

Food and Nutrition Security in Argentina



Vineyards in Maipu, province of Mendoza, Argentina © Shutterstock

Argentina

- [1] Eduardo Bianchi
- [2] María Cristina Añón
- [3] Eduardo Pagano
- [4] Martín Piñeiro
- [5] Carolina Szpak
- [6] Eduardo Trigo
- [7] Sergio Vaudagna

Argentina is a great producer and exporter of food. Yet with over eight million Argentinians living in poverty and **one and a half million lack food and nutrition security**

Summary

Argentina is a country with a vast area and range of climates, coupled with a wealth of natural resources, including products created by agricultural activity. It is a major food producer and worldwide exporter. This chapter describes the main features that make Argentina a key food producer. It reviews its current demographic status and future trends and describes the state of its population's food and nutrition security. It also details the institutional environment in which research is conducted in this field, outlining its strengths and weaknesses.

It evaluates the current degree of degradation of the water and soil, energy matrix and forests, as well as the potential impacts of climate change. Technology and innovation related to the agricultural sector and food production are also analyzed, with an emphasis on the country's biotechnology status. The possibility of increasing the efficiency of the food system, as well as aspects related to human health, particularly regarding the nutrition of the country's population are also explored. Although public policy issues run throughout the chapter, a special section is devoted to highlighting the most relevant and urgent policies required to enable the agricultural sector to play a key role in a process of overall, sustainable and inclusive economic development.

I. National characteristics

a. Territorial extension, relief, environmental heterogeneity and arable land

Argentina lies to the south of the American continent, occupying an area of 3,761,274 square kilometers, three quarters of which are on the American continent and the remainder in Antarctica. Thus, Argentina extends longitudinally from North of the Tropic of Capricorn to the South Pole. Since Argentina is a country with a vast area, it contains a variety of forms of relief. Although it consists mainly of plains, covering more than half the total area, there are also mountains and plateaus. The plains are located mainly in the East of the territory, while the mountainous areas occupy the western sector and the largest plateau, the Patagonian Plateau, is located in the South of the country.

This large area contains a succession of climates encompassing tropical ones in the North and the West; subtropical ones in the North and East; temperate ones in the Center; temperate cold ones in the southern mainland and cold in the island area and the Antarctic. This diversity of climates favors the presence of an enormous variety of natural resources. Thus, products from tropical climates, such as cotton, rice, sugar cane, tobacco, mate and citrus, and from Mediterranean climates, such as vines, olives and apples, are all grown in Argentina, due to the layout of the mountains, the circulation of the winds and the water network. However, the country is mainly known for its Pampas

plain or Pampa, an immense fertile plateau of 700,000 km² located in the Center-East of the territory. The fact that the country is nearly totally covered by a thick sedimentary mantle with gentle slopes and humid climates, together with the availability of groundwater at a low depth, has led to the development of soils suitable for agriculture and livestock, making this enormous area a preponderant factor in Argentina's economic development.

b. Demographic characteristics and future trends

Despite its enormous area, Argentina is relatively sparsely populated, with 43.6 million inhabitants in 2016, and a population density of 15 inhabitants per square kilometer, considering only its area in the American mainland. One of the characteristics of the Argentine demographic structure is the sharp difference in population density among its regions. Owing to historical and economic factors, almost half the country's population is concentrated in the City of Buenos Aires and the surrounding urban area (Greater Buenos Aires).

Argentina's life statistics are similar to those of developed nations, with a declining birth rate and a contraction of population growth. Over the past five years, the Argentinian population has registered an average annual growth rate of 1%, meaning that the population growth rate is expected to slow down in coming years, achieving a total of 57 million inhabitants throughout this century. The population change will be mainly due to population growth, since the projected migratory contribution is very low.

The most notable change in the population over the next few decades will be its marked aging, with a progressive expansion of the adult and elderly population, accompanied by the reduction of the youth and child population. Consequently, the median age will increase from 30 to 46. The third age (65-79 years) will double its relative share over the course of the century, while the fourth age (over 80 years) will be the segment with the largest relative growth, in the context of a significant increase in life expectancy throughout the present century. This phenomenon will pose a serious challenge to the financing of health and social security systems, since the economically active population will decline in relative terms.

c. Poverty and food security

In Argentina, poverty has been a matter for concern for a number of decades. The 1990s saw sharp increases in the unemployment rate, and therefore in the vulnerability of broad sectors of society. The crisis in late 2001 caused a significant fall in real wages, a significant increase in unemployment levels and higher poverty levels. Consequently, over the past 15 years, poverty has been an issue on the economic and political agenda, and has proved difficult to reduce, despite the presence of inclusive policies and solid social welfare programs. Thus, a hard core of the population remains marginalized, even in times of economic prosperity.

Data obtained by the Argentinian Catholic University in 2015, which explores poverty from a multidimensional perspective, including income, safe food, health protection, access to basic

[1] **Eduardo Bianchi**, Chapter Coordinator. Researcher and professor, Escuela Argentina de Negocios (EAN), eduardodbianchi@gmail.com

[2] **María Cristina Añón**, Doctor of Science in Biochemistry; Full Professor, Faculty of Exact Sciences, National University of La Plata; Senior Researcher, CONICET; Center for Research and Development in Food Cryotechnology (CONICET, CIC, UNLP), mcacidca@gmail.com

[3] **Eduardo Pagano**, University of Buenos Aires, National Council of Scientific and Technical Research; Institute of Research in Agricultural and Environmental Biosciences, INBA, Faculty of Agronomy, epagano@agro.uba.ar [4] **Martín Piñeiro**, Member of the Argentine Council of International Relations (CARI) and the Group of Southern Producing Countries (GPS), martin.pineiro2@gmail.com [5] **Carolina Szpak**, Researcher and professor, Escuela Argentina de Negocios (EAN). carolina.szpak@ean.edu.ar [6] **Eduardo Trigo**, Grupo CEO S.A., ejtrigo@gmail.com [7] **Sergio Vaudagna**, Professor, Food Technology Institute, Agroindustry Research Center, National Institute of Agricultural Technology (INTA), vaudagna.sergio@inta.gob.ar

services, decent housing, access to education and employment and social security, estimate that during that year, nearly 20 million people had at least one shortcoming in the areas mentioned (47.7% of the population), 11.4 million had at least two (26.4% of the population) and approximately 6.7 million had at least three of these shortages (15.1%). On the other hand, according to data from government agencies for the second quarter of 2016, people living in poverty - measured in terms of incomes - accounted for 32.2% of the population and 23.1% of households. At the same time, about 6.3% of the population were indigent, equivalent to 4.8% of households. In absolute terms, there were 8.8 million people living in poverty and 1.7 million in extreme poverty.

According to these studies, a household is considered poor if the incomes of its members are unable to meet a set of food and non-food needs considered essential. For its part, a household is considered indigent if its income is insufficient to cover a food basket capable of meeting a minimum threshold of energy and protein needs. In this respect, then, in the first four months of 2016, there were 1.7 million people in Argentina lacking food security.

In geographical terms, the most severely affected households are those located in the metropolitan area of Buenos Aires and the large metropolitan areas in the interior of the country. In terms of stratification by education, the most vulnerable households are those with heads of household who have not completed middle school, are engaged in informal employment and have children.

d. Agroindustrial production

The agroindustrial sector has been and continues to be a key component of the Argentinian economy. Currently, primary and processing activities contribute approximately 20% of the Gross Domestic Product (GDP) and 45% of the Gross Added Value (GAV) in goods. In turn, they account for 8% of total direct employment and 36% if one includes indirect employment linked to agroindustrial value chains.

