Natural Resources, Climate Change and Governance

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Abstract  As per the recent 2019 World Population Prospects, the world population will reach 9.7 billion in 2050, and this rise in population will lead to a 70% increase in the demand for agricultural production. Given the wrath of climate change and resource constraints in Asia, Latin America has a comparative advantage in terms of physical resources which make it the most plausible contender for the role of world food factory at large, considering value added incorporating biotechnology advances, logistics and the contribution of new technological development. The paper considers the local and global governance challenges due to economic and social disruptions, resulting from this significant opportunity for growth and development in the current world scenario.

Keywords  Climate change · Governance · Population growth · Land use · Water use

Introduction

As per the recent 2019 World Population Prospects, the world population will reach 9.7 billion in 2050, and this rise in population will lead to a 70% increase in the demand for agricultural production. Given the wrath of climate change and resource constraints in Asia, Latin America has a comparative advantage in terms of physical resources which make it the most plausible contender for the role of world

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food factory at large, considering value added incorporating biotechnology advances, logistics and the contribution of new technological development.

This chapter discusses the prospects of a development path for the region capturing the benefits of the potential response to world food demand. We will briefly introduce and discuss the trade-offs between the productive capacity to engage in the above strategy and the environment and social tensions arising from such a promising road for economic growth and development. The local and global governance challenges resulting from this development model in the current world scenario will also be considered. The chapter includes four sections. After this introduction, the second section presents the basics of world population, the supply and demand forecasts for food, as well as the physical endowments of Latin America in land and water; the third section discusses the trade-offs between the production scenarios and climate change, sustainability and governance tensions. The fourth section contains the conclusions.

Natural Resources and Neo-Malthusianism

Population and Food

Latin America accounts for about 8.4% of the global population today, and it is expected to account for 7.8% by 2050 and 6.3% by 2100 (Table 1).

The region has almost achieved its demographic transition with total fertility of 2.0 children per woman on average in 2019, against 5.83 in 1960s. This transition was, in many cases, achieved with a chaotic family planning, or even with the absence of it. Brazil, for example, did not have any active plan but fertility habits have changed dramatically. Today, the fertility rate is less than two children per woman, and the demographic growth is very close to European standards.

In the next decades, Asia and Africa are expected to experience the relatively highest rates of growth in population, and the former is expected to show a significant rise in income, whereas this is more uncertain for the latter. Concerning the world population, there will be almost two billion Asians and two billion Africans more by the year 2050, which adds up to four billion people more on the planet. Asia, in particular, is likely to experience strong income growth and will, therefore, combine two main drivers of world consumption.

Are we in face of neo-malthusian era, in the framework of growing middle classes? In particular, with more people and a higher income, Asians will increase the demand for food products (richer in protein and more diverse) in the world. In the case of Africa, income growth might also come with the population growth, but this is more uncertain despite a significant stock of natural resources, due to severe local governance problems. Political instability, ethnic and religious conflict, weak institutions,
Table 1  Population and fertility rates, world and SDG regions (2019, 2050, 2100)

| Region                           | Population (millions) | Average number of live births per woman |
|----------------------------------|-----------------------|----------------------------------------|
|                                  | 1960 | 2019 | 2050 | 2100 | 1960 | 2019 | 2050 | 2100 |
| World                            | 3034 | 7713 | 9735 | 10,875 | 5.02 | 2.5 | 2.2 | 1.9 |
| Sub-Saharan Africa               | 220  | 1066 | 2118 | 3775  | 6.64 | 4.6 | 3.1 | 2.1 |
| Northern Africa and Western Asia | 129  | 517  | 754  | 924   | 6.55 | 2.9 | 2.2 | 1.9 |
| Central and Southern Asia        | 619  | 1991 | 2496 | 2334  | 6.05 | 2.4 | 1.9 | 1.7 |
| Eastern and South Eastern Asia   | 1019 | 2335 | 2411 | 1967  | 5.62 | 1.8 | 1.8 | 1.8 |
| Latin America and the Caribbean  | 220  | 648  | 762  | 680   | 5.83 | 2.0 | 1.7 | 1.7 |
| Australia/New Zealand            | 12   | 30   | 38   | 49    | 3.38 | 1.8 | 1.7 | 1.7 |
| Oceania                          | 3    | 12   | 19   | 26    | 6.31 | 3.4 | 2.6 | 2.0 |
| Europe and Norther America       | 810  | 1114 | 1136 | 1120  | 2.74 | 1.7 | 1.7 | 1.8 |

Source by author, based on data of UN (2019)
including very fragile judicial systems imply high discount rates for investment projects jeopardizing growth prospects. Latin America and North America are also expected to show some population growth, while population growth in Europe is in decline.

