The Outlook for Agriculture and Rural Development in the Americas:

A Perspective on Latin America and the Caribbean

2019-2020

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3.2.4 **Inclusive agricultural sectors for diversified, competitive rural economies.** Pablo Faret (FAO).

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3.2.6 **Making better use of trade agreements in the agricultural sector.** Anabel González, Adriana Campos and Joaquín Arias (IICA).

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General Index

Figures Index

Tables Index

Abbreviations and acronyms

2030 Agenda 2030 Agenda for Sustainable Development. 14, 15, 17, 18, 39, 40, 42, 44, 46, 47, 49, 64, 90, 139

A3Ps Public-Private Partnerships with Producers. 81, 82

ABBI Brazilian Association for Bio-innovation. 103

AEI Agri-environmental indicators of the OECD. 63

AF Family farming. 45, 46, 63, 64, 65, 66, 74, 75, 121

AI Artificial intelligence. 54, 55

ANII National Innovation and Research Agency. 105

BioEmprende Center for the Promotion and Facilitation of Bio-business. 105

CBIO Biofuel decarbonization credit. 102

CENTA National Center for High Technology. 104

CONABIA National Biosecurity Commission. 101

DA Digital agriculture. 52, 54

DNA Deoxyribonucleic acid. 56, 57, 59

EBS Sustainable Bioeconomy Strategy. 105

FAO Food and Agriculture Organization of the United Nations. 15, 23, 27-32, 34, 35, 41, 42-47, 48, 51, 63-68, 73-75, 80, 90, 98, 105, 114, 118, 125

FNS Food and nutritional security. 73, 75

G-20 Group of 20. 61, 79

GDP Gross domestic product. 23, 24, 27, 28, 80, 83

GHG Greenhouse gas emissions. 32, 43, 45, 63, 31, 89, 97, 98

GM Genetically modified. 56, 59

GMO Genetically modified organisms. 96, 101

GP Green Productivity. 61

GSP Generalized System of Trade Preferences. 106

IAU Uruguayan Antarctic Institute. 105

ICTs Information and communication technologies. 53, 54

IFAD International Fund for Agricultural Development. 64, 79, 81, 121

IMF International Monetary Fund. 23, 25, 26, 29

INIA National Agricultural Research Institute. 105

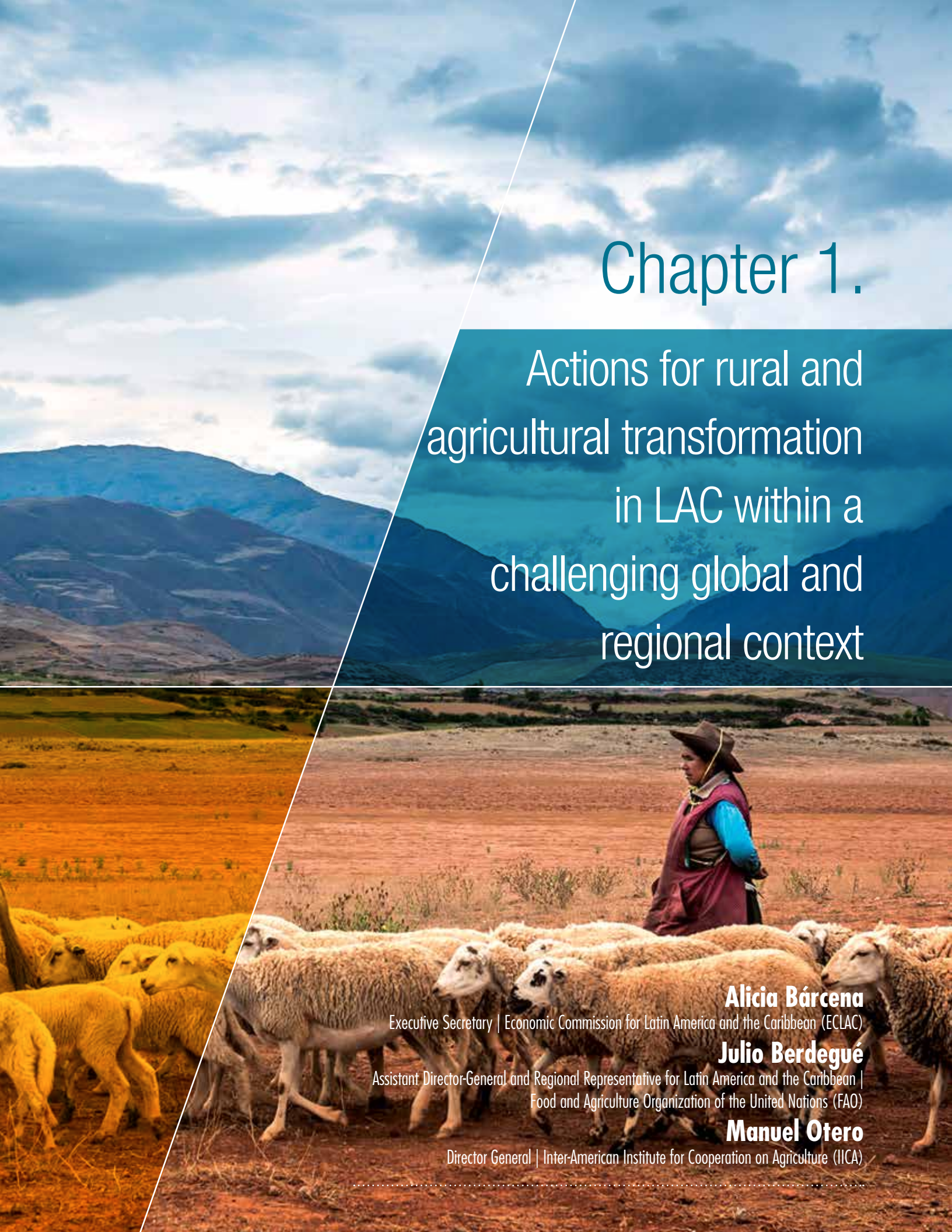
IoT Internet of Things. 54, 55

IRCCA Institute for the Regulation and Control of Cannabis. 103

ITCR Technological Institute of Costa Rica. 98

LAC Latin America and the Caribbean. 14-18, 23-26, 31, 33-35, 39-44, 48, 53, 58, 60, 63, 64, 67-69, 71, 73, 74, 79, 80, 84, 88,-93, 99, 101, 105, 106, 109, 113, 122

LMO Modified Living Organism. 57-59
MAE Ministry of the Environment. 104
MAG Ministry of Agriculture and Livestock. 58, 104
MAPA Ministry of Agriculture, Livestock and Supply. 103
MEIC Ministry of the Economy, Industry and Trade. 104
MGAP Ministry of Agriculture, Livestock and Fisheries. 105
MICITT Ministry of Science, Technology and Telecommunications. 104
MICTIC Ministry of Science, Technology, Innovation and Communication. 102
MIEM Ministry of Industry, Energy and Mining. 105
MINAE Ministry of Environment and Energy. 104
MINAGRO Ministry of Agroindustry. 102
MINCYT Ministry of Science, Technology and Innovation. 102
MIT Massachusetts Institute of Technology. 100
NAMA Nationally Appropriate Mitigation Actions. 98, 104
NAFTA North American Free Trade Agreement. 70, 73
OECD Organization for Economic Co-operation and Development. 28-30, 56, 61, 63, 71, 80, 100, 105
PACTI Action Plan in Science, Technology and Innovation. 102
Plan ABC Sectoral Climate Change Mitigation and Adaptation Plan to Consolidate a Low-Carbon Economy in Agriculture. 98
PFP Partial Factor Productivity. 58
PTAs Preferential Trade Agreements. 16, 17, 69-72
PTF Total factor productivity. 60
PTFV Green total factor productivity. 60
R+D+i Research, development and innovation. 45
RCA Revealed Comparative Advantage. 69
RNAE Rural non-agricultural employment. 33
SAFIN Smallholder and Agrifood SME Financial and Investment Network. 79
SDGs Sustainable Development Goals. 14, 16, 24, 35, 39, 40, 42, 44, 45, 46, 47, 49, 51, 53, 61, 62, 63, 67, 70, 73, 76, 77, 78, 79, 103, 108
SEEA United Nations System of Environmental Economic Accounting. 63
SPC Chymosin produced from safflower. 100
TFA Trade Facilitation Agreement. 72
TRP Total resource productivity. 60, 62
UCR University of Costa Rica. 104
UNA National University. 104
WTO World Trade Organization. 26, 70, 72, 97, 107



Chapter 1.

Actions for rural and agricultural transformation in LAC within a challenging global and regional context

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By the end of this century, the rural population is expected to represent only 10 % of LAC's total population, while most of the natural resources on which the region depends for growth will remain concentrated in rural areas.

However, if the rural-urban continuum is taken into account, or other definitions of rural areas are applied, so as to include small municipalities or areas with a low population density, almost 60 % of the population in some countries can be considered "rural" (Dirven 2019).

The 2030 Agenda for Sustainable Development (2030 Agenda) is global in nature, both in terms of its scope as well as the commitments undertaken, which are organized into 17 Sustainable Development Goals (SDGs). The SDGs are closely intertwined, rendering the Agenda innately indivisible. "Leave no one behind," one of the key principles of the 2030 Agenda, requires that all social sectors and stakeholders take part in partnerships aimed at mobilizing and sharing knowledge, capacities, technology and financial resources, as well as guaranteeing the Agenda's implementation in all countries.

The "leave no one behind" principle poses significant challenges for Latin America and the Caribbean (LAC). Despite the socioeconomic progress it achieved over the past decade, LAC is still the world's most unequal region. This inequality is attributable, among other things, to the development gaps between urban and rural areas, which are reflected in much higher levels of rural poverty. In recent years, poverty levels in the region have increased, as have urban-rural gaps with respect to poverty and extreme poverty, schooling, social protection and security, overfeeding and obesity, access to basic services, as well as health and employment.

In light of these issues, we must acknowledge and capitalize on the harmonious relationship between rural and agricultural development, whose complementarity can contribute to the achievement of the SDGs. The causality between these two elements is clear: rural development cannot be achieved without agricultural development, and sustainable development cannot be achieved without rural development. Rural poverty is closely linked to serious deficits in terms of decent work opportunities in agriculture (and in other primary production activities), as well as the limited presence of labor institutions in rural areas. In order for agriculture to contribute to reducing poverty and inequality in rural areas, it is important not only to bridge salary gaps between agricultural and non-agricultural sectors, but also to extend the coverage of social security and other employment benefits to agricultural workers.

Furthermore, it is important to bear in mind that the progress required to fulfill the 2030 Agenda will need to take place within a complex global and regional context for LAC, characterized by less economic growth, greater volatility, commercial restrictions, as well as the need to respond to climate change and the aforementioned gaps between rural and urban areas. This scenario could even worsen due to the risk of recession in some of the main global economies, including both developed and developing countries. Additionally, less momentum from economic activity and trade is expected to slow down the global demand for agricultural products, which could further worsen the poverty and hunger situation in LAC.

In the longer term, by 2050, agricultural production must increase by 50 % compared to 2012, in order to meet the growing global demand for food, as a result of population increase and certain changes in consumption patterns. Over the next decade, the growth of global agricultural production must be sufficient to meet this growing

demand as well as to maintain prices relatively stable or even to trigger a downward trend in prices. These price trends are a result of the factors that are expected to predominate in the next decade, particularly increases in productivity. Despite the general downward trend in agricultural prices in real terms, there is still a risk that harvest losses and other supply shocks could lead to sudden price increases.

In light of these challenges, new paradigms and courses of action are necessary in order to fulfill the 2030 Agenda. Although LAC is strategically positioned due to its wealth of natural and biological resources, resources in the region are overexploited, which causes their degradation. Furthermore, the region's natural resource base is unequal; in some countries, for instance, it is not possible to expand agricultural production, in terms of surface area, without having to replace forests.

In this 2019-2020 report, the Economic Commission for Latin America and the Caribbean (ECLAC), the Food and Agriculture Organization of the United Nations (FAO), and the Inter-American Institute for Cooperation on Agriculture (IICA) propose a "two-way" intersectoral approach to address the aforementioned scenario. In the first place, it calls for acknowledging the fact that it is not possible to overcome poverty or to combat hunger, malnutrition and climate change, unless societies and political stakeholders in LAC begin promoting rural areas as engines for economic, social and environmental development in the countries. Secondly, the proposed approach calls for considering agriculture and related activities as crucial for carrying out other complementary economic activities that foster sustainable development in rural areas.

New production models and an in-depth reform of the agrifood system are necessary in order to address the abovementioned challenges and undergo an exponential technological revolution. Adjustments made to the agrifood system should take into account the urgent need to reverse degradation trends; to this end, the management of soils, water, forests, and agroecosystems must be improved, in order to boost soil fertility, reduce erosion, increase biodiversity, foster water retention and prevent deforestation.

In this regard, rural areas should cease to be viewed as poverty-stricken areas with deficiencies; instead, they must be thought of as areas that provide opportunities to transform food and energy systems while also fostering ecosystem services, efforts aimed at combating climate change, and the sustainable management of natural resources.

Below, we highlight a series of technological alternatives, political-institutional options and production models that could be the key to success, provided that we succeed in breaking the inertia of isolated sectoral actions, while acknowledging the fact that comprehensive approaches have a greater possibility of yielding positive results.

With just 9 % of the world's population and 4 % of the rural population, LAC accounts for 16 % of the planet's farming land; 33 % of land that is suitable for, but not currently dedicated to agriculture; 23 % of the forest area; 50 % of biodiversity resources; 22 % of drinking water; and 31 % of the planet's 35 million cubic kilometers of fresh water.

Despite LAC's privileged position in terms of its wealth of natural and biological resources, it is important that we remain vigilant against the degradation of this heritage, which could worsen unless important changes are implemented. Water shortages, land degradation due to erosion, dwindling forest area, loss of biodiversity and overexploitation of marine and fishery resources are becoming graver in many countries across the region, which could have considerably negative repercussions at the environmental and economic levels.

Poverty operates as a mechanism that reproduces gaps between urban and rural areas, affecting access to basic services, health, education and infrastructure, among other things.

First, we encourage countries to improve their social protection systems, given that this represents the primary, most elementary tool for generating broad rural development policies, especially when complemented by productive inclusion policies. This strategy would allow for complementing the provision of urgent assistance with the promotion of small-scale production which, in turn, would revitalize local markets and territorial activities.

Second, we call for decision-making geared toward the sustainable intensification of agriculture, which involves integrating different technological options. This would make it possible to transition towards agroecological production models, the development of the bioeconomy, the sustainable use of natural resources, and the application of information and communication technology tools that can contribute to creating diversified food systems, with greater value added, that are more resilient and sustainable from a socioeconomic perspective. Agroecological production models contribute to building food systems that are more resilient and sustainable from a social, economic and environmental standpoint. Additionally, by focusing on people as agents of change and on their knowledge and territories, these models make it possible to transform the manner in which food is produced, marketed and consumed.

As part of this socioproductive model, we propose developing different marketing channels as well as fostering producers' access to local, regional and global markets. Family farmers' provision of food to public food assistance programs should also be expanded, as a means of simultaneously improving producers' income and the food and nutritional security of the population in the corresponding territories; this, in turn, would reduce the environmental impact of agrifood chains. In LAC, short circuits have proliferated, primarily in the form of ecological and organic fairs and markets. Additionally, the public procurement of food from family farmers is an emerging trend that is gradually being incorporated into the agendas of LAC countries.

Third, we encourage countries to acknowledge the fact that the development of competitive, diversified and sustainable agriculture sectors, with a view to achieving the SDGs, will not be possible without the inclusion of the broad socioproductive sector comprised of family farmers and rural dwellers who do not own land. Many of them are living in a state of hunger, poverty and climatic vulnerability, which threatens the sustainability and the competitiveness of agriculture in the region.

Fourth, we urge countries to undertake actions that respond to the urgent need to better capitalize on LAC's tremendous potential for agricultural and agroindustrial production, given the fact that, at present, the region's production base is not very diverse, and its agricultural exports are characterized by a low level of complexity and a strong focus on commodities (soy, corn, wheat, meat, etc.) versus other products. Value adding represents a crucial but challenging task for most countries in the region, which have achieved little progress in exporting more elaborate products.

Fifth, we suggest undertaking actions aimed at better capitalizing on current trade agreements in the region. Over the past two decades, countries in the Americas have signed a little over 140 preferential trade agreements (PTAs), in order to increase and diversify products and export markets, boost their competitiveness and, in turn, spark economic growth, generate employment opportunities, foster the transformation of production, and reduce poverty. In the agriculture sector, in which trade barriers are more numerous, the role played by PTAs in facilitating market access is even more relevant. However, the signing of a PTA is often not sufficient to foster trade, given that it is also necessary to overcome several barriers (which are analyzed in this report) that can limit the ability to capitalize on these agreements, particularly as tools for fostering new exports or new exporters.

Sixth, there is a pressing need to foster the application of information and communication technology tools, which afford a wealth of opportunities to improve production processes and drive the transition towards agroecological production. Digital agriculture can contribute to reducing the use of supplies, fostering innovation to boost productivity and competitiveness, driving cooperation among farmers, and facilitating a direct connection between opposite ends of agrifood chains: producers and consumers.

Seventh, we call upon countries to undertake efforts to increase the financial penetration and inclusion of the agriculture and rural sectors, as well as to bridge long-term investment gaps. To this end, we propose a series of necessary interventions, in the form of regulations, institutions and instruments, both at the individual, organizational, value chain and territorial levels, as well as the macro level.

Eighth, we must adopt new criteria for the development of public programs, within a restrictive context for fiscal resources. In this regard, we must acknowledge the fact that public goods are the priority, given the crucial role that they play in the sector's successful operation. With respect to private goods (although not exclusively), a new combination of financial resources is necessary: resources from producers, governments, international cooperation, companies, social funds, non-governmental organizations (NGOs) and ethnic communities living in developed countries (through remittances or the purchase of products from their countries of origin), among other possibilities.

Strengthening research, development and innovation (R+D+I) is also a priority, as this would allow for developing and disseminating technologies that allow for improving agricultural production, capitalizing on energy resources, and utilizing terrestrial and marine natural resources in a competitive and sustainable manner. It is also necessary to further capitalize on opportunities that foster rural innovations, allow for improving production processes and contribute to disconnecting production from greenhouse gas emissions.

Ninth, the growing complexity of development problems requires more sophisticated institutional

In 14 LAC countries, family farming accounts for more than 50 % of jobs in the agriculture sector; consequently, efforts aimed at increasing productivity and bridging salary gaps in family farming could contribute to strengthening economic and social sustainability, in accordance with the "leave no one behind" principle of the 2030 Agenda.

The achieve the goal of zero hunger by 2030, USD 265 billion per year would be needed during 2016-2030 period, of which USD 67 billion and USD 198 billion would be needed for social protection programs and pro-poor investments, respectively.

In the case of LAC, an additional USD 6 billion and USD 2 billion would need to be allocated per year to social protection programs and pro-poor investments, respectively.

responses. Consequently, intersectoral coordination must be transformed into a reality, despite the challenge that it represents for governments and other stakeholders, simply because coordination implies higher transaction costs, given the need to reconcile different interests.

Therefore, it is necessary to promote a new type of rural governance, which would foster consensus-building and more expeditious actions, in order to expand the level of inter-institutional and intersectoral coordination and, in turn, acknowledge the different roles of a wide range of stakeholders, even those that have traditionally been rendered invisible during decision-making processes. We must possess legal institutions and frameworks that are able to drive the coordination of efforts between various stakeholders, including public-private entities, as well as to monitor and evaluate progress achieved within the framework of the 2030 Agenda, in order to guide budgetary allocations and other incentives for all stakeholders involved.

Lastly, as a special topic in this report, we propose capitalizing on the bioeconomy to coordinate actions related to the 2030 Agenda. LAC must generate political, economic and environmental conditions that are conducive to the development of the bioeconomy, as a development approach and a new technical-economic paradigm for production and consumption. Among other things, the region should: a) reformulate the role of agriculture in the economy and society; b) develop new technological concepts (such as biorefinery); c) make adjustments to technological relations, in terms of scale and investment requirements; d) develop standards for new products and for products with distinctive characteristics; e) transition towards a more circular economy; and f) ensure that investment decisions and markets take into account environmental aspects, costs and spillovers.

Outlook for Agriculture and Rural Development in the Americas: A Perspective on Latin America and the Caribbean 2019-2020

#TOWARDS2030

THE POSITIVE LINK BETWEEN RURAL DEVELOPMENT AND AGRICULTURAL DEVELOPMENT

"LEAVE NO ONE BEHIND"

WHAT ARE THE CHALLENGES AT THE INTERNATIONAL LEVEL?

Economy

3.5 % Projected global economic growth (2020).

0.5 % Projected economic growth for LAC (2020).

Trade

2.6 % Projected growth in the volume of international trade (2019).

An increase in trade protectionism will affect investment and productivity in the medium-term.

Prices

-1.5 % Estimated decline in the food price index over the coming decade.
*in real terms.

Agriculture

Decline in the growth rate of global agricultural demand.

Natural resources

Forecasts (2050) suggest that there will a decline in the amount of natural resources available for use in agriculture (due to natural resource degradation and competition with other uses).

75 % of agricultural land in LAC was degraded in 2015.

29 p.p greater decline in the size of species populations in LAC, in comparison to the global level.

2nd largest source of GHG emissions is agriculture, with a consequent impact on land use.

23 % of the world total.

WHAT ARE THE OPPORTUNITIES AND CHALLENGES ON THE PATH TOWARDS TRANSFORMATION?

LAC boasts (in comparison to the world):

- **9 %** of the population
- **4 %** of the rural population
- **16 %** of the agricultural land
- **33 %** of the available but unused area for agriculture
- **23 %** of the forest cover
- **50 %** of the world's biodiversity

Rural areas compared to urban areas in LAC:

- Poverty is **1.8 times greater.**
- Extreme poverty is **2.6 times greater.**
- Child labor is **more than double.**
- The **female** component of rural poverty is on the rise.
- **64.1 %** vs **87.9 %** has access to basic infrastructure.
- **22 %** vs **54.7%** of the population receives a pension.
- Young people in rural areas receive **11 p.p less** education.

HOW DO WE ACHIEVE TRANSFORMATION?

The need for a two-way intersectoral approach in rural areas, offering a range of complementary options.

Position agriculture and its related activities as core businesses, which will serve as the foundation for the development of other complementary economic activities:

OPTIONS TO ENSURE A SUCCESSFUL TRANSITION TOWARDS THE SUSTAINABLE INTENSIFICATION OF AGRICULTURE:

Agroecology | Digital agriculture | Gene editing | Bioeconomy

Bioeconomy: framework for the alignment of actions with the objectives of the 2030 Agenda.

RURAL SECTOR ACTIONS

Alignment of **social welfare** actions and **agricultural interventions.**

Inclusion of family farmers and the landless rural population.

PRODUCTION AND TRADE ACTIONS

Capitalization of PTA's

Diversification and value adding.

Access by producers to local, national and international markets

This calls for a new cross-cutting institutional framework with actions promoting:

Greater interinstitutional and intersectoral **coordination**.

More efficient reallocation of **public spending**.

More efficient **and inclusive** rural and agricultural financing.

Visit the website at www.agrirural.org to access other information resources that may be of interest to users: historic reports, technical bulletins, executive summaries, infographics, videos, *inter alia*.

Chapter 2.

Global and regional context

LAC countries face a complex global scenario, with lower economic growth, greater volatility, trade restrictions and the need to act against climate change.

2.1. Economic growth prospects

LAC countries face a complex global scenario, with lower economic growth, greater volatility, trade restrictions and the need to act against climate change.

The latest International Monetary Fund report (IMF 2019) estimates that 2019 growth rates will decrease in almost three quarters of countries. Global growth, which reached a maximum of 4 % in 2017, softened to 3.6 % in 2018, and is projected to decline to 3.2 % in 2019 and return to 3.5 % in 2020 (IMF 2019). The institution acknowledges, however, that the expected rebound in global growth, backed by lower interest rates and fiscal and monetary stimuli in some of the major global economies, depends on the stabilization of emerging markets and resolution of trade disputes., which, at the close of the preparation of this report, would not seem to be fulfilled in the coming months.

Growth in the euro area is estimated to decrease to 1.3 % in 2019 and 1.6 % in 2020, down from 1.9 % in 2018. The latest growth data for the second quarter of 2019 show, however, that the slowdown could be even greater and that the risk of recession in Europe is real: Germany and the United Kingdom showed a contraction in growth of 0.1 % and 0.2 %, respectively, while the Gross Domestic Product (GDP) stabilized in Italy. In the United States, growth is expected to decrease from 2.9 % to 2.6 % in 2019 and even more so in 2020, reaching 1.9 %, due to the reduction of the fiscal stimulus (IMF 2019).

In 2019, global growth will also be affected by the performance of emerging and developing economies. Economic growth in China, despite the fiscal stimulus, is projected to slow down in 2019 and 2020, from 6.6 % in 2018 to 6.2 % and 6.0 % in subsequent years. The forecast incorporates the increase in US tariffs, from 10 % to 25 %, on USD 200 billion of exports from China, which occurred in May 2019. In India, growth is projected to increase slightly, from 6.8 % in 2018 to 7.0 % in 2019 and to 7.2 % in 2020, backed by the continued recovery of investment and consumption.

Trade disputes between China and the United States intensified in August, following the announcement that the United States will impose tariffs on other Chinese imports valued at USD 300 billion. In retaliation, China introduced additional tariffs on imports of USD 75 billion from the United States. The weighted average of Chinese tariffs on US imports will increase from 20.7 % to 21.8 % on September 1 and to 25.9 % on December 15, at which time 69 % of US exports to China will be affected. These developments triggered strong stock market fluctuation, a decrease in oil prices and increased capital outflows from emerging economies. Given the inconclusive state of trade negotiations, there is a growing risk that trade tensions will intensify further in the future. As trade disputes become widespread, the global growth outlook has deteriorated (UN 2019).

Global economic growth of **3.5 %** is projected in 2020 (IMF 2019).

More than **two thirds** of the expected deceleration in global economic growth is explained by a decrease advanced economy growth (IMF 2019).

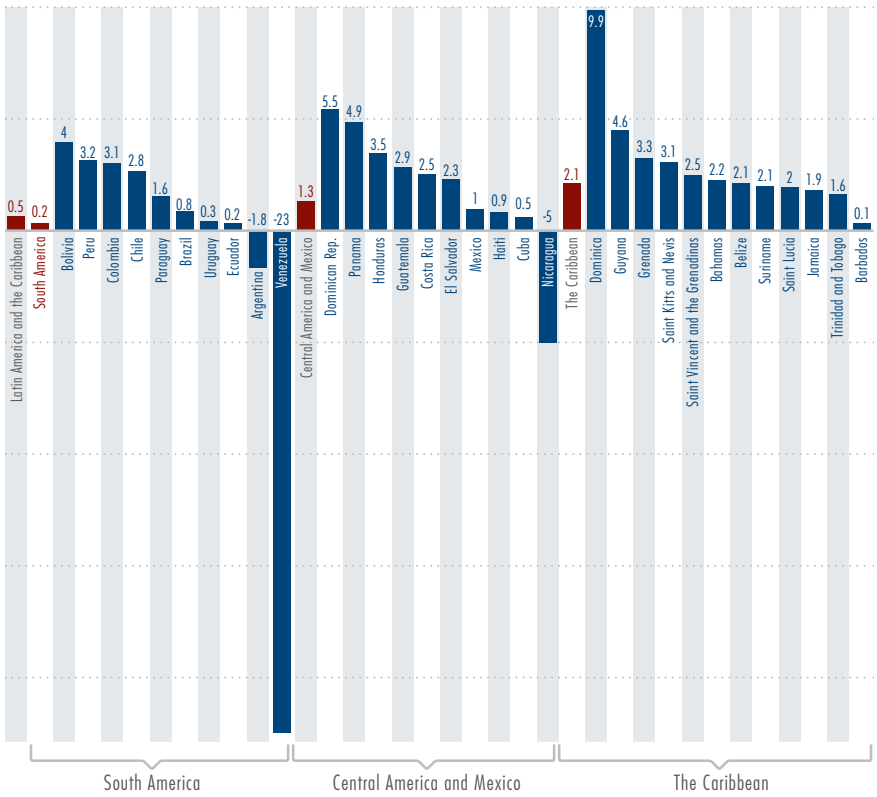
The dynamics of economic growth in LAC tend to differ between countries and subregions but, this year, **the slowdown** should be more widespread, affecting 21 of the 33 countries in the region (Figure 2.1).

In LAC, a GDP growth slowdown is expected in 2019, to 0.5 %, compared to 1.1 % in 2017 and 0.9 % in 2018 (CEPAL 2019). The expected slowdown for China and for emerging countries, coupled with a lower growth rate in the United States, the eurozone and, in general, in developed economies, has impacted the recovery in LAC.

Recently disclosed data show that, as in the case of the euro zone, the LAC slowdown could be even worse than expected: the two largest regional economies, Mexico and Brazil, have only just avoided official entry into recession (the first with zero growth and the second with a positive rate of 0.4 %), defined as two consecutive quarters of contraction. These economies are also expected to remain weak for the remainder of the year.

The weak economic performance in LAC has resulted in an increase of informal employment and unemployment, which in the case of urban areas reached a regional average of 9.3 % (ECLAC 2019). Also, lower growth rates translate into direct impacts on several SDGs, particularly SDGs 1 (end of poverty) and 2 (zero hunger). It is estimated that between 2014 and 2016, when the region presented slightly negative growth rates, poverty, extreme poverty (especially in rural areas) and undernourishment levels increased, reversing the trend from years of greater economic growth (FAO et al. 2018).

Figure 2.1: GDP growth projections for 2019 (%)



Source: Prepared based on data from (ECLAC 2019).

2.2. Risks of an even more intense slowdown

Some of the main international agencies (IMF 2019, World Bank 2019, CEPAL 2019) enumerate several risks that could lead to an even greater deceleration of global economic performance in the remainder of 2019 and in coming years. These risk factors, which are detailed below, are also valid, to a greater or lesser extent, for the growth of LAC economies.

Global growth projections assume a low probability of recession in the United States, the recovery of growth in the euro area economies as, among other factors, a no-deal Brexit is avoided, and the gradual reduction of growth in China, thanks mainly to the maintenance of a robust internal consumption. An eventual adverse change in these assumptions, given the importance of the economies mentioned, would reduce global growth directly and through real and financial linkages. Stimuli measures continue to strengthen the short-term outlook in these countries but could contribute to a more abrupt slowdown in the future, insofar as structural weaknesses are not addressed. On the other hand, in the United States and China, despite the stimuli, the activity may not meet expectations if trade disputes are not eased.

In the financial domain, a harder-than-expected global market adjustment, including a rapid revaluation of the US dollar, would mainly impact emerging economies and could lead to a lower global growth rate. In 2018, as a result of trade disputes and the normalization of interest rates in the United States, there was an increase in risk, financial volatility and capital outflow from emerging markets, including LAC, while the dollar appreciated in a sustained manner versus most currencies. Regionally, double-digit depreciations in Argentina, Brazil and Jamaica stand out (CEPAL 2018).

Projections indicate that the **dollar** will probably remain strong in the coming years compared to the values reached at the beginning of this decade, which could boost **inflation** in several countries, especially those that are food importers.

Commodity prices are expected to drop around 5 % in 2019 as a result of reduced economic activity and trade (CEPAL 2019).

The intensification of **trade protectionism** could have a negative impact on investment and productivity in the medium term.

2.3. International trade slowdown

The lethargy of world trade has been at the center of economic analysis in recent years because of its impact on economic growth. In April, the World Trade Organization (WTO) reduced its forecast for 2019 world trade (volume) growth to 2.6 %, which is about one third of the annual growth achieved between 2003 and 2007. However, given the escalation of the trade conflict between the United States and China since May, to which other countries have been added, this forecast now seems overly optimistic[1]. Indeed, the outset of 2019 showed negative year on year growth in world trade volumes, something not observed since the global crisis of 2008-2009 (CEPAL 2019).

At the regional level, the threat of a progressive tariff increase on Mexican exports by the United States as a possible retaliation for the illegal migration flowremains ongoing and could also impact the evolution of LAC exports and growth. While some countries may benefit from short-term trade diversion, the increase in trade protectionism can have a negative impact on investment and productivity, with higher price levels and greater trade policy uncertainty. Finally, the prospect of lower corporate profitability could reduce financial market confidence and further drag growth (IMF 2019, World Bank 2019).

In summary, the trade conflict between the United States and China affects the economic outlook for LAC, even as some countries have seen short-term gains due to a trade flow deviation. There are several channels through which economic activity in LAC could be affected. First, 55 % of the region's exports are destined for either China and the United States,. Slower demand growth in the two countries would have a notable impact throughout the region. Secondly, the trade conflict puts downward pressure on commodity prices, including oil and metals. In early August, copper prices fell to the lowest level in two years, causing export revenues in Chile and Peru to decrease significantly. Third, the trade conflict adds to economic instability, which is already high in several countries, including Argentina, Brazil and Mexico, due to internal policy issues. High levels of instability hampers investment and capital flows to the region, reducing the prospects for recovery (UN 2019).

[1]The escalation of the trade conflict began when the United States raised tariffs applied to Chinese products valued at USD 200 billion from 10 % to 25 %, to which China responded with a similar increase applicable to US products worth of USD 60 billion. The United States also excluded India from the Generalized System of Trade Preferences, to which the country acted in retaliation by raising tariffs on 28 US products (CEPAL 2019). According to (World Bank 2019), in 2018 the administration of the United States had already raised tariffs on imports valued at about USD 300 billion, mainly from China. In response, other countries had retaliated with tariffs worth approximately USD 150 billion in US exports. In total, new tariffs had been imposed on approximately 12 % of US imports last year.

2.4. Growth prospects in agricultural demand and production

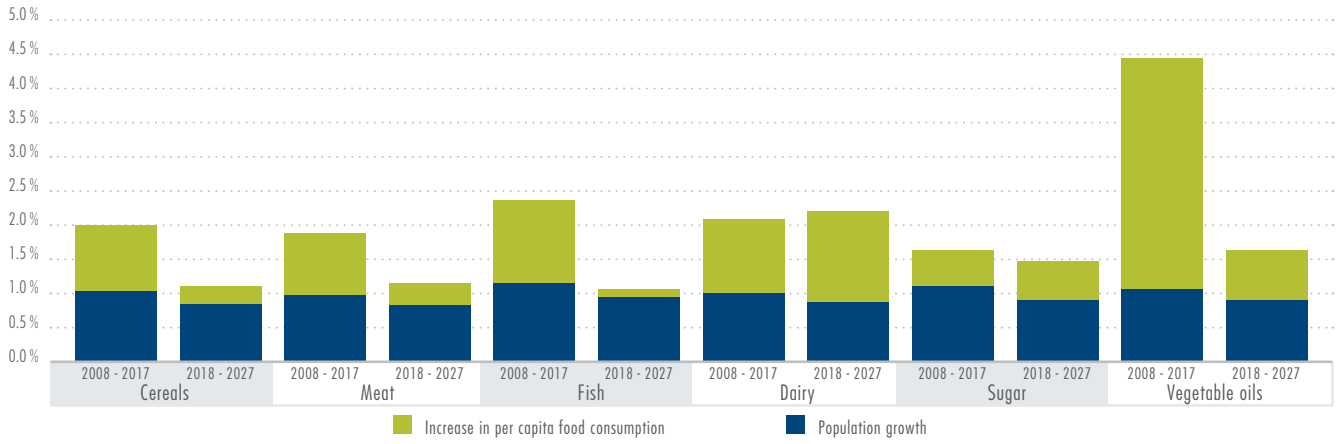
A slowdown in global agricultural demand and international prices is expected with respect to the last decade.

World economic growth trends and projections discussed in the previous section have several implications for the agriculture sector. Economic growth in emerging economies is and will continue to represent more than double the projected growth rate for developed countries in the coming years. Consequently, the share of emerging and developing economies in world GDP will continue to increase. China, India and Southeast Asian countries should account for most of this increase.

In parallel, although world population growth is slowing (expansion of just under 1 % per year over the next decade, compared to an annual rate of 1.4 % in the 1990s and 1.2 % in the 2000s), in some regions the population will continue to expand at higher rates, especially in low-income countries. In addition, more people now live in cities (54 %) than in rural areas, and the urbanization process is expected to accelerate as the population grows. Population growth and urbanization generate changes in food patterns and in the dynamics of the agri-food system (FAO 2018).

