the sector, and enrollment in agricultural training programs swells. A new generation of highly skilled, technologically savvy entrepreneurs brings fresh enthusiasm into the sector and fuels a groundswell of innovation.

Technology penetrates deeply into every aspect of the agriculture and food system. The percentage of farmers using data systems to inform production decisions in real time increases dramatically. Further downstream in the value chain, new technologies improve coordination, enhance transparency, and reduce transaction costs. Food loss and waste decrease dramatically, encouraged by policy incentives.

Innovative financial instruments provide farmers and other food system actors with access to the capital needed to take advantage of the new technologies. For smallholder farmers, greater access to capital fuels a wave of investment in more efficient farming techniques.

Climate metrics and broader accounting regulations are in place, stabilizing natural resource usage. Deforestation slows and then reverses. Use of renewable energy surpasses use of nonrenewable energy based on fossil fuels.

5.3.1 Insights from the use of qualitative methods to build scenarios

As stipulated previously, the scenarios emerging from this exercise should not be understood as forecasts or projections. Rather, they represent a series of alternative futures that could materialize if the postulated drivers evolve in plausible ways. In that sense, the scenarios help us to imagine what the world could look like should different combinations of drivers—both trends and disruptors—prove particularly influential in shaping the trajectory of LAC agriculture and food systems. By drawing attention to drivers that could be particularly influential, the scenarios help us to identify areas in which actions may be needed to avoid undesirable outcomes or seize desirable opportunities.

Among the many insights emerging from the qualitative scenarios building exercise, four stand out. First, supply-side factors and demand-side factors both have the potential to drive the trajectory of agriculture and food systems, so it would be a mistake to focus exclusively on one or the other. Second, large, well-integrated markets have enormous power to cushion shocks, so the degree of openness of the global trading system matters enormously. Third, technology can have a transformative effect on agriculture and food systems, but technology is a two-edged sword: if properly managed, it can have enormous benefits, but if improperly managed, it can leave millions behind. Fourth, climate change is a wild card the impacts of which on LAC agriculture and food systems could range from fairly modest to severe.

An additional insight emerging from the qualitative modeling work is similar to the insight that emerged from the quantitative modeling work described earlier: because different drivers are likely to impact LAC agriculture and food systems differently, the region's diversity can be a valuable asset if it can be used properly. Policy makers thus need to embrace diversity, avoiding the inclination to replicate everywhere some variation of the same "modern" food system. They should instead focus on encouraging the emergence of multifaceted food systems that perform up to modern standards of efficiency and hygiene but at the same time incorporate and derive value from local knowledge and traditions.

5.3.2 Value of the scenario building exercise

The five future foodscapes described above contain important information that can be helpful in identifying actions needed to shape the future trajectory of LAC agriculture and food systems, but they do not reflect the full value of the scenarios building exercise. As important as identifying potential future foodscapes was in itself, equally important was the process used to generate these future foodscapes. The process comprised four important elements: (1) thoughtful pre-identification and validation of key drivers (trends and disruptors), (2) quantitative exploration of selected drivers using state-of-the-art modeling tools, (3) selection of workshop participants to include the widest possible range of relevant agriculture and food system perspectives, and (4) eliciting a wide range of plausible outcomes by using a scenarios building methodology that encouraged out-of-the-box thinking.

Perhaps predictably, at the beginning of the workshop, when the participants were asked to select key drivers they considered most likely to influence LAC agriculture and food systems through 2030, many made selections that reflected the interests of their own constituencies as producers, processors, consumers, champions of the environment, or regulators. Participants representing producer groups tended to focus on the importance of robust innovation systems and availability of production inputs. Participants representing the food industry stressed the importance of reliability of supply, robust agro-logistics systems, and the need for a conducive business climate. Participants representing consumer groups prioritized the availability, accessibility, and nutritional quality of food. Participants representing environmental interests highlighted sustainability issues and climate resilience. And public officials gave priority to areas in which policy reforms and supporting public investments are likely to have impact.

In many cases, the key drivers that were initially proposed for use in building scenarios were challenged by others having different views. The often animated discussions that ensued as proposals were contested and counterproposals defended opened new perspectives, forced the reconsideration of many prior notions, and in the end changed the mindsets of almost all the workshop participants. The participatory and iterative process led eventually to the identification of a wide range of plausible scenarios, all of which had been enriched by a multiplicity of perspectives and none of which would likely have been built by any of the participants working alone.

As the final step in the scenarios building exercise, the workshop participants were asked to identify actions needed to shape the trajectory of LAC agriculture and food systems so as to increase the likelihood of desirable outcomes and decrease the likelihood of undesirable outcomes. A critical subset of these proposed actions are discussed in the following section of this report.

Note: The scenario-building exercise carried out for this report predated the COVID-19 pandemic, which beginning in early 2020 enveloped the region and the rest of the world in a matter of months and touched all facets of socio-economic activity. But even if the five foodscapes identified through the scenario-building exercise were developed using drivers other than the one that disrupted the planet beginning in early 2020, the insights provided by those five scenarios and more importantly the proposed actions needed to prepare for a wide range of possible futures remain valid. The principal conclusions of the scenario-building exercise and the resulting recommendations therefore continue to meet the relevancy test.

Photo: MJ_Prototype.

Priority Entry Points: Changing the trajectory

CHAPTER 6

KEY MESSAGES

- With the goal of providing a menu of options to encourage the emergence of efficient, inclusive, climate-smart and resilient agri-food systems in LAC, a set of proposed actions is identified, consisting of policy reforms, institutional reforms, and investment choices.
- Two categories of proposed actions can be distinguished: (1) Imperatives, and (2) Strategic Choices. Each category can be further sub-divided into two action clusters.
- **Imperatives** are actions that can be considered mandatory, either because they are guaranteed to pay off or because they are needed to protect against risks that could be catastrophic. They include **No Regrets** actions and **Risk Mitigation** actions.
- **Strategic Choices** are actions that can be considered discretionary, because they are motivated by a desire to bring about improved performance outcomes but are not guaranteed to pay off. They include **Options Open** and **Game Changers**.
- To be effective, operationalization strategies for the proposed actions will need to be country-specific, and as such they will depend on an array of local circumstances and characteristics. The report lays out some general principles that should be considered in developing implementation strategies for the proposed actions.
- Business as usual is not an option. Now more than ever, in light of the COVID-19 pandemic, LAC agriculture and food systems demand attention. As policy makers have come to appreciate, agri-food systems have a key role to play in the region and worldwide.

6.1 Future agriculture and food systems: What do we expect them to deliver?

With the world population projected to grow to 8.5 billion by 2030 and to close to 10 billion by 2050, questions are being raised concerning whether global agriculture and food systems will be capable of keeping up with the rising demand for food coming from a population that will be not only more numerous but also wealthier. Can the needed production increases be achieved, even as pressure increases on already scarce land and water resources and the negative impacts of climate change intensify? And if the production increases can be achieved, will it happen in a way that is socially inclusive and environmentally sustainable? These are challenging questions, given that today hundreds of millions of people are chronically hungry, agriculture uses almost one-half of the vegetated land, and agriculture and related land-use changes generate an estimated one-quarter of annual greenhouse gas emissions.

The consensus view is that the world's agriculture and food systems are capable of producing enough food, but to do so in an inclusive and sustainable manner will require major changes. These changes will be needed to enable the emergence of technically efficient, economically profitable, and environmentally sustainable agriculture and food systems that contribute to the multiple objectives that have been described in this report: economic growth and diversification, employment and poverty reduction, food security and improved nutrition, and ecosystem services, including climate change mitigation. The changes will be needed to allow the world to achieve a socially inclusive and environmentally sustainable food future that will not only feed the population but will do so in a way that helps stabilize the climate, promote economic development, and reduce poverty.

These questions being asked of agriculture and food systems worldwide pertain to LAC as well, where the population is projected to grow from 660 million people today to 750 million by 2030 (UNDESA 2018) and 780 million by 2050 (UNFPA 2019). The questions actually have even greater relevance for LAC, because the future performance of LAC agriculture and food systems will have impacts not only within the region but also far beyond. What happens in LAC agriculture and food systems matters globally, for two main reasons. First, LAC is an important net exporter of food and agricultural commodities, accounting for 16 percent of total global food and primary agricultural exports. LAC farmers and ranchers directly feed millions of people in other regions, and LAC agricultural exports help keep international commodity prices low, making food more affordable even for those who are not directly consuming LAC commodities. Second, LAC biomes—such as those in the Amazon basin—provide many extremely important ecosystem services, including provisioning economically valuable goods, enabling nutrient cycling and soil formation, rainmaking, and regulating the climate by capturing and storing carbon. In many parts of LAC, expansion of the agricultural frontier is a major driver of deforestation, which is compromising the ability of the region's forests to deliver these ecosystem services. Estimates of the amount of carbon stored by the Amazonian rainforest vary, falling mainly in the range of 75 to 125 billion tons of carbon, but agreement is widespread that the Amazon basin contains more than one-third of all carbon stored by tropical forests worldwide. Should LAC agriculture and food systems continue to drive land use changes to the detriment of the region's natural biomes, then this could have significant adverse impacts on climate change, with severe consequences not only within the region but worldwide.

The fact that these developments in LAC have global repercussions points to a simple conclusion: the performance of LAC agriculture and food systems matters greatly, within the region and worldwide, so policies affecting the future of those systems are too important to be ignored. Policy makers, private firms, civil society organizations, and the public at large therefore share the responsibility for ensuring that emerging challenges are effectively addressed and promising opportunities successfully captured. In the absence of informed collective action, the consequences will be dire.

6.2 Future agriculture and food systems: How to get there from here?

What is needed to achieve the vison of a dynamic, resilient, technically efficient, economically affordable, socially inclusive, and ecologically sustainable food future for LAC? Answering this question is not easy, due to the vast amount of heterogeneity found within the region (geographical, agro-climatic, political, social, and economic); the complexity of LAC agriculture and food systems when considered in all their dimensions; the fact that LAC agriculture and food systems are continuously evolving and, in most countries, multiple stages of the food system are found side by side; and the difficulty of projecting with precision the influence of the drivers that have the potential to shape the future course of events.

This chapter identifies actions that merit priority attention on the part of policy makers and other key LAC agriculture and food system actors as they seek to position themselves for what might come ahead. Taking into account knowledge about the drivers that could affect system performance, as well as insights that emerged from the quantitative and qualitative scenarios modeling exercises described in Section 5, a set of actions was identified that offer opportunities to unlock transformational change that will contribute to the desired agriculture and food system outcomes. The initial large set of actions was then reduced to a more manageable set based on their perceived practicality and judgments about their likely impacts. The proposed actions will impact differentially the four main agriculture and food system outcomes: (1) growth and trade promotion, (2) job creation and poverty reduction, (3) food and nutrition security, and (4) climate resilience and ecosystem sustainability.

The proposed actions are classified into two categories: **Imperatives** and **Strategic Choices**. Each category in turn includes two types of proposed actions.

A. Imperatives

Imperatives are actions that can be considered essential, either because they are guaranteed to pay off or because they are needed to protect against risks that could be catastrophic.

1. No Regrets

These are actions that will pay off no matter what scenario materializes. Examples might be initiatives aimed at reducing market inefficiencies or building human or institutional capacity. Some No Regrets actions are relatively inexpensive to implement, while others can be pursued at a scale that makes them expensive. Even when the level of financial commitment is high, policy makers often focus on No Regrets actions because of their high probability of success.