In the case of Europe, the role of immigration in its demographic dynamics and the sustainability of immigration over time is still an open question. In any case, the growth in world population and world income leads to a growing demand for food. According to estimates by the Food and Agriculture Organization, there will be a 70% increase in the world demand for agricultural products by 2050. Will Latin America be able to increase its agricultural production to meet some of these future needs? An exciting possibility arises here. Historically, the volatility in commodity prices has been a challenge for countries in which productions depend heavily on agricultural products. However, if the market for agricultural products shows persistent dynamism, prudent public policies may mitigate the intrinsic price volatility.

Latin America might find out that it has a new comparative advantage in the agri branch at large and will have to seek the appropriate means to capitalize on this advantage. The established view of inevitable decrease in the terms of trade maybe in question beyond the recent phase of sharp rise and relative decline in prices. Latin America, and particularly South America may face a “neo-malthusian” global era, reshaped in view of climate change and new dimensions of scarcity. If a proper balance in product specialization should be aimed by policy-makers, the neglect of these trends in long-term dynamics may lead to miss significant opportunities for economic and social development.

### Cultivated Land

Of the world habitable land (104 million km$^2$), 50% is dedicated to agriculture, some 51 million km$^2$ (Fig. 1), of which 23% is crops for food, and 77% allocated to livestock (this includes land to produce feed for livestock). Land is a finite resource, in a world of growing population (Ritchie and Roser 2013).

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3Since the early years of the twenty-first century, we have observed a sustained rise in international markets food commodity prices. If the boom years seem behind, despite the big global recessions, of 2008 with the financial crisis, and of 2018 with the Covid 19 pandemia, international market prices stay high as compared to the levels experienced since the 1990s and before (FAO 2020). Forecasts for 2050 and beyond point to the sustainability of this path (FAO 2018).
Asia faces a strict limit on the extension of its agriculture land. As mentioned above, this continent is the most significant contributor to world demand because of its population and income growth, but it does not have the necessary land to meet its demand. This explains China’s attempts to buy land abroad, engineered diverse agreements to secure resources in Africa and Latin America: Asians face a growing demand but do not have the extension and quality of land to produce its consumption needs. In the past, colonial wars were the solution to this dilemma. But in the future, the world will have to find better means to solve it.

Where is cultivable land? Latin America accounts for 24% of potentially world arable land (Table 2) and 17% of the pastures (FAO 2011). Therefore, Latin America has a good stock of physical (natural resource) capital needed to support the increase in world production. Latin America has only 9% of the world’s cultivated land in 2020, and the region can nearly double its cultivated land by 2050 (from 142 to 228 million ha, Table 3), given the starting point and the current productive conditions. Additionally, more than 90% of Latin American land cover is cultivated, forest or grasslands (Fig. 2).

According to various sources of scenarios and forecasts, Latam may increase its production by 50 to 100% between 2020 and 2050, or double to triple since 2000. This sharp increase in supply potential is the result of a significant increase in cultivated land coupled with varying degrees of productivity growth. We should highlight a yield gap of about 52%, which means that in Latin America actual yield is just 48% as compared to the potential yield. In contrast, the yield gap in East Asia is just 11%, showing the constraint in food production capacity of the latter region with very limited land resources (Table 4). Latin America can take advantage of this opportunity. On the demand side for agricultural production, the biodiesel branch sharp increase in production adds to food leading to higher pressure on world agricultural supply and prices (Fisher 2009), in ranges from 10 to 60% depending on the share of first generation biofuels in transport fuels (1–8%). But even before considering technological improvements, arises the question on the opportunity for Latam to become the “world food powerhouse” of the twenty-first century? An open question in motion.

Additionally, meat demand and production will increase globally. Two effects drive the additional demand, the increase in world population and higher incomes in developing nations such as South and East Asia. It is estimated that global meat production will have to increase from 258 million tons globally in 2007 to 455 million tons in 2050.

