

Fruit frontiers

Research on feijoa cultivation in Brazil and Colombia

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Abstract: *In the twentieth century, Latin American countries were persuaded to import projects from the United States that aimed to increase production of basic commodities to supply the international market. As a result, space for agricultural practices of peasants and the cultivation of foodstuffs outside the logic of productivism shrank over time. These alternative practices were maintained in peripheral form, including the production of native fruits, feijoa (*Acca sellowiana*) among them. Feijoa was chosen due to its unique flavour, aroma and pharmacological and nutritional properties. In this article, we argue that scientific research and small-scale producers, not public policies, were the main drivers of feijoa cultivation in Brazil and Colombia. Scientists supported the increase of production and productivity of a fruit species which remained at the margins of industrial, science-based agriculture. These countries came under heavy international influence to adopt plans intended to modernize their agricultural sector. Despite being on the margins of these development plans and receiving few direct financial subsidies, research on feijoa continued. Today, while Colombia produces monocrops for export, cultivation in Brazil remains incipient and limited to smallholdings.*

Keywords: feijoa, guayabo del país, goiabeira-serrana, Environmental History, History of Science

Anthropic interferences have transformed the natural world for thousands of years. However, the changes with the greatest impact occurred during the various phases of the Industrial Revolution, when environmental alterations became more intense. From the 1940s, Brazil aligned with other countries in expanding the frontiers of agriculture. This period marked an era of anthropization, currently denominated the Anthropocene. During the Great Acceleration, as phase of the Anthropocene, changes became more accentuated, as various indicators of human activities, including population growth, urbanization, modernization of agricultural practices, increased use of natural resources and energy resources, a proliferation in the number of hydroelectric dams, among others, show (Steffen et al., 2011). Political and economic factors contributed to accelerating environmental changes and had repercussions in the following decades.

Development theory emerged during this era of Great Acceleration. Elaborated by economists, it advocated that development's primary objective should be to



promote economic growth in areas considered underdeveloped. To achieve such growth, greater economic intervention was needed from states, including the formulation of macroeconomic policies. Formulated during the Cold War, '[development's] aims were to increase the zones of U.S. influence, incorporating capitalism into the former colonies of France, Britain, Portugal and other European countries' (Mello, 2017: 22).

From the Second World War, therefore, U.S. foreign policy for Latin America underwent changes and intensified. As Nodari and Nodari review (2020: 306), U.S. functionalism drove the dominant economic thought in Brazil during the period. The U.S. expanded its area of influence in Latin America, principally through cultural diplomacy and technical cooperation (Reis, 2014: 23-29). There was a dissemination of developmentalist discourse and support for the institutionalization of international technical cooperation, especially in the farming sector. Not all agricultural practices received attention from these plans, however. These policies focused on regions containing mineral ores, areas of natural timber reserves, or localities favourable to the implantation of monocrops with a high commercial value.

This system of investments and technological support geared towards economic development through large-scale farming ignored traditional agricultural practices of peasants and other small farmers. The production of native species and the conservation and preservation of natural resources were not prioritized in government plans. However, even if they were not aligned with the interests of governments and overseas agencies, some activities agricultural benefitted indirectly from the high levels of investment channelled towards Latin American countries. In this article, we argue that scientific research and small-scale producers, not public policies, were the main drivers of feijoa cultivation in Brazil and Colombia. Brazil and Colombia came under heavy international pressure to adopt plans for modernizing their agricultural sector. Our working hypothesis is that research on feijoa took place on the margins of these developmentalist plans, though, and received few direct financial subsidies. Even so, it was able to develop, albeit incipiently.

Why study feijoa?

The feijoa fruit has unique flavour and aroma. It tastes delicious, and it is sweet-acidulated and aromatic. In addition, it can be grown by smaller farmers and is cultivated in several countries on all continents, even though at small scale. Exceptions are Colombia and New Zealand, where it is grown in larger scale. Moreover, research has shown that the consumption of feijoa can provide human health benefits.

The feijoa (*Acca sellowiana*) or pineapple guava (*feijoa* or *goiabeira-serrana* in Portuguese) is a fruit tree native to the southern Brazilian plateau and northern Uruguay. In Brazil, it is found mainly in the Pampa and Atlantic Rainforest (Mata Atlântica) biomes, more frequently in the phytophysognomy of mixed ombrophilous forest. As well as being locally known as *goiaba-serrana*, it is also called *goiabeira-do-mato* or *goiabeira-do-campo*. In Uruguay, the tree is called *guayabo del país* (Moretto/Nodari/Nodari, 2014: 70). The species was taken from South America to France (Andre, 1890) and from there introduced to other countries outside its natural area of occurrence. In the twentieth century, due to its economic potential, the species became widely dispersed to countries like Colombia, Israel, Italy, New Zealand, Russia, Turkey, Ukraine and the U.S. Today Colombia is the world's



largest exporter of the species *in natura* and New Zealand is the largest producer of feijoa subproducts (Moretto, 2014).