Global per capita consumption of various agricultural products is expected to remain relatively flat in the coming years (Figure 2.2). This is the case for some basic foods such as cereals, roots and tubers, but also for other products such as meat. According to the data in Figure 2.2, global demand among the large food groups will grow over the next decade, but with the exception of dairy products, growth will decelerate versus the previous decade. While the average growth rates observed between 2008 and 2017 for these large food groups has been 2.4 % per year, an average increase of 1.4 % is forecast for the next ten years.

Figure 2.2: Annual growth in global demand for groups of agricultural products, 2008-17 and 2018-27



Source: The authors, based on data from (FAO and OECD 2018).

The share of emerging and developing economies in world GDP is expected to increase from **38 %** in 2018 to **45 %** in 2027 (USDA 2018).

The projections indicate a need of less than **100** million additional hectares for agricultural use in 2050 (FAO and OECD 2018), that is, an increase of about 2 % compared to 2012 levels.

Emerging and developing economies should account for **more than four fifths** of the projected increase in global demand for meat, cereals and oilseeds over the next decade (USDA 2018).

This increase in global demand for agricultural products will lead to a rise in production of about 1.3 % per year over the next decade, achieved mainly from intensification and enhanced efficiency (see section 3.2.1), while the expansion of agricultural area will be minimal (OECD and FAO 2019). Crop reallocations are expected in response to changes in demand and relative prices. For some crops, soybeans in particular, land will play a more important role, since both an expansion of the cultivated area and the intensification of production are expected in Brazil and Argentina. The availability of improved seeds, fertilizers and digital technologies (see section 3.2.2) will favor the rise in production, but concerns about sustainability, such as those reflected in SDG 12 (sustainable production and consumption) and climate change can impose restrictions (see section 3.2.1).

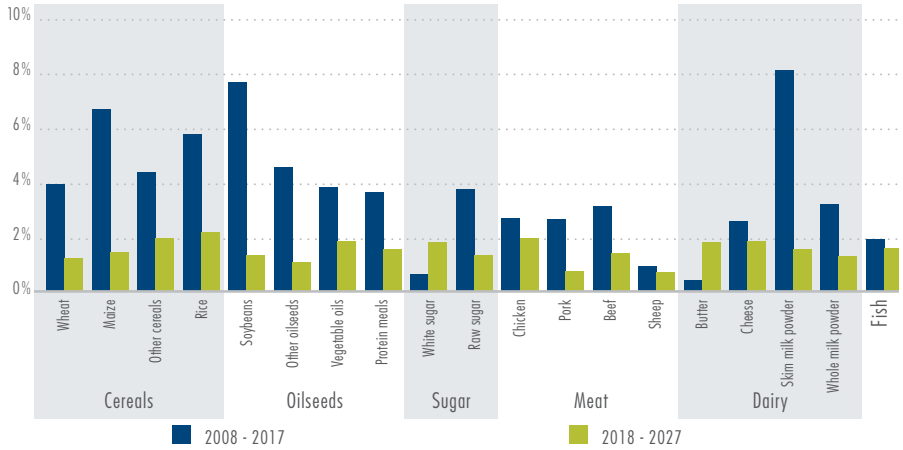
One of the consequences of the stabilization of per capita consumption is that population growth will be the main determinant of the increase in food demand in the next decade. Thus, most additional food consumption will originate in regions with high population growth, such as sub-Saharan Africa, India and the Middle East and North Africa. As several of these countries are food importers, trade in agricultural products is expected to continue increasing in the next decade, although at a slightly slower pace than in the previous decade (OECD and FAO 2019).

2.5. Evolution of agricultural trade and prices

Trade expansion is forecasted for all major agricultural products, but especially for rice, other cereals, chicken, vegetable oils, butter and white sugar (Figure 2.3). Only white sugar and butter are expected to show trade acceleration versus growth from the last decade. The expected deceleration is evident: while between 2008 and 2017 world trade of the main agricultural products grew at an average rate of 3.7 % per year, between 2018 and 2027 it is estimated that its growth will be limited to 1.5 % per year. (OECD and FAO 2019) still stresses that net exports will tend to increase from regions and countries with abundant land, especially in the Americas, while countries with a high population density or high population growth should experience an increase in net imports (FAO and OECD 2018). The expansion of agricultural production over the next decade should be sufficient to meet the increase in world demand and keep real price growth null or negative. Since mid-2016, the FAO food price index has shown some stability, but at a higher level than in the early 2000s, both in nominal and real terms (figure 2.4). This behavior has been observed for all groups of agricultural products whose price indexes are calculated by FAO (cereals, meats, dairy products, oils and sugar) (FAO 2019).

Compared to other commodities, the prices of agricultural products and especially metals rose in the last year, while the price of energy fell sharply, driving a reduction of 6.9 % in the IMF primary commodity price index since the second half of 2018. It is possible that commodity prices will fall again in 2019 (CEPAL 2019).

Figure 2.3: Trade growth for major agricultural products, in volume.



Source: The authors, based on data from (FAO and OECD 2018).

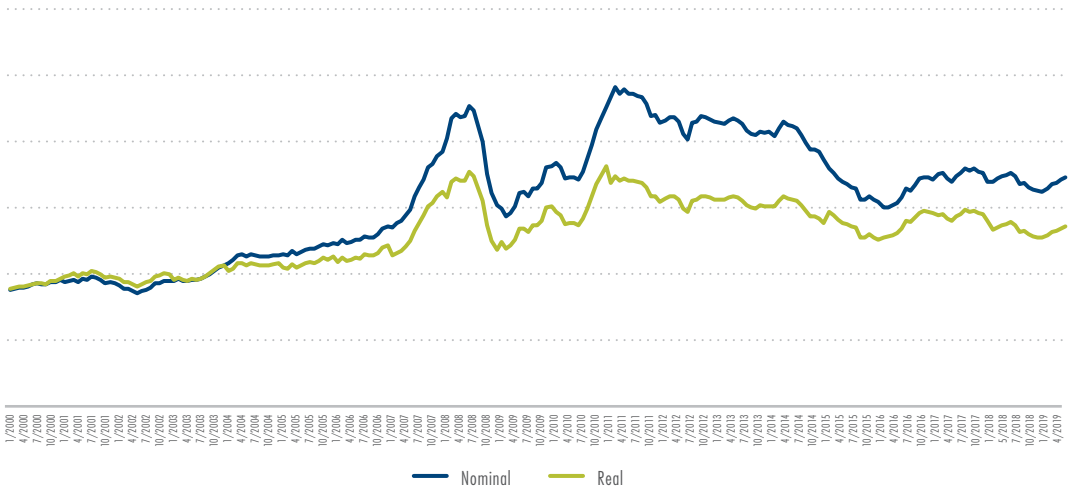
The origin of **agricultural exports** will be increasingly concentrated in some countries. This might increase the vulnerability of agricultural markets to supply shocks derived from natural and political factors.

Lower **energy prices** treduce agricultural production costs while, in contrast, higher **interest rates** and a greater volatility of financial flows can increase borrowing costs and limit farmers access to credit (see section on agricultural financing 3.3.2). FAO and OECD (2018) estimate that the FAO food price index will increase **0.7 %** per year over the next decade, in nominal terms, and will decrease on average **1.5 %** per year in real terms.

Over the next few years, international prices should continue to adjust downwards for most agricultural products. Both nominal and real prices are expected to remain below the maximum levels reached between 2008 and 2014, but above the levels observed in the early 2000s. This behavior is a consequence of downward price pressure expected to prevail over the next decade on an increase of productivity. Since the prices of different agricultural products (cereals, oilseeds, dairy products and meat, for example) are highly correlated, similar behavior is projected across the board: falling in real terms, but with levels that will remain above the low prices of the early 2000s. Some dairy products are an exception, whose prices are projected to move upwards.

Despite the general downward trend in agricultural prices in real terms, the risk of sudden price increases, as a consequence of crop failures and other supply shocks, remains valid. It is important to stress that demand, production and price projections made by FAO and OECD (2018) reflect structural trends and average climatic conditions that do not take into account possible unforeseen events that could increase volatility, including extreme weather events. In that sense, a recent study (Chatzopoulos et al. 2019) relaxed the assumption of average weather conditions and modeled the implications of extreme weather events for agricultural markets. The study reveals important production effects from extreme weather events, such as heat waves, droughts and heavy rains, which are expected to occur more frequently and to last longer in many areas in the next decades (IPCC 2019)[2].

Figure 2.4: FAO Food Price Index, in nominal and real terms



Source: The authors, based on data from (FAO 2019).

[2]Depending on the duration and intensity of extreme events, the estimated impacts on national production range from -28 % (Australia) to +41 % (Kazakhstan) for wheat, from -49 % to +68 % (South Africa) for corn, and from -12 % to +13 % (United States) for soy. These impacts lead, in turn, to significant differences in national and international crop prices compared to a situation with average conditions. In general, domestic prices could vary from -10 % (Kazakhstan) to +125 % (Pakistan) for wheat, from -21 % to +310 % (South Africa) for corn, and from -24 % to +58 % (India) for soy. In general, the extreme events analyzed would lead to lower competitiveness of exports, a greater dependence on imports, a lower self-sufficiency and, occasionally, a temporary price volatility compared to an average scenario FAO-OECD (2019).

2.6. Demand for natural resources and climate change

Food production in 2050 will have to increase by 50 % versus 2012 levels to meet the growing global demand for food that results frompopulation growth and changes in consumption patterns (FAO 2018). One implication of this will be greater pressure on natural resources and the environment. The growing demand for food and other agricultural products raises the question of how the sector will be able to expand production and, above all, if it can do so sustainably. More than a third of the world's agricultural land is moderate to highly degraded, according to FAO data, and there are few areas where agricultural land could still be expanded. In addition, agriculture is estimated to be the main driver of around 80 % of deforestation worldwide. Furthermore, water withdrawals for use in agriculture represent about 70 % of total water withdrawals (IPCC 2019), with significant differences between countries and regions. With urbanization and climate change, the availability of water is increasingly concentrated, and supply and demand of water do not necessarily coincide in time and space (FAO 2018). Finally, in the case of energy, the agrifood sector, including agriculture and the food industry, consumes about one third of the energy generated globally.

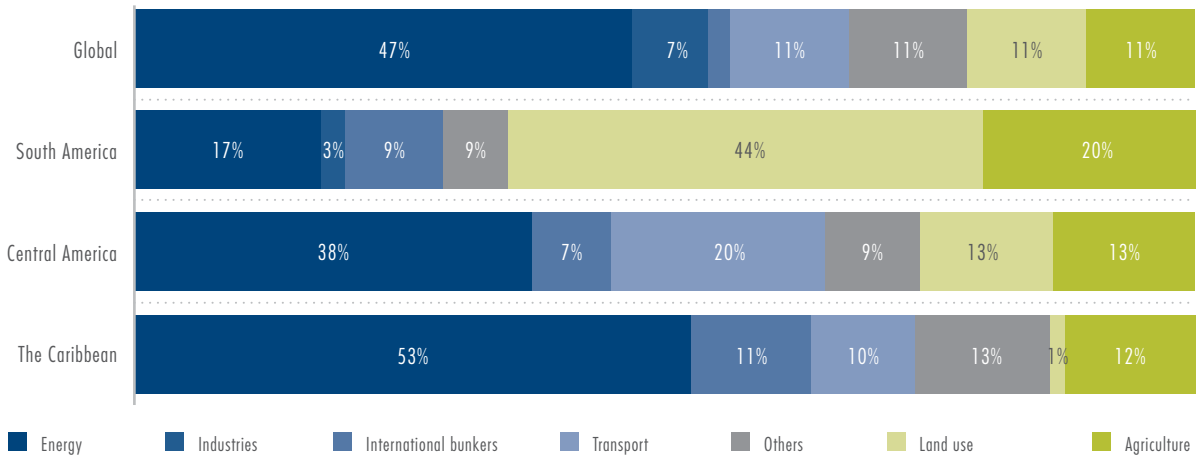
Agriculture and its impact on land use, such as deforestation, are the second main source of Greenhouse Gas (GHG) emissions, with a share of about 23 % worldwide, reaching up to 37 % when considering the whole agrifood sector, that is, including pre- and post-harvest activities (IPCC 2019). In the case of LAC, the sector's participation in GHG emissions is even higher, especially in South American countries, given the importance of livestock as a source of methane emissions (see Figure 2.5).

Despite estimates that world agriculture will boost production to meet the projected food demand for the coming decades through the incorporation of technology and increasing yields, there are risks that this will not occur due to, among other factors, an intensification or acceleration in the impacts of climate change (see box 2.1). The sector cannot, therefore, be excluded from practices for climate change mitigation, and must also actively participate in adaptation practices. The adaptation of the agricultural sector to climate variability and extreme events should serve as a basis to reduce its long-term vulnerability. The necessary change should be towards decoupling, that is, an agricultural production that releases less GHG emissions per unit of food. Adaptation will require new investments in infrastructure, risk management, and varietal adaptation (See technology practices and options in section 3.2.1).

The projections for 2050 suggest an additional shortage of natural resources for agriculture, either through degradation or increased competition from other uses. These effects, on top of stricter regulations, could limit food production and increase agricultural costs.
Since that almost a third of produced food is lost or wasted, there is a great margin to reduce the demand for natural resources simply by reducing losses and waste along the food chain.

Si se tiene en cuenta que casi **un tercio** de los alimentos producidos se pierde o se desperdicia, hay un gran margen para reducir la presión sobre los recursos naturales simplemente disminuyendo las pérdidas y los desperdicios a lo largo de la cadena.

Figure 2.5: Participation of different sources in GHG emissions, at global and regional levels, in percentages



Source: The authors, based on data from FAOSTAT.

Box 2.1: Differentiated impacts of climate change

Climate is an essential input in agricultural production. Compared with the pre-industrial period, the 2006-2015 observed land surface air temperature has increased 1.53oC, almost double the increase registered over the same period for the global average temperature (0.87oC). Warming has resulted in increased frequency, intensity and duration of heat waves, while the frequency and intensity of droughts have also augmented in some regions (including South America). There has also been a rise in rainfall intensity on a global scale. Climate change has already negatively affected food security and terrestrial ecosystems while also adding to desertification and land degradation in many regions (IPCC 2019).

Most studies agree on the unequal impact of climate change. Adverse impacts are expected to be more intense in low- and middle-income countries, where agriculture is very important. In these countries, climate change may have a substantial negative impact on the availability of calories per capita, with consequences for food security and public health (FAO 2018).

Reallocations in the agricultural aptitude of different areas are expected, especially in low-latitude regions, which will imply the need for new investments in fixed assets and infrastructure for productive reconversion. In addition, greater concentration of production is projected in some countries and regions, which will increase global vulnerability to supply shocks and make international trade an even more important tool for food security.

2.7. A new rurality

Accelerated urbanization of emerging and developing economies and increasing internal and international migratory flows, especially among young people and men, are examples of demographic trends that are characteristic of LAC countries which help understand regional rurality in the XXI century. On the one hand, the share of the rural population in the total population is decreasing while, on the other hand, the rural population is increasingly older. In 1950 the rural Latin American population reached 94 million people, representing 58 % of the total population; by 2015 it was 122 million, which constituted about 20 % of the total population. In parallel, the proportion of the rural population over 65 moved from 3.2 % to 7.4 %, while the proportion of young people (age 15 to 29) has remained relatively stable at around 25-26 % of the rural population.

In LAC, the greatest portion of income is derived from work (CEPAL 2019) and, in the rural areas, despite the growing importance of remittances and public transfers, wages and other remuneration from work remain the main source of income. Therefore, the development and well-being of rural areas depends largely on the dynamics of agricultural production and the labor market. The participation of agriculture in rural employment fell more than eight percentage points between 2000 and 2017, while the share of industry and especially, services, increased (see table 5.3 in annex).

In Latin American rural areas, sources of income have been diversified to include not only rural non-agricultural employment (RNAE), but also external sources of income, such as remittances and state programs. The available information reveals that, in half of the rural households, the RNAE has increased at a higher growth rate than the agricultural employment and that the income derived from the RNAE is on average higher than the agricultural wage (Escobar 2016).

It is estimated that the economically active population in the rural areas of LAC is about **50** million people, the majority of whom are engaged in agriculture.

Towards the end of this century it is projected that the rural population will represent only **10 %** of the total population of the region, although much of the natural resources on which LAC depends for its growth will continue to be concentrated in rural areas (see section 3.1.1).

2.8. Poverty and inequality

Despite the significant progress observed over the past 15 years, poverty and extreme poverty rates in rural LAC areas represent about **1.8** times and **2.6** times, respectively, the rates of urban areas.

Despite the socioeconomic progress achieved in LAC in the last decade, the region remains the most unequal in the world. One facet of this inequality is the development gap between urban and rural areas. The lags in rural labor markets, for instance, with respect to urban areas result in a much higher level of rural poverty compared to urban poverty.

The incidence of poverty is higher among people living in rural areas; children, adolescents and youth; indigenous people; women of working age; people with lower educational levels; and those whose basic needs are not met. While some of these gaps have narrowed since 2012, others have widened (CEPAL 2019).

Although the number of small farmers with low productivity represents more than 90 % of total agricultural holdings in the region, they are in possession of only 23 % of the agricultural land, according to FAO estimates. The average size of family farms in the region is 13 hectares, but, if the Southern Cone is excluded, the average is reduced to 2.5 hectares. Self-employed agricultural workers and their unpaid family members, the majority of whom are family farmers (although definitions vary from country to country), have the lowest level of income among the different categories of labor insertion in rural areas.

Rural poverty is closely linked to the serious deficits of decent work in agriculture, and exacerbated by the weak presence of labor institutions in rural areas (Reinecke and Faiguenbaum 2016). OIT (2016) emphasizes that, despite the increase in agricultural productivity, there are still profound differences between the employment status of rural and urban workers (see section 3.1). To overcome poverty, labor policies must reach rural areas and must consider the specificities of their labor markets: a high contingent of family farmers, seasonal workers, high levels of informality, low female participation in paid positions and a higher incidence of child labor and forced labor. The seasonality and temporary work that is characteristic of agriculture pose limitations for the broadening of social security and demands innovations in the design of coverage systems, their administration and financing.

Stronger wage growth in the agriculture sector alone cannot contribute to reducing poverty and inequality in rural areas without extensions to the coverage of social security and labour benefits to agricultural workers. Additionally, the environmental dimension and sustainable use of natural resources, themselves contributors to competitiveness, should not operate as barriers to the entry of family farmers and less

qualified workers in agricultural markets. Instead, family farmers should be encouraged to take advantage of some of their assets in this area compared to industrial agriculture, such as the sustainability of their production practices and their pluriactive nature (Escobar 2016).

Generally speaking, rural poverty is associated with the existence of a large contingent (about **16.5** million farms in LAC) of small agricultural producers with low productivity and with restricted access to land and public goods.

Faced with the challenge of reducing poverty in the context of the SDGs, agriculture, by employing less-skilled workers with the lowest incomes among all economic activities, can play a fundamental role (FAO 2018) (see section 3.2).

Chapter 3.

Key actions for rural and agricultural transformation towards inclusive and sustainable development in LAC

3.1. No sustainable development without rural development

It is not possible to overcome poverty or combat hunger, malnutrition and climate change, if societies and political actors in LAC do not recognize rural areas as an engine of economic, social and environmental development in their countries, at least with the same importance assigned to them in developed countries.

In order to progress towards the SDGs, it is increasingly important to take a multisectoral and multidimensional approach, and, in particular, to understand that rural and urban territories coexist and impact each other in efforts to reach the goals of the 2030 Agenda.

Most agri-food systems are based in rural areas, where renewable energy systems can be developed and actions taken to combat climate change and promote the sustainable management of natural resources, through agricultural development and the provision of ecosystem services. Therefore, it is extremely important to address rural development by focusing on economic, social and environmental aspects, which would help to close the urban-rural gap, as well as by proposing models that promote economic growth through social and inclusive development (Bebbington 2019) in rural and urban areas. Without that commitment, it will be impossible to achieve the synergies necessary to achieve the 2030 Agenda in LAC.

3.1.1. Overcoming the urban-rural dichotomy is crucial

Today, rural areas are much less visible than urban areas in policy discussions, which is the result of an exclusively demographic perspective and traditional definitions of rurality, which do not consider the contributions of rural areas or their potential for economic and social development. Since the industrial revolution, the rate of growth of the urban population has far exceeded that of the rural population.

One of the consequences of greater growth of the urban population is that it has made rural areas invisible in public policies and in discussions regarding international agreements.

It also means that the important contribution and opportunities offered by rural areas to achieve the SDGs as part of the 2030 Agenda have not been recognized (Saravia–Matus and Aguirre 2019, Figure 3.1). In order to face the challenges of the 2030 Agenda, it is essential to recognize that all territories, whether urban or rural, are interconnected in terms of infrastructure needs, social protection policies and gender equality, with people living in the same environment and with the same basic rights.

It is essential to raise awareness about the lack of visibility of rural areas in policy agendas, while recognizing their potential to prevent, mitigate and overcome the different causes of poverty and hunger in rural territories.

In 1970, urban dwellers already outnumbered rural dwellers. By 2030, more than 80 % of the population of LAC is expected to live in urban areas (UN 2018).

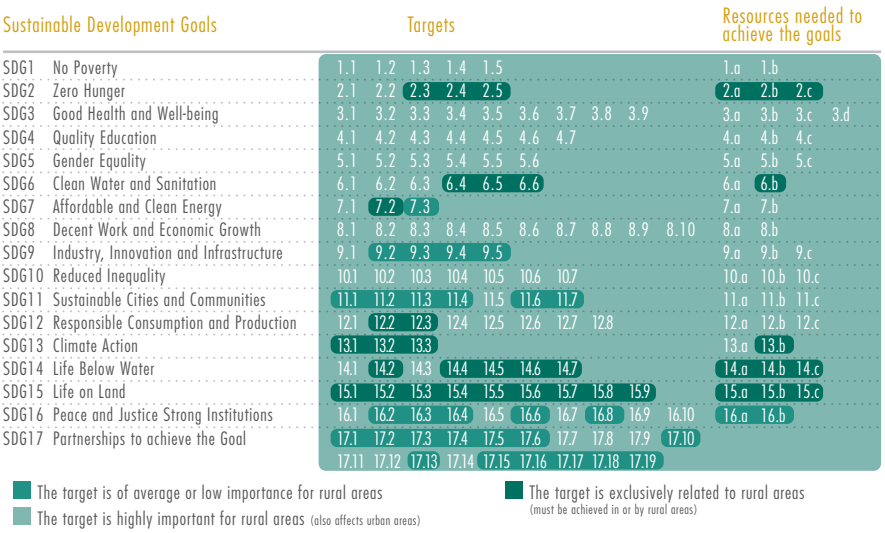
It is essential to prevent poverty from increasing, since its persistence operates as a mechanism that reproduces gaps between urban and rural areas, affecting access to basic services, health, education and infrastructure, among others.

The 17 SDGs for 2030 are comprised of 169 targets, divided into objectives (126) and the resources needed to achieve them (43), of which a total 132 must be achieved in rural territories (figure 3.1).

Rural areas have ceased to be considered as spaces characterized by deficiencies and poverty, and have begun to be understood as spaces that present opportunities to transform food and energy systems and promote ecosystem services, biodiversity conservation, the fight against climate change and the sustainable management of natural resources, such as land and water (Saravia–Matus and Aguirre, 2019).

Between 2014 and 2017, poverty increased in LAC from 45.1 % to 46.4 %.

Figure 3.1: The importance of rural areas in the 17 Sustainable Development Goals



Source: Adapted from (FAO 2018).

From a geographical perspective, it is important to note that only 10 % of the world's territories are urban, which means that 90 % are "rural" or "rural-urban" (Demographia 2019, Cox 2010), including territories in which the vast majority of the world's renewable and non-renewable natural resources, as well as its terrestrial and marine ecosystems, are concentrated.

3.1.2. Urban-rural gaps in LAC must be closed to achieve the 2030 Agenda

In order to achieve the 2030 Agenda, it is not enough to make marginal adjustments in the dynamics of rural development, but rather a deeper structural transformation of rural areas is needed to strengthen and modernize them in economic, social and environmental terms. Rural development is a multidimensional issue that offers opportunities in agriculture, food systems and energy development, as productive areas in which the region can make important progress in meeting the SDGs. To achieve this aim, however, the existing lags in rural areas must be overcome:

- There are multiple interconnected urban-rural **socioeconomic gaps,** with poverty being one of the most worrying manifestations:

  – **Poverty:** During the period 2014-2017, the downward trend in rural poverty levels in LAC was reversed. Poverty actually increased in LAC in this period, although men and women were affected in different ways.

- **Social protection:** Despite the accelerated growth in coverage of pension systems since 2002, the level of rural coverage (22 % of the rural population) is still far from that observed in urban territories (54.7 % of the population). Despite the expansion of social programs, the rural population remains at a disadvantage compared to the urban population — 32.6 % of the rural population does not have health insurance and only 11 % live in households that receive social security benefits, compared to 9.8 % and 19 % in urban areas, respectively (OIT 2016).

- **Undernourishment and obesity:** The manifestations of food insecurity have a greater impact in rural areas. For example, although chronic child malnutrition in rural areas has decreased in recent years, it is still greater than in urban areas in virtually all countries of the region (Trivelli and Berdegué 2019), which is a clear setback in efforts towards SDG 2. In addition, the prevalence of obesity has increased in LAC, especially in rural areas, becoming one of the leading causes of death from chronic noncommunicable diseases (FAO 2018), which hinders progress towards SDG 3.

- **Access to infrastructure and basic services:** In LAC, access to these services remains limited for the rural population (Fort 2019). Connectivity and accessibility (roads, telecommunications, Internet) are limited, as is access to basic services, such as drinking water, sanitation and electricity (Saravia–Matus and Aguirre 2019, Fort 2019), which represents an important obstacle in efforts to achieve SDG 6 (Clean water and sanitation) and SDG 9 (Industry, innovation and infrastructure), and even SDG 1 (End of poverty) (see Appendix 5.2). In addition, the urban-rural connectivity gap is not only physical, but also digital. For example, the difference in Internet access between urban and rural populations has reached 28 percentage points in some countries (see Digital Agriculture [AD], Section 3.2.2).

- **Education:** Education coverage levels in rural areas have increased significantly, but quality levels are lower than those in urban areas (Scott 2019, OECD 2010, Fuica et al. 2014, Saravia–Matus and Aguirre 2019). The gaps are even greater in tertiary education than in secondary school. In general, the gaps in education of rural youths compared to their urban peers are mainly explained by the income level and education of their parents (Scott 2019).

- **Health:** Despite the greater coverage of health services registered in recent years, and their greater use (partly thanks to the massification of social programs conditioned to the use of health services), the infant mortality rate continues to be higher in poorer rural population groups, such as indigenous peoples.

- **Employment:** Rural areas not only provide opportunities for productive transformation sectors,

In that period, the femininity index of rural poverty increased 6 percentage points (from 108.7 to 114.7), while the femininity index of extreme poverty rose by almost 2 points, from 113 to 114.9 (FAO 2018).

In 2015, 87.9 % of the urban population had access to potable water and sewerage infrastructure, while only 64.1 % of the rural population enjoyed such access (Saravia–Matus and Aguirre 2019, Fort 2019).

In 2017, the gap between the percentage of young people aged 15 to 24 with completed secondary education in urban and rural areas reached more than 20 percentage points in some countries of the region (see Appendix 5.2), compared to an average of 10.9 points in the region (Saravia–Matus and Aguirre 2019, Fort 2019).

Rural employment in LAC in primary activities associated with agriculture remains at 54.6 %, and is the main source of labour.

The proportion of child labour is more than double in rural areas compared to urban areas in most countries (CEDLAS and BM 2019).

It is alarming that the proportion of women who own land in the region ranges from 7.8 % to 30.8 % (FAO 2017). Given that this productive resource is fundamental for the generation of income and well-being, the lack of ownership limits the development of women in the region.

Ensuring the full and effective participation of women in the workforce is essential to achieving SDGs 5 (Gender equality) and 8 (Decent work and economic growth).

In LAC, land ownership is particularly concentrated, with a Gini coefficient of 0.79, the concentration in South America (0.85) being higher than in the Caribbean (0.75) (Oxfam 2018).

in which there has been a 20 % increase in rural labour, but also for service sectors, where there has been an increase of 25.8 % in rural labour associated with non-agricultural activities.

A problem to be addressed is that most rural jobs still have lower productivity than urban ones, which is reflected in the labour income gap.

- **Gender:** In LAC, gender disparities are present in terms of poverty, social protection coverage and access to key productive assets. The most worrying disparity is in the ownership of productive resources, which is persistently less favourable for rural women, and continues to limit their productive autonomy and access to markets.

  With regard to wage labour, the participation of women is a minority. In 2010, women represented 25 % of the economically active population in agriculture in South America, 12 % in Central America and 24.5 % in the Caribbean (FAO 2017). However, the evidence indicates that women in the agriculture sector devote more hours to unpaid work than the average for those employed in the sector (CEPAL, 2016b).

  Women in rural areas have higher illiteracy rates and lower secondary school attendance rates (Trivelli and Berdegué 2019), so their chances of achieving economic autonomy and accessing employment opportunities are lower than those of men.

- **Land access and tenure:** Many of the challenges of today's societies (eliminating poverty and hunger, improving environmental protection, etc.) have a dimension that is clearly related to land tenure, use and administration. Work must be done to improve the conditions of land tenure, and thereby reduce the high concentration of land ownership and use, and avoid the growing number of social conflicts in rural territories. Land tenure and administration must be adapted to allow socioeconomic development, increase incentives for productive and social investment, reduce the risks of ecological degradation, improve access and management of natural resources, facilitate tax collection processes and the generation of conditions for the protection of vulnerable communities through social programs, and, ultimately, create the foundation for achieving SDGs 1 (End of Poverty) and 2 (Zero Hunger).

- **Environmental challenges**: The wealth of biodiversity, natural resources and ecosystems in LAC stands out globally, constituting the main productive asset and source of knowledge generation for the region. Therefore, it is of utmost importance to develop sustainable means of production that protect the productive capacity and innumerable qualities of ecosystems and natural resources for the development and well-being of the population. The goals of the 2030 Agenda related to climate change (SDG 13), the conservation of marine resources (SDG 14) and the protection of biodiversity and

terrestrial ecosystems (SDG 15) should not only ensure the care of resources, but also seek to promote the development of sustainable and resilient modes of production (see Section 3.2.1). (UNEP 2016).

– Biodiversity, ecosystems and natural resources: The increasing loss of biodiversity is one of the most obvious consequences of the environmental degradation facing the region. It is estimated that around 74 forest ecosystems in the region are under threat and that tropical and subtropical humid forests, grasslands, savannas and tropical and subtropical scrublands have experienced the greatest loss of terrestrial biomes (Durango et al. 2019).

  In terrestrial ecosystems, the reduction of biodiversity means a loss of intrinsic and genetic wealth. The costs that land degradation represents for the region are equivalent to USD 60 billion annually, which directly affects productive capacity and the possibility of exploiting environmental services in rural areas (Durango et al. 2019).

  Unsustainable agriculture also has an impact on environmental degradation, especially due to land use changes, which are responsible for 70 % of the estimated loss of terrestrial biodiversity in the region (CBD 2014), together with the 70 % reduction of forest areas, compared with 35 % in Africa and Asia (FAO 2016).

  Excessive use of inorganic fertilizers in some territories has influenced the acceleration of soil carbon mineralization and its subsequent emission into the atmosphere. Organic carbon reserves in the soil are at critical levels due to unsustainable agronomic practices and deforestation (GARDI et al. 2014).

– Climate Change: There is no time to lose in facing this challenge. In 2014, extreme weather events linked to the increase in global temperature meant losses of grains and livestock in developing regions equivalent to USD 13 billion, and almost half of the losses occurred in LAC (FAO 2017). Agriculture, forestry and land use change are responsible for 42 % of GHG emissions and energy development accounts for 25 % of these emissions (Trivelli and Berdegué 2019, López, César Augusto Salazar and De Salvo 2017, CEPAL 2018).

  Although natural disasters do not distinguish urban from rural, or gender differences, rural areas are often the ones with the most vulnerable infrastructure and, therefore, with the least resilience, so they are usually the most affected (Saravia–Matus and Aguirre 2019). In addition, women are more vulnerable to the effects of climate change, due to their reduced access to productive assets, the precariousness of their jobs and lower social protection coverage.

  On the other hand, rural areas present the greatest opportunities to introduce a new productive logic to achieve sustainable development and combat climate change and its

LAC, with only 16 % of the planet's land area and 9 % of the world's population, contains 50 % of its biodiversity (UNEP 2016).

Between 1970 and 2014, according to the Living Planet Index of the World Wildlife Fund (WWF 2018), the reduction in the populations of LAC species exceeds the world index by 29 percentage points.

In terms of agrobiodiversity, it is estimated that 75 % of crop varieties have been lost in the last 100 years (FAO 2005), thereby affecting their resilience to pests and possibilities of adaptation to climate change.

LAC, 75 % of agricultural land suffered from degradation in 2015 (FAO and GTIS 2015).

Rural areas are responsible for 67 % of GHG emissions in the region.

The climate has a direct impact on the quality of life. The number of people affected by some type of natural disaster related to extreme weather events in LAC increased from 2.7 million in 1990 to 11 million in 2017 (Saravia–Matus and Aguirre 2019).

Between 2008 and 2016, energy produced from bioenergy sources increased by 48 %, which makes these sources attractive alternatives for the agricultural bioeconomy (see Chapter 4).

There is an important virtuous relationship between rural and agricultural development, and their complementarity is key to achieving the SDGs.

Decoupling economic growth from carbon emissions (decarbonization and green and blue growth), as well as promoting the use of renewable energies and the protection of ecosystems, will help to increase rural employment.

effects. In particular, technologies are being implemented in these areas to produce energy from unconventional sources, which increased production by 186 % between 2008 and 2016 in terms of gigawatts per hour (GWh) in LAC (Appendix 5.2). Among these technologies, it is important to highlight those associated with solar energy, which saw production rise from 63 GWh in 2008 to 5,353 GWh in 2016, and those related to wind energy, whose production increased from 1,704 GWh to 45,274 GWh in the same period.

3.1.3. Rural opportunities to contribute to the 2030 Agenda and proposals for a new roadmap

The transformation of food and energy systems, extensions of ecosystem services and the fight against climate change will not be possible without an effective commitment from governments and work by key actors in rural territories. Despite the lags in rural areas in relation to urban areas, it is important not to lose sight of the opportunities offered by rural areas to help achieve the 2030 Agenda.

Some proposals are as follows:

- Invest in agricultural and non-agricultural activities in rural areas to promote non-agricultural rural employment, through policies to promote innovation, financing and investment (see Sections 3.3.2 and 3.3.3).
  - Support the sustainable development of non-agricultural activities in rural areas, with a focus on geographical identity in areas such as tourism, gastronomy, handicrafts, training and hospitality for domestic animals, among others.
  - Promote the diversification of activities to face the risks associated with vulnerability and income variability.
- Promote coordinated territorial development policies that take advantage of and strengthen the capacities of rural workers:
  - **Infrastructure:** Promote the development of centers that provide comprehensive primary care to rural households, expand electrification and sewerage and improve physical and telecommunications connectivity in a planned manner with a vision toward territorial development.
  - **Social protection programs:** Design programs that combine the benefits of rural productive inclusion and territorial development, with the objective of managing risks related to agricultural activity, increasing liquidity and facilitating access to credit (see specific recommendations in Section 3.3.2).

- Promote healthy eating habits: Beyond rural education, it is essential to promote changes in eating habits (healthy portions, traditional foods of indigenous peoples in local diets, etc.) and increase the supply of non-industrialized products at low cost and easy access for rural households.

- Increase access to land and tenure security, in order to increase productivity and avoid underutilization. Land tenure and management instruments should be expanded to provide support that guarantees legal security and resource management to promote productive investment and sustainable land use.