Table 8. Proposed Actions: No Regrets

No Regrets Proposed Actions	Expected areas of impact			
	Growth and Trade Promotion	Job Creation and Poverty Reduction	Food and Nutrition Security	Climate Resilience and Ecosystem Sustainability
Strengthen agricultural research and extension systems	Major	Limited	Moderate	Moderate
Modernize agri-logistics infrastructure, including ICT	Major	Moderate	Moderate	Limited
Up-skill agriculture and food system workers	Moderate	Major	Limited	Limited
Promote healthy diets	Limited	Limited	Major	Moderate
Reduce food loss and waste	Moderate	Limited	Major	Major
Make agriculture and food systems climate smart	Moderate	Moderate	Limited	Major
Deepen rural financial markets	Major	Major	Moderate	Moderate
Improve land tenure security	Major	Major	Moderate	Moderate

Expected impact: Major Moderate Limited

2. Risk Mitigation

These are actions taken to reduce exposure to potential risks that could emerge under some scenarios. Examples might be putting in place early warning systems to guard against the impacts of climate change or strengthening systems to ensure food safety. Risk Mitigation actions often require relatively modest investments that generate returns under all circumstances but are especially valuable when more favorable scenarios fail to materialize. The desirability of implementing Risk Mitigation actions depends on the nature and scale of the risk, including the potential costs should the risk materialize, the cost of mitigating the risk, and the appetite of policy makers to avoid the risk.

Table 9. Proposed Actions: Risk Mitigation

Risk Mitigation Proposed Actions	Expected areas of impact			
	Growth and Trade Promotion	Job Creation and Poverty Reduction	Food and Nutrition Security	Climate Resilience and Ecosystem Sustainability
Step up climate monitoring	Moderate	Moderate	Moderate	Major
Strengthen defenses against food-borne diseases	Major	Moderate	Major	Limited
Build social safety nets that can be activated quickly in times of crisis	Moderate	Major	Major	Limited
Promote the use of financial instruments for managing risk	Major	Moderate	Moderate	Limited

Expected impact: Major Moderate Limited

B. Strategic Choices

Strategic Choices are actions that can be considered discretionary, because they are motivated by a desire to bring about improved performance outcomes but are not guaranteed to pay off.

3. Options Open

These are actions taken to maintain the option to play in the future as scenarios develop. Most Options Open actions involve making modest initial investments that will allow public or private actors to ramp up or scale back their level of engagement later as the scenario evolves. The desirability of implementing these actions depends on the nature and scale of the benefits that would be realized and the cost of implementing the action.

Table 10. Proposed Actions: Options Open

Options Open Proposed Actions	Expected areas of impact			
	Growth and Trade Promotion	Job Creation and Poverty Reduction	Food and Nutrition Security	Climate Resilience and Ecosystem Sustainability
Maintain access to established and emerging markets	●	●	●	●
Invest in irrigation where appropriate	●	●	●	●
Support development of biofortified foods and nutraceuticals	●	●	●	●
Facilitate the emergence of peri-urban and urban agriculture	●	●	●	●

Expected impact: ● Major ● Moderate ● Limited

4. Game Changers

These are large commitments designed to fundamentally change the trajectory of a complex system: in this case, LAC agriculture and food systems. They tend to require major capital investments that will result in extremely large payoffs under some scenarios and no payoffs under others. The desirability of implementing Game Changers will depend on policy makers' level of ambition as well as the country's resources and implementation capacity.

Table 11. Proposed Actions: Game Changers

Game Changers Proposed Actions	Expected areas of impact			
	Growth and Trade Promotion	Job Creation and Poverty Reduction	Food and Nutrition Security	Climate Resilience and Ecosystem Sustainability
Decouple all agricultural production support	●	●	●	●
Ensure that all agri-food system work is safe and fair	●	●	●	●
Make agri-food systems carbon neutral	●	●	●	●
Declare war on junk food	●	●	●	●

Expected impact: ● Major ● Moderate ● Limited

The four types of actions can be mapped in two-dimensional space, according to the level of risk and the level of commitment (Figure 67).

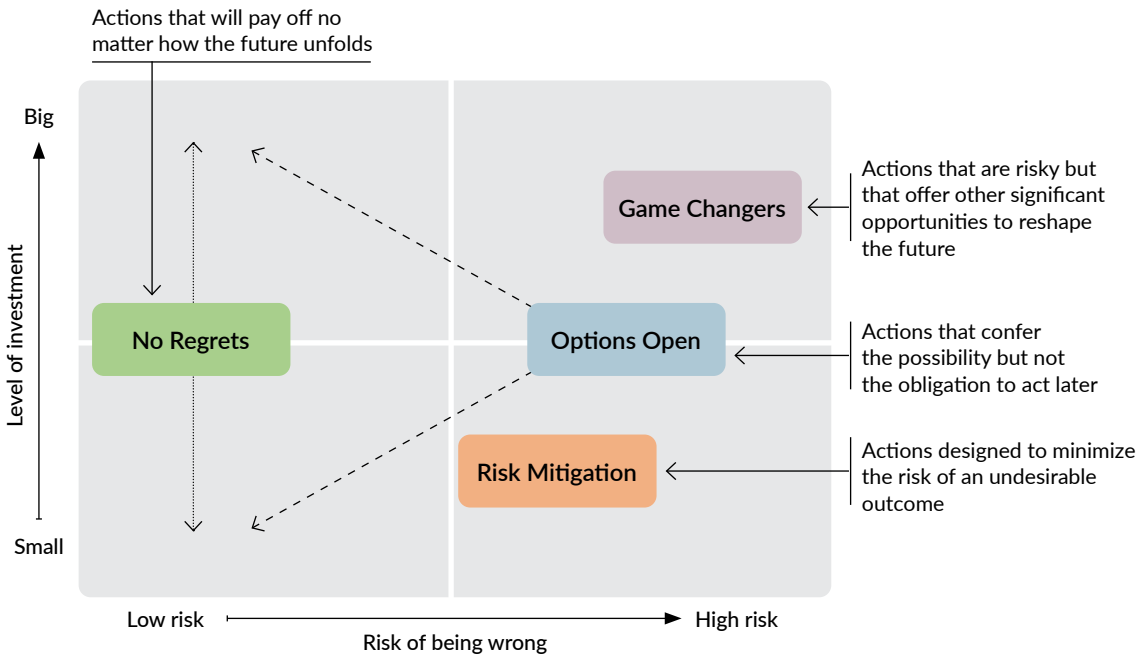


Figure 67. **Types of actions: Building blocks of a flexible strategy**

Distinguishing among these four types of actions can help in thinking about the strategies that could be pursued to improve the performance of LAC agriculture and food systems, but it is important to note that the same proposed action can fit into different categories depending on the circumstances. This is particularly the case with Risk Mitigation actions and Options Open actions. Normally these two types of actions would be undertaken when there is a high level of uncertainty about the future, but over time, as events play out and the level of uncertainty about the future diminishes, Risk Mitigation actions and Options Open actions either become converted into No Regrets actions or lose their relevance and disappear from the policy agenda.

6.3 Proposed actions to improve performance of future LAC agriculture and food systems

Proposed actions having potential to shape the future trajectory of LAC agriculture and food systems are described below. The proposed actions were identified based on a review of the forces that have influenced the performance of agriculture and food systems in the past (Section 2), as well as assessments of key drivers (Section 4) and of the insights derived from the forward-looking scenarios building exercise (Section 5). In view of the large amount of heterogeneity among and within individual Latin American and Caribbean countries, the proposed actions are necessarily described at a relatively high level of aggregation. Implementation details for each of the proposed actions at the subregional, national, or subnational level will vary depending on the local context. For each proposed action a set of operationalization principles is described that offer basic guidelines for the application of that action in any particular setting.

A. Imperatives

1. No Regrets

1. Strengthen agricultural research and extension systems

Productivity growth due to technical change has long been a powerful driver affecting the evolution of LAC agriculture and food systems, and it will continue to be one in the future. Research will play a vital role in generating the innovations needed to bring about the productivity gains that will lead to growth and diversification, and extension services will ensure that the innovations reach the end users. Even relatively modest changes in the rate of productivity growth can have large cumulative impacts over time. Because the benefits of research (especially basic research) are often difficult to appropriate, the private sector will tend to invest in such research at socially suboptimal levels, leaving a gap that must be made up by public investment.

Operationalization principles:

- Create an enabling environment for private investment in research and extension by simplifying intellectual property laws and streamlining product prototype development processes.
- Focus public resources on upstream research and research on topics that are unlikely to provide attractive commercial opportunities (e.g., orphan crops, smallholders).
- Promote innovative mechanisms for delivery of extension services to accelerate technology adoption while reducing service costs.
- Target extension services to encourage women to pursue agricultural entrepreneurship, innovation, and access to non-traditional export markets.

2. Modernize agri-logistics infrastructure, including for information and communications technology

Drivers acting on both supply and demand are profoundly affecting the way food is produced, handled, and consumed. One development has been a pronounced lengthening of supply chains, which affects price but also quality of food when it reaches consumers. Post-harvest practices play a critical role in determining the final price and quality attributes of food products, so investments are needed in agri-logistics infrastructure to ensure that food can move quickly and efficiently from farm to plate. Some agri-logistics investments will be assumed by the private sector (e.g., packing houses, processing and storage facilities, cold chains, vehicle fleets), while others will require commitments of public resources (e.g., roads, railways, port facilities, energy transmission lines, ICT infrastructure). As agriculture and food systems develop and physical connectivity challenges are overcome, the focus will shift increasingly to strengthening coordination mechanisms that can help to lower transaction cost, speed responsiveness to changing market conditions, reduce loss and waste, and enhance climate resilience. Emerging digital technologies offer enormous opportunities to transform LAC agriculture and food systems, but their potential will not be realized without ICT connectivity. In some LAC countries impressive progress

has already been made in extending ICT coverage, but in other LAC countries many people still have little or no access to the internet, especially in remote rural areas. As new technologies bring down connectivity costs, policy makers should consider massively scaling up ICT coverage, with the goal of ensuring secure, fast, low-cost internet coverage throughout the national territory.

Operationalization principles:

- Invest strategically in road, rail, and port infrastructure to improve connectivity between high-potential food production zones and important food consumption centers.
- Provide incentives to support start-up and growth of private agri-logistics firms through concessional regulatory policies combined with strategic investments in capacity building.
- Promote private investment in ICT infrastructure and manage the market for ICT services to ensure widespread availability of ICT services at affordable prices.
- Strengthen coordination for smoother and publicly accessible information flows through national price and information systems for all important commodities in important value chains.

3. Up-skill agriculture and food system workers

Lack of human capital poses a perennial constraint in LAC agriculture and food systems. Many workers struggle to keep up with the changing occupational needs required by rapidly evolving technology. The problem is particularly severe among women, youth, Afro-descendants, and other disadvantaged groups whose educational opportunities are often limited. In traditional food systems, the occupational needs are often quite basic, yet many workers especially in primary production lack even basic literacy and numeracy skills. In those contexts, efforts are needed to strengthen basic education provided through primary and secondary schools, which can be complemented by technical training targeted mainly at primary producers that may take place on-farm or off-farm. In transitional and integrated food systems, the occupational needs typically become more complex, as workers are expected to have the knowledge and skills needed to perform more challenging technical tasks and manage increasingly complex systems. In those contexts, research institutes and universities can often play a greater role serving workers and innovators funded through grants and scholarships. While some features of future LAC agriculture and food systems remain unknown, what is certain is that a better-educated and more skilled labor force will be needed regardless.

Operationalization principles:

- Improve basic education services, especially in rural areas that contribute disproportionately to the agri-food labor force, targeting vulnerable groups in the population. Focus on the specific skills development needs, barriers to education, and education sorting of women.

- Complement basic education services with specialized technical training relevant to the evolving needs of the agri-food sector, including by facilitating learning exchanges and formal courses of study in the agricultural sciences and related fields.
- Facilitate integration of agri-food system workers into the formal labor market, including through digital platforms that facilitate matching of labor supply and demand and public programs designed to support transitioning costs.

