The dictatorship of agrochemicals: the National Program of Agricultural Defensives and changes in pesticides production and consumption in Brazil, 1975-1985

Leonardo de Bem Lignani[i]

[i] Professor, Centro Federal de Educação Tecnológica Celso Suckow da Fonseca; PhD candidate, Programa de Pós-graduação em História das Ciências e da Saúde/Casa de Oswaldo Cruz/Fiocruz.
Rio de Janeiro – RJ – Brazil

orcid.org/0000-0001-9145-2392

leonardo.lignani@cefet-rj.br

Júlia Lima Gorges Brandão[ii]

[ii] PhD candidate, Programa de Pós-graduação em História das Ciências e da Saúde/Casa de Oswaldo Cruz/Fiocruz.
Rio de Janeiro – RJ – Brazil

orcid.org/0000-0002-5284-7516

juliagorges@hotmail.com

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Abstract

This paper relates the National Agricultural Defensives Program (1975-1980) with the developmentalist policies of the Brazilian civil-military dictatorship and the debates on agrochemicals regulation. The program stimulated internal production of pesticides, an important element in the project of agricultural "modernization" and "imports substitution." Questionings on the use of agrochemicals were minimized by the notion of "safe use," despite insufficient monitoring of health and environmental consequences. Besides the production in Brazil of compounds banned elsewhere, the program signaled a profile change of agrochemicals used, which puts into perspective the prohibition of organochlorine insecticides in the 1980s.

Keywords: history of agrochemicals; developmentalist policies; civil-military dictatorship; organophosphate compounds; herbicides.

In 1972, at the Stockholm Conference (the first United Nations Conference on the Environment), the Brazilian delegation defended that poor countries, such as Brazil, were not to be concerned about environmental issues and this stand became well-known. These countries should prioritize "development" strategies that would enable them to strive against "the pollution of poverty," postponing whatever kind of concern about environmental impacts from economic activities (Brasil pede..., 7 jun. 1972; Duarte, 2015, p.73-74). Three years later, in 1975, the civil-military dictatorial government initiated an incentive program for the installation of agrochemical[1] industries in Brazil, thus materializing those ideas in a context of increasing criticism about the use of those substances.

The National Program of Agricultural Defensives (Programa Nacional de Defensivos Agrícolas, PNDA) lasted five years and its objective was to increase agrochemicals production in Brazil and reduce import dependency. In the mid-1970s, Brazil appeared as a growing market for pesticides consumption and, despite the presence of some companies responsible for the formulation of commercialized products (i.e., the final stage of the process), few active ingredients were produced in the country.[2] The PNDA objective was to internalize the production of agrochemicals, hence being closely linked to the II National Development Program (II Programa Nacional de Desenvolvimento, II PND) and its policy of imports substitution by means of governmental subsidies. In addition to ensuring the supply of inputs for use in agricultural activities, the Brazilian government intended that the PNDA would function as an incentive mechanism for the chemical industry in the country. The industries were seen as partners in this enterprise, having the installation capital partially financed, besides receiving fiscal incentives.

In the international context, the PNDA occurred simultaneously to the prohibition by some countries of the use and commercialization of certain agrochemicals in their territories (especially organochlorine insecticides, such as DDT). In international agencies, such as the United Nations Food and Agriculture Organization (FAO), the presence of pesticides residues on agricultural production was a reason for debates and attempts to issue regulations. In practice, the movement observed globally was the prohibition of agrochemicals in "developed" countries (notably the United States and European countries) and their use in "developing" countries (Weir, Schapiro, 1981). The options of projects financed in the PNDA outline should be analyzed in this context.

In this paper, we intend to contribute to a better understanding of this historical process, by analyzing the PNDA as crossing point between the Brazilian civil-military government's developmentalist policies and the unequal global dynamics of restrictions to the use of agrochemicals in "developed" and "underdeveloped" countries. We argue that the PNDA was not solely an opening of Brazil to the production of poisons that were prohibited in other countries, but it also signaled the change in the profile of agrochemicals that were used (notably an increase in the use of organophosphate insecticides and herbicides). Analisys of the results obtained with the PNDA also helps to explain the late prohibition of organochlorides in Brazil, which occurred only in the 1980s.