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4FAO 2011. The state of the world’s land and water resources for food and agriculture.
5FAO 2011, Page 22 (adapted from Fischer et al. (2011)). See Fig. chap 1.1 in the Appendix.
6See Agrimonde (2009), Agrimonde et al. (2014), Allan et al. (2019), Fisher (2009), Alexandratos and Bruinsma (2012).
7FAO 2011, Page 37 ((adapted from Fischer et al. (2011)). See Table chap 1.7 in the Appendix.
8See Fisher (2009).
9For example, Alexandratos and Bruissma (2012) estimate that the daily energy supply (calories per capita per day) will increase from 2772 in 2007 to 3070 in 2050.
### Table 2  Land with rainfed crop production potential (million ha)

| Region                      | Total land surface | Suitable land (1)       | Not usable (2) | Suitable for use (3 = 1-2) |
|-----------------------------|--------------------|-------------------------|----------------|---------------------------|
|                             |                    | Total (A + B)           | Prime (A)      | Good (B)                  |                           |
| World                       | 13,295             | 4495                    | 1315           | 3180                      | 1824                      | 2671                      |
| Developing countries        | 7487               | 2893                    | 816            | 2077                      | 1227                      | 1666                      |
| Sub-Saharan Africa          | 2281               | 1073                    | 287            | 787                       | 438                       | 635                       |
| Latin America               | 2022               | 1095                    | 307            | 788                       | 580                       | 515                       |
| Near East/North Africa      | 1159               | 95                      | 9              | 86                        | 9                         | 86                        |
| South Asia                  | 411                | 195                     | 78             | 117                       | 43                        | 152                       |
| East Asia                   | 1544               | 410                     | 126            | 283                       | 140                       | 270                       |
| Other developing countries  | 70                 | 25                      | 9              | 15                        | 23                        | 2                         |
| Developed countries         | 5,486              | 1,592                   | 496            | 1,095                     | 590                       | 1,002                     |
| Rest of the world           | 322                | 11                      | 3              | 8                         | 7                         | 4                         |

*Source* by author, based on data from GAEZ v3.0
Table 3  Land in use, 2009–2050, forecast by region. Cultivated (C) and harvested (H) in million hectares and cropping share of world total (CSW) and cropping intensities (CI) in %

| Region            | 2009 | 2050 |
|-------------------|------|------|
|                   | C (M ha) | CSW (%) | H (M ha) | CI (%) | C (M ha) | CSW (%) | H (M ha) | CI (%) |
| Asia              | 542 | 35 | 588 | 109 | 541 | 32 | 641 | 118 |
| South Asia        | 204 | 13 | 232 | 113 | 212 | 13 | 243 | 115 |
| East Asia         | 133 | 9 | 176 | 133 | 133 | 8 | 191 | 144 |
| Southeast Asia    | 101 | 7 | 111 | 109 | 107 | 6 | 124 | 115 |
| Rest of Asia      | 103 | 7 | 70 | 68 | 88 | 5 | 83 | 94 |
| Americas          | 395 | 26 | 279 | 59 | 468 | 28 | 384 | 82 |
| Norther America   | 253 | 17 | 146 | 58 | 241 | 14 | 192 | 80 |
| Latin America     | 142 | 9 | 128 | 90 | 228 | 14 | 193 | 85 |
| Africa            | 251 | 16 | 214 | 85 | 342 | 20 | 270 | 79 |
| Norther Africa    | 28 | 2 | 21 | 74 | 27 | 2 | 25 | 92 |
| Sub-Saharan Africa| 223 | 15 | 194 | 87 | 315 | 19 | 245 | 78 |
| Europe            | 293 | 19 | 184 | 63 | 264 | 16 | 219 | 83 |
| Oceania           | 46 | 3 | 26 | 57 | 58 | 3 | 48 | 83 |
| **World**         | **1527** | **100** | **1286** | **84** | **1673** | **100** | **1562** | **93** |

Note: Difference between Total Land Use (1) and Rainfed Use (2), is Irrigated Use (3), so $1 = 2 + 3$. Crop intensity is the ratio between Harvested and Cultivated Land, so $H/C = CI$