4. Promote healthy diets

The considerable benefits of good nutrition and the extremely high costs of poor nutrition are becoming increasingly evident. Yet despite the accumulating evidence, far too many people in LAC continue to consume diets that are nutritionally incomplete and/or high in unhealthy ingredients. Dietary patterns in LAC are beginning to change, but the rate of change is very slow, in part because too many consumers are unaware of the consequences of what they put on their plates and into their mouths. Consumers in many LAC countries also often are not aware of the composition and nutritional content of the food they purchase. The need for change through consumer education and regulatory reform on food may be less urgent in traditional food systems, where a much higher proportion of the diet tends to be locally sourced, so that its provenance is known. Attempts to impose high quality standards in such systems runs the risk of unnecessarily burdening producers and consumers with high costs. In contrast, in transitional and especially integrated systems, as supply chains become longer, the source of food is often unknown, lending increased importance to traceability.

Operationalization principles:

- Engage and empower consumers by increasing their knowledge about the benefits of healthy, nutritionally diverse diets, targeting especially groups most able to benefit from improved nutrition (e.g., school children, pregnant women, elderly people).
- Promote regulatory reform on food labeling and strengthen sanitary and phytosanitary standards and ensure traceability of food, so that consumers can know where their food comes from and how it was produced.
- Use feeding programs provided through publicly supported institutions (e.g., schools, hospitals, the military, prisons) to strengthen demand for nutrition-rich foods, thereby creating new opportunities for producers and agri-food firms.

5. Reduce food loss and waste

Recent estimates suggesting that as much as one-third of all food produced in LAC never makes it onto consumers' plates point to the enormous potential benefits that could be realized by reducing food loss and waste. The potential benefits may be less urgent in many traditional food systems, where a higher proportion of food comes from own production and where many consumers are

relatively poor and are motivated to make full use of the food available, regardless of its appearance, and to take advantage of all by-products. Awareness campaigns may be helpful, but regulatory reforms to provide greater flexibility to food distributors combined with supporting investments in post-harvest infrastructure and waste management practices show even more promise.

Operationalization principles:

- Support initiatives designed to raise public awareness about the high cost of food loss and waste and highlighting strategies for reducing the extent of the problem.
- Introduce mechanisms to facilitate the formation of alliances between producers, agri-logistics firms, wholesale and retail distributors, food service providers, and others to divert unused or unwanted food to productive uses, including production of compost, bio-fertilizers, feed, etc.
- Promote public and private investment in waste management systems equipped with more sophisticated sorting systems and composting mechanisms.
- Increase efficiency of agri-logistics and food distribution networks.

6. Make agriculture and food systems climate smart

Climate-smart technologies and practices have been identified for virtually all agriculture and food production systems and value chains in LAC, and new technologies and practices are appearing constantly. As the impacts of climate change intensify, undermining productivity and raising costs, policy makers should enact policies to ensure that climate-smart agriculture (CSA) practices are widely adopted to help safeguard productive capacity and ensure that agriculture and food systems continue to serve as dynamic engines of inclusive and sustainable growth.

Operationalization principles:

- Put systems in place for monitoring climate change, projecting likely impacts on productive systems, disseminating information to food system actors, and educating food system actors about the likely impacts on their productive enterprises.
- Scale up research on CSA technologies and practices.
- Incentivize adoption of viable and appropriate CSA technologies through subsidies, credit lines, and other programs that include payments for mitigation to contribute to country NDCs.
- Promote the development and uptake of financial risk management instruments appropriate for vulnerable agri-food system actors.

Box 17. Food loss and waste

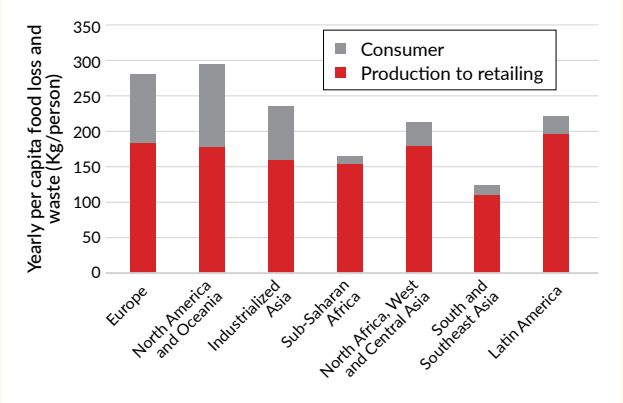
Among the many actions required to achieve sustainable food systems, reducing food loss and waste is crucial. Worldwide, approximately 1,300 million tons of food are lost or wasted each year, equivalent to about one-third of the food produced for human consumption and enough for 36 million people to meet their minimum caloric needs (FAO 2016a). The global cost of food loss and waste is estimated to exceed US$1 trillion. Food losses tend to be higher in developing economies, while food waste is typically more prevalent in highly urbanized and developed economies.

Food loss refers to the decrease in quantity or quality (appearance, flavor, texture and nutritional value) of food intended for human consumption. Loss occurs as food moves along the supply chain, mainly due to inefficiencies in post-harvest production, storage, and transport. The underlying causes of food loss typically include inadequate infrastructure, ineffective markets, distorted prices, and inappropriate policies. *Food waste* refers to the discarding of food appropriate for human consumption downstream in the value chain. This mainly occurs during food distribution and consumption, for example, when establishments that provide meals and consumers decide to throw away otherwise good food. Food waste tends to involve fresh produce that deviates from what is considered optimal in terms of shape, size, and color, as well as foods that are past the "best-before" date. In addition, a lot of food is unused or left over and discarded from household kitchens and eating establishments.

Food loss and waste (FLW) represent a misuse of the labor, water, energy, land, and other natural resources that go into producing food. Worldwide, FLW accounts for about 173 billion cubic meters of water consumption per year, representing 24 percent of all water used for agricultural production. In addition, about 1,400 million hectares are used to produce food that is not eaten. Inefficient use of natural resources is only one of the costs associated with FLW; another cost is the contribution to climate change. In 2012, the carbon emissions associated with FLW were estimated to be up to 5,600 million metric tons of carbon dioxide. If FLW were a country, it would rank third among producers of greenhouse gases, contributing about 8 percent of global emissions.

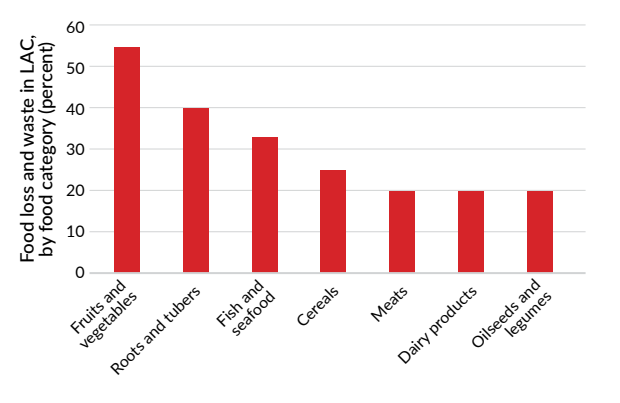
Globally, the level and relative importance of FLW varies by region (Figure 68). LAC performs better than some other regions, but reducing FLW continues to be a significant challenge. Across the entire region, more than 127 million tons of food are lost or wasted each year, equivalent to 223 kilograms per capita per year. Fruits and vegetables account for one-half of the total. Losses are particularly high in the case of fruits and vegetables (55 percent), roots and tubers (40 percent), and fish and seafood (33 percent) (Figure 69).

Figure 68. Food loss and waste by region



Source: FAO 2011.

Figure 69. Food loss and waste in LAC, by food category



Source: FAO 2016a.

Box 17. Food loss and waste (cont.)

Actions to address FLW include improving the efficiency of harvesting operations and post-harvest logistics, optimizing manufacturing lines, improving and expanding sustainable cold chains for food systems, standardizing labeling, educating consumers, adjusting regulatory frameworks to incentivize donations, and promoting home and community composting, among others. The effectiveness of each action will depend on the type of commodity involved and the specific characteristics of the local market, so it is important to understand the structure and dynamics of each value chain to identify where losses and waste are being generated. This means identifying where FLW occurs, what are the contributing factors, what corrections are needed, what are the associated costs, and who should take the lead in implementing solutions.

7. Deepen rural financial markets

Financial services can play an important role in boosting productivity in agriculture and food systems and stimulating increased economic activity throughout the value chain. Agri-food actors, both individuals and enterprises, that can establish bank accounts, obtain credit, purchase insurance, and access other financial services are better able to accumulate financial resources, invest in productive activities, and manage risk, all resulting in higher incomes. But they can access these services only if financial intermediaries reach rural landscapes and are ready to engage with a wide range of clients. Public policies can play an important role in promoting financial inclusion, especially when policies directly targeting the financial sector are complemented by policies in other areas. Digital technologies have the potential to play a particularly important role in promoting financial inclusion. In the past, farmers and poor households needed a certain level of education and technical skill to be able to access formal financial services. Digital technologies tailored to the needs of low-skill users are rapidly changing this traditional mindset by allowing clients with limited education and modest skills to access financial services that previously may have been out of reach, while at the same time allowing financial institutions to better customize their products, increase their efficiency, and extend their reach.

Operationalization principles:

- Support the development of innovative financial instruments and services adapted to the needs of all agriculture and food system actors.
- Introduce programs to build financial literacy in rural areas to strengthen demand for financial services among low-skill users. Support the creation and upgrading of the knowledge and skills of poor farmers, women, and other vulnerable groups.
- Provide incentives for financial intermediaries to widen and deepen their presence in rural areas and deploy more financial agents to provide physical presence.
- Address information problems caused by lack of experience among rural women borrowers, helping women access small-scale credit and build a track record of borrower performance.

Box 18. Financial inclusion in rural LAC: Expanding coverage with digital technologies

Financial inclusion—which refers to the willingness and ability of financial institutions to extend financial services to all potential users—is an important development objective. In most LAC countries, use of formal financial products and services by the rural population is still limited. This is particularly true among the poorest 40 percent of rural inhabitants. Measured in terms of ownership of an account in a financial institution, financial inclusion is especially high in Costa Rica, while it is very low in Mexico, even though Mexico's economy is very active (Villarreal 2017). Credit penetration is particularly low in rural areas of LAC and, as shown in Figure 70, the degree of economic development does not align with the share of loans.

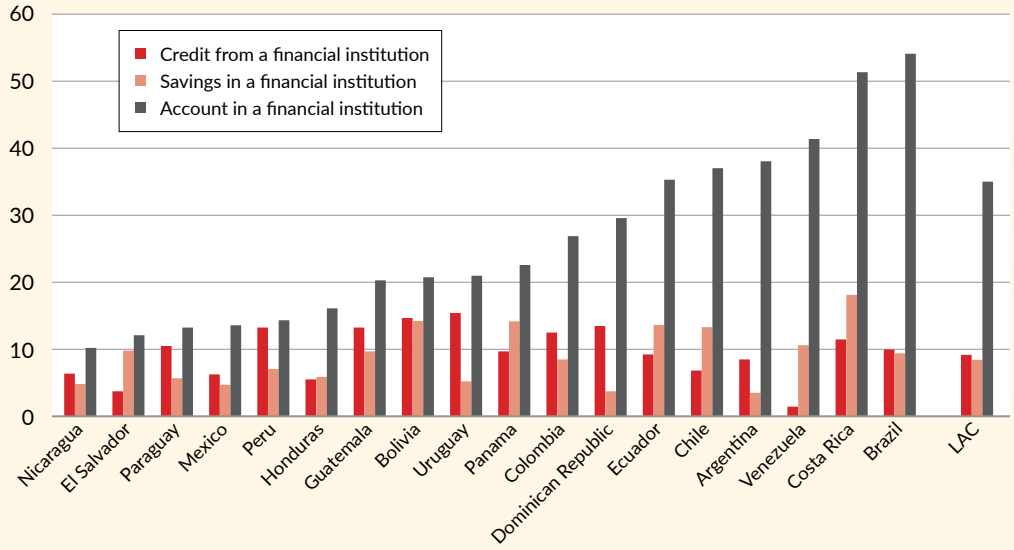


Figure 70.
Use of financial products by the rural population, LAC 2014

Source: Authors, using Villareal (2017) based on data from World Bank Global Findex data (2014).