This research analyzed documentation available at the collection of House of Oswaldo Cruz (Casa de Oswaldo Cruz), of Oswaldo Cruz Foundation (Fundação Oswaldo Cruz, Fiocruz) and at the Memory Center (Centro de Memória) of the Biological Institute of São

Paulo (Instituto Biológico de São Paulo). Reports published in newspapers and journals of that period were researched at the Digital Periodicals Library (Hemeroteca Digital) of the Brazilian National Library (Biblioteca Nacional).

The PNDA international and national contexts

Before starting our analysis, it is necessary to situate the PNDA in the historical context related to pesticides in the second half of the twentieth century. In this section, we highlight three processes that unfolded during the 1950s and 1970s, in which agrochemicals were relevant elements: the diffusion of the "Green Revolution," the implementation of policies for "development," and the emergence of the environmental theme. It is necessary to have a panoramic view of these processes to better understand the meaning of the PNDA implementation by the Brazilian civil-military dictatorship.

The dissemination of the use of pesticides in agriculture is associated to the "Green Revolution" and the diffusion of the agribusiness model, especially as from the 1950s. Projects financed by the Rockefeller Foundation, Ford Foundation and the US government, through the US Agency for International Development (Usaid), expected that the increase of agricultural production needed to adopt "modern" techniques, which meant the use of chemical inputs (pesticides and fertilizers), the motorization of cultivation and harvesting, the production of varieties resistant to severe weather conditions, and genetically homogenized seeds. The perspective of increasing the production through the reduction of agricultural "pests" and by shortening the time-span between planting and harvesting stimulated the adoption of those techniques by numerous countries in Latin America, Africa and Asia. Beyond the technical-scientific innovations, the diffusion of this agricultural pattern received strong support from the US government, because it was also linked to a geopolitical strategy of communism containment in poorer countries in the context of the Cold War (Picado, 2008, p.47-48).

The "Green Revolution" became a paradigmatic model of agricultural development, transforming economies and landscapes worldwide, and resulting in political, cultural, environmental and economic consequences (Wright, 2012, p.152-154, 2005, p.245-246). Impacts on the environment and on farmers' health, the increase of inequality in rural areas, and the rise in productivity focused on agricultural products for export are among the main problems related to the "Green Revolution" (Bull, Hathaway, 1986, p.77-89; Weir, Schapiro, 1981, p.32-38). Such findings were acknowledged even in analysis that were less critical to the process (Conway, Shah, 2012, p.50-58).

The propagation of those technological packages reverberated on political "development" projects directed to countries that occupied peripheral positions in worldwide economy. The processes of industrial and agricultural transformation that occurred in Europe and North America during the nineteenth and twentieth centuries became parameters of "modernization." Hence, countries that had not gone through those transformations and were categorized as "underdeveloped" should receive support in order to reach the stage already achieved by "developed" countries (Borowy, 2013, p.453). Moved by this ideal, multilateral agencies such as FAO and the World Health Organization (WHO) conducted

different projects in the post-war period, investing in the participation of specialized scientists, seeking cooperation between public and private groups, and counting on technical-scientific apparatuses that had been presenting satisfactory outcomes in previous contexts. It was expected that by using those "universal solutions" it would be possible to eradicate permanent problems and raise the quality of life of "underdeveloped" populations, with the improvement of child mortality rates and agricultural productivity (Staples, 2006, p.6-7).

Pesticides were one of those "silver bullets" used in projects of agricultural "pests" eradication and public health campaigns, much of it due to outcomes achieved in wars (in the control of vectors that transmitted diseases among soldiers or as chemical weapons) (Russell, 2001, p.165-171). The expectations about organochlorine insecticides (which presented high persistence in the environment, such as DDT and dieldrin) were in the center of campaigns that promised to turn into "past" problems those diseases that had arthropods as vectors, as the malaria eradication campaign organized by WHO in 1955 (Staples, 2006, p.161-163). Optimism was such that many control programs were converted into eradication programs, with massive investments in the use of those substances. This change was observed in programs conducted by the Brazilian government, especially in the 1950s (Hochman, 2008, p.177-178).