- Promote the effective productive inclusion of women: Beyond raising awareness, concrete actions should be taken that help to reduce the differences between men and women in access to land, productive assets and markets. It is also necessary to promote practices and policies that reduce the burden of unpaid work experienced by women, as well as ensuring their full and effective labour participation, which means adopting the following measures:

  – Promote measures and programs focused on overcoming the inertia that disadvantages women in rural areas, generating a virtuous circle of public-private cooperation and contributing to the awareness and prevention of the violation of women's labour rights.

  – Encourage family co-responsibility, the protection of women's rights and validation of the diversity of adults responsible for the care of children and dependents.

- Promote Research, Development and Innovation (R+D+i), in order to develop agricultural production technologies, energy resources and other opportunities that encourage innovation in rural areas, while also promoting sustainable use of the environment, improving production and contributing to the process of decoupling GHG emissions in the respective countries, as well as facilitating the sustainable use of terrestrial and marine resources (see Section 3.2.1).

- Generate institutional transformations and inter-institutional strategies aimed at proposing goals and timelines for the transfer of resources to help achieve the SDGs (see Section 3.3).

Social protection can be the first and most important tool for the development of broad rural development policies, especially when it is complemented with productive inclusion policies (inputs, technical assistance, credit) in "extended social protection" schemes (FAO 2018, Winder and Faret 2019).

Family farming (AF) and some forms of non-agricultural rural employment are instruments for overcoming poverty, when there are effective opportunities for access to factors of production, services and markets (Grisa and Sabourin 2019).

Creating a new rural narrative requires a deliberate effort to strengthen rural organizations, especially their capacities for negotiation and action in the public sphere, in order to strengthen the presence of rural actors in national, municipal and local decision-making schemes (Bebbington 2019).

3.2. Agricultural development is key to rural development: a menu of complementary options

The causal relationships are relatively clear: Agricultural development is a necessary condition for rural development, and rural development is a necessary condition for sustainable development.

"We need a profound reform of the world agrarian and food system, if we want to nourish the 815 million hungry people currently on the planet and 2000 million additional people who will live here by 2050".

"Investment in agriculture is crucial to increasing the productive capacity in the sector, and sustainable food production systems are necessary to mitigate hunger-related problems".

The importance of productive inclusion and the "two-way" intersectoral approach mean agriculture and its related activities should be taken as a "hard core" from which other complementary economic activities (industry, commerce, services) can be developed to promote development in rural territories.

The SDGs defined by the 2030 Agenda are a call to address the technical and financial difficulties of all family farms (FF) – ranging from the most consolidated to the poorest, where farming is at least partially for subsistence. In the latter type of agriculture, the problem is essentially investment: innovation exists, but it has another scope if we compare it with those faced by companies in general. This is not about promoting disruptive technologies - for example, introducing new productive items - that differentiate companies from their competitors and secure a place in the market. This can be done only in exceptional cases. Rather, the challenge in the case of the poorest FFs is to apply a comprehensive investment program capable of generating a volume of production that ensures, partially or totally, a minimum income and a certain level of well-being.

Facing this task is extraordinarily complex in very difficult conditions and with few resources, since it is about these farms reaching their productive ceiling through innovation and improvements in efficiency. To do so, producers must achieve two objectives:

1. To generate the largest amount of one or more subsistence agricultural products, some of which can be sold for monetary income.

2. To generate a minimum level of equilibrium biomass, so that the necessary ecological services that allow soil to efficiently sustain biological activity, support species diversity and act as the source of essential elements for the development of life remain uninterrupted.

There are then several "productivities" associated with the first objective, whose measurement depends on the context: as subsistence production loses importance, monetary income is increasingly valued. On the other hand, as food problems worsen, calories gain value, with a premium for proteins when the food problems are qualitative. (Dupriez 1982).

The second objective determines the long-term sustainability of the farm but is also relevant for immediate results in terms of productivity. Soil is the key

ingredient, understood as an edaphic complex that depends on the physical and chemical characteristics of the mineral substrate, its water supply and the quality of the materials of biological origin of which it is composed. Soil is the key factor that determines agricultural productivity and it is very sensitive to climate and biomasic activity, as it is a particularly unstable substrate, which is disaggregated and displaced by the effect of sometimes very weak kinetic energies. This is more important in tropical agriculture regions, where rainfall is particularly aggressive and soils are easily eroded by the impact of rain drops. (Dupriez 1982).

As in any system, a single imbalance can compromise the efficiency of the whole: demographic pressure and fragmentation of the property play a structural role, as they tend to intensify soil rotations, depleting their fertility and generating erosion. But there are other imbalances: excessive use of machinery can generate soil compaction, which changes its texture. These changes modify water dynamics, which can compromise the soil's biological capital. In the current context of climate change and strong pressure on natural resources, a new balance is essential, and a new production model – based on the relationship between crops and agroecology - must be applied at the primary production level.

The strategy of combining subsistence production with production aimed at generating monetary income is expressed in Central America and southern Mexico, for example, in the corn-bean binomial, which is at the base of the productive and food systems of the peasant and indigenous rural population.

3.2.1. Sustainable intensification to end hunger, achieve food security, improve nutrition and reduce pressure on natural resources

We have three challenges ahead: adapt to climate change, provide food for a rapidly growing world population and absorb an exponential technological revolution. To face them successfully, new productive models are required in all segments. How should the reform of the global agri-food system proposed in the 2030 Agenda be carried out?

Small producers are critical to achieving the SDGs established by the 2030 agenda. Together they comprise 16 million small businesses and represent a majority segment in all countries, representing between 80 % and 90 % of all holdings (Sotomayor y Namdar-Irani 2016).

Currently, agriculture has a strong environmental impact and producers are the first victims of climate change. As a reaction to this phenomenon, the first steps in the application of more sustainable technologies and productive models have been taken. This process of sustainable intensification is combined with a new agricultural revolution, associated with exponential technological changes that occur globally.

Sustainable intensification means making several technological options compatible. At the primary level, it is critical to move towards agroecological production models, that is, "diversified agroecosystems, (which) mimic natural systems as faithfully as possible to improve sustainable production and independence" (FAO 2018d). This definition does not preclude the possibility of applying this approach in more or less specialized farms, and therefore, of working while connected to large agribusiness chains.

There are experiences of large-scale agroecological production in Argentina - mixed units of crops and livestock with an area of between 50 and 600 ha (Patrouilleau et al. 2017).

As biological material is processed, whether for food or for industrial raw materials, the key is to promote the aggregation of value and the emergence of a circular economy and a green economy. The development of life sciences for the replacement of fossil fuels is another critical aspect of this strategy. All these factors are relevant to move towards a bioeconomy-based global society (see chapter 4).

What does it mean to implement an agroecological transition throughout LAC agriculture?

Examples of how digitalization can contribute to the ecological transition: (see also section 3.2.2):

- The use of weeding robots in organic agriculture avoids the use of agrochemicals.
- Use of sensors in irrigation systems could generate a **50 %** saving in the use of water in agriculture.
- Precision agriculture has reduced the application of agrochemicals by up to **60 %** in some regions and crops.
- The use of light, automated and remote-controlled machinery minimizes soil compaction.
- The use of robots in the wine sector allows for nighttime harvesting, which saves energy and improves fruit quality, as fruit should be cool before being placed in cold storage.

What specific characteristics should the transition towards more sustainable world agriculture have at the regional level? Conceptually, the priority is to preserve the great natural systems of the region that fulfill a global function in maintaining environmental balances. The Amazon (600 million ha and 30 % of the regional area), and other large natural systems, such as those of the Cerrados (11 % of the regional area), the Gran Chaco (3 %) and Patagonia (3 %), are still relatively poorly operated. At the other extreme, there are densely populated systems, such as the coastal plantations (9 %) and the Mesoamerican corn-bean system (3 %), or areas that are subject to intensive agriculture, such as the Pampas in Argentina and Uruguay (5 %) (Dixon et al. 2001). The basic premise is that each major productive system has to make its own agroecological transition.

The soy production system is a case of interest, as it is highly specialized and large (occupying almost a third of cultivated land in South America). Under current conditions, monoculture is synonymous with vulnerability and

instability. However, grain production models, especially in the United States and Brazil, can combine the cultivation of soybeans and corn on a rotating basis (Cap y Malach 2012), and are therefore more adaptive than hyperspecialized. In Uruguay, Law 19,355, enacted in 2015, seeks the same objective, as it requires soy producers to give space to pastures for livestock. In both cases they are models that combine different productive options designed to ease the ecological transition.

Sustainable use of natural resources

It is urgent to reverse degradation trends, changing soil dynamics, forest and agro-ecosystem management and to increase soil fertility, reduce erosion, increase biodiversity, promote water retention and prevent deforestation.

To the extent that it depends on them, the degradation of natural resources - soils, water, biodiversity, forests - and associated ecosystem services, together with climate change, restrict agricultural development (Steffen et al. 2015, Rockström et al. 2009, IPCC 2014). At the same time, the sector contributes substantially to humanity being close to exceeding several of the nine planetary limits within which we can operate safely (Campbell et al. 2017, Neufeldt et al. 2013), making a change in the management and use of resources that are essential to achieving the goals of the 2030 Agenda, especially of SDGs 1 (End of poverty), 2 (Zero hunger), 6 (Clean water and sanitation), 7 (Affordable and sustainable energy), 12 (Responsible production and consumption) and 15 (Terrestrial flora and fauna).

The soil is the element on which rural life is based. Still, it remains undervalued and threatened by degradation, desertification and deforestation, which, in turn, makes it more vulnerable to growing climate changes. Degradation implies a lower capacity to maintain moisture in the soil, and it is anticipated that climate change is going to exacerbate the situation (IPCC 2014). The most productive areas of commercial agriculture (meat, soybeans and palm oil) generate the most degradation.

Some urgent actions for sustainable natural resource management:

- Encourage integrated landscape management, seeking more holistic and comprehensive solutions and systemic approaches that promote intersectoral approach, inclusion and establishment of public-private partnerships at different levels of government, in order to find solutions that make it possible to achieve balance in the different development goals in conditions of increasing uncertainty (Ringler y Lawford 2013, Thaxton et al. 2015).
- Use tools that facilitate understanding (ex ante) of possible impacts, dichotomies and synergies of alternatives that can be generated at different time scales to move more rapidly towards sustainability and evidence-based

In the región, 350 million hectares are deforested (Vergara et al. 2018) and at least 300 million hectares show signs of soil degradation, due primarily to deforestation and overgrazing. (GARDI et al.2014).

The 20x20 initiative, with the participation of 17 regional countries seeking to restore 50 million hectares, recognizes and promotes the restauration of degraded soils.

The restoration of 20 million hectares has an estimated value (net present value, NPV) of USD 23 000 million over 50 years, or about USD 274 per hectare of agricultural production (Vergara et al. 2018).

Increasing production diversity as the size of the farms grows is a challenge, but is necessary to maintain the production of diverse nutrients and viable, multifunctional and sustainable landscapes.

"The yield per day of work is almost twice as high in agroforestry systems as in monocultures in full sun. " (SDG 1) (Armengot et al. 2016).

"Over 286 agroecological projects in 57 poor countries show an average yield increase of 79 % on more than 12 million farms, with an average increase of households at 1.7 t / year (73 %). "(SDG 2) (Pretty et al. 2006).

decision making (Rosegrant et al. 2014, Rosenzweig et al. 2016).

- Implement and scale sustainable and comprehensive models, adjusted to local contexts, that promote integrated water and soil management to increase the resilience, productivity and profitability of systems.
- Continue developing capacities at the subnational level to facilitate the implementation of policies that improve the management of natural resources.
- Take advantage of the availability of digital tools to observe the land and monitor the state of its natural resources, in order to boost precision agriculture and proactively respond to threats, by combining the efforts of the private, public and academic sectors (Maria Loboguerrero et al. 2018).

3.2.2. Technological options for transformation

Agroecology, digitalization, gene editing and bioeconomy provide technological innovations whose application is unavoidable. However, these advances must proceed with caution, and be based on transparent procedures of social participation and interdisciplinary views. Using these premises, the actions proposed below can contribute to a successful transition towards the sustainable intensification of agriculture.

Agroecology

Agroecology contributes to building more resilient and sustainable food systems from social, economic and environmental perspectives. Focused on people, knowledge and territories as agents of change, it facilitates transformation in the way of producing, marketing and consuming food (FAO 2018c).

By focusing on people, agroecology is characterized by the creation of multi-actor and multi-disciplinary networks and by the co-creation of knowledge between scientists and local communities.

Agroecology emerges as an approach to sustainable agricultural production based on the application of ecological, social and economic principles to food systems (see box 3.1. Regional consultations promoted by FAO with stakeholders indicate that agroecology is not a unique technology, but a set of practices adapted to each context that result in a fair and sustainable food system (see technologies in annex 5.2; (FAO 2018a, FAO and Commission on Genetic Resources for food and Agriculture 2019).

Agroecology allows an increase in the diversity of biological components and a reduction in external inputs in agricultural production systems at the farm and landscape level. Diversification implies having a wider range of species, varieties or races in a given sector, promoting positive or complementary interactions among them in the production systems. This diversity. It also serves to enhance the benefits of associated biodiversity, for example pollinators and biological control agents, as well as to generate

favorable microclimates to promote the nutrient cycle and contribute to pest control (Nicholls y Altieri 2015, Attwood et al. 2017).

Agroecology contributes to creating more stable and resilient agroecosystems, which are ultimately reflected in greater yield stability. The alignment of agroecology principles and concepts with the sustainability of food and production systems motivated FAO to launch an initiative in 2018 to expand the scale of agroecology (FAO 2018b). This initiative calls on governments, producer organizations, consumers, civil society, academia, the private sector and international agencies to foster agroecological transition, based on evidence that proves its multiple benefits and positive impacts to achieve the SDGs.

"Through greater proximity between producers and consumers, agroecology helps reduce food waste (associated with SDG 12.3)." (Beausang et al. 2017 in (FAO 2019b).

"Long-term data show how, for a drought-sensitive crop such as field tomato grown in rotation with corn, organic soil management leads to more stable yields over time." (Tittonell 2014).

The increase in the costs of animal husbandry in complex systems is more than offset by the reduction in costs associated with agrochemicals and by higher and more diverse incomes (Tittonell 2014).

Box 3.1: Phases of the transition towards agroecological systems

The transition to agroecological systems is carried out through five phases. The first three focus on the farm, while the other two focus on the entire food system. These phases include:

1. Increase in the efficiency of practices and resources: The efficiency of conventional practices is improved to reduce the use and consumption of expensive, scarce inputs or those that are harmful to the environment.

2. Replacement of external inputs: Harmful practices and products are replaced with others that are more ecologically friendly. Organic agriculture puts the emphasis on this second phase, which reduces the harmful effect of some products. Includes practices aimed at comprehensive pest management and tillage reduction.

3. Redesign of agricultural production systems: Agroecological systems are redesigned to work on the basis of a new set of ecological processes, with the aim of addressing the root causes of problems, such as land degradation, loss of biodiversity and ecosystem services and water scarcity.

4. Strengthening of adapted markets: Consumers value locally grown food, and their purchase supports farmers who strive to move to the first, second and third phases of the transition process.

5. Construction of a new sustainable food system based on equity, participation and justice: The creation of a favorable environment is essential to support agroecology, as producers who wish to follow a more sustainable path often face limitations and risks.

Source: (Gliessman 2015, FAO 2018c)

For many farmers, the transition cannot be made at once, but through progressive changes towards greener practices and more sustainable food systems.

Improving efficiency in the use of resources is crucial for sustainable agriculture. The value of buying "locally" is a kind of "food citizenship" and becomes a force for change in the food system.

Short-term support will be needed through public policies that address structural barriers, providing positive incentives for diversification, while supporting producers in the critical period of transformation of their systems.

DA proposes a paradigm shift, which seeks to reconcile productivity and sustainability. It also closes the gaps between production and distribution, and producers and consumers.

Digital agriculture (DA) as an engine for the agroecological transition.

The application of Information and Communications Technology (ICT) tools in agriculture opens up a range of opportunities to improve production processes and promote agroecological transition.

DA reduces the use of inputs, favors innovation and improves productivity, facilitates cooperation between farmers and allows a direct link between the two ends of the chain: producers and consumers. However, in order to take advantage of these benefits in an inclusive manner, profound adjustments in policies and service provision are required.

Digital tools are already being used to accelerate the transformation, for example:

- For many years, an important segment of farmers has been informed about the weather through cell phones and in many rural territories, Facebook has begun to be used to generate new contacts between producers and consumers.
- Horizontal experiences of the peasant-peasant type have emerged (for example, Yo Joven Rural in Chile) and WhatsApp groups have begun to be used to coordinate production chains (Think Tank Cacao in Ecuador). At the farm level, in Argentina, the 2018 harvest of extensive crops was carried out via 11,240 yield monitors, covering practically 100 % of the occupied area (Méndez and Vélez 2018).
- In the field of logistics, the large global companies specializing in grains—Archer Daniels Midland (ADM), Bunge, Cargill, Louis-Dreyfus Company (LDC) and China National Cereals, Oils and Foodstuffs Corporation (COFCO) - have created an alliance to standardize data and digitize global transactions of agricultural shipments, using digital technologies, such as blockchain and artificial intelligence.

  This approach is being applied in the soy chain and in other large chains in which the countries of South America are great players. This will increase the transparency and efficiency of the chain worldwide (Business Wire 2018).
- The SWIIN company operates a digitalized water rental system in the United States (called the "Airbnb" for water) (Renaissance Numérique 2015).

The Access problem. Despite advances in Internet access (see box 3.2, figure 3.2), more than half of the households in the region are still unable to access the network, and the access gap is larger in rural territories and in the lowest income quintiles. Thus, the digital rift between lagging rural territories and the most advanced urban sectors is still very high. There are many territories in the region that do not have network coverage, so-called "white areas", where the dispersion of the population does not make private operations profitable.

This is a central problem, but it is likely to be solved relatively quickly. Technology is already available and there are even public initiatives to universalize the service through satellite technology.

Box 3.2: Progress in internet access

The number of households connected to the Internet in the region grew 103 % between 2010 and 2016, from 3.9 % in 2000 to 56.4 % in 2016.

In terms of affordability, the cost of fixed broadband service of 1Mbps was equal to about 18 % of average monthly income in 2010, but by November 2017 that figure was only 1.2 %. All countries are below the 5 % threshold established as an affordability reference by the Broadband Commission of the United Nations.

Source: (CEPAL 2018b).

However, costs are still an important barrier for areas where the population is dispersed. On the other hand, it is not possible to install land bases in territories that do not have energy coverage, which also makes it difficult to charge users' devices, although solar energy is a solution. There are several initiatives underway that are designed to bring the Internet to most remote rural areas.

Several projects are currently competing to install a global satellite network:

- The Amazon Kuiper project, which aims to create an interconnected network of 3,236 satellites to give high-speed connectivity and low latency to offline communities worldwide.
- The PoitView Tech project, powered by Facebook, contemplates the launch in 2019 of the Athens satellite, located in low orbits, as the first step to subsequently install an equivalent satellite network.
- The SpaceX Starlink project, which seeks to create a network of 11,000 satellites to cover the Earth.

These projects, which aim to be in operation by 2022, will deliver connectivity (final solutions) to the most remote locations on the planet, that currently do not have the resources or infrastructure necessary to access the network (EMOL 2019)), achieving important cost reductions and service quality improvements. In addition, the region added 9 submarine cables (another 6 are planned for 2019 and 2020) between 2016 and 2018, and 18 internet exchange points (IXPs) were created between 2015 and 2017 to improve connectivity and data flow (CEPAL 2018b).

ICTs play a key role in achieving the 17 SDGs (D'Almeida y Margot 2018) and, in the case of agriculture and food systems, they promise a radical worldwide change, towards the elimination of hunger and poverty (Maru et al. 2018). Digital agriculture contributes to the achievement of several linked goals **SDGs 1, 2, 9 and 12.**

In terms of quality of service, the two highest performing LAC countries (Uruguay and Chile) had 15 % of their connections with speeds greater than 15 Mbps in 2017, while the worst had 0.2 %. As a reference point, worldwide, in the 10 most advanced countries 50 % of connections are above 15 Mbps (CEPAL 2018b).

62.1 % of individuals in LAC used the internet in 2017 (CEPAL 2018b).

The average adoption rate of 4G technology in LAC is 16.1 %, while 2G and 3G technologies each claim 40 %. There are great differences between and within countries (D'Almeida y Margot 2018).

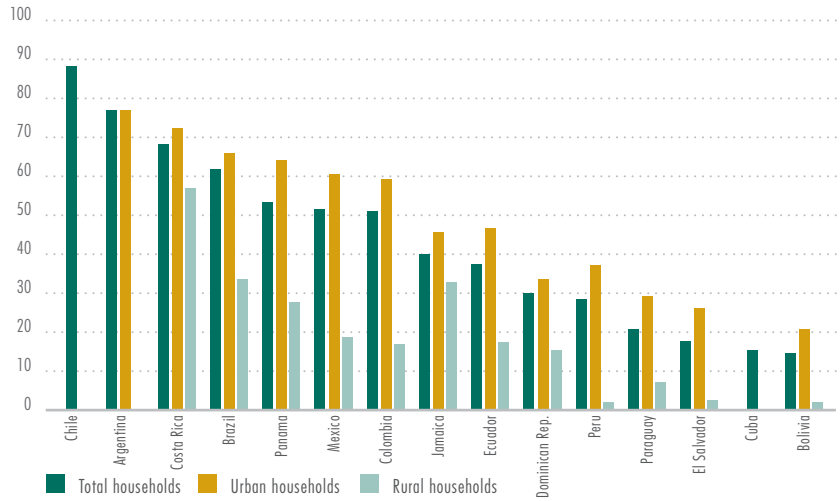
All this information confirms that the Internet will reach all rural corners very quickly, which will open up new possibilities for radical changes in food production, distribution, marketing and consumption.

In the digital area the main advances are associated with the operation of digital platforms, sensors, Internet of Things (IoT), robots, drones, big data, cloud computing, Artificial Intelligence (AI) and blockchain (box 3.3).

The potential of the sensors to implement traceability systems (tracers) is of particular importance for logistics or supply chains (for example, radio frequency identification or RFID are useful for recording the location and condition of perishable products and generate alerts for potential contaminants).

The use of IoT requires the design of new regulatory frameworks (for privacy, interoperability, among other reasons).

Figure 3.2: Households with internet access, by location (%).



Fuente: (ITU y ICTs 2019).

Digital applications in agriculture: Digital agriculture is based on two closely-associated lines of work:

1. The collection and treatment of a large amount of data, which makes it possible to optimize and rationalize decisions and use of resources, and at the same time, predictive analysis to anticipate scenarios; and
2. Peer-to-peer exchanges, which break with the traditional isolation of farmers and allows the emergence of collaborative governance and coordination modes, where a large number of actors can interact with ease.

Box 3.3: DA Applications

- **Digital platforms:** Allow the integration of information, promote wider access and improve effective use of information and services. Platforms facilitate commercial and non-commercial transactions between companies (B2B), between companies and consumers (B2C) or between consumers (C2C). Other electronic platforms provide information on environmental regulations and administrative processes from both public and private sources.
- **Sensors:** Measure multiple properties of the physical world and transform them into digital data. The small size and low cost of sensors allow their integration into a series of artifacts and machines, making the IoT possible and supporting big data. Precision agriculture, dairy control (animal tracking), transport and logistics are the most important fields for application of this technology.

- **Great potential exists for satellite mounted sensors. Advantages include:** Global coverage, homogeneous data, repeated observations that create historical series, multiple observations per day allow almost real-time observation.

Via drones, several indices can be generated, such as the normalized difference vegetation index (NDVI). This allows specific decisions to be made for a certain part of the crop plot, as well as for localized grazing.

- **IoT:** The articulated sensors in IoT are used to monitor the health, location and activities of people and animals, as well as the status of production processes and / or the environment, among other applications. A responsibility problem can also be generated, which requires a clear determination of responsibilities, in case of malfunction.
- **Robots:** Can be used to carry sensors and thus extend the farmer's field of vision, but they can also be used to do technical work on the crop plot. Harvesters, which reduce soil compaction, are an example. They can also be used in other areas such as dairy management (milking robots).
- **Drones:** These unmanned aerial vehicles equipped with cameras can be very useful for calculating biomass or for assessing the level of fertility, water stress and other parameters of a crop. These machines are used to make agrochemical sprays, reducing soil compaction and applying much lower doses (precision applications).

Big data can help make decisions in real time, combining a wide variety of information from different sources.

- **Big data:** ICT, sensors and the increasing power of computers allow the generation, processing and interpretation of a large volume of digital data which can then be used to deduce relationships, establish dependencies and predict results and behaviors.
- **Cloud computing:** Allows access to computing resources in a flexible way and with low management effort. While the IoT allows data to be collected following specific rules, cloud computing allows data storage and aggregation, supporting big data analysis. Cloud computing and data analytics include machine learning applications and make it possible to operate at a new level of artificial intelligence.
- **AI:** It is defined as the ability of machines and systems to acquire and apply knowledge and to have intelligent behavior. These technologies, based on cognition, help computers to interact, reason and learn as humans do, which allows them to perform a wide variety of tasks that normally require human intelligence, such as visual perception, voice recognition, decision making, language translation and object manipulation.

In agriculture, AI is being used for remote pest recognition or for crop evaluation (via sending photos on the cell phone). This facilitates, for example, the design of extension services that operate virtually.

- **Blockchain:** A distributed database, replicated in many places and operated jointly by many users. Decentralization eliminates custody restrictions, as all system data is digitally encrypted for a single identification. Once entered in the blockchain, no data can be modified or deleted without the knowledge of all participants. This technology is key to creating transparency, traceability and trust. The blockchain helps reduce information asymmetries and improve chain coordination.

Blockchain is used to execute transactions, through "smart contracts," which help to verify and force the negotiation or execution of the contract without the intervention of third parties. With a smart contract, transactions occur only if certain pre-established requirements are met, creating an accounting for all transactions.

Source: (OECD 2018)

The success of emerging technological innovations depends on an entrepreneurial ecosystem that enhances the opportunities offered by the region, consisting of academic research, public innovation promotion agencies, investors and agricultural producers. (Vitón et al. 2017).

This ecosystem depends on companies that provide connectivity to the rural environment and public policies that enhance innovation systems. (Vitón et al. 2017)

The potential benefits of precision biotechnology in agriculture include opportunities to improve process efficiency, increase productivity, expand crop diversity and contribute to the adaptation of agricultural activity to environmental uncertainties (Zhang et al. 2018) (Boxes 3.4 and 3.5).

Key actions: In its recent report on policy opportunities for digital innovation, the OECD identifies key areas in which policies must be adapted to the digital age:

- Data access policies, as key ingredients of innovation;
- Policies to support innovation and entrepreneurship, including the need to adapt the intellectual property system;
- Research, education and training policies; and
- Policies to develop competitive, collaborative and inclusive innovation ecosystems (OECD 2019).

In summary, efforts are required by both public and private actors to:

- Overcome connectivity gaps;
- Address the need for appropriate digital developments for different types of producers in different regions;
- Improve clarity in the regulation of information privacy; and
- Strengthen the capacities of producers, other actors in agricultural chains and agricultural support services.

Gene editing: A path towards precision biotechnology in agriculture

Biotechnology affords opportunities to improve process efficiency, increase productivity, expand crop diversity and contribute to the adaptation of agricultural activity to environmental uncertainties.

Given the growing challenges of agriculture, it is necessary to generate, know and use various available technologies, and biotechnology has advanced significantly in this direction. For more than two decades, biotechnological advances in agriculture have been deployed through genetic modification based on gene insertion (a process known as modern biotechnology or transgenesis). Certainly, the results of the application of transgenesis are seen in the almost 192 million hectares planted with genetically modified crops (GM) crops including corn, soybeans, rapeseed and cotton, and through the linking of more than 17 million agricultural producers in 26 countries (ISAAA 2018a).

However, agricultural biotechnology is constantly evolving. For some years, it has generated advanced techniques (Gupta and Musunuru 2014) that allow the replication of existing genes or the modification, replacement or fabrication of new ones with very high precision. The biological and environmental risk is low, production is relatively quick and affordable for most academic, research and development institution laboratories in both the public and private sectors. These new techniques (box 3.4) are characterized by being very precise, thanks to advances in DNA sequencing (Levy and Myers 2016) and the consequent decrease in costs (Wetterstrand 2019). Thus, biotechnology has entered a new era of precision (Wetterstrand 2019).

It is clear that precision biotechnology has very high development potential, so it is necessary to ensure the safety of its application and its products. Biosafety regulation is a way of guaranteeing agricultural health, food safety and environmental impact (Rocha 2019).

Box 3.4: Technical aspects of gene editing

Most gene editing techniques (CRISPR / Cas, TALEN, ZFN) employ mechanisms to repair double chain breaks of deoxyribonucleic acid (DNA). Said ruptures are introduced into the genome, at sites close to the area where DNA modification is desired, using nuclease enzymes from specific sequences. Once this step is completed, DNA rupture repair can be carried out by directing the precise natural DNA repair mechanisms. Through the interaction of the rupture mechanisms with those of DNA repair, modifications can be created that range from the timely change of an element (nucleotide) of the DNA sequence to the insertion or removal of several genes.

Among the experimental applications of gene editing are the following: a) generation of plants with characteristics of interest (for example, soybean with high oleic content and low linoleic content; potato with lower amounts of reducing sugars; corn with reduced phytate; purple tomato with high anthocyanin content; rice with high amylose content; potato and corn with high amylopectin content); b) crops that exhibit resistance to biotic factors (diseases of bacterial, fungal and viral origin) and tolerance to abiotic factors (drought, frost and herbicides); and c) plants with physiological modifications, such as parthenocarpy in tomato, thermosensitive male sterility in corn, acceleration of ripening in tomato, mushrooms with anti-oxidation (browning) phenotype, sugar cane with altered composition of cell walls and efficiency improvement in saccharification, etc.

Source: (Rocha 2019).

It is clear that precision biotechnology has very high development potential, so it is necessary to ensure the safety of its application and its products. Biosafety regulation is a way of guaranteeing agricultural health, food safety and environmental impact (Rocha 2019)

The discussion about regulation of products resulting from gene editing is wide (Jones2015). For example, for the Court of Justice of the European Union, organisms obtained through gene editing techniques must be subject to the Directive on Modified Living Organism (LMO) (Court of Justice of the European Union 2018), to which some European countries (Fortuna 2019) and other regions (USDA 2018a) have expressed confusion and the need to review this ruling. There have also been reactions from the European scientific community - scientists from 120 research centers requested to review the decision, citing the delay that it could cause in the development of more sustainable agriculture. The potential benefits of modification, including greater yield and less use of chemicals and water, mean long delays for approval, and places European agriculture at a disadvantage versus its main competitors (CRAG 2019). Similarly, concerns have been expressed about the implications that the judgment could have on poor countries that could benefit from the new gene editing technologies, but which may be inclined to curb their introduction (Purnhagen y Wesseler 2019). In contrast, several countries have expressed the need for appropriate regulatory approaches based on science and risk analysis (Friedrichs S; Takasu Y; Kearns P; Dagallier B; Oshima R; Schofield J; Moreddu C. 2019), which promote regulatory cooperation and build trust to avoid possible trade problems that could impede innovation (CMSF and OMC 2018).

Achieving good understanding and use of these new biotechnologies will depend on the success of communication efforts.

Biotechnology can contribute to the generation of new products and processes in the chain:

- EPrimary link: New seeds with various characteristics of agronomic interest (SDG 2).
- Processing: New enzymes to optimize energy expenditure.
- Agroindustry: Product life extension through biological process interference.

Table 3.1: Legislation on precision biotechnology in LAC countries.

Country	Instrument	Date
Brazil	Normative Resolution No. 16, which establishes requirements for submitting consultations to the National Technical Commission on Biosecurity (CTNBio) on innovative precision improvement techniques.	15 January 2018
Chile	Inquiry form for propagation material developed by new breeding techniques.	23 June 2017
Colombia	Resolution of the Colombian Agricultural Institute (ICA) No 00029299 "by which the procedure for ICA processing of requests for an improved crops with innovation techniques in plant breeding through modern biotechnology is established, in order to determine if the crop corresponds to a LMO or a conventional type".	1 August 2018
Ecuador	Articles 229 and 230 of Chapter II of the Regulations to the Organic Code of the Environment.	21 May 2019
Honduras	C.D. Agreement SENASA 008-2019 approving the authorization procedure for applications related to the use of new genetic improvement techniques (precision biotechnology).	27 August 2019
Paraguay	Resolution MAG 565 "Prior consultation form for products obtained through new breeding techniques."	13 May 2019

This has led some countries of the American continent to have issued standards for objectively and proactively dealing with precision biotechnology products (table 3.1).

As a general rule, the regulation of edited organisms is based on the nature of the change and the decisions for release authorization are made on a case-by-case

Box 3.5: Biotechnology contributions to SDG fulfillment

- Generation of new seeds and improved planting materials (SDG 1, 2, 13, 15).
- Generation of bio-inputs (SDG 1, 13, 15) for the conservation and use of biodiversity.
- Use of biochemical and molecular markers (ODS 2) for traceability.
- Use of BT technology (Bacillus Thuringensis) and generation and use of virus resistant materials (ODS 1, 2, 3, 6, 13, 14, 15) for the control of pests and diseases.
- Disinfection of planting material and generation of seeds tolerant to drought, salinity, etc. (SDG 1, 2).

basis, based on scientific evidence, so that (in the absence of foreign DNA sequences) it can be determined that the edited organisms do not conform to the LMO definition of the Cartagena Protocol on Biosafety of the Convention on Biological Diversity. Thus, the decision focuses more on products than processes.

Based on the dissemination experience associated with GM plants, it is clear that assertive communication strategies are required to inform the public about the actions of agricultural biotechnology, in general, and gene editing, in particular. This strategy should be able to explain what precision biotechnology is (especially versus LMOs), outlining key applications, scope and limitations. In addition, it is important to consider that in order to achieve such positioning it will be necessary to explain the usefulness and safety of gene editing techniques based on scientifically validated information and ensure that the gene editing is not positioned as opposed to transgenesis, but rather presented as a new biotechnological alternative that improves on current tools and has potential applications throughout agriculture.

Precision biotechnology emerged to solve problems and has generated tools that evolve and improve. The safety of its products is being rigorously evaluated by the regulatory entities at the country level. In addition, in order to achieve greater clarity, the topic is being discussed in international forums (for example, within the framework of the Convention on Biological Diversity).

3.2.3. On the need to measure the sustainable productivity of agricultural productive systems

Green productivity or sustainable productivity is a strategy to improve productivity and environmental performance for socioeconomic development in general (Ahmed 2012). It is necessary to move from partial measurements of productivity (for example, yields per hectare) to measurements of the total productivity of the factors Total Productivity Factor (PTF), and towards the measurement of the total resource productivity (TRP), which takes into account the environmental products and services of the production system (see box 3.2.3 and figure 3.3).

In 2018, the average Partial Factor Productivity (PFP) of the agriculture sector per agricultural worker in LAC was USD 7 200, which compares with a TFP per agricultural worker of USD 70 108 in the United States, of USD 93 110 in Canada and of USD 32 437 in the European Union (World Bank 2019).

According to data available for 2015, the average annual growth of agricultural TFP in LAC was 1.18 % over the last five years, compared with 1.41 % over the same period worldwide, with significant differences between countries and subregions (Fuglie and Rada 2018).