Public policies can play an important role in promoting financial inclusion, especially when policies targeting the financial sector are complemented by policies in other areas. The 2018 Global Microscope on Financial Inclusion, which calculates an overall measure of financial inclusion for 55 countries worldwide based on a range of variables, including government and policy support, financial stability, and integrity, ranked Colombia and Peru as first and second, because the financial inclusion strategies in these two countries are backed by commissions comprised of members from multiple government entities and feature quantitative targets related to inclusion (EIU 2018).

In the agriculture sector, existing policies and programs often can be used to promote financial inclusion as an additional outcome. In countries where the public sector provides farmers and other producers with input subsidies or income support, the way the subsidies or income support is delivered can be used to increase financial inclusion. For example, if farmers are required to set up a bank account to receive a subsidy or income payment, they may avail themselves of additional financial services beyond simply receiving electronic payments. Also, if financial institutions have new customers opening accounts, they may also offer them other services.

Digital technologies have the potential to play a particularly important role in promoting financial inclusion among rural households in remote areas. Digital technologies tailored to the needs of low-skill users are rapidly bridging the gap by allowing clients with limited education and modest skills to access digital user interfaces and financial services that previously may have been out of reach. Digital technologies also benefit financial institutions directly by allowing them to better understand the needs and abilities of potential clients, develop specialized products tailored to a much wider range of those needs, and extend the reach of their financial services by lowering delivery and monitoring costs.

8. Improve land tenure security

Land tenure remains insecure in many LAC countries, adversely affecting the performance of agriculture and food systems. Denying large segments of society access to land and to the benefits of secure land tenure imposes large costs. Land tenure insecurity can be a major factor contributing to poverty, dependence, social instability (including conflicts and civil unrest), land abandonment, and migration. Smallholders who lack formal land ownership rights are often locked out of credit markets, have limited incentives to invest in land improvements, and may be forced to devote time and resources to protecting their claims. Meanwhile, large-scale investors may be discouraged by lack of secure tenure from consolidating landholdings and investing in improvements to natural capital. The consequences—reduced land productivity, higher production costs, and increased land degradation—reverberate throughout agriculture and food systems. Policy makers in LAC must make it a priority to invest in the technical and institutional infrastructure required for efficient and equitable land tenure administration, with the goal of ensuring property rights for both men and women, as this will enable much faster growth leading to significant improvements in incomes, food and nutrition security, health, and welfare.

Operationalization principles:

- Modernize land administration systems, for example by investing in remote sensing tools combined with big data management and processing systems.
- Design and promote fair and context-specific regulations to ensure that vulnerable populations, especially women, are included in property rights mapping exercises for formalizing deeds.
- Strengthen and streamline procedures for buying, renting, and selling land to facilitate consolidation of land in economically efficient holdings.

Box 19. Impacts of the novel coronavirus (COVID-19) pandemic on LAC agri-food systems

The sudden emergence of COVID-19 and its rapid spread across the globe, shortly before this report went to press, illustrates the potential risks posed by pandemics to global and regional supply chains, underscores the value of contemplating a wide range of possible scenarios, and highlights the importance of identifying measures to increase resilience. While the full scale of the pandemic's effects is unfolding and still unpredictable today, the impacts on LAC agri-food systems will undoubtedly be manifested in multiple dimensions.

The global health crisis triggered by COVID-19, which is playing out across LAC where it is jeopardizing the health and safety of millions of people, is starting to cause widespread economic hardship and uncertainty that particularly affect the more vulnerable, including the rural poor. The brief discussion below focuses on the still evolving implications for agri-food systems in LAC, which will need to be monitored closely, and on potential short, medium, and long-term policy and investment responses.

1 Trade disruptions

Many governments around the world, including in LAC, have sought to control the spread of the disease by closing borders, restricting the movement of people, and imposing social distancing measures and business lockdowns. Such restrictions usually do not apply to goods, but a few small exporting countries have imposed temporary export restrictions or other protectionist measures (for example, Honduras banned exports of red beans in April 2020). While these restrictions have contributed to localized shortages and some intra-regional disruptions in food exports, as of this writing the key metrics used to track global supplies of agricultural commodities and food–production, stocks, prices, and trade—are proving stable. In the case of LAC, through March 2020 the main supply chains for soya and beef exports appeared to have remained stable in terms of export volumes and prices.

2 Demand-side impacts

The economic repercussions of the COVID-19 crisis are already being felt in many sectors on which the majority of LAC countries depend, including productive sectors such as light manufacturing and mining, as well as services sectors such as transport and tourism (the latter especially important in the Caribbean subregion). As economic activity decelerates and in some cases comes to a complete stop, many households are suffering significant losses in income. The declining purchasing power of these households is directly affecting their ability to buy food or pay for other necessities. Demand for food being relatively price inelastic, it is likely that many low-income consumers are having to resort to coping mechanisms, such as reducing consumption or shifting to lower-cost foods with reduced nutritional content.

3 Supply-side impacts

Social distancing measures, mobility restrictions, and COVID-19-related health issues are reducing the supply of agricultural labor in LAC. Social distancing measures threaten to significantly affect processing and packing facilities, where large numbers of people work in close proximity to one another. Mobility restrictions are making it difficult for domestic food-system workers to travel from their homes to farms, factories, and stores, while the closing of national borders is starting to disrupt the movement of seasonal workers on which agri-food systems in many countries depend. Over the longer term, increases in morbidity and mortality are projected to reduce the size and productivity of the labor force. All of these factors acting in combination have potential to disrupt supply chains for inputs and outputs, raising production costs and contributing to productivity and efficiency declines.

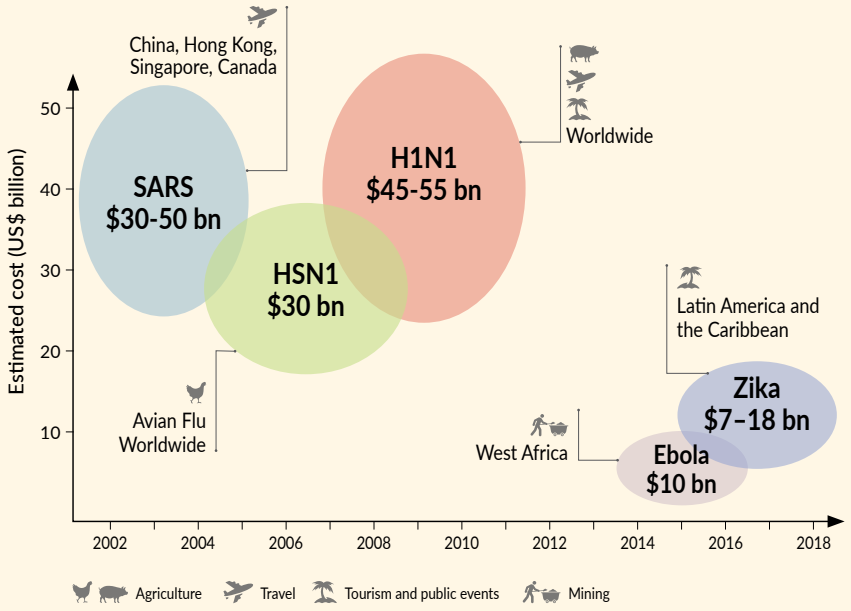
4 Macro-level fiscal shocks

Compounding the direct impacts from demand- and supply-side disruptions are shocks from macro-level forces. These shocks will manifest differently depending on a country's net trade position. For net food importers, increases in international food prices or global supply disruptions would mean rising costs and could lead to food shortages. For net food exporters, currency devaluations and rising international food prices could boost export earnings, but only if foreign demand is sustained and logistics disruptions do not impede trade flows. Significantly, these effects do not occur in a vacuum; they interact with declining oil prices, plummeting demand for commodities, exchange rate movements, rising liquidity constraints, sporadic droughts, periodic hurricanes, and political challenges. These many factors can produce the conditions for macro-level fiscal shocks, which could constrain the ability of many LAC governments to respond to the health crisis.

Figure 71.

Economic impact of emerging infectious disease outbreaks

Source: Berthe et al. 2018.



Immediate Responses, Medium-term Recovery, and Continued Resilience

Photo: zoranm.

The immediate response to the crisis must include urgent actions to preserve livelihoods and safeguard food security. The immediate priority for LAC governments must be to safeguard the health and safety of all people by controlling the spread of the virus and providing medical care to those in need. Beyond stopping the pandemic, other urgent measures need to be put in place to ensure the livelihoods and food security of the population, especially the most vulnerable.

- ***Preserving livelihoods*** requires solutions to stabilize production while preserving farmers' and workers' health. Possible measures include emergency supplies of productive inputs, critical farm extension and veterinary services, financial relief to SMEs and individual producers to allow them to overcome the temporary business downturn. To ensure that critical supply chains are maintained, especially the informal supply chains that handle a large proportion of food in many LAC countries, options must also be explored to ease the logistics barriers that prevent farmers from selling their products or buying inputs. All these measures should be accompanied by clear communication and effective implementation of regulations on "essential services", as well as clear guidelines on health and safety measures for food system workers.

- ***To safeguard food security***, social safety nets are needed to ensure access to safe and nutritious food, especially by vulnerable populations. In the worst cases, where markets are not safely functioning, direct distribution of safe food might be the only immediate option, whereas cash transfers are better-suited to a situation where food markets are working and food is available for purchase. Where vulnerable people depend on agriculture as a major livelihood source, safety nets can also be used to distribute productivity-enhancing inputs. Cash-for-work programs, on the other hand, might not be advisable, since they may involve physical proximity of workers that facilitates contagion. Countries can leverage big data and digital technologies to better monitor the food security situation and to design innovative approaches for food service delivery.

Medium-term food systems recovery means building back better. Systems, policies, institutions in the post-COVID-19 transition will need to be reframed to ensure cleaner, greener, and more inclusive foodscapes. Jobs and economic transformation should be at the center of this forward-looking strategy, building on resilient infrastructure and strengthened human capital. Measures in this sense include enhancing and innovating agri-food value chains, combining improved safety standards, climate-smart approaches, and new business formats including for agro-logistics systems; revisiting regulations on agricultural labor, also with an eye to re-skilling and up-skilling rural workers; and enhancing bio-security and food quality and safety, leveraging improved Sanitary and Phytosanitary Standards (SPS) systems to prevent the spread of pests or diseases among animals and plants, and to ensure that food is safe and nutritious for consumers. In particular, a critical step in building safer and better-functioning food systems will be to introduce traceability systems across all stages of the food chain.

Integrated risk management is paramount in order to both mitigate impacts and ensure sustained resilience. One message that the COVID-19 pandemic is painfully stressing is the importance of investing in preparedness. To ensure a more effective response in future, policy makers will need to assess and strengthen the performance of their countries' response systems. In particular, the way food is produced, transformed, moved and consumed is a major driver of risk of infectious diseases. This calls for new and better ways to establish preventative measures against infectious diseases at the human, animal, and ecosystem interfaces. Biosecurity considerations should be mainstreamed into national and regional crisis response frameworks and mechanisms in the agri-food sector, and attention will need to focus especially on preventative measures to improve resilience to zoonotic disease outbreaks. Endemic zoonotic pathogens infect billions of people and cause upward of two million deaths annually (Grace et al. 2012). Infectious disease events often have close associations with changing ecological and demographic conditions from anthropogenic activity (Romanelli et al. 2015). A serious corollary with worrying implications for food and economic security is antimicrobial resistance (AMR). Countries—especially those with significant livestock sectors—must consider policies, regulatory changes, and supporting investments to strengthen animal health surveillance programs, food safety standards, and innovative SPS systems.