Organochlorines capacity to remain active for long periods after their application was seen as a positive factor, turning them into the main group of pesticides used at the time. However, this characteristic was also associated to potential dangers, like the contamination of the physicochemical environment and bioaccumulation in organisms along food chains. Harmful effects of those substances became evident in the late 1950s and early 1960s, when appeared the first re-evaluations conducted by the international technical community about problems of safety and effectiveness of agrochemicals.

A landmark in this sense was the publication in 1962 of the book *Silent spring*, by the North American writer Rachel Carson. Analysing the scenery of environmental degradation from the use of pesticides, especially the DDT consequences in the United States, Carson (2010) exposed the need to seek alternatives of lower impact on health and the environment. The book had a strong influence on public opinion, especially the debates on organochlorine insecticides, which were re-assessed following the creation of the Environment Protection Agency in 1970. DDT, for example, had its use prohibited in the United States in 1972 (Alves Filho, 2002, p.25-26). Ironically, one of the consequences of the prohibition of organochlorines was the increase in the use of pesticides produced from other active ingredients (like organophosphates), which although having less persistence in the environment, have more intense acute toxic effects (after one sole exposure dose) (Davis, 2014, p.200-202).

Silent spring became one of the precursor elements of the environmentalist movement emerging as from the 1960s (Wright, 2005, p.XI; Russell, 2001, p.221-228; Alves Filho, 2002, p.25). As the debate on agrochemicals gained more visibility in the international scenery, the environmental issue became an agenda highlight of debates on development and health. In the 1970s, there was greater mobilization on ecological causes, involving authorities in several countries who started to seek solutions for the imminent environmental collapse that the planet would face if developmentalist policies would continue to be carried out.

The WHO, for instance, started to incorporate elements on toxic effects and environmental pollution in the debates about the use of those substances (Lignani, 2018, p.136-137).

In this context was held the 1972 United Nations Conference on the Human Environment, which gathered leaders from 113 countries to debate the environmental issue and the need to review the development model predominately adopted worldwide. In the beginning of this article we mentioned the controversial position of the Brazilian delegation in this conference. Drawing on the premise that pollution was a consequence of economic development and an inescapable result of industrialization, the military government intensified its developmentalist programs, with great stimuli for the growth of the manufacturing industry. An example of this policy was the Decree n.200 of February 25, 1967, which directed incentives to the installation of manufacturers in different domains of the Brazilian economy (including, in the chemical industry, the production of fertilizers and "agricultural defensives").

The stimulus to industries of chemical agricultural inputs was in accordance with agricultural policies implemented after the 1964 coup d'état. The government saw agriculture as the "motor" to leverage the economy and intervened directly in this field by means of various subsidies, which produced large capital infusion into the agricultural economy. The measures provided subsidised credit, price policies, creation of regional programs and research institutions, such as the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária, Embrapa) that initially had a direct focus on research related to agroindustry. Governmental policies also controlled export-import of the agricultural production, with stimuli to cultures that were not previously produced but gained prominence (such as soybean and wheat), besides the return of sugar cane production stimulated by the National Alcohol Program (Programa Nacional do Álcool) (Klein, Luna, 2019, p.38-40).

In this context, especially as from Costa e Silva's administration (1967-1969), occurred a consolidation of the understanding that the agricultural issue was associated to the introduction of new technologies, without the need to discuss any changes in the Brazilian agrarian structure (Silva, 2014, p.277-279). In the Guidelines for the Strategic Program of Development (Diretrizes para o Programa Estratégico de Desenvolvimento) of 1967, "the increase of agricultural production and productivity" by means of "changes in production methods and more intensive use of modern inputs"[3] appears as the first objective (Brasil, jul. 1967, p.45). It was essential to stimulate the use of agrochemicals and in this context the PNDA ensured the supply of this input seen as a key element for the "conservative modernization" of Brazilian agriculture.