Box 3.6: Measuring sustainable productivity

Productivity measurements combine one or more products with one or more inputs (see figure 3.3 as a conceptual frame of reference):

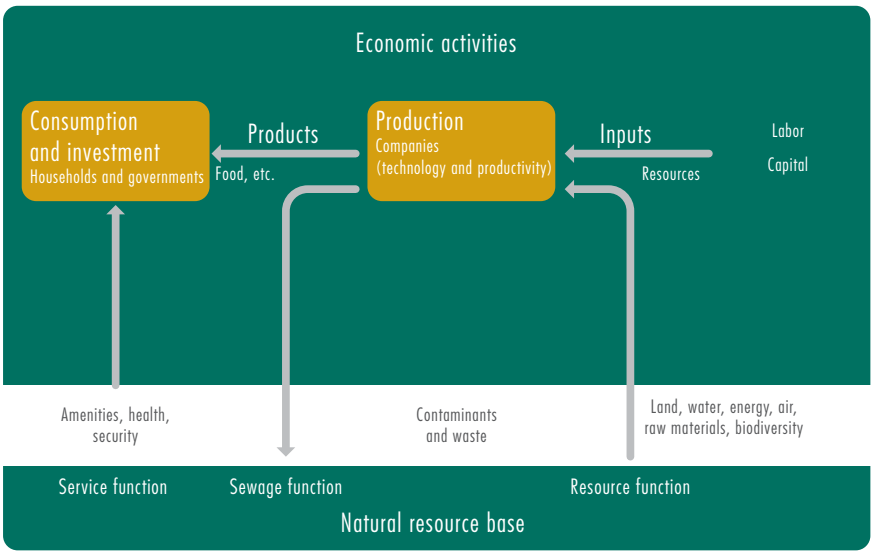
- PFP measures, such as yields per hectare or added value per agricultural worker, compares one product or a group of them with a production factor (land or labor).
- TFP measures the ratio of all marketable products (crops and livestock) and marketable inputs (land, labor and capital), but does not consider inputs or products to which the producer does not assign an economic value.
- TRP tries to extend the TFP indicator to include environmental products and services that are not valued by the market. In the calculation of TFP, the aggregation of products and production factors is based on market prices; on the contrary, non-market valuation methods (such as shadow prices, the cost of depletion and the cost of social opportunity) are required to value and aggregate environmental products and services and are therefore necessary to estimate the TRP.

Total Green Factor Productivity (PTFV) is another way of measuring productivity that internalizes in its measurement the intensity of carbon emissions (CO_2 per worker) as an additional input to those traditionally included in the calculation of TFP (Ahmed 2012).

Source: (Fuglie et al. 2016, Ahmed 2012).

In line with the 1992 Earth Summit, the concept of green productivity (GP) was launched in 1994 under the premise that both economic development and environmental protection are key strategies for sustainable development.

Figure 3.3: Conceptual framework to measure the productivity and sustainability of economic and environmental goods.



Source: (Fuglie et al. 2016).

In fact, there has been no major progress since the issue of agricultural productivity, and in particular productivity measurements that include environmental goods and services, was emphasized in a report (Fuglie et al. 2016) presented at the meeting of the Group of the 20 (G-20) of leading agricultural scientists, held within the framework of G20 Presidential Meeting in Antalya, Turkey (2015).

Towards the measurement of green or sustainable productivity in agriculture: In 2012, the United Nations Statistical Commission adopted the Integrated System of Environmental and Economic Accounting. This fact offers an opportunity to incorporate the concept of environmental sustainability in TFP measurements (Laborde and Piñeiro 2018).

However, on the input side, it remains a political and technical challenge to incorporate inputs or factors of production, including natural resources that have limited market representation (such as soil, water and biodiversity). On the supply side, consideration for the net value of environmental damage produced is the challenge.

The basic approach is to obtain measures for the quantities and economic values of environmental goods and services used in agriculture and include them, together with measures for market

An increase in TFP is attributed to the increase in the efficiency of production processes, rather than the increased use of inputs.

Appropriate measurements of the productive performance of agriculture constitute a key metric to consistently monitor progress towards the achievement of the SDGs (see box 3.7). The irreversibility of the degradation and depletion of natural resources caused by some economic activities forces us to go beyond reduced productivity measurements (see box 3.2.3).

In China, the growth of TFP, without considering the effect of CO2 emissions, was 1.35 % during the 1988-2006 period; however, productivity growth fell to -1.62 % during the same period, when the intensity of CO_2 emissions per worker was included (Ahmed 2012).

The traditional productivity indicator, which does not take carbon emissions into account, underestimates the green growth that results from efficient and effective environmental protection policies in countries of the Organization for Economic Cooperation and Development (OECD) (Shen et al. 2017).

goods and services, in the calculation of the TRP. This will not only provide more complete information on progress towards sustainable development but will also provide the means to assess the effects of policies to achieve that goal. The literature (Laborde y Piñeiro 2018, Fuglie et al. 2016, Shen et al. 2017, Ahmed 2012) suggests some criteria to be used for the identification of environmental services to be incorporated in the TRP or GTFP calculations, valuation methods, data sources and alternatives to TRP calculation.

Box 3.7: Agricultural TFP and the SDGs

The challenge and relevance of monitoring sustainable improvements in agricultural productivity are explicitly linked to goal **2.3** of doubling small producer agricultural productivity, goal **2.4** to ensure sustainable food production, goal **12.1** of achieving sustainable production and consumption and goal **12.2** of achieving efficient use and sustainable handling of natural resources.

The need to adjust the TFP measurement methodology to monitor water use would improve the metrics of agricultural efficiency and is directly related to goal **6.4** on water efficiency in all sectors of the economy. The broad goal is conservation and sustainable use of fresh water. In addition, the ecosystem services, and in the valuation of production, their potential damages must be taken into account as inputs (goal **15.1** of conservation and sustainable use of fresh water. In addition, ecosystem services must be considered as inputs, along with, in the evaluation of production, potential damages (goal **15.2** on forest ecosystems and their services).

The promotion of the achievement of sustainable gains in TFP should be an important component of the strategy of growth and diversification of income, with full environmental considerations. This is directly related to goal **8.1**, of increasing per capita income in a sustained manner; with goal **8.2**, to achieve higher levels of productivity through diversification; and with goal **8.4**, to improve the efficiency of global resources and strive to decouple economic growth from environmental degradation.

Source: Based on Laborde y Piñeiro 2018.

There is still a long way to go in the construction of standardized, consistent and comparable databases between countries and sectors, significant efforts are underway:

- The OECD Agri-Environmental Indicators Database (AEI) contains data on soil, water, biodiversity and by-products from the use of material inputs (fertilizers, pesticides and energy).
- FAO agri-environmental indicators database on GHG, soil carbon content and water extraction for agriculture.
- The United Nations System of Environmental Economic Accounting (SEEA) includes natural product flows (water, energy, emissions and wastes) and environmental asset stocks and flows (wood, water, fisheries, soil and land).
- The WORLD KLEMS initiative was created to promote and facilitate the analysis of productivity at the global level. Further work is needed to incorporate sufficient and disaggregated information on the agricultural sector and to include land as a factor of production (Laborde y Piñeiro 2018).

In 2015, the average annual income of a rural worker was USD 363, less than half the average of USD 804 earned by an urban worker (CEPAL 2018c).

3.2.4. Inclusive agricultural sectors for diversified, competitive rural economies

The development of sustainable, diversified and competitive agricultural sectors in order to achieve the SDGs will not be possible without the inclusion of the broad socio-productive sector comprised of family farmers and the landless rural population. Many of these people live in conditions of hunger and poverty and are at the mercy of climate vulnerability, which poses a threat to the sustainability and competitiveness of the region's agriculture.

An average of 54.6 % of the employed labor force in 16 countries of the region continue to work in the primary agricultural sector (see Table 5.3 in the annexes).

Social and productive inclusion of agricultural sectors

The inclusion of the region's large rural socio-productive sector through social protection guarantees and its incorporation into pathways leading to economic inclusion contribute directly to the achievement of objectives related to SDGs 1 and 2 (end poverty and hunger), by increasing the coverage of social protection (Target 1.3) and the population's access to economic resources (Target 1.4) and its resilience (Target 1.5.), ending hunger and ensuring access to safe food for everyone (Target 2.1.) and doubling the agricultural productivity and incomes of small-scale producers through secure and equal access to natural assets and financial and non-financial rural services (Target 2.3).

Affording the agricultural sectors of LAC higher levels of social and productive inclusion will make it possible not only to advance toward the eradication of hunger and poverty, but also to create

FF accounts for more than 50 % of agricultural employment in 14 of the 17 countries in the region for which information is available (Weller 2016).

In Latin America (15 countries), income from agricultural work is 40 % less than the average income of people employed in all branches of economic activity (Weller 2016).

In 19 countries in the region, an average of only 11 % of the rural population live in households with at least one member affiliated to a social security system (WB 2019).

In 19 countries in the region, an average of 63 % of the rural population live in a household that receives at least one type of social assistance (or non-contributory social protection) (WB 2019).

In 19 countries in the region, an average of 24 % of the poorest rural quintile receive no type of social protection (WB 2019).

the enabling conditions required for most rural households and productive units to adopt and take advantage of practices and technologies that will result in greater complexity, diversity, competitiveness and sustainability in agriculture and rural territories, which is a basic step toward the attainment of SDG goals 8 (Decent work and economic growth), 10 (Reduced inequality), 12 (Responsible production and consumption), 13 (Climate action), 14 (Life below water) and 15 (terrestrial ecosystems).

Need to adopt a two-way intersectoral approach in rural areas

Over the last four decades, the rural transformation processes of countries in the region have ended up consolidating rapid urbanization, relatively smaller agricultural sectors, and higher agricultural productivity, which has been accompanied by the continued existence —and in the case of extreme poverty, an increase— in the gaps in well-being between urban and rural areas and inequality (see section 3.1.1).

Thus, despite being a sector that has seen steady increases in modernization, productivity and connections with international markets, agriculture has failed to act as the strong driver of rural poverty reduction in the region. In LAC, the growth of the agricultural sector —especially during the 2000s, during the boom in exports of raw materials— was concentrated mainly in certain geographical areas best equipped to produce the goods required, and related to specific products linked to producers with access to foreign markets (Da Silva et al. 2010). It is this "Latin American paradox" (IFAD 2016b, p. 80) that will be economically and socially untenable in the medium and long terms.

The specific objectives of diversification, increased complexity (see section 3.2.5), the adoption and mainstreaming of technological innovations, sustainable intensification (see section 3.2.1), and resilience are unattainable unless the broad socio-productive sector of FF is incorporated into the process. Since FF accounts for more than 50 % of employment in the agriculture sector in 14 countries of the region (Weller 2016), increasing productivity and closing the gaps in wages (see section 3.1) can help strengthen economic and social sustainability, in line with the principle of the 2030 Agenda of "not leaving anyone behind."

This can only be achieved by overcoming inaction and the obstacles to the planning, design, implementation and evaluation of policies, strategies and programs in the agricultural sector, and adopting a "two-way" intersectoral approach to social protection and productive inclusion in rural areas.

Indeed, the lack of quality education services and market linkages, inadequate infrastructure, high levels of informal employment, limited access to credit (see section 3.3.2), the limited coverage and adaptation of social protection systems, information gaps and the economic barriers that the rural poor and FF households face daily are some of the factors that account for the stagnation of rural poverty, social immobility in the countryside, and less dynamism in the socio-productive sector (FAO 2018d).

Key actions toward the close coordination of social protection policies and agricultural interventions

1. **Decoupling decisions about consumption and investment: the coverage of the social protection system**

   The first step in a two-way strategy designed to increase inclusion and cohesiveness in agriculture is to expand the coverage of the social protection of the rural population, especially the population dependent on agriculture. Social protection is key not only to ensuring basic levels of well-being and promoting the construction of human capital, but also to achieving important productive impacts to construct inclusion strategies (purchase of inputs, change to riskier and more profitable productive strategies, small investments, etc.) (Tirivayi et al. 2013, FAO et al. 2016, Bastagli et al. 2016).

2. **Protection and promotion: coordinating social protection and agricultural interventions**

   Once the rural population's access to social protection has been guaranteed and the first social and productive impacts have been achieved, the coordination of protection and promotion should be consolidated by achieving the combined impact of pertinent, differentiated social protection and agricultural interventions on the same target population (see 5.6 in Annex 5.6). The way in which these objectives are coordinated will depend on the institutional setup in each country.

   Based on previous international experience, the options are as follows (Soares et al. 2017):

   – the implementation of economic inclusion strategies integrated into national poverty reduction and rural or economic development programs, focused on participants in social protection programs;

   – the integration of social protection elements into agricultural investment and territorial development plans;

   – a comprehensive social protection program with an approach focused on livelihoods, which combines social services (in most cases, income transfers) with productive services;

   – complementary programs or interventions that involve the coordination of two policy sectors or units sequentially, and applying a theory of broad change; and,

   – social protection and productive inclusion programs that overlap or are aimed at the same target population.

3. **Access to rural services and markets: closing the circle of double inclusion in agriculture**

   Since the 2000s, the countries of the region have promoted different policies in support of FF that mark a historical break with the agricultural development strategies implemented hitherto (Sabourin et al. 2014). The experiences and lessons learned should now be tapped to make

In the 10 countries of the region for which information is available, an average of only 1.3 % of the rural population access active labor market policies (WB 2019).

To strengthen and revitalize agricultural economies, the first step should be to protect poor rural households in order to stabilize their consumption, contain their risks and provide the basic conditions required to release all their productive potential by means of pertinent, differentiated agricultural policies.

No productive inclusion strategy without social protection will be effective unless it decouples the resources used for the household's immediate needs from those that could be used for investment.

It has been documented that around 80 % of the loans granted by Brazil's National Program to Strengthen Family Farming (PRONAF)) go to the wealthiest family farmers, promoting their incorporation into value chains dominated by agribusiness, such as the soybean and sugarcane chains (Da Silveira 2016).

One challenge is the lack of flexibility and adaptability of financial mechanisms when it comes to socially and environmentally innovative production strategies, such as agroforestry and agroecological models.

Despite the relatively unprecedented public effort since the 2000s, financing for FF continues to face challenges in terms of coverage and investment and the availability of loans to meet the needs of the different types of FF and production strategies on a scale sufficient to reverse the dynamics of social and economic exclusion at the macro level (Sabourin et al. 2014).

further, continuous improvements aimed at strengthening pathways for double (i.e., social and productive) inclusion.

In regard to financial services, even those intended to contribute to greater inclusion have not been able to incorporate the most vulnerable FF sectors (see section 3.3.2). The beneficiaries continue to be actors with a greater capacity to pay, a better position in the market and better access to information.

With respect to value chains and marketing, some authors affirm that the inclusion of producers in these economic circuits has not led, in principle, to markets that can be considered favorable to small-scale family farmers (for example, fair trade policies, local farmer markets, or specialized niche-based markets). There have been some small initiatives, which have tended to be the exception rather than the rule in general agricultural policy, dominated by instruments and facilities for the development of agribusinesses in commodity chains. (Clark 2017) has argued this point in the case of Ecuador and (Fernandes et al. 2010) in the case of Brazil's National Biodiesel Production and use Program (PNPB). The latter, rather than giving average family farmers the means to consolidate their production infrastructure collectively, actually integrates them into unfavorable production and trade arrangements dictated by large agribusiness corporations operating in the territories (see also section 4.3.2).

Finally, in the case of preferential or protected markets, the positive effects of interventions of this kind can only be achieved and consolidated to the extent that (Nehring et al. 2017, p. 12):

a) family farmers are capable of meeting the institutional demand, getting better organized and achieving higher yields with the assistance of solid agricultural policies consistent with the objectives pursued;

b) family farmers access effective, inclusive climate risk management schemes;

c) there is investment in infrastructure and services, such as roads, electricity, water, sanitation and information technology;

d) producer organizations and cooperatives are strengthened; and,

e) technical assistance and rural extension mechanisms are improved to enhance the skills required to administer this specific production and marketing model.

3.2.5. The challenge of diversification and the adding of value

Although LAC has great potential for agricultural and agribusiness production, the diversity of its productive base is limited, as is the complexity of its agricultural exports, which are dominated by commodities (soybeans, corn, wheat, etc.). The generation of value added is an important but challenging task for most countries in the region, which have made little progress in exporting more processed products.

A transformation of agriculture aimed at achieving the SDGs calls for production to be measured taking several criteria into account. Measuring the sector's health in terms of the amounts produced alone —expressed in dollars, kilograms, calories or tons of emissions— ignores one important indicator: the quality of production. A supply of quality products reflects the biological base of territories, mirroring their natural riches and biodiversity. A supply of quality products is also based on the complexity of the basket of goods and services, which depends on the capacity to create value added across the long, complex value chains organized around regional agriculture.

Despite the region's enormous biodiversity, its agricultural exports (measured in value) follow the same historical pattern, characterized by the predominance of a few products. Between 1961 and 1990, two products —coffee and sugar— accounted for 40 % of the value of the region's agricultural exports (FAO 2019a). In recent years, the weight of the two products has fallen to nearly 11 %, while the soybean complex (beans, oil and meal) now accounts for 25 % of the value of LAC's agricultural exports. Currently, ten products make up 56 % of the value of agricultural exports, while the figure for the world as a whole is 29 % (FAO 2019a). In terms of cultivated land, the region is even less diverse: 85 % of cultivated land is used for ten large categories. A single crop, soybeans, is grown on 57.4 million hectares, 34 % of the region's entire cultivated land (FAO 2019a).

The historical pattern of the region's agricultural exports is also characterized by their lack of complexity and the major role and weight of commodities (soybeans, corn, wheat, etc.). Cacao and soybeans are cases in point. At the global level, the value of chocolate by weight is 59 % higher than that of cacao beans. In the region, there are exporters of both cacao beans, (Ecuador and Peru) and chocolate (Mexico, Brazil and Argentina) (see Figure 3.4). Generating value added (downstream) is an important but challenging task for most countries in the region. In Peru and Ecuador, there is a slight trend toward exports of more processed products, but there is still a long way to go in developing those chains (Figure 3.4).

Soybeans are an example of the modern commodity; however, they are part of a long, complex food chain, with value added concentrated downstream.

Given the increase in global demand for agricultural products, LAC is in an enviable position. With only 9 % of the world's population and 4 % of the rural population (FAO 2019a), the region possesses 16 % of agricultural soils (FAO 2019a), 33 % of unused land suitable for agriculture (Deininger and Byerlee 2012), 23 % of forest cover (FAO 2019 a) and 50 % of the world's biodiversity (UNEP 2016).

In 2016, the price of a ton of soybean oil was nearly **double** that of a ton of soybean meal (FAO 2019a).

Argentina has opted for a strategy of exporting by-products (number one in the world, with **44 %** of the trade in soybean oil), while Brazil exports mainly soybeans (see Figure 3.4).

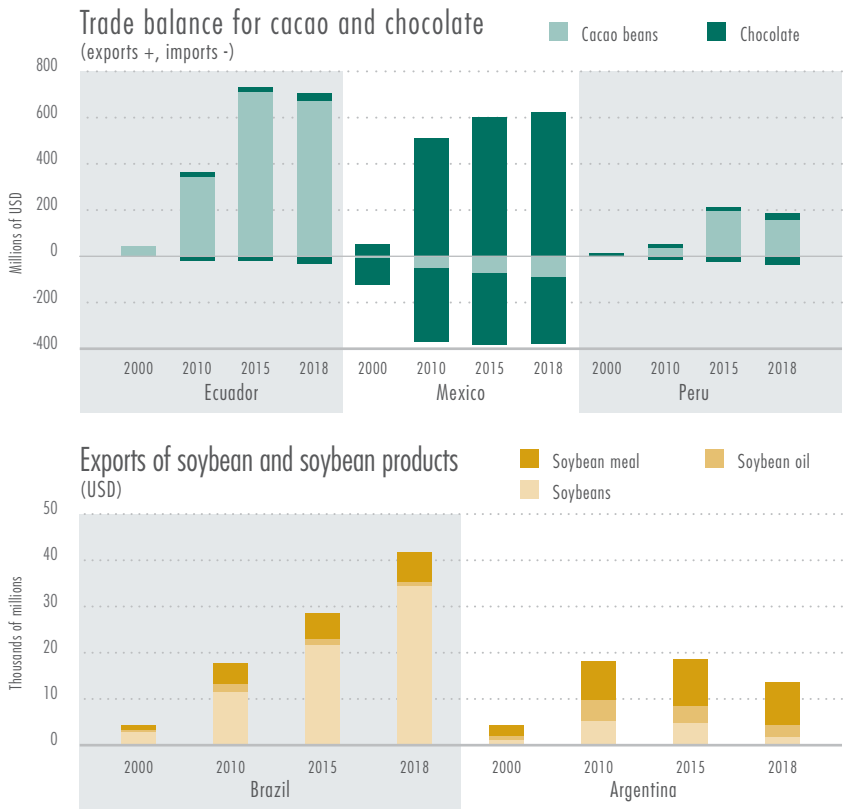
Although soybeans are a commodity, there are many **options for obtaining more value further down the chain**: meal is an important input in pork and fish production; soybean biomass is used to produce biofuels (bioethanol and biodiesel); and soybean lecithin and glycerin are important inputs for a variety of industries (they are used, for example, in the production of cosmetics and medicines).

The value of agricultural exports grew from USD 62 billion in 1995 to USD 256 billion in 2017 (se Figure 3.5), at a composite rate of 6.6 % per year. Around 16 % of this growth, USD 32 billion, involved new products.

Exports of chicken and pork from Brazil, cranberries and cherries from Chile, industrial foods from Argentina and a variety of agricultural products from Mexico to the United States are the most striking developments of the last quarter of a century.

An example of the growth of new products is the value of cranberry exports from Chile and Peru, which were worth more than USD 1.1 billion in 2018 (Comtrade 2019).

Figure 3.4: Value and complexity of LAC exports: the cases of cacao and soybeans.

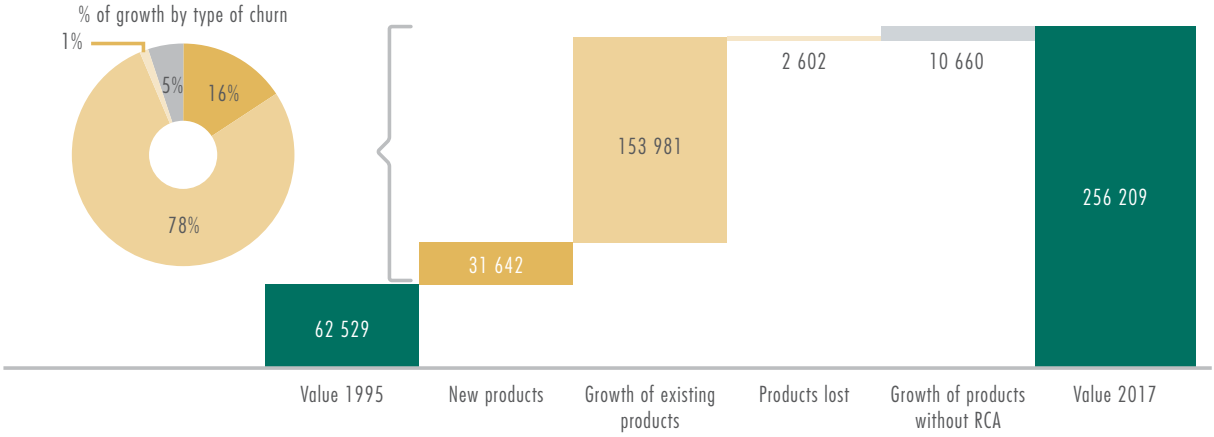


Source: prepared by the author with data from (Comtrade 2019).

Agricultural trade in constant change

Despite the fact that commodities account for a large proportion of the region's agricultural production, the mix of products is constantly evolving. Over the last quarter of a century, for example, the sector has changed significantly, generated new products and penetrated new markets. As the region takes more advantage of the diversity of local products (and markets them), new ones are increasingly being added to total exports. The region has a large range of products that have always been consumed locally and, as a result, are known in other markets. Another factor is its capacity to supply fresh, off-season products, processed food and industrial goods made from major commodities, for which the research and development (R&D) component is important. Many factors are opening up new possibilities: at the micro level, for example, changes in consumer tastes and preferences; and, at the other extreme, at the macro level, free trade agreements or technological changes promoted by the bioeconomy (see Chapter 4).

Figure 3.5: LAC: Evolution of the value of exports by type of growth (in millions of USD).



Source: Prepared by the author, based on (Comtrade 2019).
Note: Includes crop and livestock farming, forestry activities, aquaculture and fisheries. A new product is defined as one (by country) whose Revealed Comparative Advantage (RCA) was negative in 1995, and became positive in 2017. The results underestimate the impact of trade innovations due to limitations in the trade classification system, with new products sometimes being added to an existing classification, when a new tariff code should be created instead.

As a result of this series of factors, a large number of the region's products have experienced very high growth (see Annex 5.5). Since 1991, 32 products have recorded higher growth rates (value of exports) than the growth rate for soybeans. Most of the peripheral categories mentioned are innovative, if not in terms of production, in terms of exports. Furthermore, they make intensive use of labor and technology, which has given rise to new production chains. The food needs and tastes of the global population are now changing rapidly, and the region has the resources to meet those needs and the technologies to ensure that resources are not exhausted. Over the next 25 years, the changes will be even greater.

3.2.6. Making better use of trade agreements in the agricultural sector

Preferential trade agreements are valuable instruments for increasing and diversifying exports and improving competitiveness. Public policy actions and coordination between the public and private sectors can foster their use. A comprehensive approach that incorporates different measures is more likely to yield positive results than isolated interventions.

Over the last two decades, countries in the Americas have signed a little over 140 preferential trade agreements (PTAs) in order to increase and diversify products and export markets and improve competitiveness (see Figure 3.6)[3], and thereby generate economic growth, create employment, promote changing production patterns, and reduce poverty. By liberalizing trade in goods and services and establishing a framework of clear, transparent and non-discriminatory standards that give economic agents certainty, PTAs create an enabling environment for achieving those objectives.

[3]The agreements are available at http://www.sice.oas.org/agreements_e.asp.

Exports of countries signed up to 74 PTAs increased by an average of 30-40 % during the period 1998-2009 (Maru et al. 2018, Jean and Bureau 2015).

Mexico's exports rose by 642 % and its imports by 338 % between 1993 and 2015 under the North American Free Trade Agreement (NAFTA).

The specialized technical language used in such agreements is an obstacle to their comprehension and practical application (IICA 2016a, Plaisier et al. 2018).

Trade helps to promote economic growth and employment (**SDG 8**), guarantee sustainable types of consumption and production (**SDG 12**), and strengthen the means of implementation and revitalize the global partnership for sustainable development (**SDG 17**).

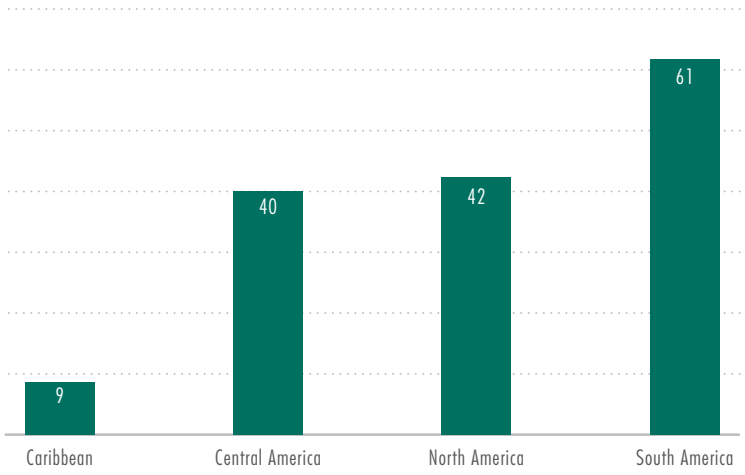
Box 3.8: Trade and the SDGs

Trade plays a critical role in supporting the attainment of the SDGs, in particular the eradication of poverty (**SDG 1**), by promoting growth (especially in developing countries), offering new employment opportunities and lowering the prices of goods and services for poor consumers, mainly of foodstuffs.

It also helps to end hunger (**SDG 2**), because it facilitates fast, reliable access to food produced overseas. In addition, rules-based trade helps to create an environment for transparent production and investment, without distortions, which is essential for food security.

Source: (OMC 2019).

Figure 3.6: Preferential trade agreements in the Americas as of July 2019.



Source: Prepared by the author based on (OEA 2019) as of July 2019.

In the agricultural sector, in which trade barriers are higher, PTAs play an even more important role in facilitating access to markets. The signing of a PTA is often insufficient in itself to promote trade, however. Beyond the baseline conditions of competitiveness and productivity that affect positioning in international markets, the factors listed below can limit the use of such agreements, in particular as tools for promoting new exports or new exporters:

- **Conditions of market access:** Even though there are differences among PTAs, it is not unusual for certain goods to be excluded from the respective tariff reduction program, with imports being subject to a most-favored-nation tariff or, in some cases, quotas with a preferential tariff for a specific volume of imports.

- **Lack of information and knowledge:** Greater knowledge of PTAs translates into greater use (PwC 2018).

- **Lack of effective export support programs:** In addition to PTAs, potential exporters need assistance to obtain information about markets and to develop those markets. The lack of such programs negatively affects the possibilities of exporting, in particular in the case of small- and medium-sized agricultural exporters (Lederman et al. 2009).

- **Weaknesses associated with the quality or volume of exports:** To enter markets, agricultural products must comply with sanitary and phytosanitary standards, as well as food safety and quality measures. The insufficient capacity of the public or private sectors to meet such standards in a sustained manner, or to negotiate the corresponding protocols, limits or impedes market access.

- **Trade costs:** The costs associated with trade in agricultural products (tariffs and nontariff measures, transportation, logistics and customs procedures, etc.) are very high in Latin America (Arvis et al. 2012). The frictions they generate can nullify a country's comparative advantages, impacting in particular the capacity of small- and medium-scale agricultural producers to participate in agrifood value chains.

- **Institutional weaknesses:** The lack of trained staff in the public sector, poor interinstitutional coordination and insufficient economic resources, among other factors, can affect the performance of government functions associated with the use of PTAs.

Public policy actions and greater coordination between the public and private sectors can improve the conditions and thus enable producers and businesses to take more advantage of the opportunities offered by PTAs. Some of the main actions that can increase the use of PTAs as export platforms are as follows:

- **Prioritization of policies:** Making the growth of exports and participation in agrifood value chains a priority helps to send a clear signal to the productive sector, coordinate institutional efforts, and allocate the resources necessary to support the utilization of trade agreements.

- **Specialized analyses:** Carrying out specialized studies on the factors that affect the use of PTAs, by market and by product, makes it possible to inform and manage more effectively the programs and resources needed to strengthen the conditions for improving their use (Álvarez 2012).

PTAs have made Chile the world's leading exporter of fresh grapes, fresh cranberries, fresh plums and dehydrated apples; the second largest exporter of fresh cherries, in-shell nuts and dormant flower bulbs; and the third largest exporter of raisins, unshelled nuts, wine in bulk and frozen raspberries.

The evidence suggests that the bigger the tariff preference, the greater the probabilities of exporting (Jean and Bureau 2015).

Very strict or complex rules of origin can also limit trade, especially for small and medium-sized enterprises (Plaisier et al 2018).

Insufficient knowledge of the content and impact of PTAs limit their utilization. An effective promotion agency helps boost exports.

Chile's experience in exporting fruits to various markets confirms the importance of the respective plant health authorizations to promote exports. In addition, smaller quantities of exports can be more difficult to place in markets.

The time/cost involved in exporting and importing in LAC is much longer/higher than the average in OECD developed countries (CEPAL 2017).

The lack of specialized business organizations can have a negative impact on producers' interests in their dealings with governments, as can the absence of a more business- and export-oriented culture in general (IICA 2016a).

PTAs can help make the agricultural sector more competitive and increase productivity by affording access to cheaper, better-quality seeds, fertilizers, agrochemicals, machinery and packing and packaging materials, etc. By fostering access to inputs and capital goods with more technological content, they can also contribute to technology transfer and improved management and production practices.

Information should begin to be disseminated when an agreement enters into force, but the process should also be continuous, as part of sustained efforts to ensure the agreement is utilized.

- **Improved conditions of market access:** PTAs should be thought of as "living" instruments, which need to be reviewed to adjust them to market conditions and, especially in the agricultural sector, to examine the exclusion of products or other factors that may be limiting their utilization. Successful experience with other products and markets can be of help with this exercise, as can the experience of other countries.

- **Dissemination of information and knowledge:** The texts of PTAs are always available, but information that is important to the productive sector needs to be "translated," so it is useful for practical purposes. Electronic platforms are useful tools for supporting the organization of events, and the preparation of publications containing detailed information about the opportunities offered by an agreement.

- **Market intelligence and trade promotion programs:** The work of export promotion agencies is critical in order to construct the country image; to provide support services, such as training, technical assistance and capacity building for exporters; to carry out marketing activities, such as trade fairs, export and import missions, establishing of international contacts, etc.; and to supply trade intelligence, market studies, and publications in support of the sector.

- **Capacity building for compliance with standards:** The capacity to export agricultural goods is linked to the capacity to comply with the standards in export markets, and to demonstrate they have been complied with. Therefore, efforts to improve the capacity of the public and private sectors to meet food safety and animal and plant health requirements are of critical importance. This includes enhancing the technical capacity to carry out testing, inspection, certification and approval procedures as part of quarantine systems; perform risk analyses and determine adequate protection levels; and make information services more effective.

- **Trade facilitation:** A settled agenda for the implementation of the WTO Trade Facilitation Agreement (TFA) and, more broadly, for the reduction of trade costs is crucial to make export products more competitive. This should include improved customs management and the facilitation and streamlining of transactions, increased public investment and better interinstitutional coordination. Transparency and simplification should be at the heart of this effort, and the use of new technologies like blockchain should be explored with a view to facilitating trade.

- **Institutional capacity building:** Improving the capabilities of public sector institutions, in particular those of ministries of agriculture and trade and the agencies in charge of customs procedures and border controls, is crucial to ensure that the public sector's approach to the use of trade agreements is closely aligned and effective. Coordination

with enhanced specialized private sector organizations that represent producers' interests is also essential.

- **Support from the international community:** The assistance of international cooperation agencies is important to build capacity, disseminate good practices, provide financial resources and, in general, improve the region's export culture.

3.2.7. The importance and challenge of developing local markets

Domestic markets play a crucial role in efforts to attain the SDGs, especially in the food and nutritional security (FNS) of the population in LAC. Moreover, these markets are essential to efforts to achieve sustainable territorial or area-based development, eradicate rural poverty and provide and increase the supply of fresh and varied foods that promote a healthy diet.

Short circuits and public procurement as options to improve the rural population's FNS in rural territories

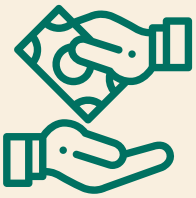
Short marketing circuits are a form of trade centered around the sale of fresh or seasonal products, such as fruits and vegetables. In general, the producers and consumers are in close geographical proximity, and therefore there is little or no intermediation between them, so the sale price is lower (FAO et al 2018).

In LAC, short marketing circuits have proliferated and have become consolidated mainly through ecological and organic fairs and markets, such as the free fairs of Chile (Box 3.9), the markets of Loja and Cuenca in Ecuador or those of Jalisco and Xalapa in Mexico. These points for the purchase and sale of fruits, vegetables, fish and other fresh products, provide easy access to food in the neighborhoods of large urban settlements, middle-sized towns and rural villages and communities (FAO et al 2018, Rodríguez and Riveros 2016).

The use of blockchain technology in a pilot program designed to test the receipt of information about certificates of origin under NAFTA permitted almost instantaneous communication with the U.S. customs and border protection agency, avoiding the duplication of information and facilitating the early identification of potential problems and more direct communication with importers (CBP 2019).

In 2017, Chile became in the second largest exporter of fresh fruits to China. With exports worth more than one billion dollars, Chile supplied 18 % of that market, surpassing other suppliers like Vietnam, the Philippines, the United States, New Zealand and Australia. (Gonzalez 2018) explains the reasons for this success.

Associated with SDG2 - to end hunger, achieve food security and improve nutrition and promote sustainable agriculture- is Target 2.C to "Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility."



The significant size and value of government food procurement programs can be used to advance various political objectives, such as encouraging healthier diets, promoting agricultural development and encouraging more sustainable food production systems.

It is estimated that FF accounts for more than **80** % of farms and that it supplies between **27** % and **67** % of total food production in the different countries. It also accounts for between **57** % and **77** % of agricultural jobs and is a key sector in the promotion of food security and poverty eradication (FAO et al 2018).

Box 3.9: Farmers' fairs: the case of Chile

There has been a major growth of farmers' fairs in Chile, where subsistence farmers have organized themselves to sell their produce at weekends in towns and rural villages. Around 600 farmers' fairs are currently operating in the country, involving around 24,000 producers. This trend is the result of a public policy (INDAP, Mercados Campesinos) and the efforts of the producers themselves.

These farmers' fairs have the following characteristics:

- They have a major impact on family incomes, improving consumption levels and allowing for reinvestment processes;
- In general, they specialize in fresh produce: vegetables, fruits, eggs, honey, cheeses, medicinal plants and crafts, etc.
- Only small volumes of production are sold; therefore, they are not suitable for medium-sized producers;
- They provide direct contact with consumers, sometimes using social networks such as Facebook and others; and
- Over time they become more professional, consolidating their internal organization, developing regulations, improving their infrastructure, raising their quality standards and diversifying their products.