2. Risk Mitigation

9. Step up climate monitoring

Rising temperatures, shifting precipitation patterns, and increased incidence of extreme weather events and natural disasters have the potential to severely disrupt agriculture and food production in many LAC countries. Central America and the Caribbean Region appear particularly vulnerable. Yet agri-food system actors will be able to adapt to the changing climate only if the impacts of climate change are well understood and detected far enough in advance to allow precautionary measures to be taken. To reduce the possibility that climate change will seriously impair the future performance of LAC agriculture and food systems, efforts are needed to identify and quantify the risks posed by climate change, develop and test measures that can be taken to mitigate those risks, and communicate this information to actors throughout the system. Unlike investments in measures that reduce GHG emissions, which produce global public goods that benefit the world at large, localized food system investments to reduce the impact of climate change produce combinations of public and private goods, some of which directly benefit the individuals and firms that finance the investments. For this reason, these investments should not require large public subsidies, although in some cases, some level of subsidy may be appropriate as poverty reduction measures.

Operationalization principles:

- Promote development of models that use information from sky-based remote sensing technologies and ground-based hydro-met monitoring technologies to monitor current weather patterns and forecast future weather patterns.
- Develop and put in place early warning systems that can quickly and effectively communicate climate-related information to agri-food system participants.
- Build public-private partnerships to facilitate the dissemination of climate information to noncommercial users including smallholder farmers in remote areas who are not willing or able to pay for generation of data.

10. Strengthen defenses against diseases, both food-borne and zoonotic

The development of agriculture and food systems is accompanied by industrial consolidation and scaling up of productive activities that offer opportunities for cost savings but also increase the risk that outbreaks of food-borne diseases will affect much larger numbers of people and exact greater economic costs. This risk is particularly acute in urban settings, where a higher proportion of meals is consumed outside the home (including in institutions) and where large numbers of consumers rely on the same sources of food. Regulatory reforms and supporting investments are needed to strengthen sanitary and phytosanitary standards and ensure their effective implementation. The need is especially urgent in transitional and modern systems, as supply chains become longer the source of food is often unknown, lending increased importance to traceability.

Zoonotic diseases pose a second major disease threat to agriculture and food systems. As the COVID-19 pandemic has made clear, the way food is produced, transformed, moved and consumed

is a major driver of risk of infectious diseases. Thus there is a need to establish preventative measures against infectious diseases at the human, animal, and ecosystem interfaces. Biosecurity considerations should be mainstreamed into national and regional crisis response frameworks in the agri-food sector, with attention closely focused on measures to ensure early detection of zoonotic disease outbreaks and comprehensive and timely tracking systems to allow close monitoring and eventual containment.

Food borne diseases and zoonotic diseases differ in some important respects, but they have two things in common. First, the outbreak and spread of both types of diseases usually originates in the way food is produced, transformed, moved, and consumed. Second, guarding against both types of diseases and managing outbreaks after they occur requires large-scale, coordinated efforts by public and private actors. Unfortunately, policy makers often fail to appreciate the scale of the risk posed by diseases, and governments therefore tend to underinvest in prevention. In many LAC countries, there is a need to spend more and more smartly on managing these risks and to better facilitate and empower the private sector and consumers to play their essential roles in ensuring safe outcomes.

Operationalization principles:

- Build public recognition that food safety and zoonotic disease prevention are shared responsibilities—among primary producers, food business operators, consumers, and government.
- Emphasize preventative (rather than reactive) measures, with priorities based on improved scientific evidence, and build capacity to take timely action to protect against outbreaks of animal, plant, and human diseases.
- Apply a risk-based approach to regulatory oversight, while facilitating the mainstreaming of good agricultural and manufacturing practices and safe food production and handling practices.
- Engage and empower consumers through multidirectional communications as well as education, labelling, standards, and other instruments.
- Ensure traceability in key value chains for quality and safety standards.

11. Build social safety nets that can be activated quickly in times of crisis

LAC agriculture and food systems will continue to suffer severe short-run shocks from various types of disruptive forces, including extreme weather events, natural disasters, political upheaval, and policy-induced price shocks. To cushion the impacts of these shocks and provide protection to the vulnerable populations most at risk of being adversely affected, LAC countries should ensure that social safety net programs are in place that could be activated quickly to permit distribution of emergency aid in times of crisis. Global experience shows that social protection systems that are in place before shocks hit are able to respond in a more timely and cost-effective manner than can initiatives that need to be launched in response to the shock. Social safety nets can take many forms, including food price subsidies, supplementary food or food vouchers, subsidized insurance (especially for smallholder farmers who do not have access to sophisticated risk management products), direct cash transfers, and labor guarantee schemes.

Operationalization principles:

- Put in place and maintain emergency response policies and programs that can be activated quickly in times of crisis.
- Take advantage of emerging digital technologies that allow accurate and low-cost identification and tracking of vulnerable populations, as well as rapid and low-cost distribution of accurately targeted payouts (cash transfers, food, or other forms of assistance).
- Where appropriate, use social protection programs to help households and communities build their resilience before shocks hit, for example, by using cash transfers combined with specialized training activity to help diversify livelihoods away from vulnerable activities.

12. Promote the use of financial instruments for managing risk

To reduce the vulnerability of food system actors to exogenous shocks that can undermine their incomes and threaten their livelihoods, efforts are needed to promote the use of financial instruments that protect against diverse risks. Of particular interest are many new types of insurance against losses caused by extreme weather events, which are appearing as emerging technologies lower the costs of quantifying losses and directing compensation more precisely to eligible beneficiaries. Similarly, as producers become more integrated into markets, they become increasingly vulnerable to unexpected price swings, the risk of which can be managed through financial instruments. The need is especially great in climate-vulnerable countries, particularly in traditional food systems that are dominated by smallholders, whom commercial financial institutions traditionally have had difficulty serving. Large-scale farmers often have access to a substantial set of increasingly sophisticated insurance products, but smallholders frequently do not enjoy the same opportunities, and they are therefore significantly more exposed to risk.

Operationalization principles:

- Invest in the collection and low-cost dissemination of reliable weather data with improved hazard monitoring and forecasting to help agri-food system actors who are vulnerable to weather hazards respond in timely fashion to emerging threats.
- Establish clear and transparent rules of the game, providing insurance companies with complete and accurate information about the financial resources available and an unambiguous legislative and regulatory framework for their operations.
- Build a solid insurance culture awareness among farmers by training them to understand the benefits of risk-transfer products, so they will not consider them to be an additional item in the production cost structure.
- When designing agricultural insurance instruments, recognize the particular needs of different potential clients and solicit input from a wide range of experts, including agro-meteorologists, agronomists, supply chain and agribusiness specialists, legal experts, and economists. Consider ways of levelling the playing field by designing innovative risk management instruments that are accessible to small farmers, women, and other vulnerable groups.

Box 20. Water resource management priorities

In LAC as in other regions, agriculture and food systems are critically dependent on water. Without water, crops cannot grow and agriculture cannot fulfil its fundamental role of feeding an ever-growing global population. In recognition of this reality, the 2030 Agenda for Sustainable Development acknowledges the importance of water scarcity and includes a specific water management target under Sustainable Development Goal 6.4.[35]

In many LAC countries, the vast majority of agricultural enterprises depend on rainfall as their principal source of water. This can be problematic, because rainfed agriculture is extremely exposed to weather-related disruptions in water availability. Droughts and floods can have major adverse impacts on agricultural production, and they are likely to become increasingly common as a result of climate change. Key strategies to increase resilience in rainfed agriculture include rainwater harvesting and storage, wetland expansion, water recycling and reuse, and wastewater management.

A more reliable way for farmers to avoid the risks posed by unreliable and/or inadequate rainfall is to invest in irrigation. Irrigation development can increase and stabilize yields, improve resilience in the face of climate change, and safeguard food and nutrition security for rural families. Recognizing these benefits, many countries have invested in irrigation. In Colombia, where land under irrigation only accounts for 6 percent of total irrigated land surface potential, the government is investing to increase coverage by 60 percent within the next 20 years (CONPES 2936, 2018). The area equipped for irrigation in LAC has more than doubled in recent decades, and in countries such as Ecuador, Chile, and Peru irrigated land now accounts for between 30 and 65 percent of all cultivated land.

While the expansion of the area equipped for irrigation in LAC is a positive development, many existing irrigation systems do not use water efficiently. More water is used than necessary, and water quality is adversely affected, contributing to soil degradation and environmental damage. These challenges can be addressed through reforms in water supply and demand management in a way that provides economically rational signals regarding the real scarcity value of water and taking into account environmental externalities. Although the optimal combination of policy instruments will vary depending on the location, financial availability, institutional capacity, and degree of water scarcity, a number of issues can be considered paramount for water efficiency and irrigation management throughout the LAC region:

1. **Efficiently increasing the water available for irrigation in a sustainable way.** Options to expand coverage, increase the quantity of water a system can deliver, improve reliability, and potentially reduce energy costs include pumping upgrades and improvements of conveyance infrastructure. One successful example in LAC is the Peru Irrigation Subsector Program, which has increased the efficiency and sustainability of existing public irrigation systems through the enhancement of the water conveyance efficiency of improved irrigation systems and the formalization about 190,000 new water rights, benefiting 135,000 farm families over a total irrigated area of 435,000 hectares.
2. **Mitigating water pollution and poor water quality.** Runoff, exposure to floodwaters, and excess wastewater in LAC threaten the quality of water resources returned to other systems intended for productive activities, including irrigated agriculture. Establishing water access rights can be a cost-effective method of increasing the amount of water that is reverted into the environment in a sustainable way. Because small towns and communities dependent on irrigated agriculture might be negatively impacted, however, appropriate complementary measures need to be put in place to restore equity.
3. **Introducing well-designed price controls, subsidies, and water valuation policies.** Many countries in LAC regulate the consumption of scarce groundwater through user subsidies, but, in the absence of additional policies sponsoring more efficient irrigation technologies and management practices, these schemes may not work. Electricity rate subsidies to poor farmers for pumping water, for instance, have produced negligible effects on the amount of water pumped and aquifer sustainability in Mexico (Tellez-Foster, Dinar, and Rapaport 2018). To avert overuse of water, some LAC countries have experimented with marginal cost pricing (MCP) mechanisms, which increase the price charged for water as water becomes more scarce.

Source: World Bank Water Global Practice.

[35] By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

B. Strategic Choices

3. Options Open

13. Maintain access to established and emerging markets

LAC agriculture and food systems will be able to grow and flourish only if there is strong effective demand for their products. For this reason, it is vitally important that LAC producers maintain access to market opportunities, both domestic and foreign. Maintaining access means not only recognizing changes in the types and quantities of products demanded in rapidly evolving markets, but also having the legal right and the technical ability to sell into those markets. This is relatively easier in domestic markets and much more challenging in foreign markets. LAC producers have demonstrated their ability to compete effectively in global markets, and a number of LAC countries have developed successful export agriculture sectors. As global demand for food continues to grow, driven by population growth and income gains, foreign markets will provide important opportunities for LAC countries not only to capitalize on the existing pattern of competitive advantage by increasing production, but also to seize important new opportunities to produce both bulk commodities and higher value added and/or niche products.

Operationalization principles:

- Build capacity to monitor supply and demand for agricultural products in domestic and foreign markets and to project changes in supply and demand that will create new market opportunities.
- Negotiate trade agreements with a range of trading partners to maintain access to attractive markets for traditional exports and to create new opportunities for non-traditional exports.
- Put in place robust traceability measures, rigorous quality control procedures, effective sanitary and phytosanitary systems, and comprehensive labeling practices to allow LAC exporters to document that their products meet increasingly stringent global health and safety requirements.

14. Invest in irrigation where appropriate

Rising temperatures, shifting precipitation patterns, and increasingly common extreme weather events and natural disasters have the potential to disrupt food production severely in many LAC countries, especially in Central America and the Caribbean region. Irrigation can play a critical role in boosting agricultural productivity and stabilizing production in the face of adverse weather conditions. In addition to contributing to risk mitigation, investment in irrigation can better position LAC countries to take advantage of future growth in demand for food despite increasingly adverse production conditions. At the same time, because the initial capital investment costs can be daunting, irrigation is not a panacea, and careful analysis is needed to ensure that irrigation makes sense economically.