Between the end of the nineteenth century and the start of the twentieth, feijoa attracted attention in Europe and the U.S. and studies started to be developed on the species. For a long time, the species was neither valorized or studied in South America – not even in Brazil, the country home to its largest area of natural occurrence. It received more attention from government agencies and South American farmers only towards the end of the twentieth century, more specifically from the 1980s, the period of the return to democracy after the civil-military dictatorships. Despite not being considered a priority species for investment, studies of feijoa indirectly benefitted from the technical and scientific investments made in Latin America, one of the areas supported by U.S. development plans launched in the 1940s.

Scientific advances in nutritional, medicinal and pharmacological properties are contributing to an increasing consumption of the feijoa fruits. In the past 30 years, medicinal and pharmacological properties (Weston, 2010; Ferrara, 2020) have been accessed outside of fruit's region of origin. Feijoa fruits are rich in polyphenols, anti-cancer flavonoids (Bomtempo et al., 2007; Paquariello et al., 2015; Vuotto et al., 2000), and antibacterial and antioxidant activities (Vuotto et al., 2000). Later, a patent to the feijoa fruit extract was issued by the U.S. patent 20150157678 to be used in treatment and prevention of rheumatoid arthritis and Type-2 diabetes (Foo/Warson, 2015). More recently, chemical and biological properties (Zhu et al., 2018), and bioactive compounds and nutritional characteristics (Phan et al., 2019) and dietary fibres and bioactive compounds (Almeida et al., 2020) increase the appeal for feijoa consumption.

The choice of the countries Brazil and Colombia to be studied in this article was because Brazil is where the fruit is endemic and it is in Colombia where there is a greater production and export of feijoa nowadays. Thus, we will show how both Latin American countries were influenced by American policies for agricultural development, and both take different directions on research and production of feijoa.

The introduction of new technologies to Latin America in the wake of development plans

From the beginning of the Cold War, the U.S. developed innumerable plans and actions for Latin America. Development agencies and plans were created during this period and applied in countries considered Third World, as part of a politics of domination and exploration consistent with capitalism's precepts (Hobsbawm, 2007: 86). The plans had direct and indirect impacts on the economy, environment and even societies of the recipient countries. Alterations arising from these actions include changes in the use of natural resources, the introduction of new technologies, stimulus for the creation of training courses and a strong cultural influence.

Latin America was seen as a field of possibilities both in political terms, driven by the need to attract allies in the bipolar order of the Cold War, and in economic terms, as an important supplier of raw materials that, as a region, was still making use of obsolete technologies. Diverse U.S. government plans and agency actions were focused on Latin America. Among these we can cite, for example, the National Security Study Memorandum 200 (NSSM-200), the U.S. Agency for International



Development (USAID),¹ Peace Corps (Alliance for Progress),² and the American International Association for Economic and Social Development (AIA). Such plans met the interests of political and economic elites in South America and gave rise to complex histories of knowledge transfer, expert mobility, and multiple agencies that all converge to a story of U.S.-driven capitalist expansion. Below, we will focus specifically on U.S. policies and actions.

According to Paulo Romeu Braga, the U.S. economy had become increasingly dependent on natural resources from abroad for its continued development. This situation was made official in NSSM-200, which established a policy to ensure a continual flow of raw materials to promote the development of the U.S. economy. The focus of NSSM-200 was to ensure access to mineral ores as well as other resources. The plan stated that these resources were physically available, but that economic-political questions needed to be solved for the country to gain access to them. This required delineating 'the terms for exploring and sharing the benefits among producers, consumers and the governments of the countries of origin' (Braga, 2002: 47). The document cited the pronounced interest of the United States in the social, political and economic stability of the countries identified as suppliers of natural resources. The document lists thirteen countries of special strategic and political interest to the United States: Brazil, India, Bangladesh, Pakistan, Nigeria, Mexico, Indonesia, the Philippines, Thailand, Egypt, Turkey, Ethiopia, and Colombia (Braga, 2002).

Technical assistance activities in Latin America, Wilson Picado Umaña (2012: 133, 167) writes, advanced considerably in 1941 when an agreement was signed between the Mexican government and the Rockefeller Foundation. Its objective was to increase the food production capacity in the country, including the implementation of technical assistance projects in the health, education and agricultural sectors. Nonetheless, despite the agreement including plans for the involvement of international cooperation in all three sectors, agriculture was the area to receive the most outside resources and assistance. This is explained by the fact that, in the context of the Second World War, the search for markets supplying raw materials and basic commodities like wheat became a priority for the Americans in the face of clear Japanese expansionism in Asia (Picado Umaña, 2008: 49).

To develop the activities proposed by the Rockefeller Foundation, scientists were recruited and instructed to copy the U.S. model of research and agricultural extension in the receiving countries. In Brazil, the American International Association for Economic and Social Development (AIA), founded in 1946, was active until 1968 (Silva, 2015: 25). Created by Nelson A. Rockefeller (1908-1979), the AIA was a philanthropic agency that developed technical cooperation projects, focused principally on agriculture and soil conservation, but also encompassed health and literary programs.