Meanwhile, public procurement of FF products is another emerging trend that has gradually been incorporated into the agendas of many LAC countries. For example, Brazil, Guatemala, Honduras, Paraguay and Uruguay have promulgated laws with mechanisms for the procurement of FF products. (see Annex 5.4). Through public procurement, the population can be provided with fresh, varied and nutritious foods (FAO et al 2018).

The role of public food procurement in efforts to provide social and economic benefits has gained importance in recent years. Countries increasingly use public food procurement schemes as a strategy for promoting the participation of small farmers in markets and improving their livelihoods. A recent study by the FAO and the International Policy Center for Inclusive Growth (IPC-IG) compiled global good practices to promote smallholders' participation in public food procurement initiatives and to promote synergies in food and nutritional security (Miranda 2018).

In LAC, FF encompasses sectors ranging from fisheries, subsistence farming and landless peasants, to

family agriculture of a scale that generates surpluses and is inserted in local and national markets.

Proposed actions

1. **Create a legal and institutional framework:** The State and local governments should create a legal and institutional framework that encourages the creation of short marketing circuits and public procurement systems. It is important to develop instruments that recognize the value of local production and its economic, social, environmental and cultural impact, as well as concrete measures to promote these.

2. **Improve the articulation of stakeholders and policies at the local and national levels:** The intersectoral nature of the different stakeholders and sectors —agriculture, development, production, trade, technological development, education, health and social inclusion, etc.— is fundamental to design and implement sustainable policies that respond to the diverse needs of different stakeholders, paying special attention to vulnerable populations (see Sections 3.3 and 3.2.4).

3. **Governments should create specific frameworks for public sector food procurement** to eliminate bureaucratic obstacles, reduce costs and give small farmers competitive advantages. Public food procurement from smallholders should also be closely coordinated with interventions in different sectors. Government food procurement initiatives should establish coordinated targeting mechanisms that can promote an overlap between the beneficiaries of agricultural interventions and the farmers that supply food to government institutions.

4. **Implement policies in support of FF:** Differentiated policies can help to ensure access to proper nutrition by those populations most affected by the inequalities of the food systems: rural dwellers, those living in poverty, women and indigenous populations (FAO et al 2018).

5. **Improve and facilitate market access:** It is important to improve the negotiating power of family farmers in the markets where their produce is sold, so that value chains can operate more effectively and in a more balanced way. This requires a combination of actions focused on promoting and consolidating associative processes, capacity building and the provision of technical assistance, rural extension services and financial resources. (Rodríguez and Riveros 2016), See section 3.3.2).

6. **Raise awareness among the population:** It is important to value diversity and the different characteristics of short market circuits and FF, both as suppliers of fresh food and as forms of sustainable production that place value on the local food culture. This can also improve the acceptance of foods that promote a healthy diet and support a change in eating habits.

Short marketing circuits for agrifood products help to respond to social demands and to support producers' insertion in markets on more equitable terms (CEPAL et al 2014).

The creation of food baskets and menus that incorporate nutritional objectives, the production of small farmers and the seasonality of produce requires intersectoral cooperation and a close dialogue between stakeholders in the areas of procurement, agriculture and nutrition.

FF is key to FNS and poverty reduction; therefore, it is essential to improve access by family farmers to production, technological and financial resources.

Differentiated policies in support of FF have a positive impact on the generation of agricultural jobs, on poverty mitigation and on the conservation of biodiversity and cultural traditions (FAO 2014).

Over **60** % of the investments required to implement Agenda 2030 must be made in rural areas; only in this way will it be possible to ensure an effective and sustainable transformation of food and energy production (Diaz-Bonilla and Saravia-Matus 2019).

The task of achieving the SDGs greatly exceeds the sphere of competence, mandate and capabilities of any ministry or rural institution, no matter effective it may be.

No single actor alone is capable of spearheading the necessary changes in the agrifood systems to reduce the alarming levels of overweight and obesity, eliminate rural poverty and tackle the challenges of climate change (Trivelli and Berdegué 2019).

3.3. Institutional framework for sustainable development

An urgent institutional modernization is required to secure and allocate the necessary funds to achieve inclusive and sustainable rural development, especially as regards the allocation of public resources to agriculture, food systems and the rural milieu.

In most countries of the region, the institutions of the agrifood sector were created by governments between the 1950s and 1960s, with the aim of significantly increasing national food production, in a context of growing urbanization and industrialization.

Subsequently, the severe adjustments implemented during the 1980s and the 1990s served to reduce the State's presence in the sector, rather than to create new institutions or modernize existing ones. The current institutional framework resulting from those two processes is notoriously inadequate to ensure the efficient and effective governance of the rural sector's economic, social and environmental processes (Penagos and Ospina 2019, Gordillo 2019, Berdegué and Favareto 2019, Trivelli and Berdegué 2019).

Institutional modernization should allow for a more efficient, effective and inclusive implementation of actions to address the challenges of Agenda 2030.

3.3.1. The need to increase the degree of interinstitutional coordination

The growing complexity of development problems demands more sophisticated institutional responses. Thus, intersectoral coordination has become an increasingly important goal in the contemporary narrative of development. However, this process continues to be a major challenge, both for governments and other stakeholders- simply because coordination implies higher transaction costs.

Breaking the inertia of isolated sectoral action demands political will at the highest level, a clear idea of the expected outcomes as well as the design, implementation and continuous evaluation of political, administrative and budgetary mechanisms that encourage coordinated action.

At least two types of inter-institutional articulation require attention:

1. **Vertical coordination:** This occurs between different political-administrative levels, from the national to the local.

Vertical coordination is especially important because it enables the local or territorial levels to play a significant role in the processes of design and implementation of policies and programs. The incentives for coordination must include efforts to improve the efficiency and efficacy of programs and their instruments, assurances that any services provided are better adapted to local conditions or situations and the possibility of complementing financial and non-financial resources between different levels of government.

2. **Horizontal coordination:** This occurs between different sectors within the same government and serves to create instruments for the focalization of policies and programs, associated with intersectoral management mechanisms, with well-defined goals and commitments. Horizontal coordination is of interest because it can create complementarity, thereby increasing efficiency, avoiding dispersion and promoting coherent public action. The incentives for coordinated action must be very well defined for all the actors involved.

To implement coordination, instruments are required for the focalization of policies and programs, associated with intersectoral management mechanisms, with well-defined goals and commitments for each institution involved. It is also necessary to use appropriate mechanisms. One option is to establish large inter-ministerial commissions and their public programs, of a hierarchical and multisectoral nature, which tend to encompass "all" the dimensions of development. The complexity of this task and the legal and administrative constraints characteristic of public administration generally hinder the implementation of these models.

In addition to the challenge of horizontal and vertical coordination, efforts are required to coordinate actions with other non-governmental stakeholders, such as corporations, supermarkets, producers' associations, civil society organizations, trade unions and consumers, among many others. These coordination efforts provide the foundation for generating State policies and ensuring a greater degree of effectiveness in the design of public programs (see Section 3.3.3) to help countries achieve the SDGs. The main technical elements for a coherent interinstitutional coordination appear to be:

- the joint definition of problems and viable solutions by different sectors;
- the precise definition of the parties or groups subject to the policies and programs, based on precise and transparent focalization tools;
- the definition of clear goals and public commitments to their fulfilment;
- the active participation of social stakeholders in supporting implementation of the policies and programs; and
- transparent monitoring and accountability mechanisms for the allocation of budgets and other incentives for the stakeholders involved.

To accelerate changes in rural governance it is necessary to create collaborative spaces involving different stakeholders: rural and urban; governmental and non-governmental; and local, national and global (Gordillo 2019, Penagos and Ospina 2019, Berdegué and Favareto 2019).

It is essential to promote a new rural governance that facilitates consensus and more expeditious action, in order to increase the degree of inter-institutional and intersectoral coordination, recognizing the diversity of stakeholders and the role played by each one, even those who have traditionally been sidelined from the decision-making process.

One option is to move beyond the arborescent and matrix-based organizational structures typical of the industrial era and operate through policy networks and issue-based coalitions implemented by two or more institutions that work on a common theme (Moulier Boutang 2007). This system has proven to be more appropriate for action in the current complex and multipolar scenario.

Figure 3.7: Diagram representing a generic solution to facilitate the achievement of the SDGs at country level.

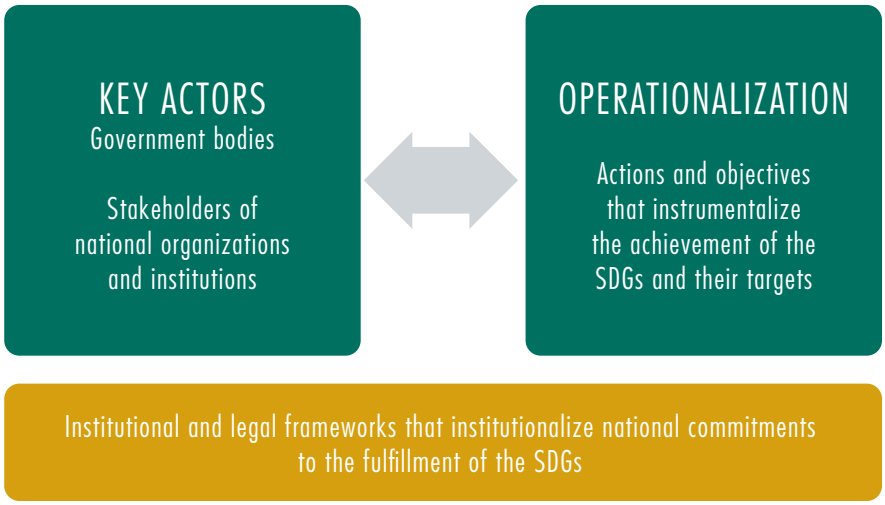


Figure 3.7 shows a formula for the governance of the SDGs and Box 3.10 provides a concrete example in the region: the case of Costa Rica. This shows that it is possible to achieve interinstitutional coordination in the national sphere, by proposing specific and gradual goals at local level and having institutions responsible for their monitoring. One of the central elements of this institutional framework is the responsibility of a government body for allocating the public expenditure required to comply with Agenda 2030.

Box 3.10: Governance for the attainment of the SDGs: The case of Costa Rica.

As part of the process for the governance and implementation of the SDGs, in 2015 Costa Rica created the High-Level SDG Council, comprised of the country's President and the highest authorities of the ministries of Foreign Relations, Environment and Energy and National Planning and Economic Policy. The Council's main functions are:

- To define a national policy for the planning, implementation and monitoring of the SDGs with a prospective approach, integrating the economic, social and environmental dimensions, in accordance with human rights and national and international law.
- To establish the measures necessary for the allocation of financial resources for the implementation of the SDGs.
- Those derived from the exercise of its areas of competence.

In addition to this body, there is also the Technical Secretariat for the SDGs; the SDG Technical Committee, whose role is to "verify the fulfillment of specific commitments assumed by public sector organizations"; the National Institute of Statistics (INEC), an advisory body that monitors compliance with targets; and the National Forum of the SDGs, as a mechanism for accountability in relation to the fulfilment of the SDGs and their targets.

Source: (CEPAL and UN 2019).

3.3.2. Financing and financial inclusion for agricultural and rural transformation

To increase the financial penetration and inclusion of the agricultural and rural sectors and close investment gaps in the long term, interventions are required in the form of regulations, institutions and instruments at the level of individuals, organizations, value chains and territories as well as at the macro level.

The role of the financial markets in the construction of sustainable agrifood systems

Rural financial markets are essential components of the banking and financial structure that links savings and investment through the economy; they can also have a substantial impact on the financial aggregates and on macro-financial stability.

Given their importance, and as a result of the global economic crisis and food price peaks of 2008 and 2011, there has been renewed interest in the operation of financial markets and the impacts of their malfunction on the economy and on human wellbeing.

As a result of these concerns, international bodies have been created to address this issue. An example is the Global Partnership for Financial Inclusion (GPFI), which is committed to implementing the Action Plan on global financial inclusion, signed by the Group of Twenty (G-20) leaders at the Summit of Seoul (2019). One of the lines of work involves supporting SMEs, including those of the agricultural and rural sector.

Similarly, in 2017, the International Fund for Agricultural Development (IFAD), together with other institutions, created the Smallholder and Agrifood SME Financial and Investment Network (SAFIN), with the aim of bringing together the private, public and philanthropic sectors, plus rural producers and businesses, to address, through coordinated action and investment, the challenges that affect rural and agricultural financing.

In this context, an important question is how to mobilize financial resources to support investments in technology, innovation and sustainable agrifood systems at the scale necessary to generate a significant global impact Diaz-Bonilla 2018, Diaz-Bonilla and Callaway 2018, Diaz-Bonilla et al 2018). In the context of that general question, an important aspect to consider is the role played by financial markets - especially rural markets - in that financing.

The levels of financing and public expenditure on agriculture in LAC remain relatively low

The inadequate levels of agricultural financing are likewise reflected in the relatively low percentage of agricultural credit's share of total credit in most LAC countries (Figure 3.8).

Agricultural financing is also low when measured in terms of agriculture's share of the national GDP, according

The SDGs contain numerous references to financial inclusion as part of the fight against hunger and poverty and for gender equality, and in general, the call to develop sustainable agrifood systems, all of which requires political, institutional, technological and investment innovations.

To achieve zero hunger worldwide by 2030, would require USD **265 billion** annually over the period 2016-2030[a], broken down as follows: USD **67 billion** for social protection and USD **198 billion** for pro-poor investments.

With respect to LAC, it would be necessary to invest an additional USD **6 billion** annually in social protection and USD 2 billion to pro-poor production investment (McGuire 2015).

[a]In constant USD of 2013: additional to the baseline scenario.

The Agriculture Orientation Index (AOI) for Government Expenditures in developed countries is 1.25, while in LAC it is just 0.31.

Only 51 % of women in LAC have a current account, seven percentage points below men. The guarantees and levels of income required prevent more women from gaining access to the financial system, and some financial institutions even continue to ask about "the head of the household" or "the owner" of the house or the land, thereby perpetuating gender stereotypes. (OECD et al 2019).

Several of the anti-rural biases of the traditional credit system, as well as their focus on marketing and processing, but not on investment, originate in the dispersion and limited scale of clients and in covariant risks (climate, prices, pests and the seasonality of production).

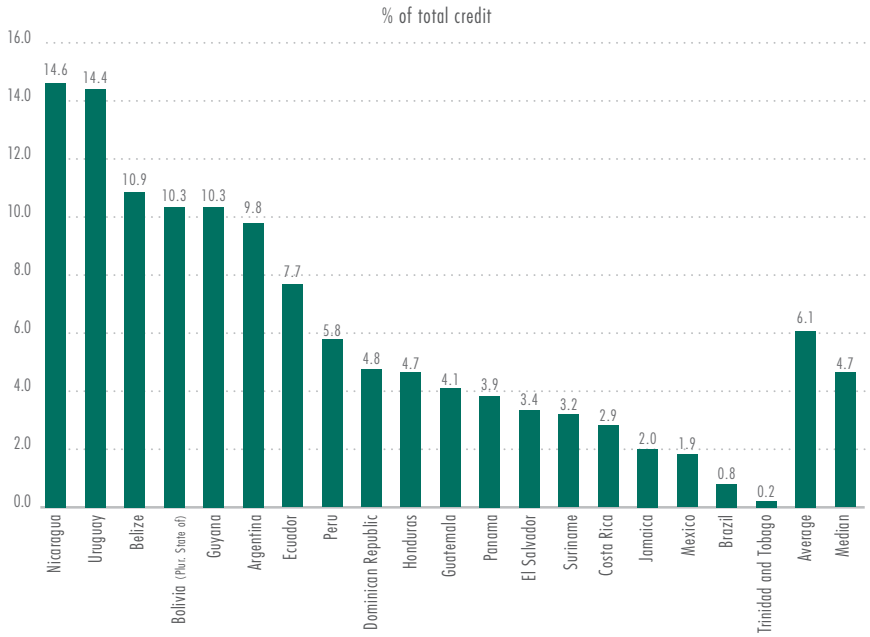
Despite an increase, only 30 % of the rural population aged over 15 years in LAC uses financial services, such as savings and loans; these services are obtained mainly from actors that operate outside the formal financial sector, such as agricultural and non-agricultural enterprises, informal loan providers, etc. (FAO and Academia de Centroamérica 2016).

to the agriculture orientation index[4] for credit (figure 3.9).

Actions to create an efficient, equitable and solid financial and banking system in LAC

Given the low levels of financing and public expenditure on agriculture, for farmers and rural stakeholders in general to become creditworthy subjects, several interventions are needed to overcome barriers associated with covariant risks, geographic dispersion, low scale production, lack of effective guarantees, limited offers of long term credit, a credit supply that is not adapted to agricultural production and investment cycles, excessive bureaucracy to obtain loans credits and the absence of information and records on the profitability and risks associated with agriculture.

Figure 3.8:
Agricultural credit as a percentage of total credit in LAC countries



Source: (Díaz-Bonilla and Fernández-Arias 2019).

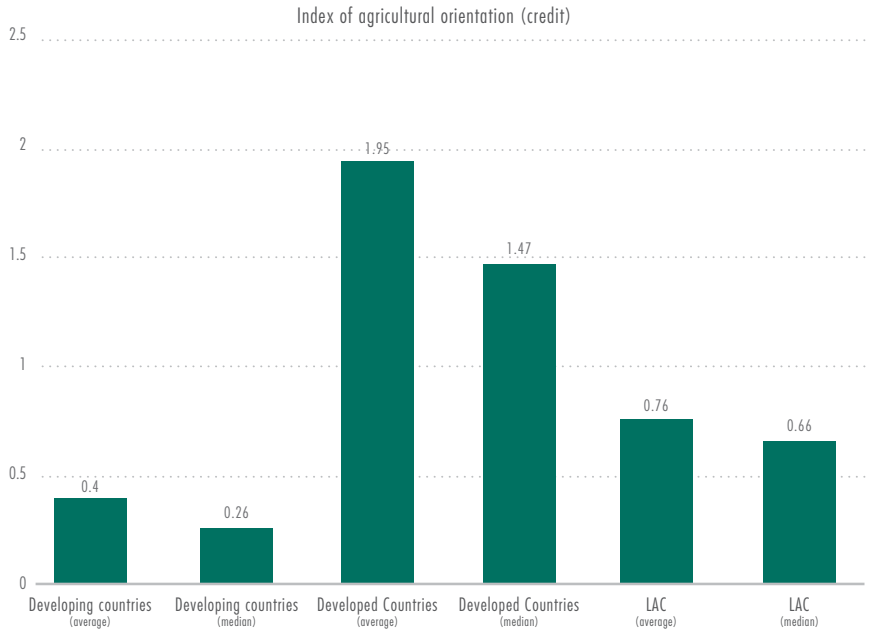
[4]Agricultural credit as a percentage of the total credit divided by the agricultural GDP as a percentage of the total GDP.

First, it is necessary to promote appropriate macroprudential policies, recognizing the need to improve the efficiency of rural financial markets, given their importance in mitigating the risks of banking and systemic crises; and to manage the aggregate instability (covariant risks) of the rural economy, considering the risks associated with credit, liquidity, foreign exchange exposure, cyclical income fluctuations and the valuation of assets.

In second place, interventions are required to improve/create regulations that can affect/enhance the operation of rural financial markets and financial institutions in relation to their three main objectives:

1. to serve as a payment system for the economy, through a set of services used for the transfer of money between financial institutions;
2. to act as an intermediary between savers and investors; and
3. 3) to act as a key provider of risk management services.

Figure 3.9:
Agricultural credit orientation in LAC, developing countries and developed countries



Source: (Díaz-Bonilla and Fernández-Arias 2019).

The combination of public goods, financial instruments and contractual arrangements with small-scale farmers and agribusiness through Public-Private Partnerships and with Producers (A3Ps) can attract additional resources and the support of banks, capital investors, input suppliers, machinery servicing firms and other providers of the value chains (IFAD 2016a).

The focus on the individual and on the totality of the home-business, rather than on the project or financial portfolio, is the best way to manage risk; this serves to capture the sector's heterogeneity since each client is different. The challenge is to establish and maintain direct individual long-term relationships at low cost, making use of the new technologies (IFPRI et al 2019).

A survey of farmers in Peru shows that when producers are linked to a business, their net incomes are on average 13 % higher; if they are linked to an organization, their net incomes are 25 % higher; but when these links are combined, i.e. they are linked to an organization through a company, their net incomes are 41 % higher (IICA 2016b).

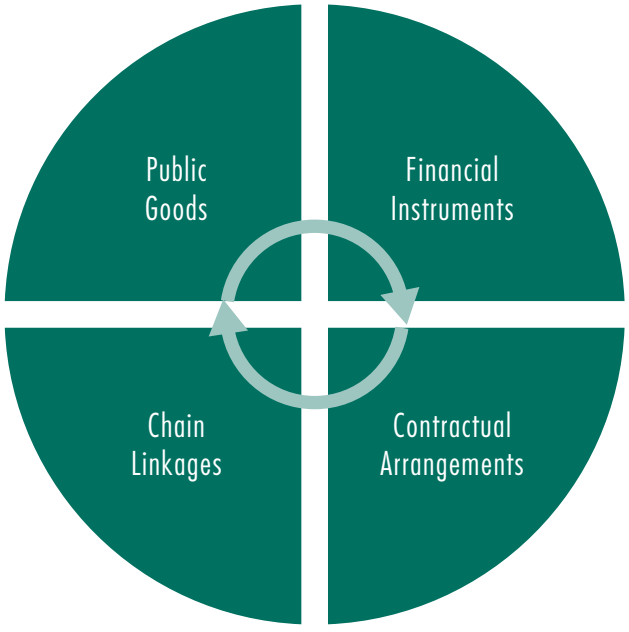
Investment in connectivity and rural infrastructure could reduce production costs in a more sustainable way, even more so than a subsidy on interest rates (IFPRI et al 2019).

In third place, it is necessary to create incentives to maximize the advantages and overcome the limitations of each type of financial institution, so that it can fulfill its role of providing credit, managing savings and offering financial services to the rural population. This requires us to consider a variety of agents, such as agricultural development banks (first and second tier), commercial banks, savings and loans cooperatives, community and communal banks, formal microcredit institutions, non-governmental organizations, charitable institutions and informal lenders.

In fourth place, it is important to promote comprehensive financial management in agricultural value chains by:

- creating conditions that enable people to access credit;
- improving the micro-management of businesses in value chains, taking advantage of available chain-based financial instruments, e.g. leasing with option to purchase, warehouse receipts, invoice discounting, etc.;
- improving the intermediate management of value chains, making use of A3Ps models (see Figure 3.10); and
- improving the macro management of value chains with a collaborative approach to policymaking, dialogue, consensus and decision-making, and for the management of shared solutions.

Figure 3.10: Model of A3Ps



Source: Authors, based on (IFAD 2016a).

In fifth place, there is a need to design efficient systems for the delivery of financial support products and services, and for the provision of other financial services. These products include traditional insurance, micro-insurance, index-based insurance, systems based on technology (photos taken with cell phones), credit guarantee funds, agricultural investment funds, social investment funds and green funds.

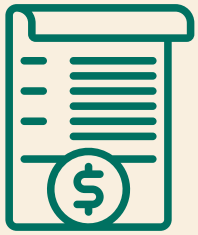
In sixth place, it is of the utmost importance to promote support services, such as investment in agricultural R&D; animal and plant health; infrastructure (roads, electricity, telecommunications and, in general, the structure of small and medium-sized cities); irrigation; land titling programs, meteorological systems, effective judicial systems and public security in rural areas.

Finally, public policies must be put in place to promote, in a manner that cuts across the actions proposed above, efficient, inclusive and solid financial markets. The task pending is to design banks for the agricultural sector that will complement the private system, address market failures, help improve public policies, provide transparent financing and incentives for good management, and that will be subject to proper regulation and supervision.

3.3.3. New criteria for the design of public programs

Despite the valuable initiatives described in the previous section, a growing gap is evident in the area of agricultural and rural development policies. The political systems appear to be overwhelmed, since they are subject to strong social pressures, in a context of tight restrictions on public funds (CEPAL 2019c). In addition to financing problems, the notion of hierarchy as a principle for creating social order is becoming obsolete. Government institutions alone are not capable of resolving current problems and challenges. Consequently, there is a need to establish a new balance between State and society, through the creation of mixed governance systems that combine self-organization by local communities, together with businesses and other civil society stakeholders, and the support and regulation of public institutions.

This is especially important for the promotion of investment in the rural milieu. Because of their economic fragility, smallholder businesses and other types of rural SMEs cannot develop or advance with the resources obtained from past earnings (cash flow). The contribution of their own resources and the commitment of local communities constitute central elements, since they define the strategic orientation and mode of operation of area-based programs. However, to achieve an adequate level of investment it is essential to secure external resources, outside of the communities, either through subsidies, soft loans, grants or other forms of financing. In order to have an impact, these investments require the support of technical and advisory systems, as well as other complementary programs. All this implies mobilizing a substantial volume of resources.



Public debt reached 42.3 % of regional GDP in 2018, compared with 39.4 % in 2017. At the level of countries, noteworthy cases include Argentina, where in 2108 public debt reached the equivalent of 95 % of GDP, while in Brazil and Costa Rica public debt reached 77 % and 53 % of GDP, respectively (CEPAL 2019c).

The use of digital platforms can help improve general coordination between stakeholders external to the area (national and foreign) with local actors, and among these.

Box 3.11:
The importance of redirecting public spending toward the creation of public goods

A study by the IDB, which included 15 LAC countries, showed that increases in total public expenditure on agriculture are important, but that the share of expenditure on public goods is far more important:

- If 10 % of the expenditure allocated to the private sector for the payment of subsidies were redirected to the creation of public goods (without altering the level of total public expenditure on agriculture), this would generate a 5 % increase in per capita agricultural income.
- Alternatively, to obtain a similar increase of around 5 % in per capita agricultural income, it would be necessary to increase total public expenditure on the agricultural sector by 25 % or more (maintaining a constant expenditure structure).

This effect on the composition of public expenditure is attributed only to public spending on agriculture, i.e. it does not include expenditure for the rural sector.

Source: Based on (Anriquez et al 2019).

In a restrictive situation, we are obliged to take advantage of technological changes to reconsider how to implement this investment process. The first step is to conduct a thorough review of public programs, seeking to make these more efficient, transparent and participatory. A major dilemma is related to the priority assigned to the provision of public goods versus private goods (see Box 3.11). In a context of fiscal constraints, public goods take priority, given their crucial role in the proper functioning of the sector. With respect to private goods (though not exclusively), a new combination of resources is required, financed by producers, governments, international cooperation, businesses, social funds, non-governmental organizations (NGOs) or the ethnic communities that live in developed countries (through remittances), among other possibilities.

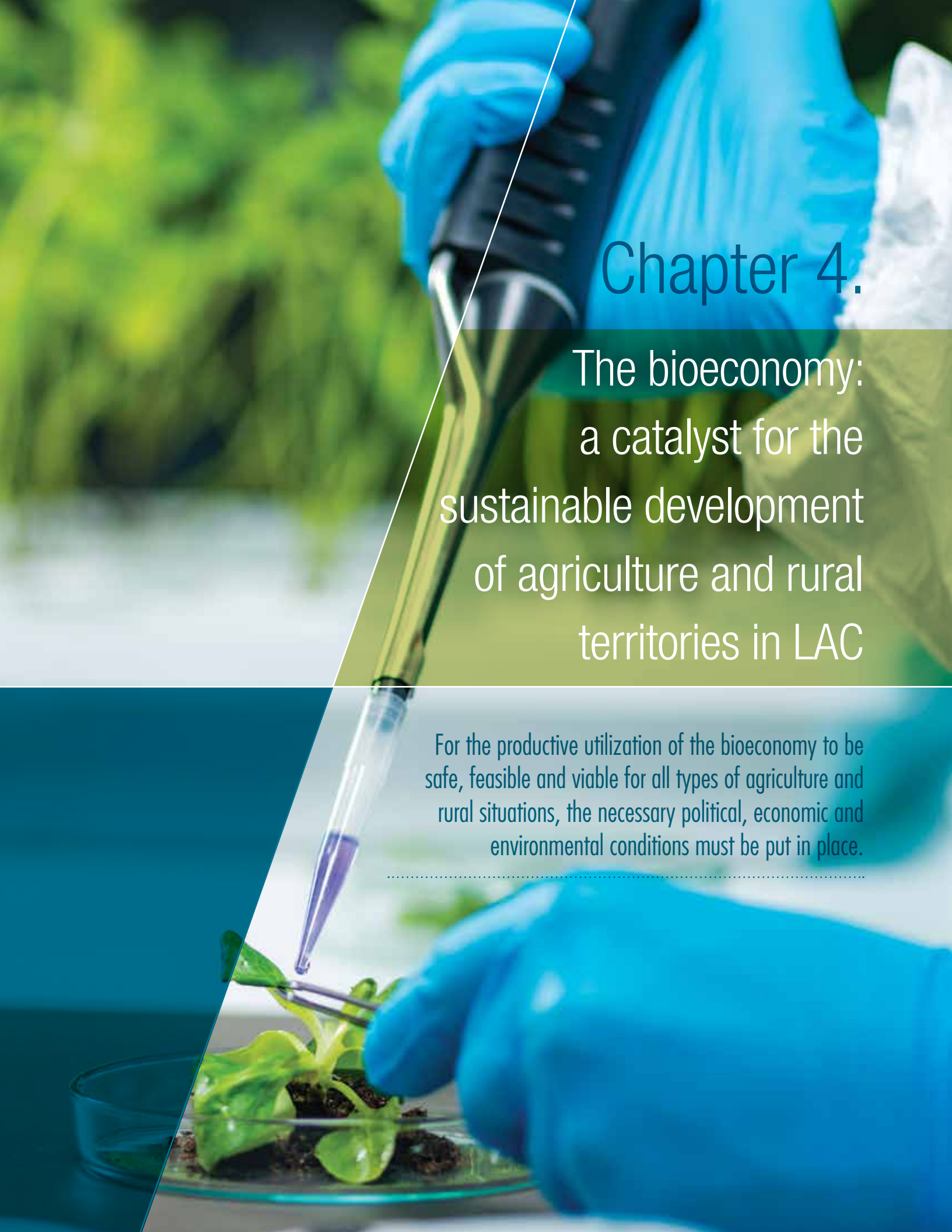
Faced with a technically challenging scenario, low capitalization, and many other restrictions, farms and rural SMEs have always used preexisting resources, re-combining these to produce new elements. In the current scenario, it is necessary to extend this approach. Traditional practices must be optimized by making use of the new technologies and reappraising the value of the local assets available in the rural milieu (Sotomayor et al 2019).

From that perspective, the installation of new platforms that provide services to producers is an option that merits careful consideration. A co-managed platform implies a far more active involvement by local communities. This means expanding the role and functions traditionally assumed by local producers and business people to include actions ranging from administering associations and setting strategic objectives, to organizing fairs and

other local events, co-financing extension services, placing value on unused resources, the joint construction and maintenance of infrastructure, peer to peer learning and the implementation of many other local development initiatives.

This approach also assigns a larger and more active role to external stakeholders with links to those territories: on the one hand, consumers and urban inhabitants, who through their consumption and other interactions play an increasingly decisive role, assisted by digital technologies; and on the other, the so-called global stakeholders, such as NGOs, universities, transnational corporations and international cooperation agencies.

The aim is to operate as a "network of networks", articulating preexisting networks and providing systematized information about the events and activities taking place in the territory (and outside of it). This will also facilitate peer to peer learning, offering opportunities to all those who wish to offer products and services, as well as to make some type of contribution. The idea is to take full advantage of the collaborative economy to make common use of infrastructure and machinery, connect machines and systems, change the scale of short marketing circuits, integrate resources and enhance businesses, encouraging the emergence of a new social intelligence to achieve the goals of Agenda 2030.



Chapter 4.

The bioeconomy: a catalyst for the sustainable development of agriculture and rural territories in LAC

For the productive utilization of the bioeconomy to be safe, feasible and viable for all types of agriculture and rural situations, the necessary political, economic and environmental conditions must be put in place.

4.1. Introduction

The bioeconomy makes it possible to tap the latest scientific and technological advances in order to make more efficient and sustainable use of biological principles and resources, which are so rich and plentiful in LAC. Although the bioeconomy is a recent concept, the region has been working on these issues for many years. Indeed, the LAC countries have been pioneers, and are now leaders, of some uses of the bioeconomy. There are many successful experiences that can serve as an example and a motivation.

4.2. Context

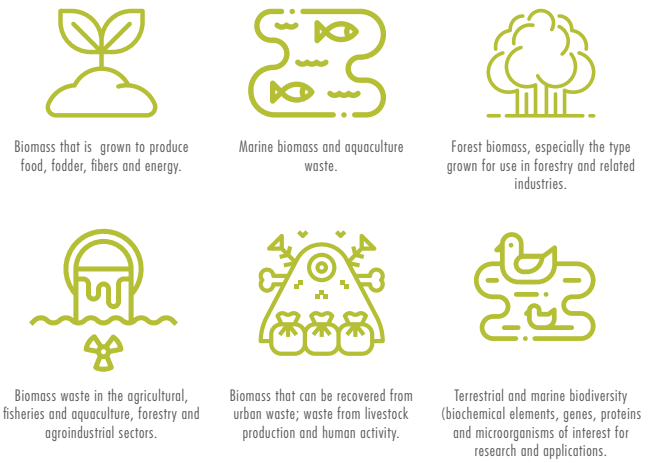
To develop fully, the bioeconomy needs to construct its own techno-economic system and political-institutional support mechanisms.

4.2.1. What is the bioeconomy?

The bioeconomy has been defined as "the production, utilization and conservation of biological resources, including related knowledge, science, technology, and innovation, to provide information, products, processes and services across all economic sectors aiming toward a sustainable economy" (IAC-GBC 2018, p. 2). This definition highlights not only the potential offered by the development of scientific knowledge (European Commission 2005), but also the potential of the biological base as a driver of development.

The bioeconomy is a new techno-economic paradigm of production and consumption.

Figure 4.1: Biological resources that biodiversity provides



The bioeconomy is a new techno-economic paradigm of production and consumption that is currently being developed following the logic of the previous paradigm, the industrial

revolution and the fossil fuel economy. In order for the bioeconomy to develop fully, therefore, it needs to construct its own techno-economic system and political-institutional support mechanisms.

In that process, there will be losers (e.g., in the fossil fuel economy) and winners (e.g., in new value chains based on biological resources) and it will be up to each country to decide how to strike that balance. Decarbonization of fossil fuels, a core element of the techno-economic model of the bioeconomy, is an objective that is increasingly being mentioned in the regional and national discussions on development policies. Little progress has been made, however, and the issue is only now beginning to be reflected in policy and investment strategies.

The concept of the bioeconomy as a development approach has benefited from advances in science and technology, and from the need to address new problems and concerns. It has appeared, then, just as the industrial revolution and other revolutions appeared in earlier times, boosted by the extraordinary advances witnessed over the last three decades in knowledge and technologies related to the biological sciences, and the complementarity and convergence of the biological sciences and the sciences and technologies of materials (especially nanotechnology) and information (e.g., digitalization, information and communication technologies, and the Internet of Things; see section 3.2.2). All this has contributed to a substantial increase in knowledge of the potential of biological resources and possible ways to harness and make sustainable use of them.

The emergence of the bioeconomy as a development approach has also been driven by the concerns associated with climate change, as the material and energy base of the economy has to change in order to combat it. Since biological resources are its material and energy base, the bioeconomy is crucial for the change of model required to combat climate change. The bioeconomy, which has also emerged in a context of concerns over the sustainability of agriculture — in terms of the use of natural resources and the GHG generated by productive activities—, provides solutions to those concerns, contributing to adaptation and mitigation, but also helping to strengthen the synergies between the two.

The proposed definition of "bioeconomy" highlights four elements:

1. The production, utilization and conservation of biological resources;
2. The knowledge, science, technology and innovation related to the previous element;
3. The production of information, products, processes and services that can be used by all economic sectors; and,
4. The objective of advancing toward a sustainable economy.