Thus, Argentina is a major producer of cereals, such as wheat, maize, sorghum,

Map 1. Geographical position of Argentina



rice, barley; oilseeds such as soybeans and sunflowers; industrial crops such as cotton, sugar, mate, tobacco and tea; and fruits and vegetables. The country also plays a key role in livestock production, mainly beef and dairy products. In several of these products, Argentina is a major global producer and consequently also a top exporter. The two main products are undoubtedly soybean and beef.

Soybean production is extremely competitive in Argentina, having adapted well to the various ecological systems of the Pampa and the NE and NW regions. Since the introduction of transgenic soybeans in 1996, in conjunction with direct sowing, there has been an exponential increase in the area planted with this crop, leading the country to become one of the main producers and exporters of soybeans and its derivatives. Thus, in Argentina, the area planted with soybean compared to other crops, mainly cereals, is much larger: approximately 70%.

Beef production is also very important, ranking second after soybeans. Primary production is extremely atomized, with a large share of small- and medium-sized enterprises, with a cattle stock of approximately 55 million head. Most of production is undertaken in systems based on extensive pastures, whether natural or cultivated, where livestock are fed.

The basis of this expansion has been the incorporation of new lands into production, mainly into agriculture, as well as the increase of productivity. In both cases this has been the result of the adoption of new technologies and organizational and management innovations. In fact, the Argentinian countryside has undergone profound modifications in recent decades. At the moment it is experiencing a technological, organizational and productive paradigm change, within the framework of the biological revolution. Process innovations in the direct sowing of crops and grasslands, associated with increased use of genetically modified varieties, have driven the exponential growth of agricultural production.

Together with the adoption of these technological packages, the emergence of new companies that supply specific inputs and services has led to a network model among producers, contractors, workers and suppliers, very different from the traditional organizational model of the Argentinian countryside.

e. Trends in urbanization

The process of urbanization in Argentina has developed rapidly since the early 20th century, with a trend since the middle of that century toward the reduction of the rural population in absolute terms. The current rate of urbanization is 90%, making the country one of the world's most urbanized nations.

Its urban system is extremely disparate in terms of population densities, concentrated mainly in large cities, particularly Buenos Aires and the Metropolitan Region of Buenos Aires, while vast regions of the country are unpopulated. Whereas the Autonomous City of Buenos Aires has 14,450 inhabitants per square kilometer, in much of the country, population density is fewer than 15 inhabitants. There are also a series of intermediate cities and small

population centers, in the latter case with fragile regional interconnections and significant differences in the capacity to provide goods and services to their inhabitants and rural surroundings.

f. Impacts of migration

Mass immigration to Argentina was a key factor in the country's transformation in the 19th century. Between 1830 and 1950, the country received 11% of the total number of Europeans who left their continent. In the following decades, migration from Europe ceased, while immigration from the neighboring countries (Chile, Bolivia, Paraguay, and Uruguay) and Peru increased. Thus, since the second half of the 20th century, immigration from these countries has constituted the most dynamic migration to the country. Although the current importance of immigrants in the Argentine population is minimal, most of the foreign population originates from these countries. According to the latest census, published in 2010, the foreign resident population in Argentina stood at approximately 1,800,000, equivalent to 4.5% of the total population. Of this foreign population, 75% came from neighboring countries and Peru.

Although the settlement pattern of these immigrants differs according to their nationality and the historical moment of the migratory current, the flow of migrants from the adjacent countries and Peru meets part of the demand for semi-skilled and low-skilled work in the country's urban labor markets, mainly in the Metropolitan Area of Buenos Aires. However, most of these workers are employed in productive sectors where unregistered employment or informal work predominates, one of the main problems that afflicts the Argentinian labor market in general. Thus, the majority of wage-earning immigrants, like Argentinian workers working in the same sectors, lack both social security coverage and the rights and benefits of a formal employment relationship.

g. Main exports, imports and markets

Argentina is a major exporter of agroindustrial products. In 2016, they stood at about US \$40 billion, accounting for almost 67% of the

country's total exports, including raw primary products (\$16 billion USD) and agricultural manufactured goods (\$23 billion USD). Three-quarters of agroindustrial exports correspond to soybean, maize, wheat, beef, sunflower, dairy and barley production chains. Foreign sales of the soybean complex (beans, flour, oils and biodiesel) account for nearly half the agroindustrial exports and 30% of the country's total.

A high level of concentration of exports can also be observed in more specific products. Thus, most agroindustrial exports consist of soybeans, soybean meal, soybean oil, maize, wheat, beef, milk powder and barley, fruit, vegetable and fruit preparations, and crustaceans and prawns (Table 1).

Export markets for agroindustrial products also show a high degree of concentration, the MERCOSUR countries (Brazil, Paraguay, Uruguay and Venezuela), the European Union and China being the main destinations. Argentina mainly sells MERCOSUR countries: wheat, soybean oil, corn, soybean meal and pellets, whole milk and beer barley. Exports to the EU are heavily concentrated on soybean meal and pellets, and beef. Meanwhile, the main products shipped to China are soybeans, frozen beef and barley.

In recent years, Argentina's biodiesel exports have increased, making it one of the world's leading exporters, with European Union countries and the United States being the most important destinations.

Argentina's food imports are insignificant by comparison, totaling US \$2 billion in 2016. The main products purchased abroad are bananas, coffee, tuna and cacao.

II. Institutional framework

a. National Agricultural and Agro-Food Research System

In Argentina, the National Agricultural and Agri-Food Research System comprises national and public institutions, among which are the National Institute of Agricultural Technology (INTA), the National Institute of Industrial Technology (INTI), National Council of Scientific and Technical Research (CONICET) centers and national universities. Agricultural research is also undertaken by private institutions, such as the Argentine Association of Regional Consortia

Table 1. Agroindustrial exports from Argentina, 2016

Main products	Million USD	% of total
Soy complex	18.400	47
<i>Beans</i>	10.000	26
<i>meal</i>	4.000	10
<i>Oils</i>	3.200	8
<i>Biodiesel</i>	1.200	3
Maize	4.100	11
Wheat	1.800	5
Meat	1.500	4
Vegetable and fruit preparations	1.200	3
Shrimp and prawn	1.000	3
Fresh fruit	900	2
Barley	600	2
Dairy	600	2
Sub-total	30.100	77
Total agroindustrial products	39.000	100

Source: Compiled by the authors based on INDEC.

of Agricultural Experimentation (AACREA) and public-private partnerships.

The National Institute of Agricultural Technology (INTA) is a decentralized state agency with operational and financial autarchy, answerable to the country's Ministerio de Agroindustria. Created in 1956, its Board of Directors comprises representatives of the public and private sectors, ensuring the active participation of the productive and academic sectors in setting and prioritizing the institute's overall policies and strategies. INTA is composed of 15 Regional Centers, 52 Experimental Agricultural Stations, 359 Outreach Units and six Research Centers with 22 Research Institutes, providing broad national coverage. The National Programs and National Networks are the programmatic instruments organized by discipline or value chain. Regarding food safety and quality, INTA has a transversal program for the various value chains that address these issues. The National Agribusiness and Value Added Program consists of three major projects that include the following areas: development and optimization of agroindustrial processes for added value; optimization of integral quality and other strategies for adding value to food, and technological processes to add value at source in a sustainable way.

INTA is the parent organization of The Institute of Food Technology (ITA), whose research and development activities are divided into four areas: Food Protection; Biochemistry and Nutrition; Food Processing, and Physical and Sensory Analysis. INTA is linked to various public and private institutions, both national and international, with which it participates in knowledge networks.

Another key institution in the science and technology sector in Argentina is the National Institute of Industrial Technology (INTI), whose main objective is the generation and transfer of technological innovation to industry, ensuring that the quality of the processes, goods and services produced in the country adhere to global norms and trends. INTI has four centers specializing in food: Agrifoods, Meats, Cereals and Oilseeds, and Dairy. These centers seek to contribute to the technological development of

the food industry, especially food of plant origin, by providing technical support and the transfer of technology to the productive sector, by promoting technological innovation, optimizing the quality and safety of food products, as well as the efficiency of production processes, while protecting the environment.