Operationalization principles:

- Include as part of irrigation development planning not only assessment of the technical feasibility of irrigation, but also careful evaluation of the projected economic returns.
- Ensure that investments in the "hard" aspects of irrigation (infrastructure) are accompanied by investments in the "soft" aspects (operating systems that ensure efficient operation and equitable management).
- Combine irrigation development activities with agricultural intensification activities to ensure that the increased production potential associated with irrigation is effectively realized. Often this means complementary investments in research and extension, provision of improved inputs, promotion of improved management practices, and other measures.

15. Support development of biofortified foods and nutraceuticals

Growing interest in more nutritious foods and foods with a reduced environmental footprint is spurring the development of new generations of "superfoods" that have the potential to positively impact human nutrition and improve health outcomes. Supporting and leveraging the emergence of this nontraditional market represents an opportunity to diversify production toward higher value added products, as well as to develop new tools to improve nutrition security and diet quality for the future.

Operationalization principles:

- Establish a conducive enabling environment to leverage the significant profit opportunities offered by biofortified foods and nutraceuticals by encouraging private investment in their development and promotion.
- Put in place regulatory systems and testing protocols to ensure that the new foods are safe and do not cause harm to human health or to the environment.
- Strengthen traceability systems and labeling requirements to ensure that consumers have access to complete and accurate information about the origins of the foods they purchase as well as its benefits and potential costs.

16. Facilitate the emergence of peri-urban and urban agriculture

Locating food production facilities closer to densely populated consumption centers provides opportunities to reduce the cost of food (by lowering transportation costs) and improve its quality (by reducing distribution time). These advantages may be partly offset by the generally high cost of land and water in urban areas, the elevated energy needs when crops are grown in enclosed spaces, and the difficulty of disposing of effluents and waste. On balance, urban and peri-urban agriculture seems destined to play an increasingly important role in the years to come, as evidenced by the recent rapid growth in urban production systems, including vertical farming operations. Changes in the location of

food production will need to be accompanied by changes in post-production arrangements for transport, storage, processing, and distribution. Innovation will be needed to allow technologies to evolve in ways that raise productivity in the face of rising resource costs, shrinking production space, and continuous changes in consumer preferences. At the same time, rising population densities in expanding urban areas will increase the impacts of outbreaks of food-borne diseases, placing heightened pressure on systems put in place to ensure traceability of food and monitor food quality. Active promotion of urban food systems could have a transformative impact not only in heavily urbanized countries, but also in more rural ones, including many Caribbean states, where most primary production already takes place close to urban areas. To ensure that the urban food systems of the future are efficient, inclusive, and sustainable, however, actions are needed today.

Operationalization principles:

- Ensure that urban planning exercises include consideration of agriculture and food systems as integral components of urban ecosystems and devote adequate attention to agriculture and food system issues, including the location of production, processing, storage, and distribution facilities; management of the externalities associated with agricultural production processes (including noise, odors, and heat); and the disposal of outputs (especially toxic by-products).
- Sensitize municipal authorities to the need to ensure reliable access for urban and peri-urban farming enterprises to critical production inputs, especially water and energy. Recycled wastewater, when appropriately treated for agricultural reuse to minimize the risk of microbial food contamination and of water-borne diseases, will often be a viable source.
- Promote coordination across multiple levels of authorities and responsibilities to achieve comprehensive and holistic policy approaches, which are needed because urban and peri-urban agriculture raises a broad range of economic, environmental, and social issues.

4. Game Changers

17. Decouple all agricultural production support

Policies prevailing today in many LAC countries reflect a legacy of past eras when exchange rates, trade policies, producer price supports, input subsidies, concessional pricing for energy and water, and regulations affecting land ownership, among others, were used to shield inefficient producers from potentially harmful competition or to protect the livelihoods of vulnerable groups. Distortionary policies can be useful in meeting some short-term goals, but over the longer term they act as a drag on growth and prevent diversification into more productive activities. Many governments in LAC continue to provide support to agriculture, for a variety of reasons: increasing production of strategic crops, reducing variability in supply, shielding producers from foreign competitors, or supporting vulnerable groups in the population. LAC countries aiming to improve the competitiveness of their food and agriculture systems could change the nature of the game by committing to decoupling agricultural production support by making direct-to-farmer payments that do not depend on the farmers' current production levels. This would not mean reducing the level of support provided to agriculture; it would simply mean providing the support in a way that does not distort production incentives and encourage wasteful use of resources. Decoupling all production support would force agri-food producers to compete in a market where prices reflect real production costs, thus leading to fewer market distortions and incentivizing modernization and technical innovation. Decoupling payments carries potential risks, however: in the short run, production could be disrupted as producers adapt to the new realities, which could lead to political and economic strain. Still, the experience of countries like New Zealand, where payments have been successfully decoupled, shows that the benefits can be substantial over the long term.

Operationalization principles:

- Phase out policies that distort market prices for inputs and outputs, encourage overuse of unsafe and/or environmentally harmful products, and perpetuate the use of inefficient and nonsustainable production practices. Minimize disruption by using a gradual approach in phasing out price guarantees, input subsidies, and other forms of distortionary support, while gradually stepping up decoupled payments to maintain the overall level of support, if desirable.
- Use cross-compliance rules to link decoupled payments to other policy priorities. Introduce mechanisms that require producers to adopt green growth practices, adhere to health and safety standards, or support social objectives, ensuring that failure to comply will result in a cut in the level of support.
- Take advantage of emerging digital technologies to narrowly target recipients and scale the level of support provided according to the needs of different beneficiary groups, while reducing the cost and increasing the speed of transfers.

18. Ensure that agri-food system work is safe and fair

At a time when policy makers in many LAC countries are struggling to reduce high rates of chronic unemployment, agriculture and food systems offer opportunities to generate significant numbers of high-quality jobs. Opportunities are particularly promising in the food manufacturing and food services industries, where most value addition will be concentrated and earning prospects are higher. At the same time, advances in automation will eliminate many routine, manual jobs formerly carried out by unskilled workers, especially in primary production, so countries must stand ready to assist displaced workers transitioning between employment opportunities. Transitioning workers from low-quality jobs to high-quality jobs will bring many benefits, but the process could be disruptive, especially for those who work in the informal economy who cannot count on the protections offered by national labor standards and who are often subjected to low-paid, unsafe, and exploitative working conditions. LAC countries could change the nature of the game by committing to dramatically reducing informality in agricultural labor markets, with the objective of bringing the vast majority of workers into the formal economy where they would be covered by national labor standards relating to minimum wages, health, and safety.

Operationalization principles:

- Commit to a dramatic reduction in labor informality in the agri-food sector, focusing especially on primary production, food processing, and food services industries, where exploitative working conditions are most common.
- Put in place and aggressively enforce labor market regulations, focusing on wages, health insurance, and retirement benefits. Where possible, eliminate gender gaps in employment and labor conditions by correcting discriminatory laws and regulations. These regulations could include special provisions to allow flexibility in the hiring of seasonal workers required in many agri-food subsectors.
- Mobilize public-private partnerships to provide support to displaced workers as they transition between jobs, for example by creating training programs and offering apprenticeships to up-skill older workers and prepare them for the next generation of more demanding technical, professional, and managerial agri-food system jobs.

19. Make agri-food systems carbon neutral

Primary agriculture continues to have a disproportionately large impact on the ecosystem in many parts of Latin America and the Caribbean. Widespread overuse of nonsustainable production practices, in many cases involving heavy application of harmful chemicals or poor management of animal waste, has contributed to land degradation, along with soil, water, and air pollution. These factors, combined with steady population growth and poor policies, have forced the expansion of the agricultural frontier, exacting additional ecosystem costs from land-use change. Efforts are needed to promote the development and uptake of more efficient land and water management systems. Particularly urgent is the need to reduce the impact of the agri-food system on the climate. In LAC, as in other regions, the

agriculture sector is a leading source of GHG emissions. That poses a major problem, but it also presents an enormous opportunity to contribute to climate change mitigation. LAC countries could change the nature of the game by committing to dramatically reducing or even eliminating GHG from the agri-food sector. This would require complete "greening" of agri-food value chains, for example, through large-scale restoration of degraded lands, conversion of productive processes based on circular economy principles, systematic adoption of energy from renewable sources, complete elimination of food loss and waste, and other adaptations. The accelerating pace of technical change, propelled in part by disruptive digital technologies, is making increasingly feasible what once seemed like an impossible dream. Still, even if carbon neutrality is increasingly within reach, achieving the necessary transformation in the sector will not be easy. The up-front costs and short-term disruptions would be significant, while the benefits, even though enormous, would be realized only decades into the future and even beyond.

Operationalization principles:

- Close the agricultural frontier, for example through initiatives to stop deforestation, increase cropping intensity on cultivated lands, intensify livestock production, and restore degraded land. Where expansion of the agricultural frontier is inevitable, limit expansion to lands with low carbon values and limited amounts of biodiversity.
- Scale up investment, both public and private, to accelerate the development and dissemination of technologies that can help make the agri-food sector carbon neutral. These will include both technologies to reduce or eliminate GHG emissions as well as technologies that can contribute to carbon capture and sequestration.
- Introduce mechanisms to reduce or eliminate GHG emissions all along the value chain, not only at the level of primary production.
- Enlist the support of producers and consumers by educating them about the importance of sustainably sourced food through awareness campaigns, promotion of greener lifestyles, green certification schemes, and marketing of green product alternatives.

20. Declare war on junk food

Dietary change has the potential to deliver enormous benefits in the form of improved human and environmental health. In Latin America and the Caribbean, where the burden of overweight/obesity and diet-related disease is the highest in the developing world, the potential payoffs are particularly large. LAC countries could change the nature of the game by taking a hard line against so-called junk food, especially the highly processed convenience foods and snack foods that are high in oils, fats, sugar, and salt. Global experience shows that while such a strategy is likely to be unpopular in the short run, over time it is possible to increase consumer awareness about the benefits of nutritional foods and to change dietary choices accordingly. More problematically, in the short run such a strategy will most severely affect the poorest elements in the population, who rely most on processed foods because of their low cost and high convenience, so compensatory measures will be needed to ease the transition.

Box 21. What works better to discourage consumption of unhealthy foods: Carrots or sticks?

LAC faces a growing threat from the triple burden of malnutrition. If the threat is not addressed, the region faces massive future costs from diet-related noncommunicable diseases. This highlights the urgent need to transform dietary quality in LAC, a daunting task that will require fundamental changes to the status quo and could impose major costs on many leading food companies.

What policy, regulatory, and fiscal measures are available to improve dietary quality? Behavioral scientists, food manufacturers, and policy analysts have long debated the effectiveness of alternative approaches to modifying consumer tastes and preferences for different types of foods. One group advocates empowering consumers to make healthier food choices by educating them about the benefits of good nutrition and by making nutritional information readily available. Another group argues that nutritional choices are influenced by economic incentives, so a better approach is to make unhealthy foods more costly by taxing them.

Which approach works better? Evidence is mixed.

In Chile, the National Law of Food Labelling and Advertising introduced in 2016 makes it easy for consumers to access information at the point of purchase about sugar, saturated fats, sodium, and calories. Has labeling changed consumer behavior? Araya et al. (2018) find critical cross-category differences in the response of consumers to the nutritional information provided through labelling. While consumers tend not to substitute away from products displaying the warning labels in the chocolate, candy, and cookies categories, evidence of substantial substitution was seen for labeled products in breakfast cereals and juices. The results are consistent with evidence from other countries that consumers make efforts to reduce consumption of non-nutritious food items when they are presented with novel information about nutritional content. Results in Chile also show that high socioeconomic groups are more likely to change consumption decisions because of labelling (Araya et al. 2018). From a policy perspective, this provides a useful lesson, as often these interventions are intended to help modify consumption habits among lower-income, less educated segments of the population, the groups that are more vulnerable to developing obesity and related diseases but that are also less likely to make the needed behavioral changes. Although labelling foods with nutritional content is mandatory in many LAC countries, evidence finds that most consumers have a low ability to interpret these labels.