Agrochemicals production and consumption in pre-PNDA Brazil

The apparent consumption of agrochemicals in Brazil (calculated from the total of imports and internal production) presented a large increase in the decade that preceded the PNDA: from approximately 16 thousand tons per year in 1964 to over 100 thousand tons in 1974 (Alves, maio-jun. 1973, p.10; Brasil, jul.-dez. 1975, p.55) (Figures 1 and 2). This increase had a direct relation with policies implemented by the Brazilian government

linked to fiscal exemption and credit stimulus (Pelaez et al., 2015, p.159). Agrochemicals were exempt from the Tax on Circulation of Goods and Services (Imposto de Circulação de Mercadorias, ICMS) since 1969 and Tax on Industrialized Products (Imposto sobre Produtos Industrializados, IPI) since 1959 (Brasil, jul.-dez. 1975, p.56). The National System of Rural Credit (Sistema Nacional de Crédito Rural) (1965) included in the concession of credit to agricultural producers the mandatory allocation of a percentage (15% of costing credit) for the purchase of agricultural inputs. Estimates point that from the total amount of agrochemicals sales in 1976 (Cr$4.1 billion), 85% were financed by rural credit (Bull, Hathaway, 1986, p.156).

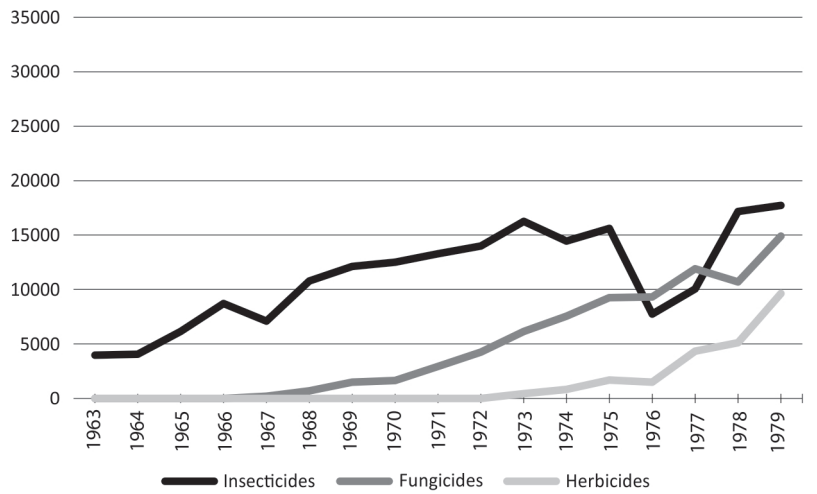

Figure 1: Graph of agrochemicals import (in tons) by Brazil, 1963-1979 (Source: Prepared by the authors with data by Alves [1973] and Galvão [1979])

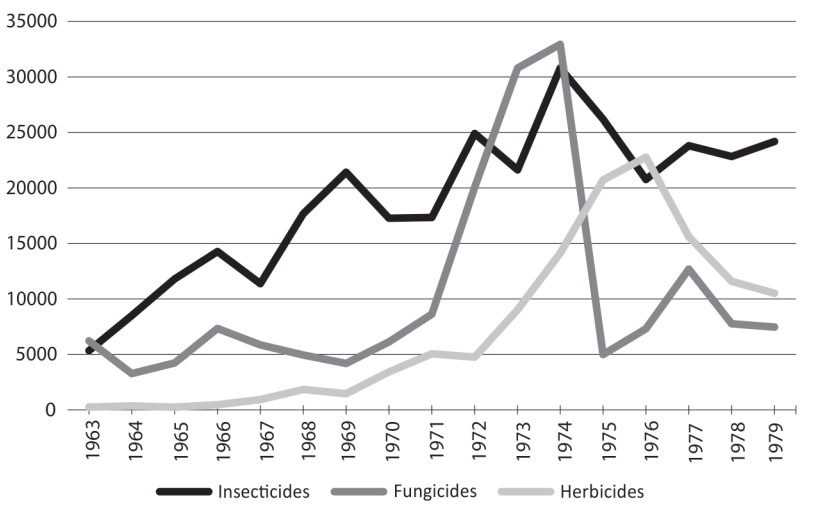

Figure 2: Graph of the national production of agrochemicals (in tons) in Brazil, 1963-1979 (Source: Prepared by the authors with data by Alves [1973] and Galvão [1979])

The analysis of Figures 1 and 2 shows that the internal consumption growth was linked mainly to the increase of imports. In 1974, the year that preceded the start of the PNDA, the national agrochemicals production responded for only 22% of the total consumption, concentrating in a small group of active ingredients produced in the country (Table 1). Imports were necessary to meet the increasing demand and covered mainly formulated products ready to be commercialized.