The AIA took as a reference point the U.S. experiences with rural credit and extension programs, among other development strategies, and adopted these models to local conditions. The alterations to the way of life of Latin American

¹ USAID made diverse agreements to promote higher education in Latin America in order to improve human resources, especially in agricultural production. In Brazil, the agency's activities were officially sanctioned in June 1965 with the signing of an agreement between the agency and the Directorate of Higher Education of the Ministry of Education and Culture (Ribeiro, 2009).

² The Peace Corps was a U.S. government agency created in 1961 and constituted by young American volunteers who assumed the mission of combatting the 'communist threat' in Third World countries. In Brazil, the Peace Corps was particularly active in the 1960s and 1970s. For further information, see Ribeiro (2009).



societies, drawing them closer to the capitalist economy, helped maintain or amplify U.S. economic and political interests, protecting them from the growing communist threat. According to Silva, the period between 1946 and 1949 saw the consolidation phase of the AIA in Brazil, when the agency proposed diverse projects related to agricultural production, ranging from the proposal for research on hybrid maize seeds to the establishment of programs designed to stimulate the planting of crop species in the Brazilian northeast. It also promoted a cultural shift through the introduction of 4-H clubs and Home Economics courses (Silva, 2015: 204). The government of president Juscelino Kubitschek exerted greater control of extension and technical assistance activities and sponsored national policies to modernize farming. The Brazilian Association of Agricultural Credit (ABCAR) grew in strength and endorsed a rupture with the AIA.

After 1964, Brazil's civil-military dictatorship³ devised strategies for modernizing agricultural production through programs that guaranteed resources for these practices. These programs primarily focused on the production of agricultural foodstuffs, the timber industry, and the exploitation of highly profitable mineral ores. Food crops that were deemed to have little value on international markets received little or no direct support from governments. They remained on the margins of the modernization processes. Technologies were not necessarily focused on the production of native species or on the cultivation of crops with little commercial value. Feijoa was one of these underutilized (or neglected) crops. However, these products also followed in the wake of the developmentalist logic. They gained importance, albeit belatedly, in the 1980s and without receiving the same attention or support given to other crops identified as priority commodities. Actions like those focused on the training of human resources had impacts, to different degrees, on some universities and research agencies in Latin America. In the case of Brazil, the influence on teaching and agricultural extension had repercussions that persist today. U.S. technicians and specialists arriving in the country ended up occupying important positions in the leading agricultural institutions, whether as directors or as authors of programs and activities (Nodari/Nodari, 2020: 318). From this perspective, with investments in the creation and improvement of universities and study centres directed toward commodity crops, a small proportion of researchers of many countries, mainly Brazilian and Colombian, found space to develop studies on genetic conservation, physiology, crop management and breeding feijoa.

Southern Brazil, the region where the species is endemic, underwent a drastic process of deforestation and was later, around 1970, a target region of projects for reforestation with exotic plant species. On the southern Brazilian plateau, the exotic species chosen for planting were *Pinus spp* (Moretto, 2010) and apple (*Malus domestica*) (Klanovicz/Nodari, 2005). The historical scenario marked by economic development and agricultural modernization influenced the expansion in the production of these commercially important crops. Introducing *Pinus spp.* into Brazil proved harmful to the environment for various reasons, including a sizable acceleration in soil depletion mainly due to the absence of precautions taken for its implantation. The tree's seeds are wind-dispersed (anemochorous), which makes it difficult to control its dissemination. As its seeds can be dispersed hundreds or even thousands of meters away from mother trees (Richardson, 1998: 260), the species ended up occupying the space of other native plants, like feijoa (Moretto, 2014).

³ As an example, we can cite the Federal Senate Decree no. 58.382, of 10 May 1966. Available at: <http://www6.senado.gov.br/legislacao/ListaPublicacoes.action?id=189918>. This law provides a framework for the modernization of agriculture and for subsidies to farmers able to pay for these improvements.



Like feijoa, the native forests of Brazilian pines (*Araucaria angustifolia*) and their understories succumbed to deforestation and the subsequent replacement by exotic species following the logic of the international markets. Brazil not only provided raw materials, it also strove to meet foreign demands, producing and exporting what the recipients of basic commodities wanted.

When Luiz Gabriel (1965-1970) became Agriculture Secretary for the state of Santa Catarina, he presented the Fruit Executive Program for Santa Catarina (PEDF) to the community, the first attempt to stimulate temperate fruit cultivating at state level. The program focused on the cultivation of temperate fruit crops in general (Klanovicz, 2007: 84). Established by Law no. 4.263 issued in 1968, the Temperate Fruit Growing Project – known by its Portuguese acronym PROFIT (Assembléia Legislativa de Santa Catarina, 1968) – set out to study and implement the development public policy for fruit growing in Santa Catarina, executed to stimulate private enterprise. However, the high consumption of apples and the high costs to import them led the species to become increasingly prominent in the development plans for the region in detriment to native species with little commercial value like feijoa. This was primarily due to a lack of knowledge about the feijoa and the low level of investments in the study of the plant in Brazil.