It is also important to highlight the creation of the CONICET Food Safety Network. The general objective of this network is to develop and analyze scientific and technological information on the current status of Food Safety to serve as the basis for the adoption of public policies. To this end, the Food Safety Network encourages and promotes the interaction of CONICET with national and international health institutions that manage risk from a Food Safety perspective. At the same time, it provides technical assistance to assess and substantiate priority issues for the country's food safety.

b. Universities and Research Institutes

Argentina currently has 54 public and 49 private universities, with a significant concentration of national university establishments in the Buenos Aires Metropolitan Area. At the undergraduate level, a significant number of public and private universities offer degree programs in the areas of food and nutrition, such as a BSc in Food Science and Technology, a BSc in Food Technology, a BSc in Food Sciences, Food Engineering and a BSc in Nutrition. There is obviously a difference in the profile of the degree programs offered in these areas between the public and private spheres. In the first case, there is a marked preference for courses related to science, technology and food engineering, particularly in Academic Units of Exact Sciences, Agricultural Sciences, Veterinary Sciences and Engineering, whereas in the second case, nutrition programs prevail, particularly in Academic Units related to Health Sciences.

At the postgraduate level, public universities offer Master Degree Programs in Food Science and Technology, Food Technology and Hygiene, Food Technology, Food Safety and Quality and Agribusiness and Food. Only three public universities offer doctorates specifically in Food and Nutrition; in the others, they are subject-based (doctorates in chemistry, biochemistry,

engineering, or medicine, etc.), even though students have been trained in the field of food, food safety or nutrition.

At the undergraduate level, the infrastructure of the Argentinian university system, both public and private, is extremely varied; investment is required, particularly for buildings and latest-generation equipment for students.

The national university system has several research groups in the area of science, technology and food engineering, which includes study groups in the areas of food and nutrition security. The degree of development of the latter varies, as does their infrastructure. Many of these groups are located exclusively in the university area, while others, particularly the most consolidated ones, depend on a university and on CONICET or other provincial entities such as the Commission for Scientific Research of the Province of Buenos Aires. Most of the consolidated groups that undertake their activities in the area of food are multidisciplinary, comprising Biochemists, Engineers, Chemists, Agronomists and Biotechnologists. These groups undertake experimental activities, at the laboratory and pilot-plant level, as well as theoretical modeling studies. The lines of research-of-interest are modified according to the latest developments in the national and international fields, and incorporate new technologies and equipment. Many of these centers have research projects related to nutrition and food security, addressed from a variety of perspectives.

A recent study commissioned by the Ministry of Science, Technology and Productive Innovation shows that in the 2009-2014 period, the publications with the greatest impact at the international level correspond to the area of food science, which includes at least partly the topics-of-interest. This area combines a low share of the country's total publications with a very high impact.

Both public and private universities and research groups/centers/institutes train human resources with the skills currently required. It should be noted that despite the importance of the food sector for the country, the number of students who choose degrees related to food, safety and nutrition is small in comparison with traditional programs. The same trend is observed

in the number of researchers involved in these areas. Over the next few years, the programmatic development and contents of the various degree programs designed to train professionals in these areas should be overhauled, in order to provide future graduates with new tools for a much more technological world, which will probably require a smaller number of jobs.

A glaring weakness in Argentina is the low participation of the private sector in the financing of scientific and technological activities, as well as in the demand for new developments/studies of interest to the industrial sector. This fact is relevant in the food sector, including the areas of safety and nutrition.

c. Outlook for the future

Argentina is a country with several opportunities in the agri-food sector, particularly if it continues applying new technological developments and increases the added value of its products. This requires a modern, efficient system of human resource training, at both the undergraduate and graduate levels. Both public and private investment is required to improve university infrastructure and equipment. Degree programs should be overhauled to adapt them to the technological changes the world will face in the coming decades, thus equipping graduates with the tools required for their subsequent insertion into the labor market. These new program developments should take into account the need for interaction with other disciplines and interdisciplinary training. It will also be necessary to maintain and strengthen the financing of the Science and Technology sector and substantially increase the contribution of the private sector, both financially and in terms of the demand for new knowledge and development, as well as possibilities for interaction.

III. The Characteristics of Resources and Ecosystems

a. Water and the challenges for the next 50 years

Although Argentina is rich in water resources, they are unevenly distributed throughout its

territory. A single area comprising 84% of the country's water resources occupies a quarter of the total area, and accounts for 70% of the total population and 80% of the country's agricultural production. The other three quarters of the country are arid and semi-arid zones, where 30% of the total population lives and agricultural production requires irrigation.

It is estimated that the country has an average annual water supply of approximately 20,000 m³ per inhabitant and an average annual rainfall of 600 mm. Average drinking water per inhabitant is 400 liters per day, although losses in the network and clandestine connections reduce this figure to 250 liters per day per inhabitant.

In terms of the economic and social use of water, 80% of the population have a household connection to a potable water network, while 47% have a household connection to a sanitary sewer network. Coverage reaches 90% when improved sanitation systems are considered. Only 12% of collected waste water is treated before being returned to the areas for receiving water. It is important to note the link between basic sanitation services and health, since approximately 15% of the population lack access to basic sanitation services. Thus, despite being a country with abundant water resources, certain sectors of the population are unable to meet their basic needs for this resource. In the metropolitan areas of the largest cities, there is a lack of supply networks coupled with the pollution of surface and underground resources, whereas in the case of rural populations in arid and semi-arid areas, water supply capacity is compromised.

As to the use of water for agricultural activity, Argentina has an average of water withdrawals for this purpose of less than 5%, well below a situation of water stress. However, agricultural water use faces problems in certain areas, such as excessive water salinity, poor soil drainage, technologically outdated irrigation systems and low water-use efficiency.

As a counterpart to the country's wealth in this resource, Argentina's total water supply is increasingly conditioned by the pollution of rivers, lakes and aquifers by diffuse and concentrated sources. For example, the discharge of liquid effluents without decontamination treatment

affects the basins of the Matanza-Riachuelo and Reconquista Rivers in the Metropolitan Area of the City of Buenos Aires, as well as other large cities in the interior of the country, reflecting a significant degree of contamination.

At the same time, climate change poses new and increasing challenges. One of these is the increase of annual average precipitations throughout the country and the frequency of extreme precipitation. Another challenge is the increase in temperatures in the mountainous zone of Patagonia and Cuyo, due to the retreat of glaciers, the increase in river flows and the greater frequency of floods.

b. Soil

Argentina's agricultural area totals approximately 150 million hectares. About 50 million hectares are cultivated areas, distributed mainly among annual crops (soybean, wheat, sorghum) accounting for nearly 30 million hectares, and cultivated pastures used for livestock production, occupying 12 million hectares, the remainder being allocated for other industrial crops (cotton, sugar, mate, tobacco and tea) and fruit and vegetable production.

Since 1990, Argentina has had a Soil Atlas, which classifies soils according to their capacity for use. The total estimated area of the best soils for crop production, classified in classes I, II and III, is approximately 46 million hectares. Given that the new technologies make it possible to cultivate some of the soils classified in class IV (with some restrictions), it is estimated that 8 million ha of this type of soil could be added, bringing the total available area to 54 million ha.

Historically, agriculture was developed on the best soils. However, technological progress enabled it to expand to land with a lower yield in the pampean zone as well as the NE and NW of the country. Although it involved an economic-productive improvement for the region, this expansion entailed other aspects in addition to social ones, related to soil erosion. Thus, pampean agricultural expansion occurred at the expense of pastures and the remnants of natural pastures, while expansion toward the NE took place at the expense of native forests. For example, the Gran Chaco ecoregion has been particularly affected

by deforestation rates higher than the continental and world averages (0.82% per year in Argentina, 0.51% in South America and 0.2% worldwide), as transgenic soybean has been introduced.