The production of fungicides presented a significant increase since 1967, when the first industries started to produce this category of agrochemicals in the country. Corporations such as Du Pont, Rohm & Haas, Rhodia and Sandoz were active in the country before the start of PNDA (Table 1). However, the production was much lower than the consumption stimulated by the agribusiness model: the import of fungicides increased over threefold between 1962 and 1973. In 1972, the expansion of the fungal disease known as "coffee rust" led to a high consumption of copper oxychloride. Although this fungicide was produced in the country by Sandoz and the national Adolfomer, the internal market was supplied by imports (Figure 1), with a highlight to the increase of fungicide imports in the period 1971-1974.

Table 1: Production of active ingredients in Brazil until 1975 and projections of production as from the PNDA

Period	Insecticides	Fungicides	Herbicides
Pre-PNDA (production until 1974)	Organochlorides: **BHC** (produced by Matarazzo) **DDT** (produced by Hoechst) Organophosphate: **Parathion (Ethyl and Methyl)** (produced by Bayer)	**Maneb** (produced by Du Pont and by Rohm & Haas) **Copper Oxychloride** (produced by Sandoz and by Adolfomer) **Ziram** (produced by Rhodia) **Thiram** (produced by Rhodia)	**Propanil** (produced by Rhom & Haas)
Post-PNDA (projection for production until 1980)	Organochlorides: **Toxaphene** Organophosphates: **Monocrotophos** **Dicrotophos** **Malathion** **Trichlorfon** **Dimethoate**	The production of existing active ingredients was maintained, with increase in produced volume.	**Trifluralin** **Triazines** **2,4-D** **Paraquat** **Diuron**

Source: Prepared by the authors with data from Brasil (jul.-dez. 1975)

The use of herbicides in Brazilian agriculture was reduced in the early 1970s, when compared to the use of fungicides and insecticides. Domestic production only started in 1973, with the production of propanil by Rhom & Haas, thus the internal market supply depended on imports (2,4-D was the main imported herbicide). However, imports increased at a fast pace: from 365 tons in 1964 to almost 15 thousand tons ten years later (40 times more).

Organochlorine insecticides corresponded to the major parcel of the national production and represented 80% of the total of pesticides produced in Brazil. The transnational Hoechst, in Suzano (São Paulo state, SP), and the national Matarazo, in São Caetano do Sul (SP), were

responsible for the production of DDT and BHC, respectively; both commercialized those technical products to other companies that worked in the area of formulations. As we have already stressed, those compounds suffered increasing restrictions in the years that preceded the PNDA. The debate on this group of substances was intensified, because despite the low acute toxicity (whose symptoms appear immediately after the exposure to the poison), those compounds have a high persistence in the environment. An increasingly higher number of studies related the accumulation of organochlorides (especially DDT) to impacts on the fauna and possible carcinogenic effects and found high levels of bioaccumulation in human beings (Dunlap, 1981, p.137-140, 193).

The restrictions to organochlorides in other countries started to impact Brazilian exports, resulting, for example, in the return of canned beef sent to the United States in 1970 and of soybean oil exported to Japan in 1971 (EUA impõem..., 29 ago. 1970; Bull, Hathaway, 1986, p.65). In response to those problems, the Ministry of Agriculture issued ordinance n.357, of October 14, 1971, which included in its text:

> To forbid the use of chlorinated insecticides for the control of pests on natural and artificial pastures, in the entire national territory. (art. 1)
>
> To subject to the penalties provided by the Regulation for Vegetal Sanitary Defence and its Complementary Measures all those who infringe the established in the Previous Article. (art. 2) (Brasil, 15 out. 1971).

The reference to the Regulation for Vegetal Sanitary Defence (Regulamento de Defesa Sanitária Vegetal), established by decree n.21114, of 1934, shows the legal vacuum that existed during the implementation of the PNDA. This regulation would only be replaced by federal law n.7802, of 1989 (known as Agrochemicals Act) and during that entire period the changes on regulatory frameworks for agrochemicals were made by means of ordinances, like the n.357, issued by government departments linked to Federal Executive (especially by the Ministry of Agriculture). The use of the 1934 decree as reference for penalties established derisory fines when converted to the currency of the time (Bull, Hathaway, 1986, p.169).