In Colombia, the species acquired international visibility as late as the 1980s although there had been a certain level of consumption and investment in fruit production in the period after its introduction in the 1930s. The Act for International Development (1950), which established U.S. foreign policy for Latin America, institutionalized technical assistance for agricultural producers, along with subsidies for fruit cultivation following the creation of large export companies which sent produce from Central America to the U.S. since the beginning of the twentieth century. The installation of these industries was accompanied by infrastructural support from U.S. universities as well as from medical and military departments. For instance, the United Fruit Company, which traded in bananas from Central America, Colombia and the Caribbean, set up a network of hospitals, laboratories and healthcare activities from 1912. In this way, government bodies, philanthropic organizations and private companies promoted technical assistance (Mello, 2017). However, the fruit species grown reflected the needs of the importer, and feijoa did not appear as a priority in the production and investments of the period.

From small-scale production to national and international prominence: feijoa in Colombia

Even though it was not included in the investments to modernize agriculture and industry that stimulated the fruit-producing sector, feijoa gradually spread in Colombia through small producers. Today, the fruit has a large presence in the country where it encountered ideal environmental and climatic conditions for its production. According to available sources, the fruit species was first introduced into Colombia in 1937.⁴ As the years passed, feijoa received increasing attention and valorization from both the government and fruit export companies in Colombia. From the 1980s, there was an expansion in the crop's area of production. Until then, feijoa had been grown for local consumption and sale by cooperatives. Now it became one of the leading species in the country's large-scale agricultural production. It is important to emphasize that both research and management

⁴ The date of introduction may have been prior to the year cited by Fischer. However, earlier documentary sources on the subject were not found (Fischer et al.: 2003, 11).



practices – in particular, the espalier pruning system still utilized in Colombia – contributed significantly to this rise in production.

Before reaching the large export companies, however, the fruit played an important role in various municipalities where feijoa production was and still is an economic motor. A prime example is the municipality of Tibasosa in the state of Boyacá, which has feijoa as the municipal symbol (Tibasosa, 2020). From the 1980s, the municipality became a leading player in feijoa production, which became its main source of income through the sale of different products and subproducts based on the fruit. Feijoa was produced not by large multinational export companies but by small cooperative groups. Among the largest involved in the production of feijoa subproducts were Agroindustria las Margaritas, Agroindustria Veloza, Fábrica San Diego, Feijolandia Industria Alimenticia, Fruboy Motta, Industrias Iraka, La Casa de la Abuela, Parador el Roble, Tibaquinua, San Nicolás and San Diego (Tibasosa, 2020).

The rise in production, though local, led to an increase in fruit growers, which in turn enabled the establishment of small industries focused on processing feijoa-based products. The municipality became renowned for its production of the crop and launched a local festival, called the Festival de la Feijoa, with the idea of developing the local tourist industry and selling produce derived from the fruit. According to the festival's organizers, the main goal of the event was to promote the culture and gastronomy built around feijoa and other fruits cultivated in the region (Tibasosa, 2020). As a result of its festival, Tibasosa became the gastronomic and cultural epicentre of Boyacá. The festival was created and maintained to encourage cultivation, stimulate the technical processing of fruits, and promote regional tourism. Thus, the town became the tourist hotspot of the Boyacá Department. What is interesting to note is that feijoa, even though not native to Colombia, assumed an important role in defining a Tibasosa identity. Throughout the promotion of the festival, feijoa is displayed as the symbol of the town and responsible for being linked to other cultural traditions.

The production of feijoa and its local importance led to the emergence of measures for maintaining and improving cultivation of the fruit species. These strategies were not directly linked to the precepts imposed by agricultural modernization or by government plans supported abroad. One such measure was the creation of the Associação Agroecológica dos Produtores de Feijoa. The association's declared mission is to supply excellent quality produce to clients, meeting the rules and requirements of the market and ensuring quality control. The association was created in 1999, during the thirteenth Festival and given the name Feijolandia. At the time, the real opportunities for planting and marketing the fruit were evaluated.

This kind of local community effort has nothing to do with a great agro-acceleration. After its cultural appropriation, feijoa became not only an important commercial input, but also a factor of social cohesion and development. Very distant from the reality promoted by the modernization of agriculture and the expansion in production of priority crops to supply raw materials and basic food commodities for international markets, feijoa production continued without high levels of investment. An example was the Feijolandia association, created through the efforts of local producers and initially run from a garage. The association defined its mission as meeting the needs of the internal market, producing

products competitive in terms of quality, appearance and innovation, and contributing to the Boyacense economy. The infrastructure of our microbusiness is constituted in accordance with all the norms and standards of quality to generate social impact and more jobs for the



young apprentices who contribute to our microbusiness. (Agroindustria Feijolandia en Tibasosa, 2012)

At the beginning of the twenty-first century, *Feijolandia* expanded its range of agricultural products to include other fruits such as tomato, gooseberry, blackberry, strawberry, peach, guava, pineapple, mango and orange. At the same time, it acquired a van to transport food items in order to offer its clients a quality service. The association also aimed to expand its sales to other chain stores, supermarkets, hypermarkets, airports and tourist spots.