This has led to the conversion of natural lands into farmland, which has increased the erosive process. Erosion has a negative impact on watercourses, riparian environments and sumps, which results in higher rates of sedimentation and clogging, eutrophication, and the reduction of the regulation capacity of the hydrological regime, therefore, greater flood intensity. Moreover, the land incorporated into the agricultural production process has also been contaminated by pesticide residues and other agrochemicals.

Argentina's challenges include the establishment of a national soil health monitoring system, increased investment in activities that promote sustainable management, the creation of programs to reduce its degradation and the recovery of degraded soils. In this respect, new technologies are particularly important for reducing the toxicity and environmental impact of agricultural activity.

c. Energy resources

The Argentinian Energy Matrix, which indicates the availability and incidence of each energy source in the total supply, shows that most of the energy consumed by the country is of non-renewable origin (about 90%), primarily natural gas and oil, while 8% corresponds to renewable energy. It should be noted that this composition is important regarding environmental aspects, given the link between fossil fuels and global warming.

Conversely, the country has energy opportunities that require development, for which technologies are available. The first opportunity lies in the degree of insolation of much of Argentinian territory, which would allow the use of solar energy. At the same time, the coastal area, particularly the Patagonian region, has winds that can be used to obtain wind power. The third option lies in the scope of national agricultural activity, where crop biomass has an enormous potential for obtaining biofuels such as biodiesel and bioethanol, as well as biogas.

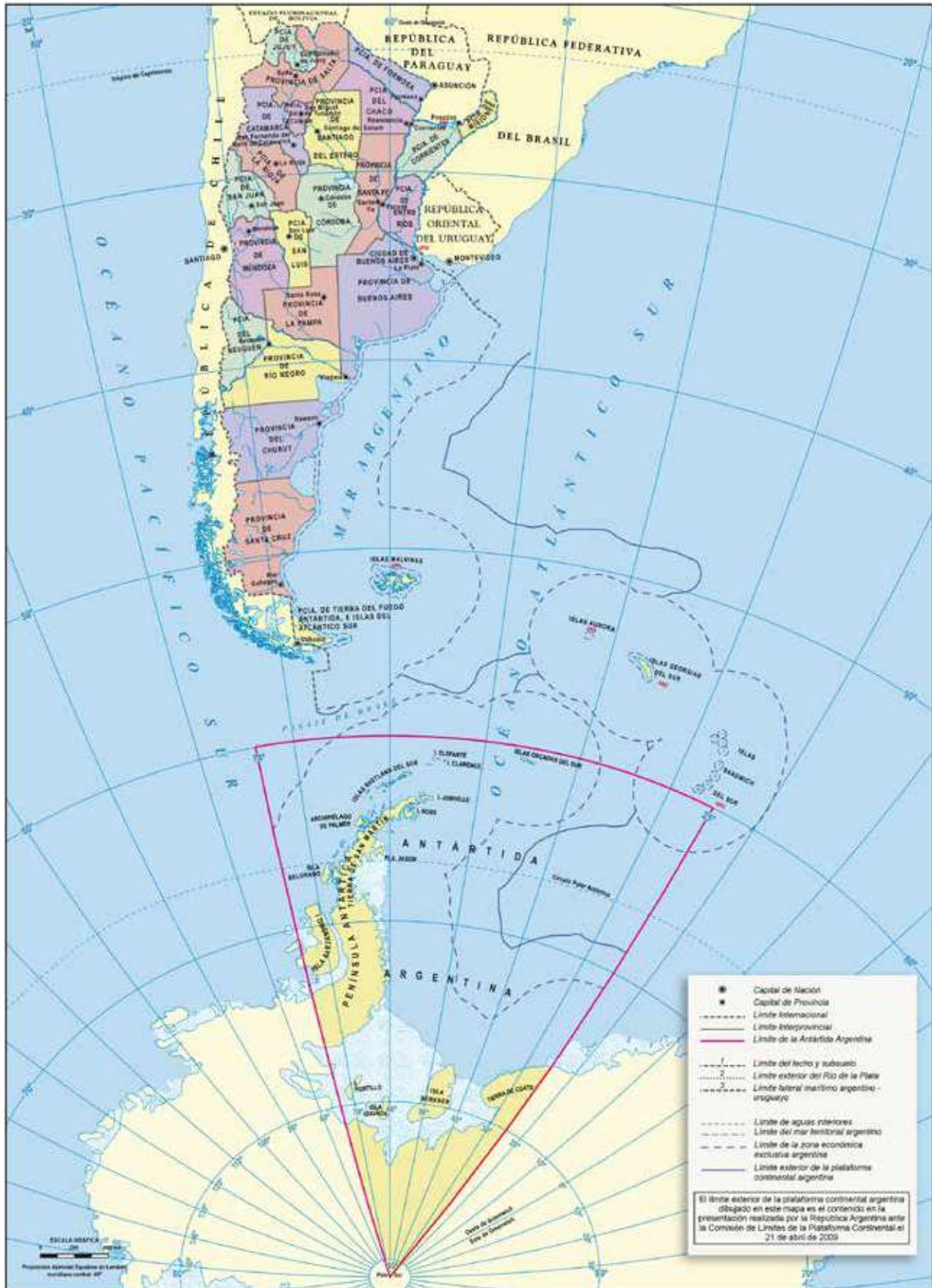
The importance the country places on renewable energies through norms and programs that encourage their use, such as the National Development Regime for the Use of Renewable Energy Sources and, recently, the RenovAr Program, which launched a call for proposals for the incorporation of renewable energy sources into the electricity system suggests that in the future, renewable energies will increase their presence in the country's energy matrix.

d. Forestry

The size of its territory and its diversity of climates mean that Argentina possesses significant forest wealth. This in turn favors climate regulation, biodiversity, water basin protection, soil conservation, water supply and ecosystem maintenance. The country boasts 1.2 million ha of forest plantations and 50 million ha of native forests. Implanted forests are dominated by rapidly growing species such as pine and eucalyptus. Native forests, however, contain trees such as red quebracho, carob and white quebracho.

The country has comparative advantages as regards forest production. It is estimated that the average yield rate is 25 cubic meters per year. In the country's most productive areas and with proper management, greater yields are obtained: 33 cubic meters per year in conifers, doubling the average of the main countries, and 43 cubic meters per year in eucalyptus.

Among the challenges facing forestry in terms of environmental sustainability, is the increase in the number of hectares of established forests and working on lines of research to achieve the genetic improvement of species. It is also essential to overcome the tendency to reduce the area of native forest to make room for other activities, particularly when deforestation is not properly handled or protected. For all these reasons, the sanitary status achieved must be maintained. It is also crucial to make progress with respect to the final use of the products and by-products created along the value chain, especially with regard to mechanical processing residues from wood and forest waste from the extraction of forests, which can be used as forest biomass for energy generation.



Argentina's features make it one of the world regions with greatest natural advantages due to the rapid growth of its plantations and its productive potential, with the possibility of increasing forested hectares and creating a significant economic and environmental impact.

e. Agriculture, environment and climate change

Recent years have seen setbacks in environmental issues. Air and water pollution, waste and deforestation have become serious problems, together with increased use of agrochemicals.

Structural change from traditional grazing to intensive farming entailed significant environmental externalities. The introduction of direct seeding implied new possibilities in areas that were closed to crops due to water constraints by turning them into productive land. However, the expansion of the agricultural frontier has also been largely due to deforestation, mainly by allocating new areas to soybean cultivation. Thus, between 1990 and 2015, nearly 20% of the forest area was cleared, particularly in the North of the country. Deforestation rates in this region reached alarming rates. Between 2001 and 2014, Argentina lost about 50,000 km² of wooded areas, equivalent to the size of Denmark or Belgium.