In Mexico, where a tax is levied on sugar-sweetened beverages and nonessential energy-dense foods to disincentivize intake and reduce externalities associated with unhealthy diets, the National Institute of Public Health (INSP) instituted the tax based on localized scientific evidence that excessive intakes of sugar-sweetened beverages posed significant risks to Mexican children's health and long-term economic outcomes. INSP's estimates of own and cross-price elasticities for these beverages suggest that demand is elastic, with a 10 percent increase in the price associated with a 11.6 percent reduction in demand. Principal substitutes are water and milk (Colchero et al. 2015). Empirical evidence from urban households and national sales suggests a reduction in consumption of sugar-sweetened beverages of 6 percent and 9 percent in 2014 and 2015, respectively (Colchero et al. 2016; Colchero et al. 2017), and a decrease in consumption of nonessential energy-dense foods by 5 percent in 2014 (Batis et al. 2016).

One approach to discouraging consumption of specific foods that clearly can work is to introduce regulations prohibiting the production and sale of such foods. Examples abound of foods or, more commonly, food ingredients considered unsafe, consumption of which fell after bans were introduced. The problem is that while people are generally willing to accept prohibitions on foods considered unsafe, they are usually far less willing to accept prohibitions on foods considered (merely) unhealthy, as such prohibitions are considered infringements on the public's right to choose. The impacts of such prohibitions, therefore, will depend on the ability of regulatory authorities to enforce prohibitions on production and distribution or on the ability of leaders to introduce politically unpopular measures that could undermine their own political support.

Operationalization principles:

- Induce consumers to make healthier food choices by educating them about the benefits of good nutrition and by making nutritional information readily available. At the same time, shield consumers, especially children, from sophisticated advertising campaigns designed to strengthen demand for calorie-dense junk foods that are high in sugar, salt, oils and fats.
- Enlist the support of food manufacturers and retailers in bringing about dietary changes, by offering incentives for them to increase the availability and improve the affordability of healthy foods available in the market. In parallel, use taxes or marketing restrictions to make unhealthy foods costlier or less accessible.
- Where appropriate, rely on targeted supplemental nutrition programs to cushion the impact on the vulnerable groups that will be most heavily affected by the elimination of unhealthy foods from the marketplace.

6.4 Mobilizing Finance for Development (MFD) in agriculture and food systems

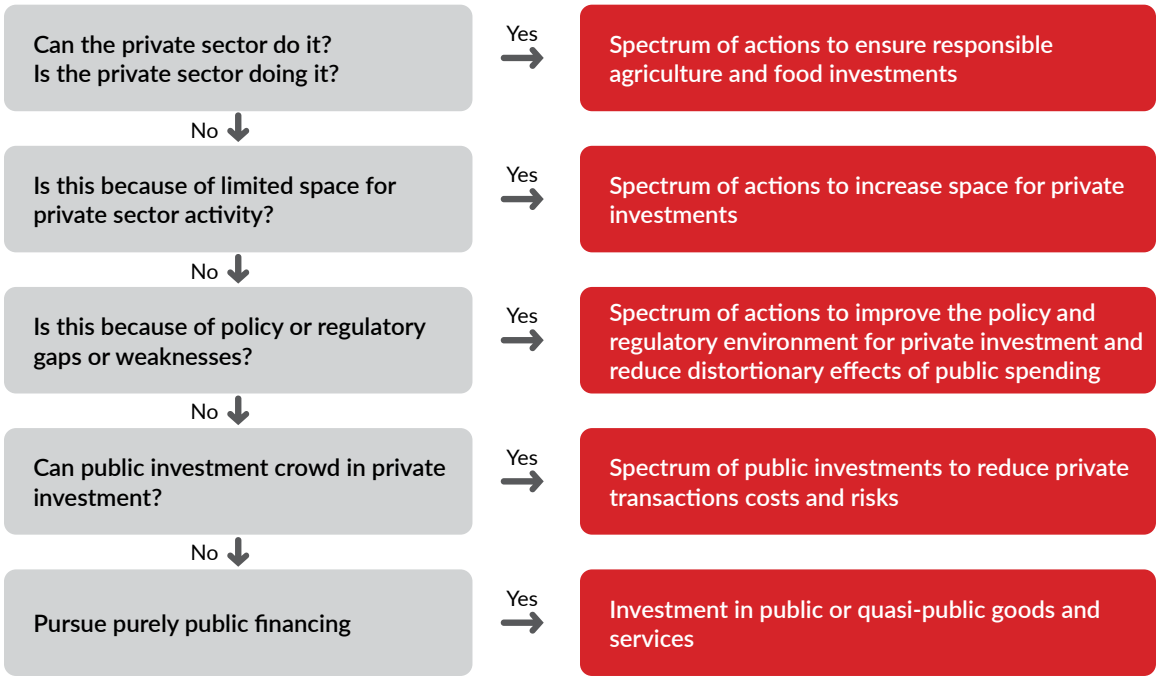
In LAC as elsewhere, current levels of investment in agriculture and food systems are insufficient to achieve key development goals. From farm to fork, developing agricultural value chains is predominantly a private sector affair, meaning agribusiness can and must play a central role in advancing the larger agricultural development agenda. It is therefore both possible and essential to leverage private sector resources in pursuing the transformational opportunities offered by agriculture and food systems.

The Mobilizing Finance for Development (MFD) approach seeks to crowd in private resources to help achieve these development goals by optimizing the use of scarce public resources to enable private sector investment and build inclusive linkages, promote good governance, and ensure environmental and social sustainability, among others. The central idea underlying the MFD approach is to discern systematically whether sustainable private sector solutions can substitute for public expenditure and to determine where the key enabling roles for the public sector are to be found. To guide this process, a structured sequence of questions can be used to systematically assess entry points for public sector interventions (Figure 72).

The questions posed at each stage of the MFD cascade are intended to clarify the respective roles of the public and private sectors in carrying out a given activity. The answers to the questions help to delineate the scope for policy reforms to shape incentives and crowd in private sector financing to support needed investments, as well as to identify areas in which public financing is likely to be needed to produce public goods and services necessary for sustainable development. Use of the MFD cascade can help identify the actions and activities in which the World Bank Group and other development partners can have the largest impact, including by supporting reforms in the enabling environment.

Figure 72. The Mobilizing Finance for Development (MFD) cascade

Source: World Bank 2018.



To apply the MFD approach in a specific context, the first step is to define an activity precisely. Once the activity has been defined, the starting question can be posed: Is the private sector doing it? The answers to this starting question and to the subsequent questions in the MFD cascade shown in Figure 72 help to identify areas in which the public and private sectors can both contribute to the achievement of the activity by playing different roles. It is important to understand that the answers to the questions are often non-binary; a "yes" answer may identify only part of the potential contribution of the private sector at that level, and movement to subsequent levels may be needed to ensure a complete assessment of all questions around MFD and to identify all potential roles of the public and private sectors in accomplishing that activity. Once these roles are understood, actual implementation of policy and regulatory changes and public investments need not be sequential. In many cases, it will make sense to implement them simultaneously, but that does not detract from the value of asking the questions sequentially.

6.5 Principles for operationalizing the proposed actions

It is outside the purview of this report to provide detailed guidance on how the MFD framework can be applied to each of the 20 proposed actions. Operationalization strategies for the proposed actions will have to be tailored to the needs of individual countries, based on the characteristics of their prevailing agri-food systems, the particular challenges present, the policy objectives being pursued, and the resources available. The challenge is further complicated by the fact that there are often important interactions between individual proposed actions—synergies, but sometimes also trade-offs—which means that a holistic, integrated approach usually will be needed to deliver desired outcomes.

It is worth noting also that there are important differences among the proposed actions, and this will affect the ease of implementation. Some of the proposed actions will require major regulatory or legislative reforms, trade agreements, and/or institutional changes, and implementation will require

significant political commitment backed by strong implementation capacity. These proposed actions will not necessarily be easy to accomplish and could involve direct or indirect costs in the short to medium run. Other proposed actions will require fewer regulatory or legislative reforms and will therefore be less controversial, assuming the implementation costs are not too daunting.

How the MFD framework should be applied will depend to some extent on the circumstances of the country, especially public budgetary constraints. Theory and experience provide some general guidance with respect to the question of which actions are likely to be good candidates for public financing and which may not be.

In assessing the case for public financing, it is important to keep in mind the distinction between "public" and "private" goods. Many of the goods and services used to produce food and deliver it to consumers are quintessentially private, and the private sector will be willing to pay for them. But some kinds of goods and services (henceforth, just "goods") have characteristics that discourage the private sector from providing them at a socially optimal level. One of the characteristics of these goods is non-excludability—meaning that if they are provided to one consumer, it is difficult to prevent other potential consumers from gaining access to the same good. A second characteristic of these goods is non-rivalry—meaning that consumption by one person does not reduce consumption by another. Non-excludability means that all potential beneficiaries cannot be charged for the good, so the provider cannot capture its full social value. Non-rivalry means that it is inefficient to charge for the good, since the cost of letting another consumer enjoy the benefits is zero. These two characteristics create a divergence between social and private returns: since those who pay for the production of non-excludable and non-rivalrous goods are unable to capture the full benefits, they will invest in their provision at below socially optimum levels. For this reason, goods with these two characteristics are frequently labeled "public goods," and public resources are allocated to finance their provision. This does not necessarily mean that governments themselves should produce such goods; in some cases, private providers are more efficient producers, in which case the economically efficient policy is for the government to subsidize production by the private sector. But with some exceptions noted below, the general rule is that if goods have characteristics that discourage their production by private providers, they should be largely financed from the public budget; if goods do not have these characteristics, financing should be left to the private sector.

The idea that government budgets are best spent on public goods rather than private goods is not just theoretical; it has considerable empirical support. Ex-post empirical evaluations of public spending programs that finance clearly private goods (e.g., input subsidies) almost universally show costs that significantly exceed benefits. Conversely, evaluations of public spending programs that finance classical "public goods" (e.g., basic research) generally demonstrate very large returns. Empirical analyses of the spending patterns of Latin American countries have found that shifting 10 percent of agricultural public expenditure away from subsidies for private goods and toward public goods (with no increase in aggregate spending) would increase per capita agricultural incomes by about 2.3 percent (Lopez and Gallinato 2007; Valdés 2008).

Among the proposed actions, which are likely to produce "public goods"? Many categories of data, information, and/or knowledge are non-rivalrous and non-excludable, so proposed actions that involve the generation and dissemination of data, information, and/or knowledge are good candidates for public funding. This includes proposed actions aimed at strengthening basic research activities,

strengthening agricultural information systems, disseminating agricultural information, and improving climate monitoring systems. Proposed actions to safeguard public health also fall into this category. Likewise, proposed actions to reduce GHG emissions or provide other ecosystem services also produce many non-excludable and non-rivalrous benefits, making them good candidates for public financing. In the case of GHG emissions reduction, the benefits accrue to the world as a whole, so in principle the public financing should come mainly from international sources, rather than national budgets.

Proposed actions that involve the production mainly of excludable, rivalrous goods are also identified in the matrix. Their provision should rely mainly on private investment. Some of these proposed actions will require regulatory reforms and/or complementary investments by the public sector. In countries where these kinds of investments are not being made by the private sector, the questions raised in the second, third, and fourth tiers of the MFD framework need to be explored.

Public spending to provide private goods—provision of which generally represents a poor use of public funds—includes direct support to farmers and agribusinesses. Often this takes the form of input subsidies, producer price supports, and payments to assist farmers to adapt to climate change. Assistance with adaptation measures is sometimes conflated with measures to reduce GHG emissions under the rubric "climate change actions." But in a discussion of public versus private goods, this obscures a fundamental difference: GHG emissions reduction produces a global public good, while adaptation measures produce benefits primarily for the agent who undertakes them, that is, a private good.