Source: by the author, based on date of FAO (2011)

Definition: The fraction of the cultivated area that is harvested. The cropping intensity may exceed 100 percent where more than one crop cycle is permitted each year on the same area. In AQUASTAT, the cropping intensity has been calculated on irrigated crops only and becomes practically the ratio of the harvested irrigated areas over the area equipped for full control irrigation actually irrigated. Irrigation, by decoupling the crop production from the natural precipitation, increases cropping intensity in countries where temperatures are not a limiting factor. Source: http://www.fao.org/nr/water/aquastat/data/glossary/search.html?termId=7587&submitBtm=s&cls=yes
Fig. 2  Regional distribution for land use and cover (agriculture area includes arable land, permanent crop and land for grazing. Forestry includes primary forest, regenerated forest and planted forest. Other land includes barren land and urban/built-up land) author, based on data. Source by author, based on data of FAO STAT

| Region                        | Yield gap 2005 (%) |
|-------------------------------|--------------------|
| Sub-Saharan Africa            | 76                 |
| Eastern Europe and Russia     | 63                 |
| Northern Africa               | 60                 |
| South Asia                    | 55                 |
| Southern America              | 52                 |
| Australia and New Zealand     | 40                 |
| Western and Central Europe    | 36                 |
| Northern America              | 33                 |
| Southeast Asia                | 32                 |
| East Asia                     | 11                 |

Source by the author, based on data of FAO (2011)
tons in 2050, a 70% rise. Most of this increase in meat production will take place in developing countries that may double their supply in the next 40 years, and Latin America will have an important role to play (Tables 5 and 6).

Latin America, however, shows a handicap in “logistics” at large. The region performs relatively low in terms of competitive infrastructure to reduce the constraints to land accessibility. Nelson (2008) constructed a data set of “travel time to major cities” to quantify accessibility of land resources, showing relevant limitations from this perspective. For currently cultivated land, only 32% of cultivated land is accessible within 2 h as compared to 85, 62 and 53% in Western Europe, Northern Africa and South Asia, respectively. For accessibility of prime and good unprotected grassland/woodland ecosystems and unprotected prime and good forestland ecosystems, the situation is much worse in Latin America, where the same figure stands at 23% and a meager 7%, respectively. For Latin America to become the breadbasket of the world, investment in agricultural infrastructure will play a pivotal role.

World Water Distribution

For the “world food powerhouse” land is necessary, but not enough. Water is crucial, and Latin America has one-third of the world permanently renewable freshwater. Thus, Latin America not only has the land but also has the fuel to support the land: water. Every here and there, conspiracy theories emerge on old and new imperialisms campaigning to seize Latam water. And while this might be an unfounded conspiracy fear, there is a tied bond between the increase in world demand and the world supply of water. Latin America is the one place in the world where there is land, and there is also an excess supply of renewable water, being the largest reserve worldwide (Table 7).

In contrast to Latam water availability, there are already very severe water shortages, most particularly in Western, Central and South Asia, that demand more than half of their water resources in irrigation (Table 7). In Northern Africa, withdrawals for irrigation exceed renewable resources due to groundwater overdraft and recycling. On the other hand, South America barely uses 1% of its resources.

| Meat production (million tons) | 1961/1963 | 2005/2007 | 2050 |
|-------------------------------|-----------|-----------|------|
| World                         | 72        | 258       | 456  |
| Developed                     | 52        | 109       | 137  |
| Developing                    | 20        | 149       | 317  |