In the agricultural sector, these elements are related to:

1. Biomass and genetic resources;
2. Knowledge derived from the biological sciences and the application of biotechnologies and modern technologies related to the bioeconomy (see section 3.2.2); and,
3. An increase in value added and diversification (see section 3.2.5).

The distinctive element of the bioeconomy as a policy framework and a development approach is the fact that biological resources are its material and energy base.

4.2.2. The bioeconomy and the 2030 Agenda

The bioeconomy provides a conceptual framework for the development of strategies designed to tackle the major social challenges and sustainable development concerns contemplated in the 2030 Agenda. More efficient productive and sustainable use of biological principles and resources, thanks to advances in science, technology and knowledge, would make it possible to put forward new economic alternatives, especially in the rural milieu. The latter include the sustainable intensification of agricultural production (see section 3.2.1), biotechnological applications for developing more productive varieties (see section 3.2.2) better adapted to climate change and with improved nutritional attributes, biopharmaceutical products, biofunctionalized materials for medical applications and better education, among others.

It should be noted that bioeconomy activities are not necessarily sustainable. When biological resources and biomass are used to generate foodstuffs for human beings and animals, fuels and biological products, there can be positive and negative environmental and socioeconomic effects. In the context of its work on sustainable bioeconomy guidelines, FAO presented 26 case studies related to sustainable bioeconomy interventions implemented across the globe, which encompassed a broad range of issues and sectors. This diversity reflects the nature of the bioeconomy. Thus, although no single model exists for the development and implementation of the bioeconomy, it is possible to suggest a series of ways of achieving a sustainable transition towards it.

The lessons learned from the 26 case studies give an idea of how the change to sustainability is achieved in practice. They also show clearly that sustainability does not occur automatically. Whenever possible, many actors should join forces to achieve synergies and reduce discrepancies with regard to sustainability goals. These lessons have been structured around six main issues, which are by no means exclusive, associated with most of the bioeconomy's development objectives, namely: food security, natural resource management, climate change, responsible production and consumption, economic growth and good governance (for further details, see Annex 5.8).

4.2.3. Why should LAC focus on the bioeconomy?

The bioeconomy is both an opportunity and a need for LAC. It is an opportunity because the region possesses the two basic ingredients that undergird the bioeconomy:

1. The broad availability of biological resources (biodiversity and genetic resources, diverse productive landscapes, the ability to produce biomass, the generation of biomass from unused waste); and,

2. The scientific and technological capabilities necessary for the development of the bioeconomy, such as the agricultural and biological sciences.

The region also needs the bioeconomy, in view of:

1. The challenge of finding new pathways for more sustainable and inclusive rural and agricultural development (it could help resolve problems of equity, distribution, poverty and territorial imbalance);

2. The urgent need to find alternative forms of mitigation and adaptation for the agricultural sector in response to climate change that also guarantee the sector's sustainability and competitiveness, as well as the inclusion of small farmers; and,

3. The global objective of contributing to the decarbonization of fossil fuels.

The bioeconomy, an opportunity

Viewed as a whole, LAC has a strategic advantage in terms of its endowment of biological resources. Its territory accounts for 13 % of the planet's land mass and is home to 9 % of the world's population. In terms of the world's resources, the region

possesses 50 % of known biodiversity, 21 % of terrestrial ecoregions, 22 % of fresh water, 16 % of marine water resources, 23 % of forests and 57 % of primary forests. It receives 29 % of all precipitation and contains 31 % of the planet's 35 million cubic kilometers of fresh water resources (UNDP 2013). Moreover, LAC is the developing region with the largest proportion of land available per capita that could be incorporated into production activities. Nonetheless, there continue to be significant gaps in productivity in the main crops (Sennhauser et al. 2011).

The situation in the field of science and technology is more diverse. In aggregate terms, in recent decades the region has significantly increased its investment in agricultural R&D, which rose by 75 % between the mid-1990s and 2010. However, most of the increase occurred in the biggest countries —Mexico, Brazil and Argentina— and, to a lesser extent, in Colombia, Costa Rica, Chile and Uruguay—, while the remainder lagged some way behind (Stads, Gert-Jan, Nienke Beintema 2016). The situation is similar in the case of biotechnology (see section 3.2.2), a crucial area for the development of the bioeconomy, with major disparities with other parts of the world not only in terms of the amount invested, but also the performance of the respective systems.

Regional cooperation initiatives on these subjects go back a long way. In the field of agricultural research, some cases in point are those of the Tropical Agriculture Research and Higher Education Center (CATIE), the Caribbean Agricultural Research and Development Institute (CARDI), the cooperative agricultural research programs (PROCIs), the Regional Cooperative Program for the Technological Development and Modernization of Coffee Cultivation (PROMECAFE) and the Regional Fund for Agricultural Technology (FONTAGRO), created with a view to promoting joint efforts to compensate for countries' unequal capacity for investment (Trigo et al. 2019, Trigo 2018). Capacity building initiatives have emerged in the field of new technologies, including the Network of Biotechnology Laboratories for LAC (REDBIO) and the Argentina-Brazil Biotechnology Center (CAABIO), designed as training platforms and for discussion and academic exchanges on scientific and policy matters related to biotechnology development. As a result of cooperation of this kind, initiatives have begun to emerge related to the development of sustainable agricultural production strategies, the use of biotechnology, bioenergy production, biodiversity-based businesses and advances in the development of markets for ecosystem services, which deal with the processes via which the environment produces resources that are essential for human beings (air, water, food and materials). See the case of Natura below (Box 4.6).

The bioeconomy, a need

It is necessary to renew the strategies for integrating rural economies and territories into the global economy, and to define new productive pathways, based on biological resources, that generate jobs and income.

The bioeconomy is an alternative approach of the kind needed to tackle the big challenges facing most countries in the region, especially their rural areas, in terms of food security, poverty and unemployment, among others. In fact, the bioeconomy has two strong

The bioeconomy is both an opportunity and a need for LAC.

arguments in its favor. Firstly, the macroeconomic benefits to be gained from a possible global balance of food, fiber and energy, and a potential improvement in environmental sustainability. And secondly, within the limits of the region, the opportunities for achieving equitable growth offered by the bioeconomy (see Box 4.1), harnessing traditional agricultural production and other forms of biomass (biofactories, for example).

Box 4.1: Social inclusion through better opportunities for rural development.

Rural areas are being undermined by the effects of the emigration of young people and the ageing of the wider population. However, thanks to the possibilities of production being opened up by new technologies and the fact that in many cases value is added locally, the bioeconomy offers new opportunities for the economic development of rural territories. Biorefineries, for example, make it possible to improve and expand many traditional value chains, and look set to provide the springboard for developing new ones. At the same time, a more reliable, decentralized supply of energy could do much to attract new income-generating economic activities to rural areas.

Many of these initiatives work with raw materials that require a smaller investment per unit of product generated than large factories. This means that, for a given level of total investment, they offer greater opportunities in terms of types of activity and employment. This, together with connectivity and the new information and communication technologies (see section 3.2.2), promotes a structure for more diversified links between agriculture and the rest of the economy, thus opening up the possibility of creating new jobs and capacities, and eliminating the reasons why young people do not find rural areas attractive.

In particular, the bioeconomy is of fundamental importance as a forward-looking approach for economies and rural territories, which find themselves needing to review their strategies for integrating into the global economy and defining new productive pathways that will generate jobs and income. The bioeconomy provides interesting alternatives for more balanced and inclusive territorial development, which is vital in order to combat the persistent problems of rural poverty effectively (see sections 2.8 and 3.1.2).

On the other hand, since biomass is a very cheap, voluminous resource in most of its forms, the rate of return is much greater when value is added close to the point of origin. This is especially true if the goal is to optimize its utilization through the development of new value chains associated with the use of "waste" biomass in productive activities with positive territorial externalities (e.g., the energy supply, generation of jobs, reduction of pollutants). The application of new scientific-technological breakthroughs around the productive model of the biorefinery makes the cascade processing of biomass possible in order to produce food and fodder, fibers, energy, biological materials and others bioproducts with high value added. This results in a reorganization of investment processes that, in turn, leads to the economic densification of territories and calls for the development of both a better economic infrastructure (roads, railways, communications, etc.) and social support infrastructure (education, health).

One important aspect of the use of waste biomass is the fact that it makes it possible to generate energy locally, which, in rural territories, could facilitate access to competitively priced energy (SDG 7: affordable and clean energy), the introduction of more efficient equipment, and access to the Internet and other services that improve the quality of life. Furthermore, the processing of local waste and residues can have a positive environmental impact, as it reduces the risk of water and soil pollution in the service areas, in addition to creating synergies for addressing climate change.

Finally, the transition toward development based on the bioeconomy opens up the possibility of abandoning the dichotomy between agriculture and industrial development that has dominated the debate on development strategies in LAC for decades (see section 3.1). The bioeconomy is a production and economic organization strategy for the economy as a whole that includes a wide variety of new, modern and traditional sectors and parts of sectors (family farming, agricultural systems of indigenous peoples, etc.) and various scales of production. What they all have in common is the fact that they share the concept of the use of biological processes and resources as a core component of their production activities and services. The model thus brings about a transformation of intersectoral relations but, even more importantly, provides a significant opportunity to revitalize rural areas.

4.3. The bioeconomy in LAC

The development of the bioeconomy is under way in the region. Legal, institutional and policy frameworks are already in place, and there are pioneering business initiatives on issues linked to bioenergy, biotechnology and sustainable biodiversity use. Pathways have also been identified for the development of the bioeconomy with a regional vision (Hodson 2015, Hodson de Jaramillo et al. 2019) and several countries are developing national and subnational strategies on the subject (see section 4.3.2).

4.3.1. Technological and productive advances

LAC has made important progress in areas such as bioenergy, agricultural biotechnology, low-carbon agriculture, the utilization of biodiversity and ecosystem services, as well as with the development of a circular bioeconomy.

Bioenergy

Bioenergy, especially liquid biofuels (mainly bioethanol and biodiesel) and biogas, is an important part of the decarbonization strategies under discussion within the framework of the 2015 Paris accords. This is an area in which the LAC countries have major advantages, not only in terms of the raw materials needed to produce energy of this kind, but also the development of both national and international markets.

From the standpoint of the bioeconomy, biofuels are a strategic platform. As well as helping to create a cleaner energy matrix, with respect to both the vehicle fleet and the production of electricity, the biorefineries that produce them could have a multiplier effect on other sectors of the economy, such as green chemistry (platform chemicals and specialties, plastics, cosmetics, etc.), fertilizers and other industrial inputs, and consumption products. Joint production and the circularity of the biorefinery model is an aspect that makes it possible to reduce biofuel production costs and make such fuels more competitive with fossil fuels, and to consolidate and enhance their virtual environmental benefits (Clark et al. 2012).

Bioethanol. In all the countries, the development of ethanol production has been closely associated with public policies, through different programs designed to promote and regulate it.

Brazil and Argentina, and to a lesser extent Colombia, Peru and Mexico, are the countries that have made most progress with both production and market penetration, and development across every link upstream and downstream from the primary production of the production chains involved (see boxes 4.2 and 4.3). In the other countries of the region, development has been more recent and on a smaller scale, although in the past few years Colombia and Peru have reached quite important levels of production that basically have involved the processing of sugarcane.

Biofuels are a strategic platform for the bioeconomy, not only because they help to create a cleaner energy matrix, but also on account of the possible multiplier effect of biorefineries on other sectors of the economy.

Thus far, 14 countries in the Americas have established a mandate of some kind for the blend of ethanol and fossil fuels, ranging from 5 % to 27 % (REN21 2019).

In Colombia, there are seven plants that produce sugar and ethanol together and co-generate electricity. The volume produced is around half a million liters per year, and it is estimated that the industry —concentrated mainly in the Cauca Valley— has created some 188,000 direct and indirect jobs (ASOCAÑA 2017).

In Peru, three processing plants are in operation, with production now exceeding 150 million liters per year, focused especially on the domestic market, but with small but growing amounts exported to neighboring countries, and even some in the European Union (EU) (Nolte and Luxbacher 2016). In Central America, Guatemala is the leader in the sector with a productive capability of around 250 million liters per year, most of which is exported to Europe and the United States (Horta Nogueira 2006). In Mexico, production is still insubstantial compared with the sugarcane sector's productive potential.

Box 4.2:
Argentina's experience in producing and exporting bioethanol

The development of ethanol in Argentina is based on sugar production, located mainly in the provinces of the northwest of the country, where the best agroecological conditions are to be found for growing the crop. In 2006, the country enacted the Law for the Promotion and Development of Biofuels (Law No. 26,093), which established that by 2010 fuels were to contain 5 % of bioethanol. Since then, an important process of diversification of production (in terms of both crops and production areas) has taken place, with strong growth in the production of corn ethanol. In 2017, the industry consisted of 14 industrial ethanol plants —9 that process sugarcane and 5 that use corn as the raw material— with a total installed production capacity of some 1.5 billion liters and production of around 1.1 billion liters, with each of the two crops accounting for half of the total (Agromaker 2017).

Box 4.3:
Brazil's experience in producing and exporting bioethanol

In terms of markets, Brazil, with nearly 3.1 billion liters in 2018, is the world's second biggest producer, behind the United States, and the number one exporter of sugarcane ethanol. The process in that country dates from 1975, when, in response to the first oil crisis, the Proálcool Program was launched to reduce the country's dependency on imported oil. It is estimated that sugarcane and its byproducts are now the most important source of primary energy in the national energy matrix, and ethanol consumption has replaced half of the gasoline sold, at a competitive price. This percentage is expected to continue to grow, at least until the middle of the next decade (Ministry of Agriculture and Supply 2009).

The productive platform of the Brazilian sugarcane ethanol industry is made up of a wide variety of biodistilleries that process sugar and ethanol separately or together. A large number of them also use the resulting bagasse to produce electricity for their own consumption —making them self-sufficient in energy— or for use on the national network. This industrial development has had spillovers, both in the production of sugarcane (new varieties have been developed that produce more ethanol) and in the production of inputs and capital goods used in the production of ethanol, and the country has become one of the market's strategic benchmarks (Cortez et al. 2012). As well as these benefits, it is estimated that the sugarcane-ethanol complex generates around 400,000 jobs per year (REN21 2019).

Biodiesel. Regional production is spearheaded by Brazil and Argentina, which have some 80 refineries between them. In Argentina, most of the refineries are to be found around the port of Rosario, while in Brazil the production areas are distributed more widely. Boxes 4.4 and 4.5 describe Brazil and Argentina's experience in producing biodiesel.

In the other countries, there are, in some cases, sizable palm oil plantations (Guatemala, Peru, the Dominican Republic). Biodiesel production is not a significant activity, however, although most countries have mandatory policies covering traditional diesel, with the need normally being met with imports (Gestión 2018). Colombia recently became the only Latin American country to use palm oil diesel to obtain the compulsory biofuel mixture (10 %) and is the leader in Latin America in the production of biodiesel from that source. The palm oil and biodiesel industry has grown notably over the last decade, with the cultivated area, in 2017, reaching more than 400,000 ha., contributing raw material for 11 processing plants. That same year, those plants produced 513,000 tons of biodiesel to meet domestic demand and exports. Most of the plants are located in the north of the country (Fedebiocombustibles (National Biofuel Federation of Colombia) 2019).

Box 4.4:
Biodiesel production in Brazil

Brazil currently produces 5.35 million metric tons of biodiesel per year, placing it among the world's top three producers. The country is preparing for a substantial increase in demand as a result of new legislation that establishes the compulsory use of the B15 blend by 2023 (the blend currently stands at 10 %), and approval of B100 on a voluntary basis for special fleets, such as city buses.

It is estimated that some 600,000 additional tons of soybean oil will be required to meet those requirements, which will mean processing a further of 3.3 million tons of soybeans. In 2015, 76.5 % of the biodiesel produced in Brazil was made with soybeans, 19.4 % with animal fat, 2 % with cotton and 2.4 % with other types of raw materials, such as used kitchen oil and oil palm, among others (De Oliveira 2016).

Box 4.5:
Biodiesel production in Argentina

As many as 37 biorefineries that process soybeans currently operate in Argentina. They can handle 4.4 million tons per year, and in 2016 produced 2.6 million tons of biodiesel, of which 1.6 million were exported, making the country the world's leading exporter (Calzada and Molina 2017). These numbers have been adversely affected in recent years by the emergence of trade conflicts sparked by the potential competition between biofuels and food, and the fiscal policies applied in Argentina. However, this development has also had some positive effects within the industry, since, as a result of falling demand, greater efforts have been made to find other options.

In the provinces where production takes place, fossil fuels are now being replaced by biodiesel in the fleets of public transportation vehicles, which will help stabilize demand and have significant environmental benefits. There is also a trend toward the local use of biodiesel in waste collection (Clarín 2019) and for the agricultural machinery used in different stages of primary production (Fernández and Aguer 2017). All this helps to create virtuous environmental circles at the local level.

In Argentina, genetically modified crops —usually referred to as genetically modified organisms (GMO)— make up almost 100 % of the cultivated area planted with both soybeans and corn and cotton (Trigo 2016). The same is true of Brazil, where the percentage of adoption is higher than 85 % of the cultivated area in all three cases (soybeans 92.3 %, cotton 94 %, and corn 86 %). (CIB and Agroconsult 2018).

Because of its diversity with regard to areas of application, biotechnology is one of the key technologies for the development of the bioeconomy.

Agricultural biotechnology (see also section 3.2.2)

Because of its diversity with regard to areas of application, biotechnology is one of the key technologies for the development of the bioeconomy. It is of strategic importance not only for the improvement of all forms of biomass production, but also because it is a crucial technological pathway for the development of new, more efficient processes that help make it even more valuable. Agriculture in the region has been one of the early adopters of technologies of this kind: in Argentina, herbicide tolerant soybeans were introduced in 1996 (Trigo and Cap 2006). Since then, a significant number of countries have adopted this type of crop (Paraguay, Brazil, Uruguay, Bolivia, Colombia, Costa Rica, Honduras and Mexico), with more than 80 million ha. now planted with different varieties of improved soybeans, corn and cotton to increase yields in response to various biotic and abiotic constraints. All this forms part of processes that are clearly identified with efforts to strengthen the region, positioning it in international markets of these products and accounting for a significant flow of economic and environmental benefits for the countries and sectors involved (ISAAA 2018b).

These processes are even more important given the dynamics of adoption that technologies of this kind have had in the different countries, especially in Argentina and Brazil.

These processes have had a significant economic and environmental impact. As far as the economy is concerned, it is estimated that in the 20 years since they were introduced in Argentina (in 1996) and up to the 2015/2016 farming year, the cumulative direct benefits in terms of increased farmer income have been close to USD 50 billion, with the lion's share (USD 37.5 billion) concentrated in Argentina (more than USD 21 billion) and Brazil (more than USD 16 billion). These countries are first adopters or those that devote most land to crops of this kind (Brookes and Barfoot 2017). The environmental benefits stem mainly from reduced use of agrochemicals and the interaction between technologies of this kind and greater use of reduced tillage practices, topics addressed below in the section on low-carbon agriculture. The scale of these processes, and their effects on the rest of the economy, have proven valuable both at the national and international levels, given the impact that these transformations have had on the food supply and, therefore, on the well-being of global consumers (Trigo 2016).

It should be emphasized that the possibility of the region being an early adopter of biotechnology was closely related to the fact that, when these practices began to become available at the international level, the region already had the institutional bases required to incorporate them into production systems. This was true of both the scientific and technological base and biosafety regulatory systems —which are essential to make new technologies available and provide access to them— and national plant breeding and improved seed systems, which are key to ensuring that genetic innovations reach production systems (for a more detailed analysis see Trigo et al. 2013).

This array of experiences, capabilities and regulatory and market environments has evolved and there is now a variety of crops with new biotechnological developments ready for production and marketing, or near-market research, that are the result of public and private sector initiatives in the region itself. A case in point is the wide variety of modified crops designed to overcome different types of limitations, such as beans tolerant to the golden mosaic virus, potatoes resistant to the PVY virus, alfalfas tolerant to herbicides and with less lignin content, soybeans and wheat tolerant to drought, sugarcane resistant to herbicides and with a bigger energy yield, and even modified safflower seeds to extract chymosin, as part of a biorefinery (see Box 4.8)).

In this process, it should be noted that these developments —which undoubtedly will be strategically important to achieve a new balance between higher productivity and sustainability in the region's traditional products— are being accompanied by a very dynamic process of creating new companies aiming to capitalize on the value to the markets of the new knowledge and technological advances available today for a wide variety of issues and products. This is taking place to a greater or lesser extent across practically the entire subcontinent, from Mexico to the Southern Cone countries, initially with a strong emphasis on matters such as micropropagation in flowers and various tropical crops.

For some time, the aforementioned topics have been evolving towards more complex applications: the production of drugs from biodiversity resources; the use of agroindustrial residues to produce bioinputs and energy, polymers and biodegradable plastics from different cheap substrata, and environmental rehabilitation through the functional optimization of microrganisms. More recently, biotechnological artificial intelligence has begun to be used to create proteins and enzymes to meet specific industrial needs and to "reimagine food" and create foodstuffs similar to conventional ones, but adapted to special segments of consumers (e.g., vegan and celiacs). Also worthy of mention are diagnostic services and assisted human fertilization and the development of biofactories for the use of animals or plants to produce drugs, industrial inputs and food with specific characteristics (processing of cattle for the production of the human growth hormone) or plants for the production of chymosin for the cheese industry (Hodson de Jaramillo et al. 2019).

This suggests that the scientific and technological-productive platform linked to biotechnology is entering a new stage in its cycle of development, particularly bearing in mind the many opportunities created by what has been dubbed "precision biotechnology" and the possible impact on production systems and the ways in which biomass and biodiversity resources are used. In the region, Argentina has taken the lead by adopting a regulatory philosophy based on the idea that precision biotechnology products do not need to be regulated any differently than conventional ones, provided they do not contain foreign genetic material. The other countries in the region supported this position in a recent presentation (ICCA 2018) to the WTO (see section 3.2.2).

Low-carbon agriculture

Agriculture is one of the sectors that contributes most to GHG emissions in the region. Therefore, any decarbonization strategy that is to be implemented should tap the potential of production and the comprehensive use of biomass in the context of a circular bioeconomy. Progress has already been made with the development and adoption of alternative approaches for low-carbon agriculture and significant results achieved, although they vary between sectors and countries. Low-carbon agriculture is often referred to as "conservationist agriculture," a concept that includes a wide variety of production strategies (direct seeding, reduced tillage, greenhouse production, crop rotation) whose general objective is to strike a balance between productivity and sustainability, with the aim of achieving sustainable increases in productivity while at the same time improving the quality of productive resources. Practices of this kind are fairly well established in most countries of the region and have been the focus of major public and private sector R&D efforts, as well as public policies and international cooperation programs. Unfortunately, the information available about the scale of adoption of these practices is limited and incomplete, making further observations impossible. But certain practices are widespread, with direct seeding a case in point. In the Southern Cone countries, a very high percentage of the main crops planted under extensive farming systems use the practice. It has been estimated that around the start of this decade, practices of this kind were being used on some 66 million ha. of farmland in those countries, 31.8 million and 29.2 million in Brazil and Argentina, respectively, with the remainder distributed among Paraguay, Uruguay,

Agriculture is one of the sectors that contributes most to GHG emissions in the region. Therefore, any decarbonization strategy that is to be implemented should tap the potential of production and the comprehensive use of biomass in the context of a circular bioeconomy.

Bolivia, Venezuela, Chile, Colombia and Mexico (Kassam et al. 2015) (see also the agroecology section in 3.2.2).

Given its scope, one very important case in the region is the Sectoral Climate Change Mitigation and Adaptation Plan to Consolidate a Low-Carbon Economy in Agriculture (Plan ABC), adopted in 2011 in Brazil (see the box corresponding to this country in the next section). Other significant initiatives include the one implemented in Costa Rica aimed at improving the performance of certain sectors with regard to emissions and carbon fixation. This is related to the Nationally Appropriate Mitigation Actions (NAMAs) in the coffee sector (the first in the world in an agricultural sector) and the livestock sector, both of which are ongoing. The NAMA for the coffee sector includes a reduction in the use of nitrogenous fertilizers, promotion of the efficient use of water and energy in processing plants, the fostering of agroforestry systems, and waste management. The NAMA for livestock farming is designed to promote the implementation of technologies and measures for climate change adaptation and mitigation, help producers increase their productivity and income.

In the case of livestock production, the experiences in the region refer to a set of technologies and policies aimed at improving economic and environmental performance. The following are some of the programs and initiatives under way:

1. **Argentina:** Ecological beef certification systems.
2. **Bolivia:** Program for the Sustainable Development of Cattle Farming.
3. **Brazil:** Carbon Neutral Meat Seal, Program for Energy Efficiency of the Resources of the Beef Supply Chain.
4. **Chile:** Conservation and Sustainable Use of the Patagonian Steppe for Sustainable Livestock Production.
5. **Colombia:** Sustainable Livestock Production.
6. **Paraguay:** Agreement for the creation of a sustainable livestock production and technology transfer in the region, Program for the intensification of the livestock production of Mennonite cooperatives.
7. **Uruguay:** Climate smart agricultural production and land restoration on Uruguayan pastureland, and sustainable Uruguayan livestock production systems based on the guidelines of the FAO Livestock Environmental Assessment and Performance (LEAP) Partnership (FAO 2018).

All these initiatives are underpinned by institutional frameworks and policies (see section 4.3.2) designed to send signals to the productive sectors that they need to adjust their activities to the emerging decarbonization priorities, which still are not reflected in the price systems of current markets. From the standpoint of the future of the bioeconomy, these institutional frameworks and promotion efforts are an important asset, as they not only aim to make a key sector of the region's economies more competitive, but also serve as pilot experiences for other strategic sectors.

Sustainable productive and commercial use of biodiversity and ecosystem services

The sustainable productive-commercial use of biodiversity and ecosystem services (Hodson 2015, Rodríguez et al. 2019) focuses on areas associated with the sustainable use of biodiversity. This encompasses efforts such as the recovery of traditional seeds, the discovery of functional traits related to specific uses, the development of new products through innovative processing and the development of markets for local products. In most of these cases, the distinctive feature is the value placed on biodiversity (for example, domestication, transformation, market linkages). In the case of ecosystem services, this includes processes through which the environment produces resources that are indispensable for humans, such as air, water, food and materials. Box 4.6 describes the case of Natura, which illustrates this point.

Box 4.6: Natura: A successful case of sustainable use and valuation of biodiversity.

Natura is a Brazilian multinational company founded in 1969 and dedicated to the manufacture and sale of cosmetics based on natural products, with an emphasis on Brazil's biodiversity. The company's product lines include body soaps, cosmetics and sun care and protection products, creams, perfumes and childcare products. Around 88 % of Natura's products are made with plant ingredients and 12 % are made with native products, extracted from the Brazilian Amazon.

Natura is characterized by its capacity to innovate. It has brand and copyright protection, has been granted 11 model and design patents and has obtained B corp, ISO 27.002:2013 (Information Security) and Carbon Neutral Program certifications. Since 2014, Natura has formed part of the Dow Jones Sustainability Index (DJSI), the New York Stock Exchange. It is also a referent for investors who consider socio-environmental issues in their decisions.

The company works under an open innovation model and develops new digital products for the business. With the launch of the Ekos line in 2000, Natura was the Brazilian company that made a commitment to share the benefits generated by innovation through access to genetic resources and traditional knowledge of local communities. About 3 % of the firm's annual income is invested in innovation. It has signed agreements for the supply of natural assets with farms, businesses and communities in Brazil and LAC. Approximately one-third of these are with traditional communities and local suppliers of genetic resources with traditional knowledge of native species.

The use of socio-biodiversity inputs is based on Natura's Policy on Sustainable Use of Socio-biodiversity Products and Services, which ensures the fair distribution of benefits among the communities that supply these and the sustainable management of assets. Through the Amazonia Program, Natura also seeks to promote the development of sustainable businesses. Together with other organizations, it is working toward the approval of new legislation on access to biodiversity.

Given the special relationship that exists between natural resources and social and economic activities based on the bioeconomic approach, the inclusion of ecosystem services should be a crucial component of any strategy that seeks to promote the sustainable bioeconomy. See section sustainable (Section 3.2.2).

Circular bioeconomy, valuation of waste and residues

The term circular bioeconomy was coined to emphasize the element of circularity in the bioeconomy, highlighting the convergence between both concepts in relation to the full utilization of biomass, under the concept of bio-refinery (OECD 2018). Thus, the concept of the circular bioeconomy is intimately associated with the development of new production activities based on the use of residual biomass (for example, from agricultural and forestry processes) and waste (including domestic waste). Boxes 4.7 and 4.8 describe the experiences of two companies: one in Mexico and the other in Argentina.

Box 4.7: BIOFASE (Mexico): Production of biopolymers based on avocado seeds

The history of BIOFASE dates back to the time when its founder, Scott Munguía, was a student of Chemical Engineering at the Monterrey Institute of Technology and Higher Education (Mexico). In 2011, after years of researching bioplastics, he managed to isolate a polymer from avocado seeds, a technological breakthrough that led him to establish his own company. His firm manufactures sustainable products using abundant resources that have no other use - in this case, the seeds or pits avocados. Mexico is the world's leading producer of avocado, producing more than one million tons annually, from which around 25,000 tons of seed are discarded each month in Mexico alone. In 2014, BIOFASE was recognized as the Innovation of the Year in Mexico by the Massachusetts Institute of Technology (MIT) and as the best green company in Mexico by the National Bank of Mexico Citi Banamex (Banamex).

In 2015, BIOFASE opened its first plant producing only bioplastics. In 2016, in order to diversify production, it opened a second plant that produces cutlery and straws. At present it manufactures between 300 and 400 tons of those products annually, which are exported to the United States, Spain, the United Kingdom, Canada and some Central American countries (El Espectador 2019).

BIOFASE's products consist of 60 % biopolymers made from avocado seed and 40 % of synthetic organic compounds that give these certain mechanical and physical properties. The company also makes biodegradable products, which are re-incorporated into Nature at the end of their useful life and compostable products, which can be discarded in a composter or landfill so that they degrade 100 %. One important benefit of these products is their low carbon footprint, much lower than that of other plastics and bioplastics, due to the phenomenon of the biogenic carbon bonus (as it grows, the avocado tree absorbs CO_2 from the atmosphere to form its tissues (BIOFASE).

Box 4.8: Porta Hermanos: the bioeconomy in agriculture.

Porta Hermanos is a family firm founded in 1882, in Córdoba, Argentina, by Italian immigrants. Originally a producer of liquors, over the years the company has expanded its range of products and diversified its areas of operation.

It has produced two technological innovations. The first is the development of the MiniDest plants, small modular distilleries that are automatic and remotely operated, designed to add value to primary production. These plants are installed on farms in order to produce corn ethanol and animal feed, thereby adding value at the point of origin, integrating agricultural and animal feed production. For each unit of energy used - from the planting of the corn to the production of ethanol – 2.6 energy units are generated. The plant has capacity to process 40 t of corn/day (14,000 t/year, can feed a herd of 4000-6000 head of cattle, which implies a requirement of 1,600 hectares of maize production. The plant produces 15 000 l/day of ethanol and 40,000 kg of distillers' grain.

The second innovation is the design and construction of a safflower bio-factory for the production and global marketing of chymosin produced from safflower (SPC), with capacity to develop plant-based industrial inputs and products transformed through biotechnology (genetically modified safflower). The industrial plant has an annual milling capacity of 6,000 t of safflower, representing around 2 million liters of chymosin (20 % of the global market).

Source: Jose Porta 2018 in (CEPAL 2019d)

Knowledge-based bio-enterprises

As explained in section 4.3.2, startups and SMEs are often pioneers and drivers of innovation in the bioeconomy. And often the greatest innovations - especially in different areas of "cutting-edge" knowledge-based technologies - are developed by young entrepreneurs. Below is a description of two examples, both associated with the use of waste (Box 4.9).

Box 4.9:
Adding value to aquaculture waste, Kura Biotec, Chile

Kura Biotech is a biotechnology company based in Puerto Varas, in southern Chile, and specializing in enzymatic catalysis, which exploits the potential of natural enzyme sources present in that country. The company was founded by Manuel Rozas and began by analyzing and extracting glucuronidases from red abalone (Haliotis rufescens) for the hydrolysis of clinical and forensic drugs. The initial motivation for the firm's development and location in southern Chile was the fact that the region has the world's largest concentration of salmon production and also produces other types of seafood (red abalone, for example), and therefore it set out to add value to the waste from that industry. Given the sophisticated nature of its products, the company focuses on the international market. It currently exports to 14 countries. Its products are used in more than 6 million analyses each year and it works with the world's two best toxicology laboratories. At the beginning of 2018, the firm employed 15 workers, most of them young Chilean scientists, specialists in enzymatic catalysis.

As part of its commitment to the local community, each year the company donates 1 % of its total sales or 10 % of its earnings, whichever is greater, to initiatives that support environmental conservation through activities such as recycling, reforestation or other ecological programs. It also supports social causes, such as community development, as well as drug rehabilitation, education, sports and cultural programs, etc.

Source: Based on Manuel Rosas (CEPAL 2018).

4.3.2. The development of strategies and policy frameworks

Although the region has clearly made strides in relation to the concept of bioeconomy, the fact is that today no country in LAC has a strategy for the promotion and development of the bioeconomy. Below is a summary of current initiatives in Argentina, Brazil, Colombia, Costa Rica, Ecuador and Uruguay.

Argentina

The institutional and policy frameworks for the bioeconomy have two antecedents: a) the early development of biotechnology and, particularly, the early adoption and local development of GMOs in the production of grains and oilseeds, the massive use of low carbon agricultural systems and the dynamic production of vegetable oils, biofuels and industrial products derived from the bio-refineries (these sectors are the main drivers); and b) the country's early involvement in the global discussion on the potential of the bioeconomy as a vision for sustainable development, which took place in the context of the ALCUE cooperation projects (Trigo et al. 2019).

In biotechnology, the main policy and institutional milestones include the creation, in 1991, of the National Biosecurity Commission of CONABIA, which facilitated the early exploration of the potential of these technologies for production development; and the high profile given to these in the national science and technology plans, particularly from 2005 onwards. In this sense, the "Argentina Innovadora 2020" Plan defines the priorities for the 2012-2020 period, based on the convergence between sectors of socio-economic importance (e.g. agroindustry, environment and sustainable development,

energy, industry, health and social development) and general-purpose technologies (biotechnology, nanotechnology and ICT).

The development of biofuels is associated with the introduction of incentives for value aggregation, first through the establishment, during the early 1990s, of tariff differentials to encourage these types of activities and subsequently, through the approval of the Regimen for the Regulation and Promotion of Production and Sustainable Use of Biofuels, established in Laws 26.093 and 26.334 of 2006 (Boxes 4.2 and 4.5).

In strategic-institutional terms, since 2013, the National Government, specifically the Ministry of Science, Technology and Innovation (MINCYT) and the Ministry of Agroindustry (MINAGRO, has undertaken a process to position the bioeconomy as a vision for sustainable development and as a basis for a new strategy for the country's insertion in international markets (Bioeconomia Argentina 2017). This process led, in 2o16, to the establishment of mechanisms for the coordination of policies, programs and projects at the level of the central government, with the aim of organizing and enhancing actions toward the development of the national bioeconomy. The process began at the end of that year and currently work is under way on a proposal for a national bioeconomy strategy (Bioeconomia Argentina 2017). In that context, MINAGRO also decided to create, within its own sphere, the National Bioeconomy Program, as a specific mechanism for coordinating its activities.

These public sector efforts have been accompanied by the private sector through specific declarations and actions, including the creation of the Bioeconomy Group, led by the Buenos Aires Grain Exchange, one of the country's oldest financial institutions (Bioeconomia Argentina 2019), as a specific private-sector space, dedicated to promoting investment in areas linked to the bioeconomy (Group Bioeconomy 2019).

Brazil

The process in Brazil has been dominated by developments in the bioenergy sector and by the aggressive institutional framework implemented to accelerate the development and use of ethanol and biodiesel as fuels. This has served to leverage the Brazilian bioeconomy, since its impact has extended beyond this sector and has led to advances in other areas, such as agriculture, genetic engineering and the capital goods industries, etc. (Boxes 4.3 and 4.4). Thus, the National Alcohol Program (Pro-Alcohol) and the National Program for the Production and Use of Biodiesel (PNPB) may be considered as central elements of the institutional framework of Brazil's bioeconomy.