The growth and popularization of feijoa in Colombia drew the attention of researchers in the country. In the 1980s, the biologist Over Quintero, professor at the Universidad Incca de Colombia, and his brother Fabio Barrero Castillo, an agronomist, began studies on planting and breeding the species. In an interview, Barrero Castillo recalled that when they started their studies and research on feijoa, he and his brother faced a long path before they developed at a promising form of production.

The technological information available on the topic was extremely poor, the literature contained little information. However, an important breakthrough was finding a site called Tibasosa, in Boyacá, which allowed us to highlight the fact that the fruit was widely recognized for its taste and as a supposed source of eternal youth. We visited different areas of the country collecting a lot of genetic material over a number of years. (Castillo and Quintero, 2012)

The brothers were guided by a question: what was the best thermal zone for feijoa in a tropical country like Colombia? During their research they found feijoa growing 1000 metres above sea level (masl) and even over 3000 masl. They concluded, then, that the ideal thermal zone for production of the crop in Colombia was between 2000 and 3000 metres in altitude (Castillo and Quintero, 2012). Consequently, it was observed that the fruit was more successful when introduced in the colder regions of Boyacá, Caldas, Cundinamarca and Antioquia than the warmer ones. A study conducted at the end of the 1980s showed that most of the feijoa production was consumed domestically. Nonetheless, studies were carried out on quality standards aimed towards future large-scale export of the fruit.

The first plantations studied by Quintero were mostly located in the towns of Duitama, Sogamoso and Tibasosa. The largest salespoints in Bogotá included Carulla, Frutas la Sabana, Olímpica, Sarjo and Pomona; those in Duitama included San Jorge, Casa Vieja, Sabrosuras, La Especial, La Campiña, El Apetitoso and in the Transport Terminal; in Tibasosa they were located in the greengrocers of Las Margaritas, La Posada de Bolívar and Fruboy (Rodríguez and Bermudez, 1996). The brothers faced the challenge of identifying how feijoa behaved in response to the climate, temperature and soil conditions in the country, as well as its endemic pests and diseases. It was during this process of evaluating and studying the behaviour of the development of the species that the brothers began to ask what the best variety of feijoa would be. In the process, various questions were eliminated, and answers sought in the search for quality fruits (Castillo and Quintero, 2012).

In their research, Quintero and Barrero Castillo travelled to the regions where feijoa was cultivated looking for distinct varieties of feijoa. As soon as they learnt about a promising plant from a farmer, they went to collect a specimen. After fetching these samples, they began compiling the genetic material from distinct areas. Through this selection process, they were able to develop better varieties. They started to notice differences in the skin, in the quality of the fruit, and in the taste, and that some varieties ripened earlier than others. Some varieties grew



vertically while others had an accelerated growth cycle, which was considered highly valuable. They selected twenty to thirty traits to identify the desired fruit.

The gathering of the genetic material, along with the research that they had conducted *in situ*, led Over Quintero and Barrero Castillo, working through the private sector, to build the National Feijoa Centre (CENAF). In 1987, CENAF was established at a farm in La Vega, Cundinamarca, situated in 2050 meters above sea level. In 2012, this site held more than 1500 germplasm accessions from different feijoa specimens. Among the different accessions, the collection holds varieties bred in New Zealand and specimens from established crops, including in Colombia. Data on the production and weight of the fruit from each tree were taken as parameters for selecting plants to be future cultivars. The first step was to select the plants followed by propagation aiming to increase the size and production of fruits. The best 15 cultivars were used to establish the first plantations. These 15 cultivars produced larger fruits than the average production of 60 grams and 20 kilos per plant/per year. (Quintero, 2014: 169).

Even with the improvement of the product, doubts still lingered concerning the consumer market. Barrero Castillo related that a lot was discovered about the wishes of consumers through an investigative study: ‘So an investigation conducted by Dr. Alberto Gasca asked 100 people whether they were familiar with feijoa (in Colombia). 64% responded yes, in 1987. Among these, 94% liked the fruit, 55% liked the sweeter varieties and 45% liked the sourer varieties’ (Castillo and Quintero, 2012). The problem of the fruit’s green colour making it appear unsuitable for consumption was one of the complaints identified by consumers, cited as a reason for not buying the fruit.

Another important question assessed through consumer opinion was that the fruit, after a nutritional analysis, proved to be extremely valuable for human health. ‘Feijoa is like a fruit of eternal youth since it has many vitamins and antioxidants’ (Castillo and Quintero, 2012). Feijoa’s high level of iodine, an antimicrobial and antioxidant agent, makes it a promising product for extracting medications and cosmetics. In practical terms, feijoa can be used on skin injuries and infections to accelerate and improve the healing process (Quintero, 2014: 175).

The Colombian Ministry of Farming and Rural Development estimated that there were more than 550 hectares of feijoa in the country in 2001. Less than 10% was sold internationally. However, the high demand on the international market invited producers to improve their harvests through new technology and to establish new crops with selected cultivars. According to Camilo Quintero, in 2012 more than fifteen international trading companies, based in Bogotá and Medellín, exported the fruit to various European countries. Feijoa is already found in German markets and is being sold by one of the largest networks, Proexport, with an office in Hamburg, after successfully agreeing a contract for importing non-perishable products for German supermarket chains. During this period, it was found that domestic consumption of feijoa in Colombia was still higher than exports (Quintero, 2014: 175).