10 The long-term view of meat production (all types) estimates from Alexandratos and Bruissma (2012).

11 See Schwab and Sala-i-Martín (2016).

12 See Table 11, 12, 13 in Fischer et al. (2012).

13 FAO (2011). The state of the world’s land and water resources for food and agriculture (SOLAW).
| Region                  | 2005/2007 | 2018     | 2050*    | 1971–2007 | 1991–2007 | 2007–2050 | 2005/2007 | 2050 |
|------------------------|-----------|----------|----------|-----------|-----------|-----------|-----------|------|
| (Unit) ('000 tons)     |           | (growth rate, %) | (% of total) |           |           |           |           |      |
| Sub-Saharan Africa     | 6802      | 11,557   | 23,928   | 2.4       | 3.0       | 2.9       | 2.6       | 5.2  |
| Near East/North Africa | 8918      | 14,072   | 23,233   | 4.7       | 3.9       | 2.2       | 3.5       | 5.1  |
| Lat. Amer. and Carib.  | 40,585    | 56,143   | 71,644   | 3.9       | 4.5       | 1.3       | 15.7      | 15.7 |
| South Asia             | 7180      | 12,645   | 40,327   | 2.8       | 1.6       | 4.0       | 2.8       | 8.8  |
| East Asia              | 85,121    | 112,961  | 156,930  | 6.6       | 4.5       | 1.4       | 32.9      | 34.4 |
| Developed countries    | 109,424   | 124,282  | 136,276  | 1.1       | 0.6       | 0.5       | 42.4      | 29.9 |
| World                  | 258,370   | 342,396  | 456,097  | 2.8       | 2.4       | 1.3       | 100       | 100  |

*Source* by author, based on Alexandratos and Bruinsma (2012) and FAO STAT
| Region                      | 2005/2007 | 2050* | 1971–2007 | 1991–2007 | 2007–2050 | 2005/2007 | 2050 |
|-----------------------------|-----------|-------|-----------|-----------|-----------|-----------|------|
|                             | (Unit)    |       | (growth rate, %) | (% of total) |          |           |      |
| Sub-Saharan Africa          | 7334      | 26,926| 2.4       | 3.0       | 2.9       | 2.9       | 6.0  |
| Near East/North Africa      | 10,292    | 27,992| 4.7       | 3.9       | 2.2       | 4.0       | 6.2  |
| Lat. Amer. and Carib.       | 34,557    | 61,003| 3.9       | 4.5       | 1.3       | 13.5      | 13.5 |
| South Asia                  | 6685      | 40,858| 2.8       | 1.6       | 4.0       | 2.6       | 9.0  |
| East Asia                   | 86,806    | 160,037| 6.6      | 4.5       | 1.4       | 33.9      | 35.4 |
| Developed countries         | 109,382   | 130,385| 1.1      | 0.6       | 0.5       | 42.7      | 28.8 |
| World                       | 256,179   | 452,230| 2.8      | 2.4       | 1.3       | 100       | 100  |

*Source* by author, based on Alexandratos and Bruinsma (2012) and FAO STAT
| Continent regions                  | Precipitations (mm) | Renewable water resources (km³) | Percentage of world RW total (%) | Water use efficiency ratio (%) | Irrigation water withdrawal (km³) |
|-----------------------------------|--------------------|---------------------------------|----------------------------------|-------------------------------|---------------------------------|
| World                             | 809                | 43,022                          | 100                              | 44                            | 2710                            |
| Africa                            | 678                | 3931                            | 9                                | 48                            | 184                             |
| Northern Africa                   | 96                 | 47                              | 0                                | 69                            | 80                              |
| Sub-Saharan Africa                | 815                | 3884                            | 9                                | 30                            | 105                             |
| Americas                          | 1091               | 19,238                          | 45                               | 41                            | 385                             |
| Northern Americas                 | 636                | 6077                            | 14                               | 46                            | 258                             |
| Central America and Caribbean     | 2011               | 781                             | 2                                | 30                            | 15                              |
| South America                     | 1604               | 12,380                          | 29                               | 28                            | 112                             |
| Asia                              | 827                | 12,413                          | 29                               | 45                            | 2012                            |
| Western Asia                      | 217                | 484                             | 1                                | 47                            | 227                             |
| Central Asia                      | 273                | 263                             | 1                                | 48                            | 150                             |
| South Asia                        | 1602               | 1766                            | 4                                | 55                            | 914                             |
| East Asia                         | 634                | 3410                            | 8                                | 37                            | 434                             |
| Southeast Asia                    | 2400               | 6490                            | 15                               | 19                            | 287                             |
| Europe                            | 540                | 6548                            | 15                               | 48                            | 109                             |
| Western and Central Europe        | 811                | 2098                            | 5                                | 43                            | 75                              |
| Eastern Europe and Russia         | 467                | 4449                            | 10                               | 67                            | 35                              |
| Oceania                           | 586                | 892                             | 2                                | 41                            | 19                              |
| Australia and New Zealand         | 574                | 819                             | 2                                | 41                            | 19                              |
| Pacific Islands                   | 2062               | 73                              | 0                                | –                             | 0.05                            |