The ordinance text presented four arguments to sustain the prohibition. Two of these referred to Brazilian export restrictions, with clear economic motivation related to its issuing: "considering that the verification of chlorinated insecticides on beef and derivative products has been causing losses to our exports" and "considering the restrictive measures to residues of chlorinated insecticides imposed by countries that import agricultural products" (Brasil, 15 out. 1971). No explicit mention was made to environmental consequences or harms caused to human health from the use of organochlorines; the ordinance considered only that "the use of chlorinated insecticides for pests control on pastures has been causing several inconvenients."

The fourth argument indicated that organochlorine insecticides could "be replaced by insecticides with other active ingredients." Organophosphate (e.g., malathion, parathion and dimethoate) and carbamate (e.g., carbaryl) agrochemicals were commercialized in Brazil before the PNDA, but represented a small part of the market (Table 2). The only one of those technical products produced in the country was parathion, synthetized by Bayer's

branch in Belford Roxo (Rio de Janeiro state, RJ) (Table 1). All other organophosphate and carbamate insecticides were necessarily imported as formulated products, making them more expensive and hindering the diffusion of their use, besides causing a negative impact on the country's trade balance.

Table 2: Comparison between insecticides and acaricides commercialized in Brazil (classified by active ingredient used in the formulation), in pre- and post-PNDA periods

Active ingredient (chemical category)	1972		1983	
	No. of commercial products	Relative proportion (%)	No. of commercial products	Relative proportion (%)
Organochlorines	333	51	405	33
Organophosphates	135	20	460	37
Carbamates	13	2	115	9
Pyrethroids	0	-	23	2
Other active ingredients*	43	7	33	3
Organochlorines + Organophosphates (mixtures)	111	17	178	14
Organochlorines + other P.A. (mixtures)**	21	3	9	1
Organophosphates + other P.A. (mixtures)**	1	0	3	0
Other mixtures**	2	0	3	0
Total	**659**	**100**	**1,229**	**100**

* Includes inorganic insecticides, methyl bromide, acetaldehydes, dinitrophenyls and phthalimides.
** In the mixtures of 1972, the category "other active ingredients" refers to products with carbamates, acetaldehydes and other inorganic compounds. In the mixtures of 1983, this category refers to products with carbamates, pyrethroids, phthalimides, dinitrophenyls and methyl bromide.
Source: Prepared by the authors, based on Giannotti et al. (1972), and Azevedo and Almeida (1983).

Nevertheless, imports of organophosphate insecticides had increased almost ten times in the period between 1963 and 1972, from 468 tons to 4,996 tons (from 10% it increased to 20% of the total of insecticides imports). Insecticides imports of the carbamate group also presented a considerable increase, from six tons in 1963 to 570 tons in 1972 (almost one hundred times more) (Alves, maio-jun. 1973, p.13). This was already an evidence that there was an ongoing process in Brazil of changes in the profile of agrochemicals use, which was intensified by the PNDA.

The PNDA: physical and technical goals

As already mentioned, the general objective of the PNDA was to increase the internal production of pesticides and reduce the need of imports. The so-called PNDA "physical goals" intended to broaden the existing production of pesticides and start the production of organochlorine insecticide toxaphene; organophosphate insecticides monocrotophos, dicrotophos, malathion, trichlorfon and dimethoate; and herbicides trifluralin, triazine,

2,4-D, paraquat and diuron (Table 1). The initial proposal of the plan projected the destination of Cr$1,309 million (without details on the precise allocation of resources) to be used on "necessary investments" (projects, constructions, equipment, supervision etc.) for the installation and expansion of the national defensives industry, aiming to achieve the production goals previously mentioned" (Brasil, jul.-dez. 1975, p.73-74).

According to the official PNDA document, the use of "modern" pesticides, and in larger quantity, was justified by the need to combat agricultural "pests" that expanded their scope in the previous years (e.g., *cigarrinhas-da-cana-de-açúcar* of the *Mahanarva* genus, and the fungus *Hemileia vastatrix* that causes coffee rust). In the optimistic view of the document, the incorporation of and stimulus to "modern agricultural techniques" would invigorate Brazilian agriculture in the short-term, increasing productivity and reducing the need to expand the cultivated area.