Most stores and supermarket chains in Bogotá sell the fruit fresh and/or processed. The quality demanded in these outlets is high, like the type of fruit selected for exportation. Because the fruit has a thinner skin in Colombia, the yield when processed is as high as 90%. This makes the crops more profitable for the industry than the thick-skinned fruits produced in other countries. As well as the favourable soil, humidity and temperature conditions found in Colombia, the high amount of sunlight – approximately 1500 hours per year – means that trees produce fruit during almost all periods of the year (Portafolio, 2006). Consequently, production in the country is also much higher than elsewhere. In 2007, the



Colombian newspaper *Portafolio* reported that Brazil had officially become an importer of Colombian feijoa (Portafolio, 2007).

In the country, there are local incentives for cultivating and studying the species with the aim of breeding feijoa. Although these studies of the fruit need to be optimized, various researchers are involved in them. The agronomist Mariela Rodríguez Santamaria obtained a study grant to conduct research in Germany on feijoa's maturation. The research aimed to provide information on the best post-harvest handling and overseas shipment plans. According to Rodríguez, the research on La Vega feijoa indicates that it is a promising fruit with a high potential for production and for national and international sale. In 2008, feijoa was exported in small quantities to the United Kingdom, Germany, Italy, France and Belgium, amounting to 2.5 tons of fruit per year (Portafolio, 2006).

Various research centres at Colombian universities are dedicated to studying the production and marketing of fruit trees, especially feijoa. At the Corporación Universitaria Minuto de Dios at the Faculty of Administrative Sciences (Romero et al., 2009), students from the international relations course developed a project to provide brief comments to the exporter on the behaviour of the international market and the importance of feijoa in Colombia. The study's importance is shown by the fact that, in terms of national production, feijoa has one of the largest turnovers of exotic fruits on the international market, principally due to its taste, smell and diverse uses. In 2003, professor Gerhard Fischer from the National University of Colombia and others edited a work entitled *Cultivo, poscosecha y exportación de la feijoa* (Fischer et al., 2003) with the aim of gathering information from different researchers who had developed important works on its cultivation, propagation and exportation.

Today, large fresh fruit exporters based in Colombia supply feijoa to the international markets – companies like Ocati (Ocati, 2020) and Caribbean Exotics (Caribbean Exotics, 2020), both of which possess export certificates. Created in the 1980s, Ocati produces and exports exotic fruits to diverse regions of the world. Caribbean Exotics was founded in 1986 in response to a campaign developed by the Government office for promoting exports, aiming to export exotic tropical fresh fruits (Ocati, 2020).

Encountered at diverse salespoints, today feijoa is an important product in the Colombian economy. Marginalized by the modernization plans for farming and fruit growing in the country, feijoa nonetheless grew within the production and sales chain inside and outside Colombia. This growth has been due to efforts like those of Over Quintero, whose research generated practical effects from the outset. After the biologist died, his son Camilo Quintero took over his father's activities, both in the production and sale of feijoa, and in taking care of the germplasm bank. However, there already exist monocrop plantations on medium-sized properties that are like commodities, albeit on a small scale.

Feijoa in Brazil: still incipient cultivation

It was during the 1980s that stimulus was given to studies of feijoa in the state of Santa Catarina, the region where the species is endemic in Brazil. In 1985, Jean-Pierre Henri Joseph Ducroquet, a researcher for the Santa Catarina Farming Research Company (Empresa Catarinense de Pesquisa Agropecuária S.A.: EMPASC),⁵ today the Santa Catarina Farming Research and Rural Extension

⁵ The Santa Catarina State Association of Rural Credit and Assistance (ACARESC), for years the official rural extension agency of Santa Catarina state, later succeeded by EPAGRI, was linked to the State Agriculture Office. Created in 1956, it was found in most of Santa



Company (Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina: EPAGRI), began an experimental program with feijoa attempting to facilitate commercial growing of the fruit, recognizing the advantage of the state being located in the centre of origin of a fruit species with such promising attributes.

EPAGRI's origins can be traced back to the 1950s. In 1948, the first steps were taken towards implanting rural extension in the country with the foundation of the extension services in Santa Rita do Passa Quatro, in São Paulo, and the creation of ACAR (Minas Gerais Rural Credit and Assistance Association). ACAR was sponsored by the Ford and Rockefeller Foundations through the AIA and the joint U.S.-Brazilian Technical Office of Agriculture (ETA) in partnership with the federal government, the Brazilian Rural Confederation and Banco do Brasil (Huller, 2003: 74).

The idea behind the creation of ACAR was to stimulate the growth of rural production and sales in conjunction with a technological package coming from the United States. To convince farmers to adopt these technologies, the Brazilian government and the federal states imported concepts and methods from rural extension in the United States and began opening technical assistance offices and hiring farm technicians, agronomists, veterinarians, and home economists. In 1957, the state of Santa Catarina created its Rural Credit and Assistance Association (Associação de Crédito e Assistência Rural do Estado de Santa Catarina – ACARESC). Shortly thereafter, when the military took power in 1964, a broad and generous system of rural credit was implemented and played a vital role in disseminating these technologies (Carvalho/Nodari/Nodari, 2017: 78).