*Source* by author, based on FAO (2011)
Therefore, Latin America can respond to a sharp increase in world demand for food and agri products at large. It has resources and tools. No other region in the world has the means to do it, except probably Sub-Saharan Africa. The problem with Africa is that although the continent has the quality of land and renewable water to participate in the food supply expansion strategy, as mentioned earlier, there is a severe and widespread governance problem coupled with weak property rights, which tends to distort appropriate incentives and leads to extremely high discount rates and thus impedes the necessary capital investments.

On the other hand, it is in Africa where the risk of hunger will remain high in the face of stress on the food markets worldwide. In 1970, there were 950 million people in risk of hunger, 26% of a total world population of 3.7 billion inhabitants. In 2020, the total population in risk of hunger is estimated to be near 830 million, 11% of 7.8 billion inhabitants, whereas the forecasts for 2050 are 460 million, 4.7% of a total population of 9735 billion inhabitants. In the face of a sharp reduction in absolute and relative population in risk of hunger, Sub-Saharan Africa accounted for 10% in 1970, whereas it will represent more than 50% in 2050 (with rather stable absolute numbers since 2010), Asia 35% and Latin America 2%.14

Natural Resources, Climate Change and Conflicts

In a nutshell, increases in world population and income growth give to Latin America the demand counterpart to expand production through agriculture. This is also true for metals, where the region has again enormous resources to supply world demand. But, while feasible, the “world granary strategy” has an underlying problem. An increase in the cultivated area requires deforestation. In turn, deforestation leads to climate change and soil pollution. Furthermore, an increase in the cultivated area may imply population displacements in many countries and thus requires the appropriation of aboriginal land. Higher wealth and income inequality, as well as, ethnic and social conflicts may result.

All such trends of economic and social development may show in the future but are already in the scene today. It is what happens in the Amazon these days. Landowners in the south of Brazil are moving to much cheaper land in the Mato Grosso. They can sell an acre in the south and acquire much bigger properties becoming landowners in the north. But, on the way to this agricultural transformation entire aboriginal communities and subsistence farmers are pushed out of their lands, and massive deforestation is needed to prepare the land for production.15

14Based on UN (2019) and IASA world food system simulations, scenario FAO-REF-00 (May 2009), see also Fisher (2009). The population in risk of hunger in Sub-Saharan Africa was 85 million in 1970, 286 million in 2020 and estimated at 240 million in 2050, whereas in East Asia falls from 500 million in 1970 to 26 million in 2050.
15Fonseca et al. (2020). Boletim do desmatamento da Amazônia Legal (maio 2020) SAD (p. 1). Belém: Imazon. https://imazon.org.br/publicacoes/boletim-do-desmatamento-da-amazonia-legal-maio-2020-sad/.
Climate Change and Governance

The natural resource-based strategy highlights two dimensions of conflict: on the one hand, the social conflict related to the extension of the agricultural frontier and the impact on migration, ethnic tensions, as well as potential changes on wealth and income inequality. On the other hand, this development path stresses climate change dynamics. These two problems lead to challenges in local and global governance, respectively. Local governance refers to the economic and social tensions within countries, whereas global governance arises from international tensions between countries related to this development compact. Beyond classical international trade conflicts and protectionist policies, global governance adds today climate change as a new key driver. The expansion of the agricultural frontier may provoke massive deforestation leading to significant global negative externalities. One wonders for how long Brazil, and its neighbor countries will be able to govern without international opinion its Amazon territories, considering that it affects the provision and quality of air on the planet. Will one day countries in the world tell Brazil that the Amazon rainforest is too vital for the planet to let Brazil decide on its own the destiny of territories that may influence the planet path? Will the moral argument that the developed countries had freely chosen climate change dynamics of the world for two hundred years deter this trend of facts? May or will the ignorance and environment neglect of the past justify the unrestricted sovereignty argument of today? National sovereignty, international conflict and politics of cooperation thus enter the scene.