In the agricultural sector, a very important initiative is the ABC Plan, led by the Ministry of Agriculture, which provides low-interest loans to farmers wishing to implement sustainable agricultural practices and climate-resilient technologies. This Plan aims to reduce greenhouse gases, by 2020, by 160 million tons of equivalent CO2 annually (CCAFS 2019). The objectives of the ABC Plan were incorporated and expanded in the Nationally Determined Contribution of Brazil (2015) under the United Nations Framework Convention on Climate Change (UNFCCC), which proposed to strengthen the ABC Plan to achieve, by 2030, the restoration of 15 million hectares of degraded land and increase the area under the zero tillage regime to 33 million hectares (Zanetti et al. 2015).

For its part, the National Biofuels Policy (RenovaBio), which enters into force in 2019 and aims to decarbonize transport, differs from traditional measures in that it does not propose the creation of a carbon tax, subsidies, presumed credit or volumetric requirements for the addition of biofuels to fuels. Instead, the program will operate based on: i) the definition of national targets for the reduction of emissions of the fuel matrix, for a period of ten years, broken down into individual targets for each year for fuel distributors, according to their share of the fossil fuels market; and ii) the certification of biofuel production, assigning different data for each producer, in a value inversely proportional to the carbon intensity of the biofuel produced. Similarly, the policy established the biofuel decarbonization credit (CBIO), which will be a financial asset traded on the stock exchange, issued by the biofuel producer, based on their commercialization. Also under implementation are several somewhat uncoordinated initiatives, which sometimes overlap or are independent, but which together are beginning to shape an institutional framework with its own identity.

The central element of this framework is the Action Plan in Science, Technology and Innovation (PACTI) in Biotechnology, launched in 2018 by the Ministry of Science, Technology, Innovation and Communication (MICTIC). It aims to produce and apply scientific and technological knowledge to promote social, economic and environmental benefits, cover essential knowledge

gaps, foster innovation and create conditions to promote the strategic insertion of Brazil's bioeconomy within the global context. The Plan's thematic lines are defined according to the production rationale of the bioindustries (biomass processing, bio-refineries, bioproducts). It also proposes to create the Brazilian Bioeconomy Observatory and a Central Coordination Board for the Bioeconomy.

In May 2019, the Ministry of Agriculture, Livestock and Supply (MAPA) launched the Program Bioeconomy Brazil-Sociodiversity, aimed at organizing production systems based on the sustainable use of biodiversity products and the selective extraction of forest products. Finally, in June 2019, the Brazilian Parliament launched the Parliamentary Front for the Bioeconomy, made up of 212 deputies and 12 senators, with the aim of creating the conditions to encourage more economic activities using renewable biological resources in the country.

In line with these advances, in 2014 the country's business sector created the Brazilian Association for Bio-innovation (ABBI), with the mission of promoting a favorable economic, social and institutional environment for innovation and the sustainable development of the advanced bioeconomy in Brazil.

Colombia

The introduction of the bioeconomy concept in Colombia, and its corresponding policy and institutional adaptations, dates back to mid-2011, when the country participated in the ALCUE-KBBE project, which served as a platform to introduce, validate and expand this concept with all the stakeholders involved. This led to the development of the first public policy instrument directly linked to the issue, the Policy for the Commercial Development of Biotechnology based on the Sustainable Use of Biodiversity (CONPES document 3697, 2011). This sought to create the necessary economic, technical, institutional and legal environment for the development of businesses and commercial products based on sustainable biodiversity use, and to allocate seed capital to small and medium-sized businesses of this sector. Even though it did not achieve its goal in practical terms, due to the lack of financial resources to make it viable, the institutional context in which it took place was important.

Subsequently, in April 2017, the First National Forum on the Bioeconomy: Sustainable Local Innovation, was held in Bogotá, resulting in the first concrete proposal to consider the bioeconomy as an engine for comprehensive development in Colombia (Henry et al. 2018). In addition, synergies were created with two new public policy instruments that were then under implementation: The Green Growth Policy (CONPES document 3934, July 2018) and the Strategy for the Implementation of the Sustainable Development Goals (SDGs) in Colombia (document CONPES 3918, March 2018).

The Green Growth Policy has two basic objectives: a) to prioritize those sectors considered strategic for the bioeconomy in Colombia; and b) to propose policy guidelines, strategies and recommendations to position these. This process resulted in an Action Plan for the Bioeconomy, that included proposed guidelines and strategies on governance, R&D capabilities, financial resources, markets and regulatory aspects.

The creation of policy instruments and of formal governmental mechanisms that directly and indirectly favor the development of this area continues and has been consolidated in the "National Development Plan 2018-2022: Pact for Colombia, Pact for Equity", which presents the country's shared vision and shared actions on the bioeconomy's role in environmental sustainability, science, technology, innovation and the development of the Colombian Amazon. These policy instruments were strengthened in February 2019 with the creation, by the National Government, of the "Mission of Experts", a group of 34 leading national and international experts, whose objective is to produce, by December 2019, a roadmap and recommendations for prioritizing science and technology, based on criteria of equity, taking into account both the National Development Plan and the achievement of the Sustainable Development Goals (SDGs). One of the Mission's eight focal areas is "Biotechnology, the bioeconomy and environment", with the task of revising previous erroneous concepts, eliminating conceptual limitations and presenting real new horizons in the medium and long term for Colombia in this thematic area (Presidency of the Republic of Colombia, 2019).

The consolidation of these advances has involved the joint recognition by academia and the public and private sectors —including production associations—of the urgent need to reconcile the current production model with criteria of economic, environmental and social sustainability, and the enormous potential offered by the bioeconomy in efforts to achieve that objective (National Bioeconomy Forum, Innovation Territorial Sustainable, April 27, 2017), and the political endorsement

given to this issue through its inclusion in both in the National Development Plan 2018-2022 and in one of the thematic areas of "Mission of Experts."

Costa Rica

Conscious of its biological potential and of its considerable scientific and technological capabilities in this field, Costa Rica — through its Ministry of Science, Technology and Telecommunications (MICITT)— has drafted a national bioeconomy strategy that is based on a solid institutional and legal framework, and is in line with international regulations in this area.

Since the mid-1990s, Costa Rica has developed major public policy initiatives for the development of the bioeconomy (Aramendis et al. 2018). In the agricultural sphere, the main policies are the Nationally Appropriate Mitigation Actions (NAMA) in the coffee and livestock sectors, and a NAMA for the energy-biomass sector, as part of the VII National Energy Plan 2015- 2030, whose objective is to encourage the utilization of organic agricultural residues from the agricultural and agroindustrial sectors for the creation of clean energies.

In the area of R&D, the country has more than 30 research centers in biological sciences, sustainability and other areas of interest for the development of the bioeconomy in its public universities —the Instituto Tecnológico de Costa Rica (ITCR), the University of Costa Rica (UCR) and the National University (UNA)—, as well as in the National Nanotechnology Laboratory (2004) and the National Center for Biotechnology Innovation (2007), which form part of the public universities' institutional framework and are incorporated into the National Center for High Technology (CENTA).

MICITT is leading the process of drafting the National Bioeconomy Strategy and to this end it has established the Inter-ministerial Bioeconomy Committee, comprised of representatives of the Ministry of Agriculture and Livestock (MAG), the Ministry of the Economy, Industry and Trade (MEIC) and the Ministry of Environment and Energy (MINAE). The background to the preparation of the strategy is as follows: a) the country's process of adhesion to the OCDE, as a framework for articulating public policies and institutional efforts; b) the development of the National Decarbonization Plan, as an initiative to spearhead the full use of biomass and productive processes of the circular economy; c) Agenda 2030 for Sustainable Development; d) structural changes to move toward a knowledge-based bioeconomy and to make use of biodiversity resources; and e) public-private articulation, a process that has begun to occur in bioeconomy-related fields based on the creation of the Biological Sciences Cluster CR-Biomed.

Ecuador

EIn Ecuador, the development of the bioeconomy is approached as a mechanism for the sustainable use of biodiversity and as a strategy for resilience to climate change. The country is currently in the process of consolidating its regulatory, institutional and political framework, in order to establish the necessary conditions to develop a public policy for the bioeconomy. The aim is to create synergies between the different public, private, academic and social stakeholders.

Ecuador's legal framework, based on its Constitution (2008), outlines a scenario that favors the formulation and implementation of an institutional framework, together with the relevant public policies, associated with the bioeconomy. It also creates the conditions to enable the country to meet its commitments under various international agreements and to take advantage of its immense biodiversity in a context of sustainability, equity and equitable distribution. The Ministry of the Environment (MAE), as the institution responsible for native biodiversity management, has taken the initiative in leading efforts to develop the country's bioeconomy, for which purpose, and in the context of the Organic Code on the Environment, it established guidelines for bio-enterprises focused on the sustainable use of native biodiversity, through Ministerial Agreement 034.

Against this background, and in coordination with international cooperation, academia and the private and public sectors, certain strategic actions have been implemented in relation to the bioeconomy, including: a) the internal institutional reorganization of MAE and establishment of a multidisciplinary team to carry out the required work and create the conditions for the development of the bioeconomy; b) formation of a group of central government institutions, led by the MAE, to coordinate public policy on the bioeconomy and its links to sustainable biodiversity use; c) inclusion of the private sector as a key player in efforts to promote a dynamic bioeconomy; d) convergence of approaches, resources and experiences from

international cooperation; and e) progressive participation of academia as an essential stakeholder that promotes research and the incubation of businesses, as well as producer groups of the popular and sharing economy, which utilize and safeguard the country's native biodiversity. Together, these five strategic stakeholders constitute the initial nodes for the establishment of a bioeconomy network in Ecuador that will develop the public policy.

Finally, the Center for the Promotion and Facilitation of Bio-business (BioEmprende), was created as a platform for the coordination of stakeholders of the public, private and academic sectors, to enhance the environmental, technical and financial sustainability of bio-enterprises. This platform will serve to consolidate production experiences in the bioeconomy at local level, in the medium and long term, which can also be used as input for the development of a public policy on the bioeconomy.

Uruguay

A multisectoral process is currently under way to design the Sustainable Bioeconomy Strategy (EBS), as part of the "Uruguay 2050" National Development Strategy, under the responsibility of the Office of Planning and Budget (OPP), which is under the direct authority of the Office of the President.

The National Development Strategy has three main pillars: social development, the transformation of gender systems and the modernization of production. The bioeconomy, along with the digital economy, constitute the innovative core that is transforming production, through which the other more established production systems are interrelated, enhanced and modernized. The design of the Sustainable Bioeconomy Strategy (EBS) is based on several complementary public policies that are already being implemented, including: a) the Uruguay Agro-inteligente Platform for Production and Technological Innovation, implemented since 2010 by the Ministry of Agriculture, Livestock and Fisheries (MGAP); b) the energy policy implemented by the Ministry of Industry, Energy and Mining (MIEM), which has radically transformed energy sources used for electricity in favor of renewable energies; and c) other sectoral initiatives implemented by the National Agricultural Research Institute (INIA), the Uruguayan Antarctic Institute (IAU), Alcoholes del Uruguay (ALUR), a company of the ANCAP group (fuels) and the Institute for the Regulation and Control of Cannabis (IRCCA), etc. (Pittaluga 2008).

A second group of sectoral policies based on the EBS stems from the establishment of the Sectoral Councils (SCs) by the Production Cabinet, in 2010. These councils are made up of business and workers' representatives, as well as representatives of academia and technological institutes and the State, and their task is to formulate sectoral plans for the period up to 2020. In this context, 18 SCs are operating, all of which have achieved different goals in terms of stakeholder participation and the implementation of their plans. The Biotechnology SC is considered one of the most successful, since much of its plan has already been executed and it has also provided the basis for the Transforma Uruguay projects and for those of the National Innovation and Research Agency (ANII). The consolidation of the biotechnology sector is particularly important for the development of the bioeconomy (Pittaluga 2008).

The process of formulating the EBS has been led by the MGAP, which in turn has established an interinstitutional leadership group comprised of the OPP, Transforma Uruguay, MGAP, MIEM, the Ministry of Housing, Land Use and Environment (MVOT-MA) and the Ministry of Economy and Finance (MEF), given the cross-cutting and systemic nature of the bioeconomy. Since 2016, the German Ministry of Agriculture (BMEL) has provided advisory services for the implementation of this process; and, in 2017 Uruguay began to participate in the International Sustainable Bioeconomy Working Group (ISBWG), financed by the German government and coordinated by the FAO. The ISBWG includes 30 members: 14 countries (Germany, via the German Bioeconomy Council, Argentina, Brazil, Canada, China, Finland, France, Italy, Malaysia, Namibia, the Netherlands, South Africa, Uruguay and the United States); 2 regional government bodies and affiliated institutions (European Commission, with BBIJU, and the Nordic Council of Ministers); 2 NGOs (WWF and TSC); 3 private sector entities (BIC, WBCSD and DSM); 5 research institutions (FARA, SEI, CIAT, EMBRAPA and CREA); and 4 intergovernmental organizations (OECD, ECLAC, UNEP and FAO).

Finally, a third set of policies based on the EBS are the policies and plans to promote sustainable development (National Environmental Plan for Sustainable Development; National Climate Change Policy; National Water Plan; and the National Strategy for the Conservation and Sustainable Use of Biological Diversity), under the leadership of the MVOTMA and the National Climate Change Response System (SNRCC). All these conditions are necessary for the development of the bioeconomy in LAC.

4.4. Strategic topics for the development of the bioeconomy in LAC

The great majority of countries in the region have already prepared numerous public policies and institutions related to the development of the bioeconomy, in areas such as science, technology and innovation, climate change, sustainable agriculture, livestock and aquaculture, silviculture and biodiversity, biotechnology, bioenergy and use of residual biomass (Rodríguez et al. 2017, Rodríguez 2019). Therefore, the design of bioeconomy strategies should focus on the identification, coordination and alignment of those initiatives, and on the subsequent implementation of dialogue processes with the public and private sectors, academia and other relevant stakeholders, to develop any policies and strategies that are lacking, including the following:

1. **Creation of a framework of enabling policies,** especially in the areas of policy and regulations; science, technology and innovation; business promotion and valuation of biological resources; and, incentives to overcome barriers, generate demand and create conditions for access to and development of markets.

2. **Identify and resolve regulatory barriers** that hinder or limit the development of the region's bioeconomy, particularly the following:

   a) the complexity of national regulatory processes (for example, access to genetic resources);

   b) the absence of appropriate regulatory frameworks for advances in the biological sciences and technologies (for example, genetic editing -see Section 3.2.2);

   c) lack of capacity to comply with regulations in the destination markets for bioeconomy products, or ignorance of such requirements;

   d) incompatibility between regulations for conventional products and similar bioproducts;

   e) lack of harmonization of criteria for the classification of new products associated with the bioeconomy; and

   f) difficulties in the enforcement of existing regulations.

3. **Promote development of and access to markets** ((see Section 3.2.6) for products and services provided by the bioeconomy, both national and international, which may be grouped as follows:

   a) products that replace similar ones of fossil origin for which there are no well-developed markets, or whose access may be limited, either due to the difficulties of competing with mature fossil-based industries (for example, energy, plastics, agricultural inputs) or consumers' ignorance of the benefits of alternative bio-products; and

   b) new products and procedures that often encounter common market barriers associated with the lack of technical and scientific studies of various types, with logistical aspects and with matters related to certification, licenses, labelling and seals, and their associated costs, and the need to convince consumers that the products in question are innocuous and safe (Aramendis et al. 2018).

To overcome these barriers, it is necessary to make progress in:

   a) creating appropriate conditions so that consumers can make informed choices, e.g. in relation to pricing systems and standards to facilitate comparison of products;

   b) compensatory/promotional policies that balance the bioeconomy's competitiveness with that of "mature" markets based on fossil resources; and

   c) the use of public procurement mechanisms for bioeconomy products.

4. **Intensify investment in science and technology** to promote research, development and innovation processes. Biology-based processes require a new technological base, which in turn demands the reorganization of scientific research and development capabilities. Changes are also needed in production

levels and management, since development strategies based on biological resources are, in general, far more knowledge- intensive than those based on natural fossil resources.

Different types of knowledge are strategic instigators of these processes, but it is not only a matter of promoting biotechnology and engineering, but also of taking advantage of conventional approaches, particularly with regard to exploiting the full potential of the available biomass and the possibilities offered by the use of microorganisms in microbiological and biotechnological processes.

5. **Promote or develop economic and financial incentives,** with their own specificities, areas of focus and rules of access to enhance bioeconomy enterprises, including public funds in national development agencies, private national and regional funds, mixed public-private funds and international, regional and global cooperation funds (Aramendis et al. 2018)). It is essential to create a business environment that promotes and protects investment directed at new businesses and value chains, including risk capital, clear rules on intellectual property and the promotion of innovative initiatives (financial support, incubators, etc.).

6. **Develop legislation and capacity in intellectual property, together with a culture of knowledge protection.** For this it is crucial to improve communications and the integration between science and industry and acquire specialized knowledge for the management of different modalities for the protection of intellectual property and associated business models. Some important conditions include the following:

   a) guarantees for the protection of intellectual property in the national legislation, at the highest level possible, ideally in the national constitutions;

   b) establishment of modern mechanisms of protection that comply with international standards;

   c) a broad menu of protection mechanisms, including copyright, registered brands, industrial designs, utility models, patents and geographical indications;

   d) legal and political security; and

   e) harmonization of national intellectual property rights with provisions of the WTO Agreement on Aspects of Trade-related Intellectual Property Rights (TRIPS).

7. **Develop bio-entrepreneurship,** in startup businesses and SMEs, which are often pioneers and promoters of innovation in the bioeconomy. Therefore, it is important to improve their integration with global value chains and with the bioeconomy and help create a more level playing field, paying special attention to the needs of young innovators and those engaged in areas requiring the intensive application of advanced knowledge. To promote innovation and develop bio-entrepreneurship the following actions are considered important:

   a) develop innovative instruments to facilitate interaction between the new bio-economic enterprises (startups) and universities or research centers, and especially to promote bio- entrepreneurship among the youth;

   b) design financial and non-financial instruments (see Section 3.3.2) to help new bio-enterprises to access the bioeconomy markets and improve their capacity to respond and adapt to the speed of technological change;

   c) promote public-private and regional-multilateral cooperation to strengthen the national infrastructure needed to comply with requirements in the countries that import bioproducts, either in terms of physical infrastructure (for example, laboratories) or of quality assurance certificates; and

   d) foster a culture of enterprise that values freedom, creativity and innovation and that does not punish failure.

8. **Develop collaborative governance** in strategies for the bioeconomy, for which the following actions are essential (also see Section 3.3):

   a) establish some type of political agreement, either between public or private institutions, involving other

sectors of society, with the aim of building consensus on the notion that such agreement is a State decision, and not the policy of a specific government;

b) define a permanent coordination mechanism for the formulation and management of the bioeconomy strategy; establish an advisory group with national or international experts; create working and consensus-building groups (with academia, government and business), focusing on the identification of bottlenecks and the search for solutions; and

c) create spaces for information and dialogue with civil society to raise awareness and educate people about the potential of the bioeconomy.

9. **Create incentives for public-private cooperation,** so that the private business sector will appropriate the objectives implicit in the bioeconomy and redirect its investments accordingly. Many of these new areas of knowledge, technologies and products are still within the academic world, and require development processes, which increase the risk in new activities and enterprises. This point should be recognized in financing or co-investment schemes. It is also necessary to systematize information on financing mechanisms for innovation and make this information available to interested and potential bio-innovators.

   Public-private and private-private cooperation is essential to assure consumers that bioproducts are safe and sustainable, and to create demand and markets for these. It is also important to use existing bodies, such as the chambers of commerce and industry, associations and technology transfer offices, to promote the creation of cooperation networks, share best business practices and, in general, educate and inform their communities about the opportunities offered by the bioeconomy, as well as potential risks.

10. **Implement communication, dialogue and awareness-raising strategies** about the economic, social and environmental potential and benefits of the bioeconomy. These communication mechanisms should be based on sound knowledge of the many benefits and possible risks of the bioeconomy and should involve all relevant levels:

    a) public policymakers, communities and parties interested in sustainable development issues, because of the response that a sustainable bioeconomy can provide to the aspirations and needs of society, given its links with many of the SDGs;

    b) the business community, because of the economic opportunities and benefits derived from the development of new products, production processes, businesses and value chains, on the one hand, to satisfy growing demand for more environment-friendly products and forms of production and, on the other, to create new jobs of quality and new markets; and

    c) citizens, to generate confidence in the safety of consuming bioeconomy products and awareness of the benefits of obtaining products with a lower carbon footprint.

11. **Monitor the progress and assess the impact of policies and strategies** that support the development of the bioeconomy, especially because its multidisciplinary and intersectoral nature implies a highly complex implementation process and effective public policies. Moreover, it is indispensable to appraise the economic value and importance of the bioeconomy, for which there is no universally accepted methodological framework. This challenge is even greater because the bioeconomy generates new products, processes, sectors and value chains, for which the current statistical systems have not yet developed classification systems (for example, tariff headings for the classification of exports). Moreover, there is no monitoring framework to cover the three areas of sustainability, i.e. economic indicators as well as environmental and social indicators.

12. **Promote international cooperation,** as an important and essential tool, not only because of its contributions to addressing the global challenges of the coming years, but also because of the opportunities and challenges shared by many countries of the region. In addition, resolving obstacles and developing the required technological base includes major public goods components, offering significant benefits derived from joint work and mutual learning.

    Indeed, a major reason that the region has adopted the bioeconomy concept as an option for a more sustainable

and equitable development, responds in great measure to the implementation, from 2012 onwards, of a series of cooperation projects in the context of the Framework Program 7 (FP7) and Horizonte 2020 (H2020) of the European Commission, with the participation of European and LAC countries, in which opportunities and options for the development of the region's bioeconomy were analyzed and discussed (Hodson 2015, Hodson of Jaramillo et al. 2019).

The importance of international cooperation in the development of the region's bioeconomy was also discussed recently at the First Latin American Symposium on the Bioeconomy, "Rethinking Development: New Opportunities for Latin America and the Caribbean" (Bioeconomia Argentina 2017), in which the participants agreed to create a Latin American Bioeconomy network. The aim is to exchange experiences and work together on the development of a vision for the Latin American bioeconomy, educate and train human resources, develop and transfer strategic technologies and methodologies to measure, monitor and assess the progress achieved by the sectors involved, and support the design of policies and standards for the sector.

Chapter 5.

Annexes

5.1. Employment and poverty indexes in LAC (see Chapter 2)

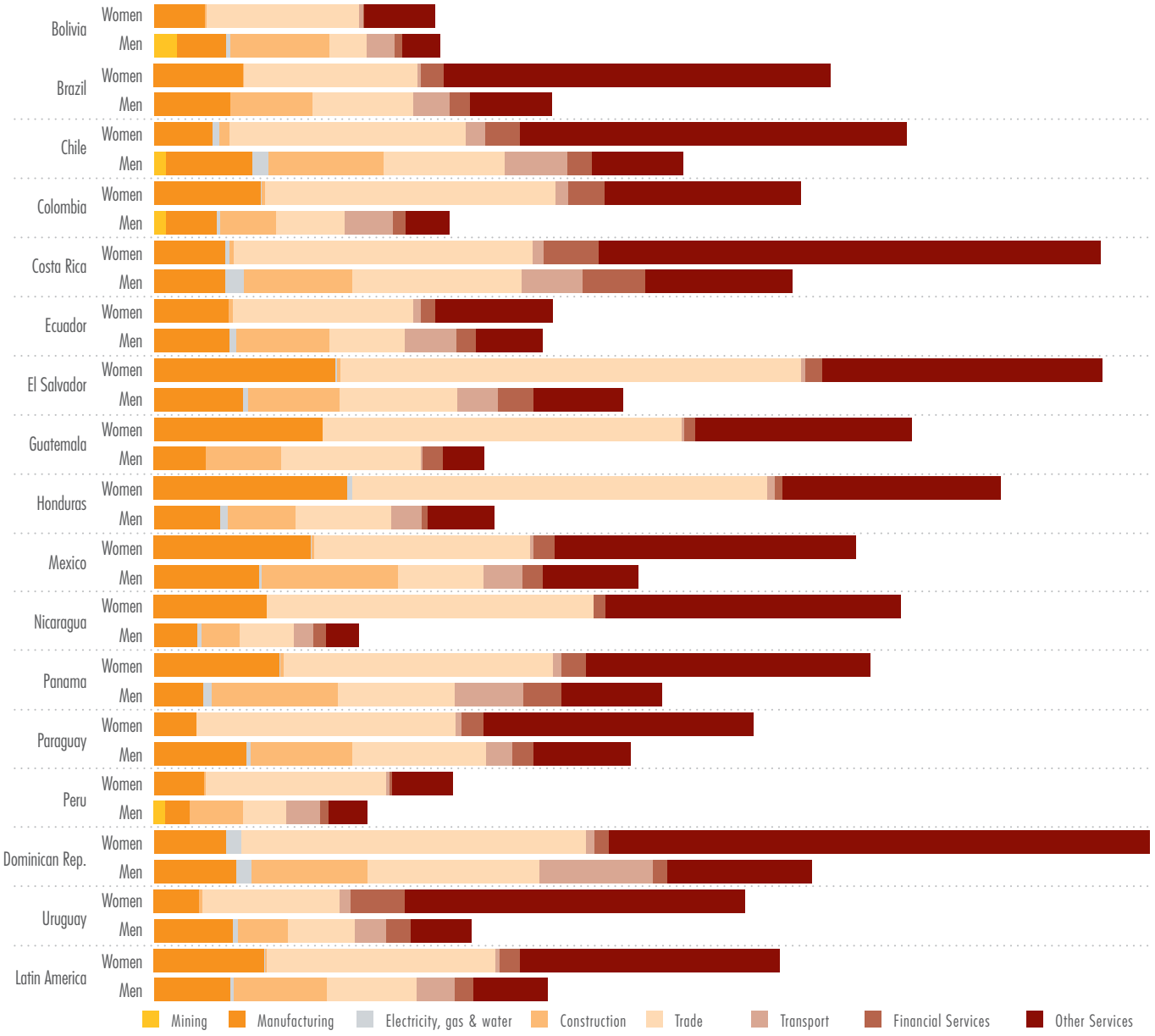
Table 5.1: Rural area employment, by sector (%).

Country	2000			2017		
	Agriculture	Industry	Services	Agriculture	Industry	Services
Bolivia	85.9	5.7	8.3	72.7	12.2	15
Brazil	75.6	7.9	16.5	53.7	13.7	32.5
Chile	63.8	12.1	24.1	42.3	17.5	39.5
Colombia	60.3	11.3	28.3	61.5	12.1	26.4
Costa Rica	37.9	19.4	42	30.5	15.9	53.5
Ecuador	67	13	19.9	62.6	13.7	23.8
El Salvador	46.9	19.2	33.9	41.2	18.3	40.5
Guatemala	56.4	17.3	26.3	57.5	14	28.6
Honduras	57.5	15.5	27.1	52.5	15.9	31.6
Mexico	57.1	19.1	23.8	45.9	20.9	33.2
Nicaragua	64.4	11.1	24.4	67	9.7	23.3
Panama	43.1	14.4	42.5	45	16.4	38.6
Paraguay	66.5	11.7	21.8	50.7	14.3	35
Peru	74.7	8	17.4	75.6	7.7	16.6
Dominican Republic	37.4	16.8	45.8	28.3	17.2	54.5
Uruguay	70.1	10.3	19.7	60.4	10.6	29
Latin America (weighted average)	**66.1**	**12.2**	**21.7**	**54.6**	**15.2**	**30.2**
Latin America (simple average)	**60.5**	**13.3**	**26.2**	**53**	**14.4**	**32.6**

Source: Prepared by author, based on CEPALSTAT data.

5.2. Urban-rural socioeconomic indicators (see Section 3.1)

Figure 5.1: Latin America, 2017, 16 countries:
Structure of the rural population employed in non-agricultural activities, by sex



Source: Prepared by the author, using CEPALSTAT data, 8 August 2019.
Note: The information used for Guatemala and Nicaragua was from 2014. The information used for Mexico and Honduras was from 2016. A weighted average was used for Latin America. Figures below 1 percent were removed from the graph for easier visualization.

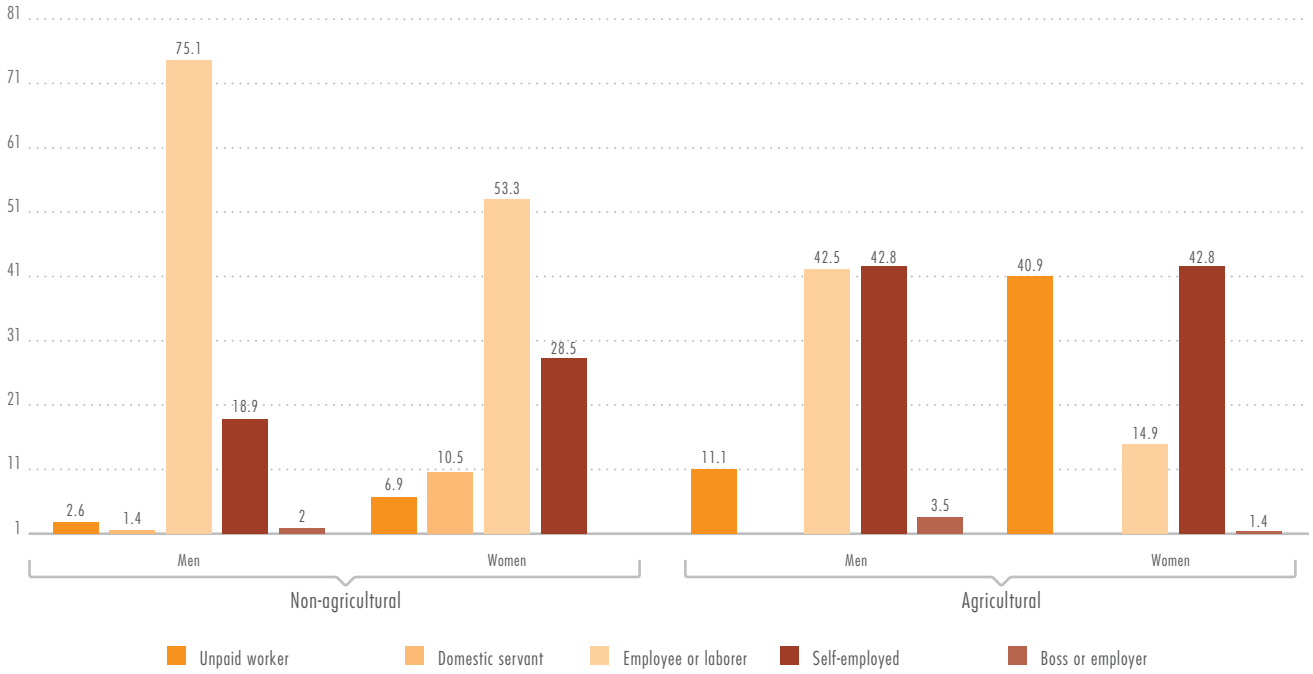
Table 5.2: Poverty and extreme poverty rates in LAC (%)

Extreme Poverty						
	Urban			Rural		
Country	2000	2014	2017	2000	2017	2017
Argentina	11.2	3.3	2.8			
Bolivia	15.4	5.6	6.5	65	34.9	38.6
Brazil	5.6	2.6	4.3	16.5	7.7	12.9
Chile	4.9	1.7	1.4	10.2	2.5	1.8
Colombia	17.1	7.5	7.4	42.7	26.7	22.9
Costa Rica	2.9	2.7	2.7	7.9	7.8	4.9
Ecuador	14.3	3.4	3	30.8	9.7	13
El Salvador	8	5.5	4.1	30.8	21.9	14.7
Guatemala	3.8	7.2	7.2	25	23.4	23.4
Honduras	11.7	12.2	11.4	40.8	27	27.5
Mexico	6.1	8.9	7.6	36.6	26.3	25
Nicaragua	25.2	8.3	8.3	50.6	32.3	32.3
Panama	5.7	1.9	1.9	25	24.2	20.4
Paraguay	3.5	2.7	2.2	24.4	15.3	12.1
Peru		1.9	1.7	35.7	15.5	16.6
Dominican Republic	5.7	7.9	7.3	15.8	16	13
Uruguay	1.2	0.2	0.1		0.4	0.1
Latin America	**7.3**	**5.1**	**7.8**	**25.1**	**18.6**	**20.4**

Poverty						
	Urban			Rural		
Country	2000	2014	2017	2000	2017	2017
Argentina	50	24.9	18.7			
Bolivia	55.7	24.5	25.4	85.2	53.9	57.1
Brazil	35.1	14.7	18	55.5	26.8	31.6
Chile	38.7	13.9	10.9	12.7	9.4	
Colombia	49	26	25.9	67.6	48	43.1
Costa Rica	20.1	13.6	13	38	27.9	20.8
Ecuador	48	19.9	18	63.7	29.2	33
El Salvador	35	33.9	28.3	68.9	62.1	52.2
Guatemala	29.8	34.9	34.9	68.5	65.8	65.8
Honduras	40.2	45.2	44	72.4	66.8	64
Mexico	39.8	40.1	38.9	75.3	61.8	59.6
Nicaragua	57	36.5	36.5	76.4	59.8	59.8
Panama	20	9.7	8.3	45.7	40	35.5
Paraguay	21.8	14.3	13.8	56.2	34.5	34
Peru		12.8	12.4		40.4	41.4
Dominican Republic	25	30.6	25.5	44.7	41.3	34.9
Uruguay	10.9	4.5	2.7		3.8	1.6
Latin America	**39.6**	**23.6**	**26.3**	**62.5**	**45.1**	**46.4**

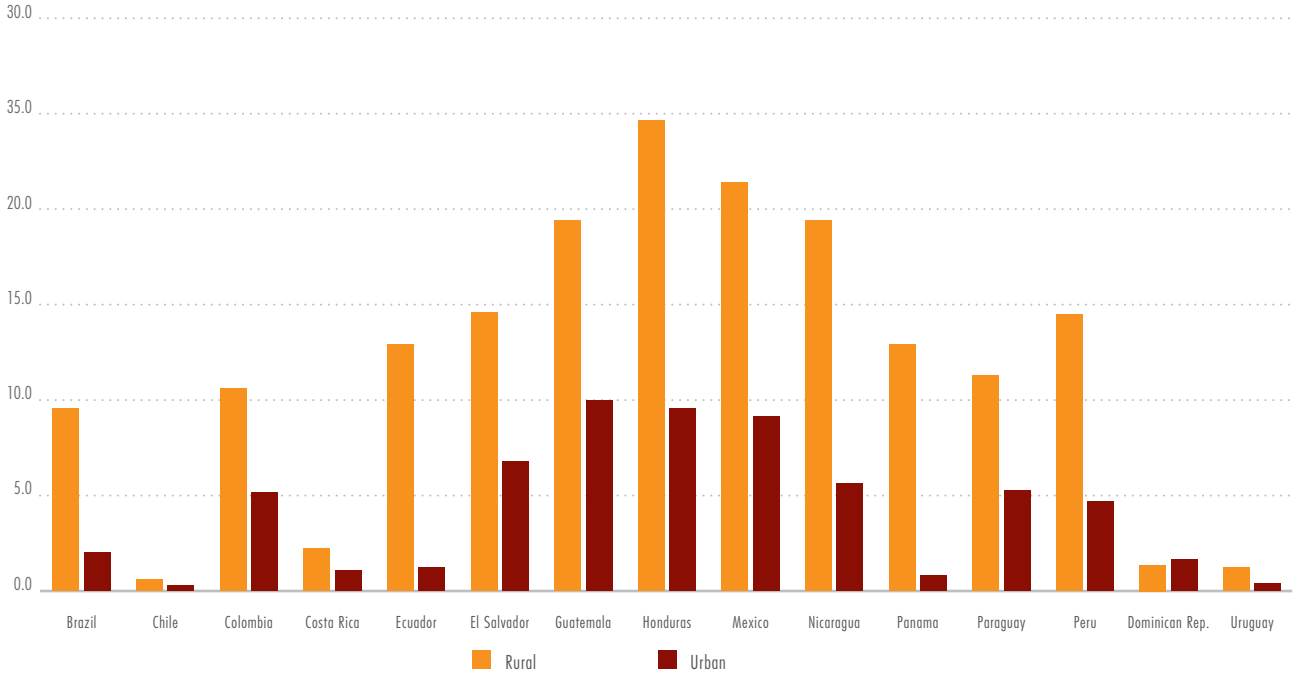
Source: Prepared by author, based on CEPALSTAT data.