Forests play a critical role in carbon sequestration, biodiversity conservation, soil fertility, watershed protection and flood prevention. Deforestation in the upper basins of the main rivers is related to riparian floods, responsible for half the damage caused by the country's natural disasters.

Climate change has also made its effects felt in the country. Since 1960, average annual rainfall has increased by 3.5% per decade, while the share of intense rainfall events has risen by 1.7% per decade, increasing the incidence of floods. In most of the country, the temperature has risen by almost half a degree Celsius since 1960, whereas in the southern region it has increased by 1°C.

Projections suggest that the country as a whole will experience a rise in average temperatures, together with an increase in

rainfall. Climate change is likely to substantially alter agricultural productivity. Thus, some crops such as maize will see a decline in yields, while others, such as soybeans, could benefit from expected climate changes, which could translate into an increase in productivity of approximately 35%, due to the increased availability of water in the month of February. In this context, and in line with past events, land degradation and land conversion are environmental threats that are a matter for concern.

The impact of farming on the environment and public health should therefore be adequately properly assessed, taking into account the fact that environmental degradation disproportionately affects lower-income populations.

IV. Technology and Innovation

a. The Role of biotechnology

Innovation is fundamental in Argentina, whose industry is based largely on small- and medium-sized enterprises and innovative entrepreneurs. Agricultural entrepreneurs have the same idiosyncrasy, characterized by their level of technical training and speed in acquiring new technologies. Among these, biotechnology has played a significant role in recent years.

The advent of biotechnology applied to agricultural activity in the late 1980s fell on fertile ground. At that early stage, two issues seemed promising: on the one hand, the genetic transformation of plants and, on the other hand, the production of plants by tissue culture. The innovation was produced by a company that appropriated the tools for transgenesis and those required for the regeneration of plants from somatic cells, either to support transgenesis or to obtain commercial clones. As for animal biotechnology, the initial interest was linked to breeding, mainly through semen-conservation and embryo-transplantation techniques.

i. Agricultural biotechnology

Although materials obtained from tissue cultures for the provision of fruit and vegetable

companies were available from the early 1990s, the key moment in the history of Argentinian biotechnology was marked by the emergence into the market of the first transgenic event: the glyphosate herbicide-resistant soybean, which began to be planted in 1996 and which, in four years, covered almost the entire area under cultivation with this crop. This was followed by maize resistant to lepidopteran and coleopteran insects due to the incorporation of the *Bacillus thuringiensis* toxin gene. These two species, together with cotton, represent all the genetically modified organisms in production in Argentina, significantly exceeding 90% of use in all cases. Although there are numerous variants and combinations, they are all related to herbicides and insect resistance. A virus-resistant potato and a drought-resistant soybean have recently been approved for marketing. These two cases are interesting for two reasons: the events do not involve resistance to herbicides or insects and both were developed in Argentina.

ii. Agricultural biotechnology

There are many aspects in which animal biotechnology can contribute to production. However, in the same way or to an even greater extent than what happens with plant biotechnology, society's misgivings make it difficult to produce materials obtained from these tools. Cloning and transgenesis are the two topics that have elicited the greatest interest.

iii. Pests and diseases

Due to the intensive use of materials with identical characteristics of insect resistance (the Bt gene) and herbicides (glyphosate), resistance appeared in animal pests and weeds. The use of shelters and crop rotation, both of which were advisable, have not been widely accepted by producers, which puts these technologies at risk. The technical response to alleviate these deficiencies is based on the generation of transgenics resistant to other herbicides (2,4-D, for example) and gene stacking. While these alternatives achieve a short-term response, they do not answer – and may even increase – the doubts of certain sectors of society.

b. Prospects for new agricultural products

Three “waves of agricultural biotechnology” have traditionally been mentioned. The promises biotechnology made to society included a first wave of genetically modified materials aimed at increasing yields with the aforementioned insect and herbicide resistance events. During the second wave, the genes incorporated would create an improvement in the nutritional quality of the materials destined for human consumption, whereas with the third wave, transgenesis would turn plants into manufacturers of products destined for agroindustry (“*agrofarming*”) and the pharmaceutical industry (“*agropharming*”). Although there are some specific cases, such as soybeans with better quality oil or the famous golden rice, interest in biotechnological development has stopped at the first wave, where the immediate beneficiary is the agricultural producer. Part of society's critical view of transgenics is based on the fact that the consumer, in his risk-benefit assessment, fails to perceive the advantages of transgenics and has many doubts.

At present, there are three areas where biotechnology could provide opportunities for Argentina.

i. Transgenics

Innovation will have to explore genes that are more widely accepted by consumers, in other words, those included in the second and third waves. A crop that produces grains with greater iron availability or human insulin might elicit a more positive reaction from society.

ii. New breeding techniques

As an alternative to transgenesis, methodologies have recently emerged which, despite involving the manipulation of DNA, do not incorporate foreign genes, thus do not produce genetically modified organisms, as currently defined. Among these, gene editing using CRISPR/Cas9 technology seems to be the one with the greatest potential. The lower relative cost and the reduction of commercial regulation obstacles increase the appeal of exploring these techniques.

iii. Improvement based on sequencing and molecular markers

Sequencing techniques have become available to a large number of research groups in various countries. Nowadays, sequencing the entire genome of a species offers no difficulty for trained groups or medium-sized enterprises. Improvement based on molecular markers has therefore become a very powerful alternative. The exploration of traits in germplasm banks and the tracking of these in the offspring make it possible to achieve materials with similar characteristics to those obtained through transgenesis or gene editing. This is crucial when it comes to quantitative traits, based on many genes, such as yield, drought resistance or meat quality.

c. Opportunities and obstacles to new management technologies

Opportunities are based on the fact that Argentinian science is developed and globally competitive. The country has significant intellectual capital, with the ability to cope with the most complex technologies. However, two key points must be addressed. The first is to achieve appropriate interaction between research centers and companies, so that creative efforts focus on solving problems related to production. The second is the development and modernization of equipment and the implementation of financing sources designed to incorporate technology.

As far as agricultural biotechnology is concerned, the threats are closely linked to those faced by the national seed industry. Lack of technological growth on the one hand, coupled with the failure to recognize the value of germplasm, on the other, could lead to the absorption of these companies by multinationals, which has happened in recent years, causing a significant reduction in the number of national breeders. Most of these companies are small- and medium-sized, undertake traditional genetic improvement and are not highly technified. Unless these companies are helped to make the technological leap, they run the risk of disappearing.

Currently, in order to compete, large companies need to jump from marker-assisted improvement using "Single Nucleotide

Polymorphism" (SNP) to broad, genomic selection. In order to survive, many companies will need to begin venturing into marker-assisted selection, even the most basic ones. National seed companies that market transgenic materials incorporate the events of multinational companies. There are no developments of national events available on the market. The alternative for growth and competitiveness is based on the New Improvement Techniques (NBT) and molecular improvement. In order to sustain these initiatives, it will be necessary to provide the country with data sequencing and analysis platforms in a representative amount. Installed capacity is currently substantially lower than that of other countries on the continent.

A similar situation has been observed in livestock biotechnology. Improving major breeds requires substantial support for sequencing techniques, particularly data analysis.

d. Marine resource development

Argentina has contact with ocean waters in the East, since it has an extensive maritime area with natural features that allow the existence of a diversity of fishing resources. The most important species, in terms of the volume of their catches, are hake, squid and shrimp. A considerable part is destined for export, representing an income of approximately \$1,500 million USD a year. Per capita consumption is estimated at between seven and eight kilos per year, well below beef consumption.

In recent years, "Pampa Azul" has been launched, a strategic scientific research initiative in the Argentine Sea that includes exploration and conservation activities, technological innovation for productive sectors linked to the sea and scientific dissemination aimed at the public in general.