About 50% of Latin America is covered with forest. Latin America has 22% of the world’s forests and 52% of the tropical forest—mainly the Amazon rainforest. Latin America is thus a crucial player in the climate change arena. It can become an active part of the problem if deforestation continues. Or it can play part of the solution if the region contributes actively to keep and preserve the 50% of the world forest that it governs today. According to a variety of projections, without policy interventions, more than one-half of the Amazon forest might be destroyed or degraded by 2030–50 (Swan et al. 2015).

On the other hand, vicious circle dynamics may arise for Latam. Climate change may seriously jeopardize the development path strongly based on the “food factory strategy”. If South America is not by far the sole driving force of climate change, this phenomena may in turn through higher frequency of extreme weather events, as well as changes in precipitation patterns, seriously affect hydroelectric supplies and water supply. Consequently, the stress on agriculture may thus endanger the “world granary and food” intensive engine of growth (Fisher 2009).

However, since 2008 we observe that deforestation has slowed down, and hopefully, Brazil has entered a new downward trend. Annual deforestation in Brazil’s Amazon forest was lowest in 2012 since 1988. But the Brazilian government now in place headed by President Jair Bolsonaro passionately enrolled in a militant neglect

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16 Regular international polls show the growing concern on climate change. See Pew Research Center, Global Attitude Survey (2019).
17 Latin American and Caribbean Forestry Commission (LACFC, FAO).
Fig. 3  Deforestation rate of the Brazilian Amazon, annual, km², 1988–2019. *Source* by author, based on TerraBrasilis, INPE

of the risks due to climate change in line with the position on this topic of the current US President Donald Trump. By accident or policy voluntary neglect, a very high level of deforestation has been observed in 2019, which is the highest in 11 years (Fig. 3). The coming years will show if we are in face of an outlying year or an upward change in the trend of deforestation. If Brazil follows the path initiated last year, the country will be unlikely meet its climate commitments made as a participant of the Paris Agreement (2015). Ongoing deforestation in the Brazilian Amazon can have long-term implications which can further fuel, sooner or later, severe local and global governance conflicts.

**Conclusions**

This chapter proposes a discussion on the potential of Latin America, particularly South America, to leverage on its natural resources to benefit from a “neo-Malthusian” scenario in the global economy for the next generation. We focus on the world market for food at large and discuss the potential demand and supply looking to 2050.

Highlighting the world food supply advantage should not lead the reader to neglect other significant opportunities for economic and social development in the region. One should consider dynamic knowledge services (TICS), tourism, certain manufacturing sectors or other natural resources industries.

We show that the demand will have a significant increase driven by a strong growth in population in Asia and Africa coupled with a sharp rise in income in the
former, while rather uncertain in the latter. Biofuels used in transport will add to food demand sustaining agricultural prices. Latin America has the appropriate land and renewable water, adding productivity gains, to increase production and supply the future demand for food worldwide. Asia does not have suitable land and the necessary renewable water to expand significantly production, whereas Sub-Saharan Africa could contribute with a sizeable increase in supply. However, despite abundant appropriate land and renewable water, the potential rise in production of the latter is extremely uncertain due to severe political and ethnic conflict, weak property rights, leading to highly disruptive discount rates that jeopardize a robust investment path for a sustained expansion in the regional supply of agriculture products. Beyond the production front, if the world population in risk of hunger will strongly decrease as a share of total population, it will be concentrated in Africa.

The Sub-Saharan African question is certainly a matter for future research. How will these scenarios and prognosis change if a strong drive for reforms, leading to lower discount rates, takes hold in the region? In the 1950s, South Korea and Ghana had the same income per capita, but economic and institutional change turned into a structural break for development in South East Asia. Could something of the sort happen in Sub-Saharan Africa in coming decades? A robust and sustained development path in the region could drive an increase agriculture production, as well as in incomes and food consumption, implying an interesting review and further debate on the topics here discussed.

In this article last section, we discuss the potential downside of the world food factory strategy, due to deforestation and climate change. On the one hand, the expansion of the agricultural frontier may lead to population displacement, social conflict and local governance tensions, while it may also lead to weather and soil quality disturbances jeopardizing the sustainability of the agricultural-based strategy. On the other hand, the growing international concern on climate change may lead Latin American countries to confront global governance tensions. Thus, policy-making in the region, to benefit from the food factory opportunity in the coming decades, requires a balanced political economy approach to manage multiple constraints.

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