Many of the proposed actions do not fall neatly into one category or other, usually because they produce a mix of public and private goods. Extension services, for example, typically benefit mainly the individual target farmer. But in cases where there are demonstration effects that benefit other farmers, or where the extension is aimed at prevention of epidemic diseases, extension services have public good characteristics. These cases are good candidates for consideration of some kind of partial subsidy or another form of public-private partnership.

Some of the proposed actions in principle involve the production of mainly private goods, but the private sector is unlikely to finance them because of some kind of market failure—high transaction costs, collective action problems, or informational asymmetries. In certain cases, use of public financing to produce private goods may be justified as a way to overcome a market failure, but such financing should be: (1) of appropriate size to correct the problem (e.g., not overdimensioned), (2) temporary, and (3) designed to avoid crowding out private sector development in the market.

Several proposed actions are aimed at objectives related to equity rather than growth and economic efficiency, in which case the private-public good distinction is less relevant. Safety nets fall squarely in this category. This would also include programs providing private goods, but targeting poor farmers for purposes of poverty reduction.

Regardless of the legislative requirements and budgetary implications, implementation of most of the proposed actions will pose political economy challenges. Any significant change to the status quo inevitably raises the prospects of winners and losers. Progress in implementing the proposed actions may consequently depend less on whether they are technically feasible or financialy affordable than on whether sufficient political will exists to absorb potentially explosive repercussions and reconcile sometimes difficult trade-offs between different interest groups.

Table 12. **Proposed actions: Suitable operationalization mechanisms**

Proposed actions	Policy reforms	Private investment	Public-private partnership	Public investment
IMPERATIVES				
1. No Regrets				
Strengthen agricultural research and extension systems		●	●	●
Modernize agri-logistics infrastructure, including ICT			●	●
Up-skill agriculture and food system workers	●			●
Promote healthy diets	●			●
Reduce food loss and waste		●	●	●
Make agriculture and food systems climate smart			●	●
Deepen rural financial markets	●	●	●	●
Improve land tenure security	●			●
2. Risk Mitigation				
Step up climate monitoring				●
Strengthen defenses against food-borne diseases	●			●
Build social safety nets that can be activated quickly in times of crisis				●
Promote the use of financial instruments for managing risk		●	●	●
STRATEGIC CHOICES				
3. Options Open				
Maintain access to established and emerging markets		●	●	●
Invest in irrigation where appropriate		●	●	●
Support development of biofortified foods and nutraceuticals		●	●	●
Facilitate the emergence of peri-urban and urban agriculture		●	●	●
4. Game Changers				
Decouple all agricultural production support	●			●
Ensure that all agri-food system work is safe and fair	●	●	●	●
Make agri-food systems carbon neutral	●	●	●	●
Declare war on junk food	●	●	●	●

6.6 Final thoughts: The challenges ahead

Agriculture and food systems in Latin America and the Caribbean are underperforming. They have been slow to respond to changes in the global environment, and many countries continue to rely on centuries-old production methods that are outdated, inefficient, and harmful to both people and the environment. Evidence is accumulating that the current trajectory is technically inefficient, socially inequitable, environmentally unsustainable, and fiscally irresponsible. And as the COVID-19 crisis has made clear, they feature structural rigidities that prevent them from reacting quickly to "black swan" disruptors. Clearly, business as usual is not an option. Yet looking forward, prospects for changing the trajectory remain uncertain. The needed characteristics of the future agriculture and food system are known, but realizing those characteristics will require fundamental changes, and many threats are looming that could prevent those changes from happening.

The COVID-19 pandemic, whose impacts were still playing out as this report went to press, provides an important wake-up call. The disruptive effects of the virus have made painfully evident the shortcomings of current agri-food systems, in LAC and worldwide. At the same time, the crisis provides an opportunity to carry out a "re-set" of what is expected from agriculture and food systems. Based on a new appreciation of what is important and what is not, it should be possible to build back better once the crisis has passed. Notably, the crisis has reinforced an insight that also emerged from the scenarios building work done for this report: food systems are shaped by the interplay of "push" factors that influence producer decision-making and food supply, and "pull" factors that influence consumer choice and civic behavior. The proposed actions described above make clear that attention needs to be directed to both sides of the equation to guarantee effective responses.

Fortunately, against the current backdrop of underperformance, awareness is growing that enormous opportunities are waiting to be seized. Demand for agricultural commodities will recover and resume their steady long-term growth trend, within the region and worldwide, providing an attractive market for future generations of producers. Meanwhile, advances in knowledge backed by technological breakthroughs are ushering in new, more efficient and more environmentally friendly ways to produce, process, distribute, consume, and recycle food, magnifying the potential payoffs to adoption of improved technologies and practices. And global warming continues unabated, elevating the importance of agriculture as a sector that can help stem and eventually reverse greenhouse gas emissions.

Looking forward, LAC agriculture and food systems will undoubtedly be increasingly called upon to perform multiple roles: contribute to rapid and stable growth, generate export earnings, safeguard food security, provide healthy and nutritious diets, generate high-quality jobs, overcome inequality, promote social inclusion, sustain the natural resource base, and mitigate the impacts of climate change. Fulfilling these multiple roles will require appropriate strategies, well-crafted policies, robust investments, and strong institutions staffed by capable people.

Setting LAC agriculture and food systems on a trajectory that prepares them to deliver on these multiple objectives will not be possible without contributions from all of the many actors who populate those systems and given them life. Governments in the region must provide strong leadership, not only in terms of enlightened policy making, but also with respect to setting an enabling regulatory framework, financing well-designed and strategically targeted public investment programs, fostering interagency collaboration, and ensuring multi-stakeholder action and public-private collaboration for achieving the outcomes. The private sector must embrace the multifunctional agenda, recognizing

the diverse benefits generated by agriculture and food systems, even when some of these are not fully monetized by the market, and acknowledging that ensuring the sustainability of the systems sometimes requires taking a long-term view and forgoing short-term profits to achieve long-term gains. Civil society organizations will be called upon to inform and educate decision makers at every level, highlighting how choices made in one context can percolate through the system and give rise to consequences—desirable or undesirable—far removed in place and time.

This report has attempted to contribute to the knowledge base needed to seize emerging opportunities by presenting information and analysis that can be used by policy makers and others to advance the agricultural and rural development agenda in LAC and deliver positive outcomes. After describing the defining characteristics of LAC agriculture and food systems and projecting how key drivers—both trends and disruptors—could produce a range of plausible future scenarios, the report has identified a series of proposed actions that policy makers should consider as they pursue development objectives, whether defined at national, regional, or global level. Significantly, the proposed actions fall into different categories, depending on their purpose: some of the proposed actions can be considered imperatives, in the sense that they are associated with outcomes that are exclusively positive, while other proposed actions represent strategic choices that would have to be undertaken selectively in hopes of delivering successful outcomes that may or may not materialize.

What this report has not done is to propose detailed implementation strategies operationalizable at the level of individual subregions, countries, or subnational areas. Operationalizing the proposed actions will require additional effort in terms of customizing the proposed actions and making them relevant for particular country circumstances and goals. This effort will require active participation by local actors, to ensure that their preferences are captured in the implementation strategy and accurately reflect local aspirations and priorities.

In closing, it seems appropriate to highlight two central messages that have emerged during the process of producing this report and that remain as its enduring legacies.

- First, charting a course for the generations to come is made difficult by the fact that the future is finally unknowable. Just as the COVID-19 pandemic has been the great disruptor of today's world, other forces—still unknown—will be the disruptors of tomorrow's world. While these future forces cannot be predicted with precision, one thing is certain: change is inevitable. As the great Argentine singer Mercedes Sosa immortalized in song, "Todo cambia": everything changes. In that light, the trends and disruptors described in the preceding pages and the scenarios built using combinations of those trends and disruptors are extremely important, because they compel us to contemplate worlds that normally would remain outside our consciousness and to consider the types of actions that we may wish to take to prepare for realities other than those that we have experienced.
- Second, the report makes clear that, contrary to the widespread perception that agriculture in LAC countries is losing importance, the agriculture sector and the much larger agri-food system that it nourishes deserve significant policy attention and commitment of public resources. The LAC agri-food system will continue to be an important engine of growth, employment, poverty alleviation, social inclusion, nutrition security, and biodiversity conservation. And that being so, it is clear that the future of LAC agriculture and food systems is far too important to be left to chance, because the performance of those systems will have a decisive influence on the fortunes not only of the region, but of the entire planet.

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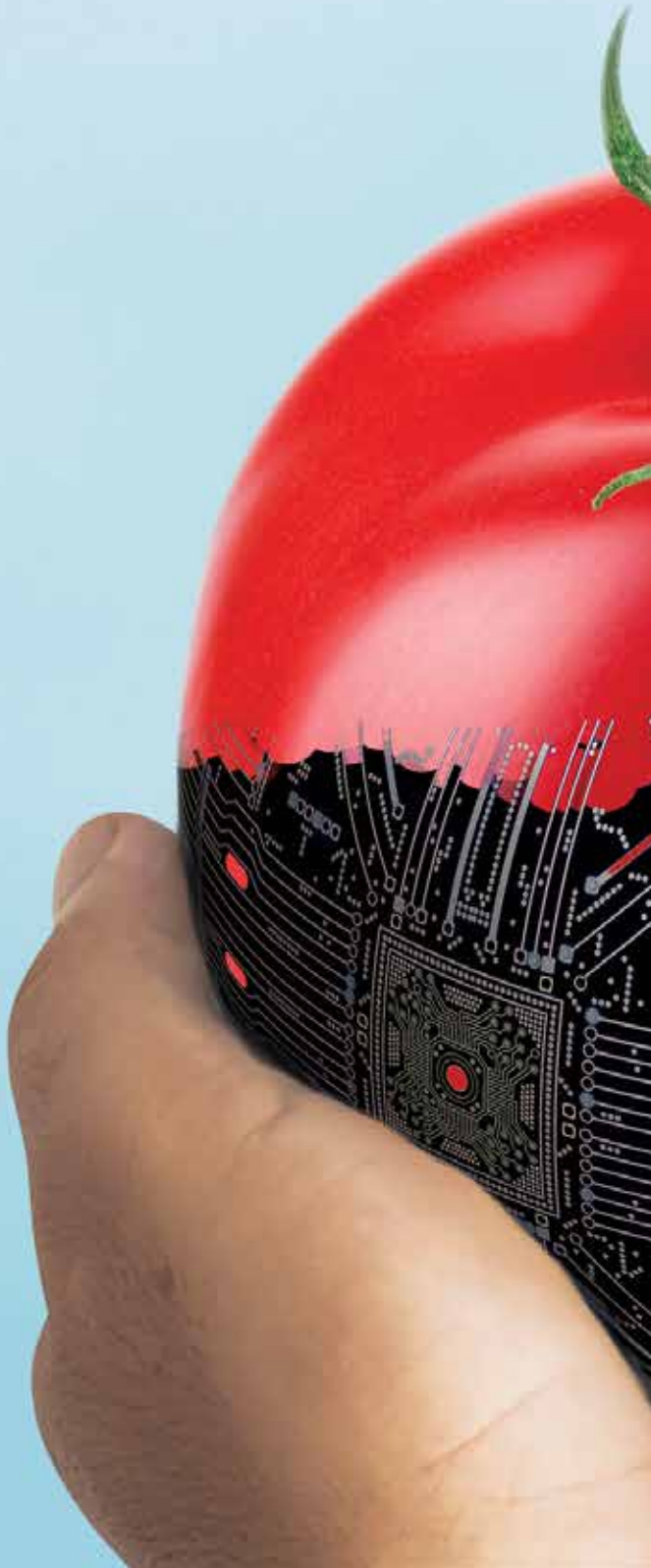

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