V. Increasing the efficiency of food systems

a. Technology applied to agricultural production

Technological and organizational changes in the value chains of major cereals and oilseeds, as well as the better international conditions recorded in the past two decades, resulted in significant

increases in the productivity of these crops. Yields have steadily risen on the basis of technological packages involving high-yield seeds, agrochemicals, direct seeding, precision machinery for sowing and harvesting and better crop and product management throughout the value chain. Thus, the productivity of annual crops grew at much higher rates than livestock production, resulting in higher relative margins per hectare and contributing to the expansion of the area planted with grains and oilseeds.

Argentina is one of the leading countries in the use of these technological packages, with almost 23 million hectares dedicated to genetically modified soya, maize and cotton. Since the introduction of these technologies in the country began in 1996 with the adoption of glyphosate-tolerant soybeans, another 20 events have been approved: 15 for maize; three for cotton, and two for soybean. Thus, the area planted with these genetically modified crops amounts to 100% of the total in the case of soybeans, 86% of the total in the case of maize and 99% of the total in the case of cotton. The dynamics of the adoption of these technologies by Argentina is nearly unprecedented in the rest of the world. The similarity of agro-ecological conditions facilitated the transfer of new technologies.

b. Technological changes in agriculture

However, these technological packages are not used to the same extent by those engaged in agriculture. Since there are significant differences or gaps among the productivity levels of the various producers, it would therefore be possible to obtain significant productivity gains if these differences were eliminated. Moreover, there are technologies currently present in advanced countries that could be adopted for use in the country.

In the first case, it has been estimated that narrowing the current technological gaps would significantly increase productivity. **Table 2** shows the productivity gains by product type derived from narrowing the gap between High (HTL) and Low Technology Levels (LTL), on the one hand, and between HTL and Medium Technology Levels (MTL) on the other. Thus, for example,

narrowing high and low technological gaps could result in 155% productivity increases in beef, 109% increases in sunflower and 100% in wheat, while closing the gap between high and medium technologies would, for example, result in productivity increases of 62% for beef, 36% for sunflower and 34% for sorghum.

At the same time, there are a number of technologies with advanced development that are expected to reach conditions for commercialization over the next decade, which could affect the evolution of the production and productivity of agriculture in Argentina. **Table 3** displays examples of these technologies.

Technological improvements, whether through narrowing the gaps among producers or incorporating new packages, are crucially dependent on the government policies that affect these decisions. These include the incentive to invest in these technologies, the existence of programs that facilitate technological diffusion and transfer and appropriate regulatory frameworks for these activities.

Other aspects that may influence the evolution of the perspectives of new technologies for agriculture are the regulatory framework related to biosafety and intellectual property issues. Biosafety regulations are very important when using genetically modified crops. Intellectual property issues are essentially related to the seed market. Although Argentina has an intellectual property protection system in place, the prevailing situation in the seed market is the presence of an illegal market that significantly reduces the capacity to protect innovations and to recover research and development investments.

VI. Health Considerations

a. Foodborne diseases

The human body is constantly exposed to toxic substances of different origins and subject to metabolic imbalances that affect its health, which can trigger acute or chronic diseases. One of the most significant health problems

Table 2. Productivity increases due to narrowing of technological gaps in % yield per hectare per year

Products	LTL-HTL Gap	MTL-HTL Gap
Barley	54%	21%
Beef	155%	62%
Cotton	50%	20%
Maize	70%	30%
Peanuts	80%	33%
Rice	60%	19%
Sorghum	66%	34%
Soybean	67%	21%
Sugar cane	44%	25%
Sunflower	109	36%
Wheat	100%	29%

Source: Trigo (2016)

Table 3: Examples of new biotechnologies

Products	Technologies
Maize	<ul style="list-style-type: none"> • Improved herbicide tolerance • Insect resistant and greater yield • Stress-tolerant (1st generation of drought tolerance)
Soybean	<ul style="list-style-type: none"> • Improved herbicide tolerance • Insect resistance • Greater yields • Greater oleic oil • Omega-3 enriched • Low in saturated fat
Rice	<ul style="list-style-type: none"> • Herbicide tolerance • Golden rice 1 (Beta-carotene enriched) • Golden rice 2 (Beta-carotene enriched)
Wheat	<ul style="list-style-type: none"> • Herbicide tolerance • Drought tolerance

Source: Trigo(2016).

worldwide is foodborne diseases, known in Spanish as ETA, which are caused by the consumption of food or water contaminated with microorganisms or parasites or by toxic substances produced by them. At present more than 250 ETA are known whose cause may be infectious or toxic. The most vulnerable groups to these diseases in Argentina are children under 5, the elderly and expectant mothers.

Argentina has a normative framework for the control and prevention of diseases and health problems associated with food, as well

as a group of organizations responsible for this issue. The Argentine Food Code (CAA), in force throughout the national territory, is the technical regulation that establishes the hygienic-sanitary, bromatological- and commercial-identification provisions that must be complied with by establishments, natural or legal persons and products within its sphere. It therefore describes the conditions in which foods must reach the consumer so that they are safe. It consists of 22 chapters which include provisions referring to the general conditions of factories and food

shops, food preservation and treatment, use of utensils, containers, containers and wrappers, specifications regarding different types of food and beverages, auxiliaries and additives, and food labeling and advertising standards.

The National Administration of Medicines, Food and Medical Technology (ANMAT) is a decentralized agency, under the Ministry of Health of the Nation, which contributes to the protection of human health, ensuring the effectiveness, safety and quality of medicines, food and medical devices. In the particular case of food, this is done through the National Food Institute (INAL), where INAL-ANMAT has a food surveillance system and can participate as extra-sector actors in the laboratory surveillance system run by the System National Health Surveillance of the Ministry of Health of the Nation. CONICET has recently implemented a Food Safety Network, whose overarching objective is to develop and analyze information related to food safety.

The safety of the food production chain varies considerably throughout Argentina: Large enterprises coexist with international quality management and certification systems, and small- and medium-sized enterprises that have begun to work with good manufacturing practices and hazard analysis and critical control points; and with artisanal and regional producers, fairs and markets with restricted access to these systems. It is therefore necessary to strengthen this branch of activity, within the framework of a federal system of effective, coordinated surveillance.

b. Overweight and obesity

Argentina, like the rest of Latin America and the world, faces another serious public health problem related to overweight and obesity. The latest world map on the prevalence of overweight, recently released by the World Health Organization (WHO), says that North America and Europe are the continents with the greatest problems of obesity. In South America, Argentina is among the countries with the highest proportion of overweight individuals, 63.9%, while the obese population accounts for 23.6% of the total. These figures are worrisome,

given that within a decade obesity in Argentina increased by over 60% (the value corresponding to 2005 was 14.6%).

As in the rest of the world, the causes of overweight and obesity are changes in habits of the population, particularly those related to a marked increase in physical inactivity and a change in diet reflected in a growing intake of processed foods, fast foods and above all, sugary drinks, crackers and cookies. Moreover, Argentinians consume insufficient amounts of fruits and vegetables (about half the recommended amounts). One of the most vulnerable populations is children and adolescents: one in three adolescents between 13 and 15 years old is overweight or obese. According to WHO, Argentina has a high percentage of obesity in children under 5, with a prevalence rate of 7.3%. Obesity is a prevalent disease at all levels of income, making it a public health problem.

Undoubtedly, beyond what has been done to date, Argentina faces the challenge of reducing foodborne diseases and drastically modifying the population's eating habits to reduce the serious problem of overweight and obesity it faces. It is essential to obtain reliable statistics that will include all the country's social classes and regions and find new ways to educate the population about the influence of food on health and change, not only their eating habits, but also their lifestyle.