EPAGRI was created in 1991 through the amalgamation of EMPASC, ACARESC, the Santa Catarina Credit and Research Assistance Association (Associação de Crédito e Assistência Pesqueira de Santa Catarina: ACARPESC) and the Santa Catarina Apiculture Institute (IASC)⁶. It was at EPAGRI that the first research emerged on feijoa, albeit years after the company's creation in the 1980s, as well as in Colombia. At the institution, a series of studies was developed on feijoa, resulting in breeding programs and publications, aiming to disseminate information on the cultivation, conservation and management of the species.

Ducroquet worked for many years at EMPASC, today EPAGRI, and was a pioneer in the experimental studies of the species in Santa Catarina. The agronomist first learnt about the species when he arrived in Brazil in the 1970s. In 1978, he had contact with the fruit of the feijoa tree for the first time, but his interest in studying the species had yet to be awakened. It was in the 1980s, after the visit of Professor Ralph H. Sharpe from the University of Florida that his ideas for studying the species would change:

I was awakened to the potential of the goiabeira serrana [feijoa] at a roundtable at the Experimental Vine Station with Professor Ralph H. Sharpe from the University of Gainesville, Florida, and other researchers from the station in 1980 or 1981. Prof. Sharpe, on a consultation visit sponsored by EMBRAPA, analysed the various fruit species with potential for the upland regions of southern Brazil, feijoa among them. Among those present, nobody had any idea what species it was. He explained that it was native species from southern Brazil that had been explored and bred in various parts of the world, especially New Zealand, Israel, and the United States. Later, on the way to São Joaquim, he showed me a feijoa tree by the side of the road. (Ducroquet, 2014)

Catarina's municipalities, responsible for rural extension, with the primary goal of promoting rural development. "Conheça a EPAGRI." EPAGRI. Available at: <<http://www.epagri.sc.gov.br/>>. Last accessed 15 December 2020.

⁶ Ibid.



At the time, Ducroquet witnessed the difficulties of plant breeders working with exotic fruits, apple trees, peach trees and other species, in introducing germplasm to adapt these species to the edaphoclimatic conditions of Santa Catarina. It was at this moment that he decided to work with the native fruit.

I thought, therefore, that it might be a great opportunity to work with a still unexplored native fruit species in its centre of origin and with an appearance and taste capable of reaching a good market for its in natura consumption. So, I planted two saplings in the back garden of our house in Videira, one taken from a garden in Urubici (accession 101) and another bought from a small nursery owner in Videira (Mr. Francio, Rua José Formigheri) who produced saplings of native and ornamental species for the local gardening market, including saplings of goiabeira serrana obtained from seeds. (Ducroquet, 2014)

In 1986, at Ducroquet's initiative, EPAGRI (EMPASC at the time) decided to begin a collection with the best native specimens from the region and with some accessions⁷ bred in other countries. That same year, approval was given to Ducroquet's project (Ducroquet, 2014) to create the Active Germplasm Bank (Banco Ativo de Germoplasma: BAG) at the Experimental Videira Station in Santa Catarina where genotypes were selected in the field and propagated vegetatively, accompanying the evaluation of their agronomic performance. Simultaneously, evaluations started on the populations derived from the interbreeding of pre-selected genitors and the selection of plants superior for some agronomic characteristics. In the 1990s, the research on feijoa continued and Ducroquet expanded his network of relations with researchers studying the species:

In 1992, I met the agronomist João Rodrigues Mattos, then the biggest expert on the native fruit species of Brazil's south and southeast with various publications, including on goiabeira serrana. In 1993 the first contacts began with the Centre of Agrarian Sciences at UFSC, initially through Professor Aparecido Lima da Silva, aiming to stimulate the micropropagation of the species and, through him, a fruitful partnership extended to Professors Rubens Nodari and Miguel Guerra. We had various projects financed by CNPq and I coordinated the elaboration of an integrated project, 'Domestication of goiabeira serrana,' approved in 1998 by PRODETAB (funded by the World Bank via Embrapa). (Ducroquet, 2014)

In this context, the professionals of both institutions developed research looking to improve the cultivation and propagation of feijoa.⁸ The BAG at the São Joaquim Experimental Station (SC) has 313 accessions, most of them coming from Santa Catarina, as well as specimens from abroad, in particular from New Zealand. Out of the 313 accessions, twelve came from the north-eastern region of Rio Grande do Sul; 148 from Santa Catarina in the micro-regions of Lages (96 accessions), Curitiba (six accessions), Joaçaba (45 accessions) and Canoinhas (one accession); just one accession from the state of Paraná; 122 genotypes that comprise selections from progenies of crosses; twelve accessions from other countries; and 19 accessions without definite origin (Saifert et al., 2020). Seeds from natural populations and accessions from the BAG are also being held by EMBRAPA –

⁷ Accession is a distinct, uniquely identified sample of seeds or plants maintained as part of a germplasm collection (National Research Council, 1991:149).