Figure 5.2: Latin America, 2010, 12 countries: Labor activity of the employed rural population, by sector, occupational category and sex



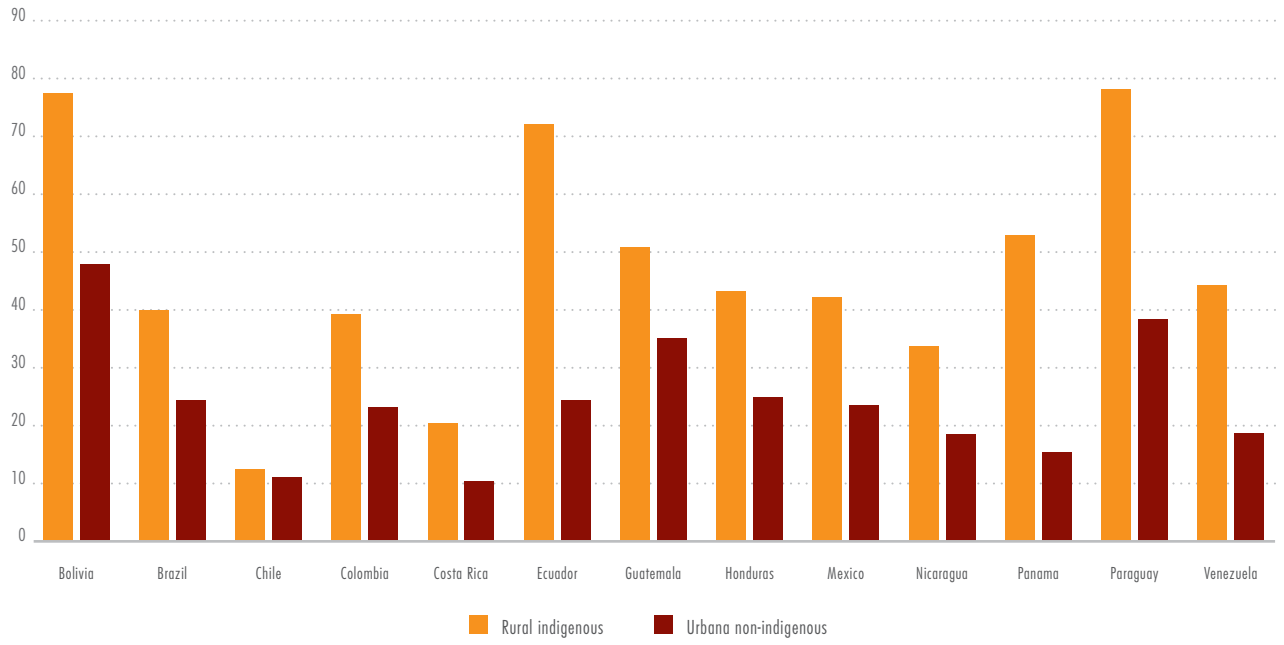
Source: Using special tabulations from the FAO/ RLC Office, based on Household Surveys in the respective countries in 2010, with the exception of Brazil and Chile, which were surveyed in 2009.

Figure 5.3: Child labor, percentage of children 10 - 14 years of age, 2015



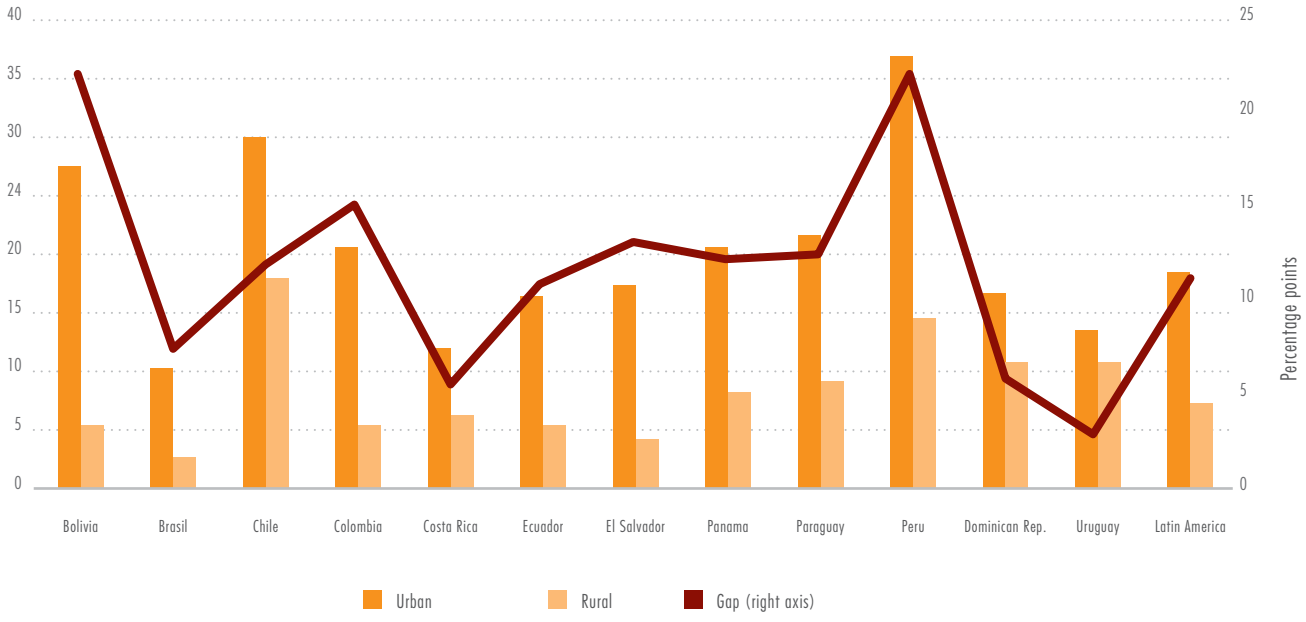
Source: Prepared using data from the Center of Distributive Labor and Social Studies of the National University of La Plata, sponsored by the World Bank. 16 July 2019.

Figure 5.4: Infant mortality rate (every 1000 births), 2000-2005



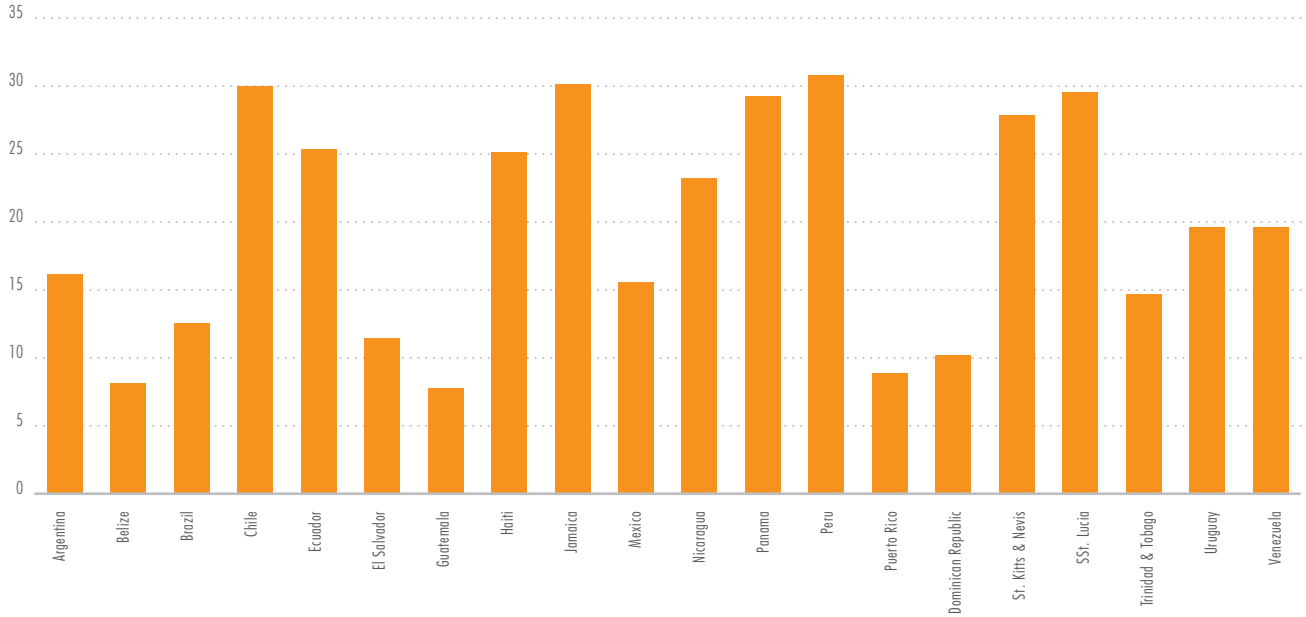
Source: Prepared using data from Jimenez et al. 2007. La reducción de la mortalidad infantil en América Latina y el Caribe: Avance dispar que requiere respuestas variadas. Desafíos 6:4-9, December. CEPAL.

Figure 5.5: Percentage of the population 15 - 24 years of age with 13 or more years of schooling, 2017



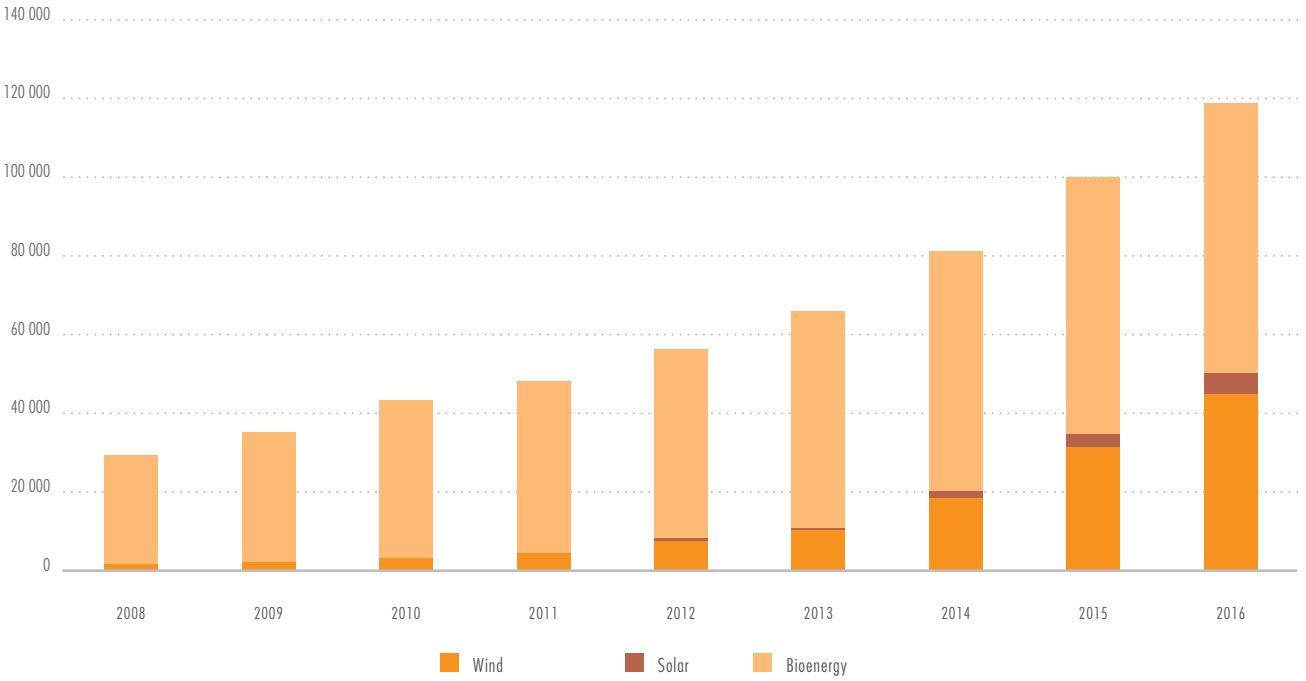
Source: Prepared by the author, using CEPALSTAT data, 16 July 2019.

Figure 5.6: Percentage of rural women that are owners of agricultural land, 1998-2012



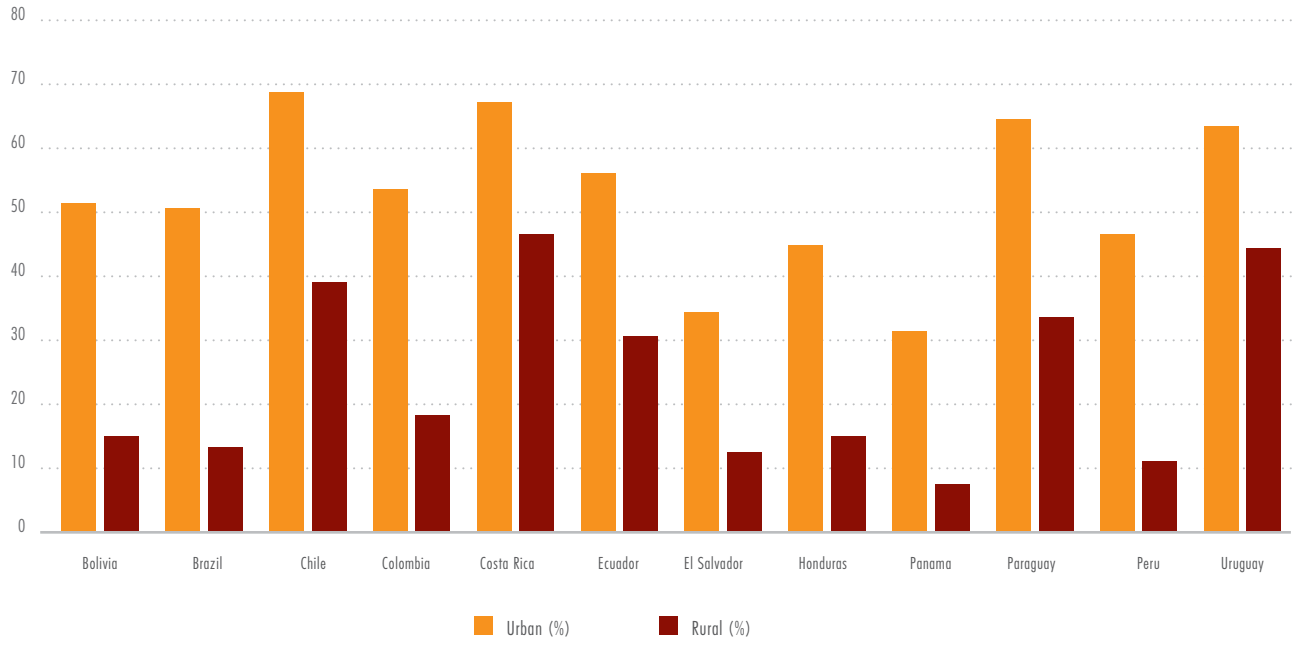
Source: Based on FAO data. 2007. Atlas de las mujeres rurales de América Latina y el Caribe: Al tiempo de la vida y los hechos.

Figure 5.7: Non-conventional renewable energy production in Latin America and the Caribbean (GWh), 2008-2016



Source: Prepared using data from IRENA, 2018. Renewable Energy Statistics.

Figure 5.8: Percentage internet use, 2015



Source: Prepared using data from Saravia-Matus and Aguirre, 2019.

5.3. Agroecological technologies applied to primary production (see section 3.2.1)

1. COLLABORATIVE WORK: Agroecology relies on collective processes. Peer to peer learning, horizontal extension (producer / producer), associative projects.

2. TRADITIONAL KNOWLEDGE: Taking advantage of the valuable cognitive experience of farmers, which must be mobilized and combined with new knowledge.

3. SHORT CIRCUITS: The sale of products at local fairs and other short circuits allows families to generate income, some of which can be reinvested to make new investments. These short circuits also generate new social bonds and transform food systems (see section 3.2.7 on p.62).

4. ASSOCIATED CROPS: Crop rotation favors the increase of carbon and nitrogen in the soil, as well as weed control and erosion control.

5. CLIMATE ADAPTATION: The incorporation of organic matter contributes to the storage of greenhouse gases in the soil, improving its ability to retain water.

6. SOIL BIODIVERSITY: Living soil organisms improve soil structure and water retention, facilitate rooting and erosion control. They also play an active role in decomposition, organic matter and in the generation of nutrients.

7. BIODIVERSITY: The protection of wildlife and natural vegetation plays a critical role in maintaining environmental balances.

8. NITROGEN FIXING: This element plays a central role in plant nutrition and can be produced by certain types of plants (especially legumes), from the fixation of nitrogen gas.

9.AGRICULTURE / LIVESTOCK INTEGRATION: The use of waste from one or another subsystem generates synergies and increases the value of a resource that is often not used.

10. ENERGY: Use of biomass as an energy source, including waste, firewood, methane. Other energy sources are also important (hydro, solar, wind, among others).

11. BIOLOGICAL CONTROL: Use of insects and other living organisms to control pests and diseases, as a means of creating a natural balance, rather than resorting to eradication.

12. AGROFORESTERY: The promotion of tree planting in livestock and crop systems fosters biodiversity, erosion control, firewood generation and wind control, among other benefits.

13. POLLINATION: Pollinating insects, especially bees, play a key role in the reproduction of plant species.

14. WATER MANAGEMENT: Agroecology makes rational and optimal use of this resource, in keeping with an integrated vision of ecosystems. It promotes water storage in the soil through practices that limit runoff, erosion and evapotranspiration.

15. TRADITIONAL SEEDS, QUALITY SEEDS: the valuing of traditional seeds and the creation of new varieties enriches biodiversity and shapes natural ecosystems. The use of healthy seeds reduces the use of phytosanitary products.

Source: FAO 2018c.

5.4. Public purchases (see section 3.2.7)

Table 5.3. Public procurement programs for FF

	Type of Initiative		
Country	FF purchasing experiences	Enactment of Laws/ Decrees for FF purchases	Establishment of a specific institutional framework for FF purchases
Central America	P4P project (WFP) "Glass of Milk" pilot; "Cooperación Brasil" pilot	Public procurement law, in general	Inter-institutional committee for operation of pilot programs
Brazil	30 % of the food supplied through the PNAE program must be from small farmers	Law No. 10,696 of 2003 (PAA); Federal Law 11,974 / 09 (30 % of the PNAE food supplied)	Food Acquisition Program (PPA)
Uruguay	IFAD pilot	Law No. 18,362 of 2008 established the "Public Procurement Program for Development"; Law No. 19,292 declared that family agricultural production and artisanal fishing were matters of public interest.	
Colombia	At the municipal level: the Antioquia Food and Nutrition Improvement Plan (MANA) of the Government of Antioquia	Decree 2474/08 (Objective selection of food suppliers.)	
Paraguay	No direct public purchases from FF are made for the *Glass of Milk* and *School Lunch* pilot programs, neither in the capital city or in inland areas.	Decree No. 1,056 / 13; Decree No. 11,464 / 07 (National Registry of Family Farming); Decree No. 3,000 / 15 (Simplified process for the acquisition of agricultural products from family farms; Law No. 5,210 / 14 (School Feeding and Health Control programs).	Inter-institutional technical committee
Peru	National Cuna Más Program of the Ministry of Development and Social Inclusion PNAE Qali Warma, local purchases.	State Procurement Law. There is no clear policy to support local purchases.	
Bolivia	At the national level: by the Ministry of Health, for the breastfeeding subsidy. At the municipal level: for school lunches.	Decree No. 27328/03 Compro Boliviano (Buy Bolivian); Law No. 144/11 of the Agricultural Community Production Revolution	Food Production Support Company (EMAPA)
Ecuador	Direct purchases from small farmers through inclusive fairs.	Organic Law of the National Public Procurement System, LOSNCP; Executive Decree No. 1112; Constitution of the Republic 2008 (Articles 12, 288 and 336) and the Organic Law of the Food Sovereignty Regime (Article 30).	Food Provision Program (PPA)

Source: Based on FAOSTAT data.

5.5. The dynamics of LAC's trade in products (see Section 3.2.5)

Table 5.4. The 32 crops and livestock products whose export growth outpaced soy (1991-2016, annual growth rates)

Product	Compound annual growth rate (%, 1991-2016)	Trade value (2016, US$ million)	Largest trade partner (2016)	(% of LAC excl. largest partner)	Largest exporter (LAC, 2016)	(% of LAC excl. largest exporter)
1 Meat, pork (prep.)	61.7	1981	Russian Federation	25	Brazil	65
2 Cranberries	41.6	677	USA	60	Chile	100
3 Potatoes, frozen	36.1	183	Brazil	81	Argentina	97
4 Meat, dried N.E.S.	36.1	417	Netherlands	55	Brazil	96
5 Meat, chicken, canned	24.5	642	Netherlands	37	Brazil	91
6 Cherries	20.9	820	China	82	Chile	98
7 Palm Oil	20.5	1282	Netherlands	32	Honduras	29
8 Avocados	19.7	2936	USA	59	Mexico	72
9 Baby food	19.1	484	Brazil	17	Mexico	50
10 Oil, palm kernel	18.7	216	Netherlands	46	Colombia	43
11 Fat N.E.S., prepared	17.9	203	Brazil	29	Uruguay	41
12 Pet food	17.7	294	Chile	27	Argentina	39
13 Nuts, shelled	17.3	490	USA	69	Mexico	69
14 Barley	15.9	613	Saudi Arabia	43	Argentina	98
15 Flour, maize	15.9	194	USA	42	Mexico	43
16 Lettuce and chicory	15.8	164	USA	98	Mexico	99
17 Meat, pork, sausages	14.7	166	Angola	16	Brazil	71
18 Cow's milk, whole (dried)	14.6	833	Brazil	42	Uruguay	39
19 Food waste	14.2	510	Chile	13	Brazil	37
20 Brazil nuts, shelled	14.2	205	USA	57	Peru	89
21 Cauliflower and broccoli	14.0	232	USA	97	Mexico	100
22 Wine	13.6	2688	USA	20	Chile	69
23 Pastry	13.5	1731	USA	66	Mexico	67
24 Papayas	13.2	176	USA	67	Mexico	63
25 Maize	12.9	8874	Viet Nam	14	Argentina	47

26 Feed, vegetable products N.E.S.	12.5	333	UK	16	Argentina	99
27 Lemons and limes	12.4	991	USA	48	Mexico	46
28 Nuts in the shell	12.4	353	USA	54	Mexico	72
29 Asparagus	12.4	808	USA	81	Peru	52
30 Juice, orange	12.2	850	USA	45	Brazil	57
31 Breakfast cereals	12.2	515	USA	36	Mexico	52
32 Meat, turkey	12.0	326	USA	19	Brazil	54
33 Soybeans	11.8	25284	China	69	Brazil	77

Source: Based on FAOSTAT data.

Note: Ordered by decreasing export value CAGR (1991-2016). Products with a current export value of less than US$ 150 million are not included.

5.6. Social and production inclusion (see section 3.2.4)

Figure 5.9. Linkages between social welfare, household consumption, production activities and the local economy

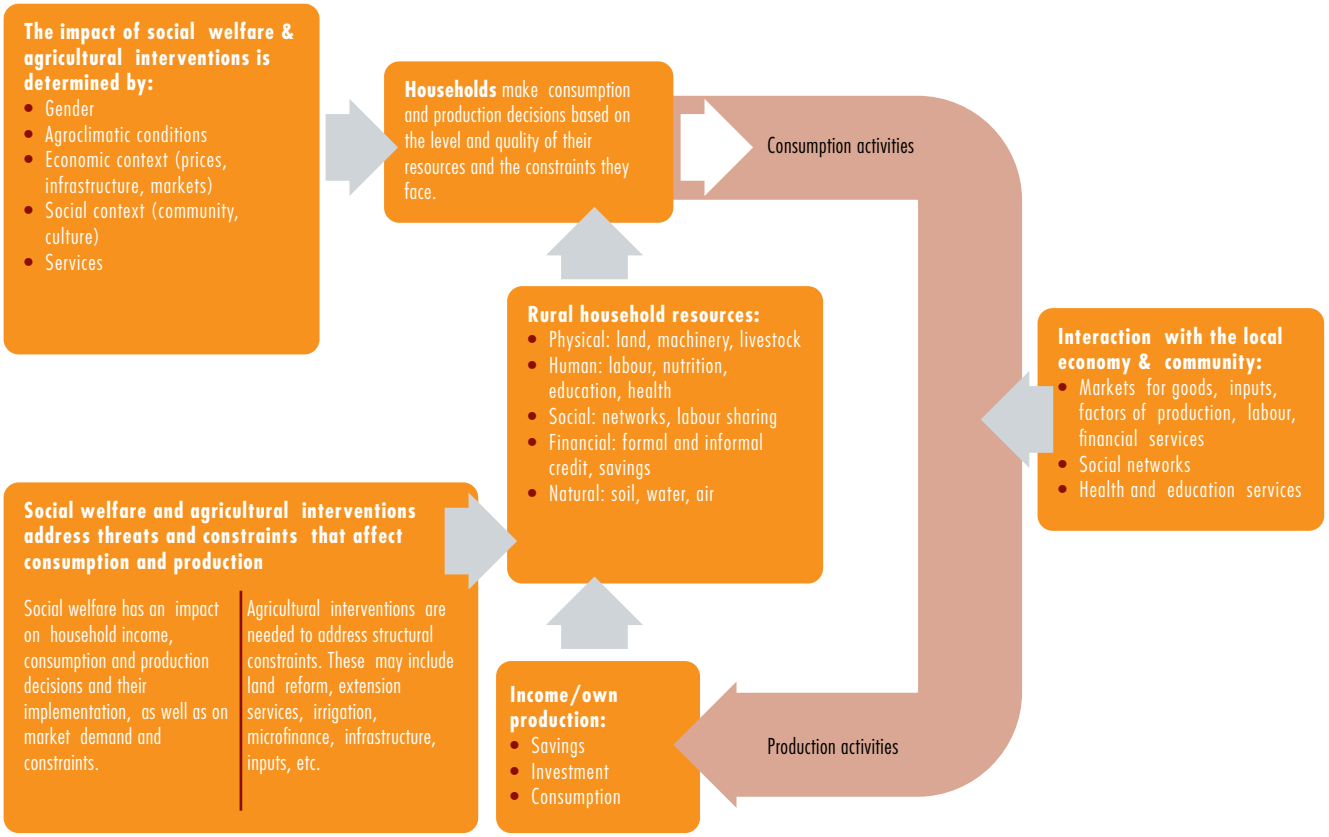


Table 5.5: Differentiated objectives and pathways for social and production inclusion in family farming

	Subsistence family farming	In-transition family farming	Consolidated family farming
Social welfare policies for family farming households	Non-contribution-based social welfare: • Protect the consumption of basic goods • Promote the SANN • Promote human capital development • Mitigate the effects of disasters and catastrophes • Promote entrepreneurship and profitable and ambitious strategies	Combination of contribution-based and non-contribution-based social welfare: • Protect the consumer • Promote medium-term economic planning • Promote strategic investments with production inclusion mechanisms Social security and insurance: Reinforce efforts to prepare for climate, economic and social contingencies	Social security (They are now in a position to make their own contributions to contain their risks) Make the application of standards in relation to decent employment more effective, considering that this segment uses more labor and more seasonal workers.
Production policies for family farming	Creation of capital (capital formation) • Capacity-building • Production improvements and own consumption • Access to production assets and inputs • Regularization of assets and records for recognition by users	Management and organizational strengthening (in terms of production, associations, and community groups) • Promotion of the formation of associations and organizations • Capacity-building and business management (with women playing a key role) • Market access • Training • Access to production assets • Differentiated financial mechanisms	Production/ trade linkages • Access to financial investment mechanisms • Capacity-building (investment and management) • Production diversification • Access to new markets • Production and trade partnerships • Generation of employment opportunities

5.7. Towards a sustainable bioeconomy: lessons learned from case studies (see chapter 4)[5]

Food Security

1. The impact of bioeconomy initiatives on food security is not automatically determined based solely on the use of food or non-food raw materials. This should be considered in addressing problems such as the debate on foods versus the production of fuels, which has arisen with respect to biofuels.

2 The production of bioproducts should contribute to rather than impede food production. This can be achieved by intensifying land use, using different types of terrain (including marginal land) to produce food and non-foods products, and by shifting to integrated production systems that combine the production of food and non-food products, such as integrated food and energy systems. In so doing, two key aspects should be addressed, namely:

a) The notion of what constitutes marginal land is complex (For example, should land that is used only occasionally be considered marginal?) and dynamic, as it can change over time. Thus, the decision to classify land as marginal and to define its use, should arise out of an inclusive process, involving all principal stakeholders. In determining its use, one should carefully consider actions that will be taken when the land is no longer marginal and when other options (e.g. for food production) may be available.

b) Special attention should be paid to possible competing uses (e.g. soil management, animal feed, bioenergy and bioproducts) of food production residue. Indeed, the growing demand for various bioproducts may increase competition for biomass and natural resources among various sectors of the bioeconomy, including the food sector. Actual and potential uses of residue should always be included in any feasibility analysis of bioeconomy initiatives based on the use of residue, since it can be the source of important goods and services for communities.

3. Accessing food often poses a challenge. Improved access can be achieved by increasing land tenancy security—a precondition for bioeconomy development which is often overlooked—and by adopting technologies that make optimal use of all components of biomass, thereby creating opportunities to obtain greater revenue from food and non-food products.

4. The optimal use of food is another dimension of food security to which the development of the bioeconomy can contribute, through: (i) better access to sustainable bioenergy for cooking; (ii) increased production of bionutrients; (iii) improved knowledge about healthy microbiomes.

5. Traditional and innovative processes and technologies used in the bioeconomy can facilitate the efficient and effective use of biomass, by utilizing all components of a given raw material, which in many cases was originally a food product. Local knowledge, including from indigenous communities, should be respected and valued, since it can contribute significantly to the development of the bioeconomy, particularly to the production of biocosmetics and biopharmaceutical products.

Natural resource management

1. The sustainable management of natural resources undoubtedly affects the sustainable development of the bioeconomy. It is often considered to be a matter that should be addressed in order to guarantee sustainable production and processing of biomass, and thus, good practices related to the sustainable management of land, water, forests and biodiversity are often part of bioeconomy operations. However, direct and indirect changes in land use are usually not considered when the local development of the bioeconomy calls for a modification in the production of biomass.

2. The sustainable management of natural resources and inputs related to bioproducts can benefit the environment

[5]Summary of lessons learned from the FAO project "Toward Sustainable Bioeconomy Guidelines", with the support of the Federal Ministry of Food and Agriculture of Germany (BMEL), based on [Gomez San Juan, M., Bogdanski and Dubois 2019].

and supports commercial arguments in favor of bioeconomy initiatives.

3. Small-scale biomass producers, including indigenous people that are the custodians, users and beneficiaries of natural resources, must be duly considered and given the power to make decisions regarding the development of the bioeconomy.

4. Sustainable management of natural resources is a pre-condition to ensuring that the bioeconomy can assist in tackling climate change-related challenges.

Climate change

1. Bioproducts are not climate-smart per se. A shift towards low-emission biomass production and the climate-smart management of natural resources needed to bring about this shift, as well as the use of clean energy throughout the bioeconomy value chain, are the major factors that will determine the extent to which the bioeconomy will contribute to mitigating the effects of climate change. Other factors are reduced deforestation, rehabilitation of degraded lands, carbon capture and use and the elimination of practices involving the burning of residue.

2. Although it is not stated openly, the bioeconomy usually improves adaptation by:

   a) sustainably managing natural resources, thereby boosting the resilience of the local environment; and

   b) increasing the standard of living by generating additional opportunities for income and employment through the production and trading of bioproducts.

Responsible production and consumption

The lessons learned in this area primarily point to the importance of establishing linkages between producers and consumers during different phases of bioeconomy activities, in order to ensure that a balance is created between their respective rights, responsibilities and benefits in terms of the bioeconomy, which can be achieved in different ways:

1. By adopting a value web approach rather than a value chain approach, since the former considers two ways of addressing the growing demand for biomass and the competition that arises as a result of the development of the bioeconomy: greater integration between all components of the value web and the promotion of the cascading use of biomass. It also calls for the establishment of partnerships that promote and link production and responsible consumption throughout the entire bioeconomy value web to ensure efficiency and inclusion. Moreover, these partnerships will be a means of developing bioproduct markets through purchase agreements. This includes contract farming and partnerships between providers and investors in technological intellectual property, business to business partnerships and partnerships between public entities and manufacturers of bioproducts (e.g. public procurement programs).

2. By creating regional bioeconomy clusters that promote the forging of partnerships at different levels.

3. Certification is very limited in terms of scope, affordability and feasibility. By itself, it cannot guarantee the sustainability of bioeconomy value chains to any great extent. Certification systems should be combined with other types of support (e.g. pOlicies, regulations, institutions and communication activities) to create an enabling environment that can support expansion of bioeconomy certification initiatives.

Economic growth

Value Added

1. The use of multi-purpose raw materials may contribute to adding value to biomass, since it enables the manufacture of various bioproducts. It also allows for the combined production of new and traditional products, reducing the risks associated with new technologies.

2. Production of various bioproducts may occur in a sequential manner (cascade approach) or simultaneously, such as in some biorefinery operations. Decisions to determine the cascading sequence of biomass uses should not be made solely on the basis of adding economic value. Other criteria (such as carbon storage, local uses such as dendroenergy for cooking, and processing costs) can be important for various stakeholders. Thus, all decisions regarding sequencing in biomass processing should be the result of an inclusive local process involving multiple stakeholders.

Employment

1. New bioeconomy activities offer numerous employment opportunities, particularly for rural women and youth. Nonetheless, training is often an essential requirement to generate employment through bioeconomy initiatives that introduce new technologies, particularly in the biomass processing phase.

2. In great measure, urban populations are responsible for driving the demand for bioproducts. Economic resilience can be bolstered by strengthening the linkages between the rural and urban environments and improving territorial cohesion by way of sound local value chains.

3. There are potential risks associated with employment in the new bioeconomy.

   a) Competition may arise between traditional jobs (for example, production of traditional food products) and the new types of jobs (such as in the bioproduct value chains). New technologies may also reduce employment opportunities, whereas more conventional technologies that are more labor-intensive may be less profitable.

   b) Attention may be focused on increasing the number of job opportunities, while paying scant regard to guaranteeing the quality of these new jobs.

Circular economy

1. Microbiological and biotechnological processes are key elements in the application of circular principles in the bioeconomy. They involve the use and ever-increasing production of bioproducts linked to carbon dioxide, through carbon capture and use. The application of circular principles often fosters the increased sustainability of bioeconomy initiatives. Thus, the challenges to be faced are related to the possible competition between the various uses of residue and the costs and logistics that this implies. The quality of bioproducts influences the extent to which they are biodegradable and compostable. These characteristics should not be taken for granted, since they can significantly affect the successful application of circular principles in the bioeconomy.

Good governance

Governance in the production and use of biomass refers to decision-making processes that should be established, that is the roles, rights and responsibilities of various actors, as well as the requisite types of policies, regulations, institutions and information and communication channels.

A review of case studies has revealed that the following factors have proven successful in the governance of the bioeconomy.

1. Inclusive decision-making in all relevant spheres is critical to the design and implementation of the bioeconomy.

2. A territorial/ landscape approach can contribute to the efficient production and use of biomass and the related inputs within a territory.

3. Regional bioeconomy clusters can assist in the application of circular bioeconomy practices.

4. Contract farming benefits biomass producers, since it can provide them with a guaranteed market and in some instances, with technical assistance. It also assists biomass manufacturers and retailers, as it affords them a continuous and regular supply of material. As mentioned before, governments usually become involved to ensure that these contracts are fair for both parties.

5. A supra-ministerial organization close to the highest level of Government can coordinate national bioeconomy efforts.

6. Public mechanisms (e.g. public procurement programs, coherent policies regarding incentives and taxes or public awareness campaigns) should promote consumer acceptance.

7. Collaboration mechanisms between stakeholders, including public-private partnerships and bioeconomy platforms should contribute to the transparent sharing of information and knowledge, while playing a pivotal role in decision-making. Defined, profitable and inclusive targets to monitor and assess progress and sustainability should be flexible enough to be adjusted in keeping with the objectives of a country's bioeconomy strategy.

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