Since obesity is part of the metabolic syndrome and constitutes a risk factor, it is an indication of an individual's susceptibility to various noncommunicable diseases, particularly cardiovascular diseases, type 2 diabetes *mellitus*, sleep apnea, osteoarthritis, certain forms of cancer and dermatological and gastrointestinal diseases. According to official data, noncommunicable diseases account for just over 70% of deaths, particularly cardiovascular diseases (40.2%), followed by cancer. These diseases are also the main cause of potentially lost years of life and require the use of significant health resources.

In recent years, the population has become increasingly aware of the incidence of good nutrition in reducing chronic diseases. The production sector has accompanied this awareness through the introduction into the market of various functional foods, particularly in

the dairy and bakery chain. However, legislation has not accompanied this process, since so far there has been no specific regulation regarding functional foods and possible function and health claims. In the scientific-technological sector, many working groups are engaged in the search for new foods and/or bioactive components and the study of the physiological bases that demonstrate their beneficial action for consumer health.

c. Incentives to change patterns of consumption and personalized nutrition

In order to encourage changes in consumption patterns, the state is promoting actions designed to directly affect companies in the food value chain as well as consumers. The Ministries of Health and Agroindustry of the Nation made an agreement with the Coordinator of Food Product Industries (COPAL) in order to promote a healthy, balanced diet. In particular, it will work to reduce critical nutrients in food production, such as fats, sugars and sodium. It will also encourage smaller portions in certain foods that are harmful in excess, especially for children. An important aspect to be addressed is the reduction per capita of beef consumption, an important component of the consumption pattern of Argentinians, which currently stands at 70 kilograms per inhabitant.

With regard to consumers, the aim is to work on education as a key success factor, therefore incorporating these issues into schools, as well as into the information provided to society in general, through food labels and responsible advertising practices. Specifically, in schools, the authorities have begun to promote the introduction of food and nutrition education into school curricula, in addition to regulating the incorporation of a supply of healthy food into shops and school cafeterias.

With a longer-term, more complex vision, it is important to point out the progress being made in other nations, which Argentina must achieve. Beyond the physiological effects of the components of the diet, the genetic base of each individual is fundamental. In more developed countries, significant progress has been made in linking genes to diseases and the effect of food components on the expression or silencing of these genes. The ultimate goal of these studies

is to achieve personalized nutrition based on each individual's genetic load. Argentina is still a long way from being able to achieve this type of nutrition. A major challenge is for these developments to be available to the entire population rather than to just a select few.

VII. Policy considerations

a. Policies for a more efficient and environmentally sustainable agriculture

The Argentinian agricultural sector is traditionally competitive, particularly in certain products such as soybean, wheat and maize and their derivatives, as well as beef. Global demand for agricultural products is expanding for a number of reasons. These include increased food demand, mainly through the incorporation of part of the world's population into higher income segments, the use of plant sources for energy production and also their use through biotechnology, for example, in the production of industrial inputs and the food industry. This scenario generates good prospects for the country's productive activity while at the same time posing the challenge of joint work between the public and private sectors.

The country has replicated the global market structure, which has become more complex and concentrated in large players. This latter feature could encourage the achievement of a substantial technological leap, but it requires Argentina's insertion into agroindustrial value chains to prevent it from being relegated to the mere provision of raw materials or first-stage processing products, as is largely the case at present. A fundamental characteristic of this challenge is that it be achieved in a balanced way, in other words, through an equitable, environmentally sustainable income distribution process firmly rooted in the local economy, in order to create a spillover effect into other productive sectors.

To this end, traditional policies must be implemented that seek to improve profitability, family farms must be incorporated with a greater degree of market access, while transparency in price formation must be improved. A set of

policies are also required to work on responsible, environmental sustainability for this activity, while scaling up value aggregation within the global value chain of biological origin.

The objectives of these policies focus on:

- a. Encouraging sustainable development in order to promote the increase of agroindustrial supply to enable it to be directed to both the domestic and overseas markets. This increase must go hand in hand with an improvement in the standard of living of small producers. This requires the development of mechanisms to ensure the achievement of competitive, transparent prices, freedom to market, the facilitation and extension of access to credit, the increase in the supply of insurance against production losses, the effective dissemination of Associativism tools and their advantages and the adoption of good practices with the incorporation of the corresponding technology.
- b. Improving competitiveness through the incorporation of technology and knowledge, tax promotion and the improvement of logistics and infrastructure.
- c. Advancing international insertion through global value chains while advancing beyond its current stage of being a supplier of raw material and first-stage processing products. To this end, good agricultural practices are important, such as the consolidation of the formalization of certain tasks or productive links, as well as a suitable regulatory framework for international standards. All of this must be accompanied by a trade policy that improves Argentina's market access conditions.

i. Financing

In order to achieve these objectives, various types of policies must be developed. Expanding access to the financial system is crucial to the sustainability of agricultural production and the growth and modernization of the latter. This requires maintaining and improving existing lines of credit for investment and working capital, facilitating credit conditions, and implementing

new lines, together with technological and environmental aspects, as well as joint activity by the producer rather than just the financing of a product. In order to promote access to credit, it is essential to change current regulations, and above all to encourage access by small producers and rural contractors. This should be complemented by the development of new financial instruments, such as making it easier for agribusiness companies to go public and reciprocal guarantee tools.

ii. Competitiveness

In terms of advancing the search for competitiveness, this involves not only maintaining a competitive exchange rate and limiting tax distortions on the final product, but also working on various aspects of the value chain, including infrastructure and logistics (transitability of roads, rail transport system, navigability and port system, energy works, works to contain floods, etc.), sanitary and phytosanitary aspects, more and better access to market information, reference markets for non-traditional products and minimizing concentrated groups' abuse of their dominant position, among other aspects. Some of these points are particularly significant for small producers and their sustainability and growth over time.

iii. Environmental legislation

In terms of environmental legislation, a law must be passed on Minimal Budgets for Environmental Land Management, drawing up a strategy for the use, handling and resolution of conflicts related to the soil and associated natural resources. It is also necessary to advance a Water Use Law in order to regulate the use of this resource in an environmentally friendly manner and reduce the underlying conflicts between provincial and municipal jurisdictions. A similar situation should occur with land use. In the latter case, it is necessary to draw up Phytosanitary Management and Application regulations that will provide a framework of safer applications, taking care of the environment. In forestry, it is necessary to work on the implementation of Native Forests Law No. 26,331 in various parts of the country, in order to facilitate its implementation, as well

as to promote forest development, particularly in erosion-sensitive areas. Regulating the advance of the agricultural frontier and its planning is a priority task for environmental preservation.

iv. Research, innovation and development

Work is also required on the research, innovation and development component. The country must develop specific legislation in order to provide credit incentives and encourage risk capital investment for the development of new technologies. From an operational point of view, public research, innovation and development institutions should be able to provide modern legal instruments that provide agility, flexibility and autonomy in resource management to work in conjunction with other associations related to the value chain (public-private consortia and special-purpose entities), implement subsidies and tax incentives for the establishment and operation of technology parks and incentives for patent registrations. In order to speed up the incorporation of issues being dealt with in other parts of the world, which would facilitate environmentally responsible production with added value, it is essential to work to promote the internationalization of these institutions as a way of incorporating new knowledge and speeding up technology transfer.

One of the topics that require particular attention is strengthening advanced research (biotechnology, nanotechnology, earth sciences) in sustainable production systems, competitive biomass products and production models that combine high productivity with efficient resource use, while maintaining resistance to pests, diseases and climate change.

v. Energy Matrix

One of the technological aspects that can be developed is the agro-energy component. This gradual conversion of the energy matrix to renewable energy sources requires a policy that will prioritize clean energy production, as well as promoting the production of hydrated ethanol; linking the state's role to the announcement of public tenders for electricity, taking into account the environmental, electrical and economic attributes of the use of bioelectricity. Industry

sources propose instituting a differential auctioning program by source and/or region as a key factor in enabling power generation from biomass.

vi. Food and human health

Another issue that must be worked on is agrifood protection. To this end, it is necessary to strengthen the economic and human resources of control agencies, to prepare and update them according to international standards and at the same time, to enable them to access small producers' markets. Effective access to up-to-date information, control procedures and the implementation of good practices are a key aspect of the process.