⁸ Among the studies we can highlight the research showing that the causal agent of anthracnose to be responsible for the plant death and fruit rot that makes cultivation of feijoa in the Videira region impractical (which contributed to the transfer of the BAG and cultivation of the tree to colder regions like São Joaquim), the identification of pests and species of bees that pollinate feijoa, and the response of the plants to correction of soil acidity with lime and fertilization with phosphorous (Ducroquet, 2014).



Genetic Resources and Biotechnology. There also exist other collections of germplasm in Rio Grande do Sul and in other countries (Saifert et al. 2020). The first Brazilian commercial varieties of feijoa originated from AGB-Feijoa accessions: SCS 411 Alcântara (obtained by selection of a progeny originating from a plant sampled in 1987 in Bom Jardim da Serra-Santa Catarina), SCS 412 Helena (a progeny of the cross accession 101 × Unique), and SCS 414 Mattos (a native plant collected in São Joaquim), and SCS 415 Nonante (a progeny of the cross accession 101 × 50) (Ducroquet et al., 2007; 2008).

The agronomist João Rodrigues Mattos, cited by Ducroquet, was one of the pioneers in the study of feijoa in Brazil. Mattos, who wrote the first three books on the fruit species in the country (Mattos, 1969; 1978; 1990), was given a site and funding to conduct studies relating to feijoa. In 1978, he planted an orchard in Maquiné, Rio Grande do Sul, with assistance from EMBRAPA. After a year, the funding was cut since the project was not considered important by the federal company. However, Mattos states that in the 1980s other professionals began studies and the ‘plant began to appear throughout Brazil’ (Mattos, 2009). Mattos’s remarks illustrate the argument presented here that financing and stimulus existed for studies of the priority species on the list of short-sighted projects.

Unlike Colombia where feijoa became popular and is also produced for export, the crop was, until recently, incipient in Brazil and grown by small farmers, principally from Rio Grande do Sul and Santa Catarina. Even though slowly, the cropping area and the marketing strategies are changing. After the development of the first four varieties (Ducroquet et al., 2007; 2008) and the release of cutting is allowing the increase of cultivated area. As an example, the cultivated area in São Joaquim municipality jumps from 11 ha in 2012 (CEPA, 2013) to at least 30 ha currently. In addition, the produced fruits that were sold mainly in farmers markets, now the fruits are marketed at markets and supermarkets in distinct cities in south of Brazil. Furthermore, in addition to the consume of fruit in nature, other products have been developed and are currently marketed, such as, ice-cream and pulp of feijoa fruit.

Overall, both research, trade and development of the feijoa industry in Brazil were not affected by the great agro-acceleration. On the contrary, advances in research, genetic improvement and product marketing resulted from the efforts of a few research groups, with partial funding from public resources and the private sector. But much less than the public support given to fruits that are commodities, such as apple trees.

Final remarks

The economicist thinking present in the domestic and foreign policies of the United States can be considered responsible for the incessant search to increase agricultural yields during the twentieth century. Latin America, from the second quarter of the century, was the target of many projects originating in the United States designed to enhance political dialogue, as well as insertion in these territories for potential domination of the cultural and natural resources of the countries involved. A technological package was introduced in Latin America in the places seen as potential suppliers of raw materials. It was introduced with the endorsement of local elites and in accordance with the political interests of the countries that received it. Our focus was not to show the particularities of each country, nor to analyze in depth specific development projects. Our aim was to show how in Brazil and Colombia many of agricultural modernization projects, which were perceived as promising, were established and pushed the peasantry and conservation practices

to the edge of the system. These actions generated an increased anthropization of the environment, marking the period as the era of the Great Accelerations.

On the margins of agricultural modernization processes were native fruit species or those considered to have little potential for supplying the foreign market – as was the case of feijoa. Projects using other fruit species were implemented, such as the case of apple in the south of Brazil and banana or groundcherry (*Physalis peruviana*), in Colombia. Fruit crops are accepted and chosen for diverse reasons. A set of cultural, economic, geographic and physiological aspects inform the choice and the acceptance of a species, and these aspects are indirectly responsible for whether a plant species is propagated or not.

Feijoa, despite not receiving investments for its production and for entering the market financed by multinationals, managed to attract attention from professionals working at centres linked to networks of knowledge production. The investments in these places of knowledge production and in the training of human resources were fundamental to studies of feijoa. Consequently, in the 1980s, the species became the object of studies in Latin America. Today the research activities developed by universities, study centres and the feijoa BAGs in Brazil and Colombia are a reference point for the study of the species.

In this article, we focused on studying Colombia as it is currently the world's largest producer of feijoa and Brazil as the place where the species is native, but not cultivated at large scale. The documents analyzed and the facts mentioned indicate that it was possible to develop a production chain and an industry associated with a genetic resource with local efforts. Both countries had particularities in their production processes and in studies aimed at feijoa. However, as investments were very discrepant compared to those given to other commodities, the development of cultivation and production of feijoa, particularly in Brazil, is still incipient, but with signs of growth. Overall, this article showed that even outside the productivist approach, the production and studies of feijoa were viable and effective to support the development of feijoa fruit production.

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