In order to progress steadily in all these points, it is essential to have human resources trained in both theoretical and management aspects. To this end, both the state and the private sector should allocate funds to the development and dissemination of technical and university degree programs, as well as to specializations in environmental issues and their application in various types of production.

From the point of view of the consumer, there are two aspects that must be achieved on a massive scale to raise awareness about environmental and health issues in terms of the responsibility associated with purchase decisions. The first of these is education, which requires incorporating information and debate from an early age. The daily application of responsible consumption at a young age should be massive and available to all socioeconomic levels. At the same time, the state can act by providing financial incentives for consumers who choose to consume responsibly. Civil associations are another alternative, which play an increasing important role in consumer awareness. The development of indicators by degree of corporate responsibility in environmental aspects and in terms of healthy products is an example of some initiatives by this type of association that end up influencing a larger sector of the population.

Last, it is necessary to promote the collection of statistical data of appropriate quality to be used as the basis for risk assessments, and to enable the state to promote a systematic survey

of information on the country's nutritional and health status, and how they influence eating habits, through comprehensive consumer surveys of the population. It is also vital to promote the development of new foods with improved nutritional profiles and instill healthy lifestyles in the population for the various age groups and people who need special diets, to promote public policies that encourage the incorporation of new processing technologies, emerging technologies and incorporate new technologies (processing, nanotechnology, functional foods, etc.).

b. International trade, food security and global governance

World food production and consumption projections indicate that geographical divergence between production and consumption will increase. International trade will therefore become increasingly important as a mechanism for balancing needs and availability. In this respect, then, there is and will be a growing link between food security in many countries, particularly net food importers, and the trade policies of other countries, which are usually net food exporters.

In the context of the sharp rise in food prices, a proliferation of policies aimed at improving or preventing worsening food security was recorded in many countries in

2007-2008. Several of these policies were defensive and some had negative impacts on international trade, further damaging food security, particularly in net food importing countries.

Examples of these policies include domestic production support, export taxes and quantitative restrictions - including bans - on exports. Argentina was one of the countries that adopted some of these policies in order to decouple domestic prices from the rise in international food prices. Many of these measures were implemented within the framework of World Trade Organization (WTO) agreements as well as outside them.

This strong link between international trade and food security, and the experience of what happened during the 2007-2008 food crisis, point to the need to build institutional instruments that allow a certain degree of capacity for the global governance of food and nutritional security,

thereby restoring confidence in international trade as an adequate food source. An agreement between net exporting and importing countries, with supply commitments and market access, could be one route toward a multilateral food security agreement.

VIII. Abstract

The agricultural sector is of vital importance to Argentina, not only because of its impact on the creation of domestic wealth, but also due to its key role as a net food exporting country. Despite its importance as a food producer, there are currently around 9 million people living in poverty, 1.7 million of whom lack food and nutrition security.

The country is a major producer of cereals, oilseeds, industrial crops, fruit and vegetables, beef and dairy products, as well as a significant global exporter of some of these products. The agricultural sector is currently undergoing a technological, organizational and productive paradigm shift, with the emergence of new economic actors, giving rise to a very different organizational model from the traditional one.

Although the country has a large national agricultural and agri-food research system, public and private investments are required to improve its infrastructure and equipment, and to reverse the low participation of the private sector in the financing of scientific and technological activities related to these issues.

Argentina has an abundance of water, coupled with good soil quality. However, pollution and climate change are affecting the availability of these resources. For its part, the energy matrix makes intensive use of non-renewable energy, although the country has many objective possibilities of developing alternative energy sources.

Technological and organizational changes in the value chains of major cereals and oilseeds have led to significant increases in the productivity of these crops. However, these technological packages are not used to the same extent by the actors in agricultural activity,

meaning that significant productivity gains could be achieved if these differences were reduced. Moreover, the country could adopt technologies that are present in more advanced countries, which would also boost productivity.

Thus, Argentina has every possibility of achieving a sustainable increase in food production, based on its high level of competitiveness and its wealth of natural and human resources. These possibilities must be

consolidated through long-term state policies that promote investment and increased funding for innovation, research and development. A consensual strategy must be implemented for agricultural activity and food production that strikes a balance among economic, social and environmental sustainability.

These possibilities of the country imply that Argentina is in very good condition to collaborate with the global food and nutrition security goal

References

- Anlló, G., R. Bisang y M. Campi (2013). *Claves para repensar el agro argentino*. Buenos Aires, EUDEBA.
- Banco Mundial (2016). "Análisis Ambiental del País: Argentina", *Serie Informes Técnicos* N° 9, May 2016.
- Bianchi, E., M. Piñeiro, M. Trucco and L. Uzquiza (2010). "Food Security Policies in Latin America", *Series on Trade and Food Security, Policy Report 4*, International Institute for Sustainable Development.
- Geografía de la Argentina*. CREDILIBRO, Ediciones Credimar, 1998.
- González, Leandro M. (2015), "Proyecciones de la población argentina a lo largo del siglo XXI", *Notas de Población* N° 101, July-December 2015, Año XLII, pp. 37-58. Santiago, CEPAL, Naciones Unidas.
- GPS (2015). *Objetivos y políticas para la agroindustria argentina 2015-2020*. Grupo de Países Productores del Sur, January 2015.
- INDEC (2013). *Estimaciones y proyecciones de población 2010-2040: total del país*. Instituto Nacional de Estadísticas y Censos.
- Interamerican Network of Academies of Sciences (IANAS) & Foro Consultivo Científico y Tecnológico, AC (2012). *Diagnóstico del Agua en las Américas*. México, March 2012.
- Ministerio de Ciencia, Tecnología e Innovación Productiva (2016). *Biotecnología argentina al año 2030: Llave estratégica para un modelo de desarrollo tecno-productivo*. Digital book, November 2016.
- Ministerio de Planificación Federal (2011). *Plan Estratégico Territorial Avance II: Argentina Urbana. Lineamientos Estratégicos para una Política Nacional de Urbanización*. Ministerio de Planificación Federal, Inversión Pública y Servicios.
- OIM (2012). "El Impacto de las Migraciones en Argentina", *Cuadernos Migratorios* N° 2, April 2012, Organización Internacional para las Migraciones, Oficina Regional para América del Sur.
- Pascale Medina, C., M. Zubillaga and M. Taboada (Eds.). *Los suelos, la producción agropecuaria y el cambio climático: avances en la Argentina*. Ministerio de Agricultura Ganadería y Pesca.
- Pellegrini, Pablo A. (2013). *Transgénicos: ciencia, agricultura y controversias en la Argentina*. Editorial Universidad Nacional de Quilmes, 1st edition.
- Piñeiro, M., M. Myers and L. Uzquiza (2016). "Securing Global Food Supply: What Role for Latin American's Net Agricultural Exporters", The Dialogue and Group of Producing Countries from the Southern Cone (GPS).
- Propato, T. and S. Verón (2015). La matriz energética argentina y su impacto ambiental, *Revista Ciencia Hoy*, N° 144, July 2015.
- Trigo, E. (2016). "Potential productivity increases in the Argentine agri-food production", Grupo de Países Productores del Sur (GPS), October 2016.
- UCA (2016). "Tiempo de Balance: Deudas Sociales Pendientes al Final del Bicentenario", Observatorio de la Deuda Social Argentina (OSDA), Universidad Católica Argentina.