The use of agrochemicals in agriculture already accumulated controversies in 1975. Besides the concerns with restrictions to Brazilian exports, public health issues started to be structured. Some researchers were systematically monitoring intoxication cases of rural workers, and the presence of residues in food caused greater concern to consumers (Almeida, Svetlicic, 1972). From the agronomical perspective, the use of integrated control techniques (using not only the chemical control of "pests," but also biological control and cultural management) was advocated by agronomists who identified limits in the use of agrochemicals (Heinrich, 1973; Gonçalves, 1996).

Pereira (2016, p.170-175) points that when the PNDA was created, the harmful effects of agrochemicals were under discussion in different social spheres of the country. The author demonstrates that there was a certain clarification in society regarding agrochemicals, from the action and growth of an environmentalist movement, with the highlight of the activity of José Lutzenberger and the Natural Environment Protection Association of Rio Grande do Sul (Associação Gaúcha de Proteção ao Ambiente Natural, Agapan), as well as from the increase of food contamination caused by the use of those substances, which started to be denounced by the media.

As a way to demonstrate concern about the consequences of the use of pesticides in food production, the PNDA included the adoption of measures to reduce the impacts of the use of agrochemicals. The so-called "technical goals," by incorporating elements of health and environment protection, were part of the construction of the idea of "safe use" of pesticides and included actions such as:

- the expansion of studies and actions, on national level, on the toxicity of pesticides and the biological consequences;
- the creation of laboratories for the control of the effects of pesticides on food and for assessment of residues;
- the establishment of specifications aiming at quality control of commercialized products;
- the intensification and expansion of campaigns of "adequate use of defensives" aiming at the user's protection, residues reduction and environmental protection (Barragat, 19 out. 1976).

Constituted by representatives of the Secretariat of Planning and the Ministries of Industry and Commerce, of Agriculture, and of Treasury, a Special Group of Coordination and Follow-up (Grupo Especial de Coordenação e Acompanhamento, Geca) was created to examine the achievements of the PNDA from the view of members of specialized fields. The inclusion of a representative of the Ministry of Health in the composition of Geca produced the perception that the harmful effects on health caused by agrochemicals would be taken into consideration (Chaves, jun. 1976). The appointment of the Ministry of Health's representative, Paulo Barragat, deserves to be analysed with more details.

Barragat was a chemist who started his career in 1947 at the Agricultural Chemistry Institute (Instituto de Química Agrária) of the Ministry of Agriculture. Later, he worked at the Malariology Institute (Instituto de Malariologia), established in the town of Duque de Caxias (RJ) with the objective of developing scientific research and providing support to field studies carried out by the National Service of Malaria (Serviço Nacional de Malária) (Hochman, 2008, p.168). Among its activities, there was the production of DDT and BHC, used in vectors control campaigns. At the Malariology Institute, Barragat was the head of the Technical Section, responsible for the production and tests performed with those organochlorine insecticides. With the creation of the National Department of Rural Endemics, in 1956, Barragat started to work with insecticides production at Service of Prophylactic Products (Serviço de Produtos Profiláticos, SPP). The SPP was installed at Oswaldo Cruz Institute (Instituto Oswaldo Cruz, IOC) at the Manguinhos campus. Under the direction of Barragat, it became the Institute of Medicaments Production (Instituto de Produção de Medicamentos) after the fusion with the Department of Serums and Vaccines of the IOC (Paulo Barragat..., s.d.).

The indication of Barragat to represent the Ministry of Health was an evidence that the main issue to be followed by the PNDA regarding the effects on health was related to the area of "quality" in the production processes and use of poisons, rather than actually the toxicological aspects. This was confirmed in the main technical goal linked to the health area achieved after the implementation of the program: the establishment of a laboratory to monitor agrochemicals residues on food.

Implemented projects and strengthening of the agrochemical industry

The analysis of the projects carried out in the scope of the PNDA shows that the program consolidated the installation in the country of transnational corporations branches (Table 3). The participation of national capital in those enterprises continued to be reduced, considering that of the "16 most significant projects that are being implemented since 1975, four have the participation of national capital" (Galvão, 1979, p.3). The report referred to projects of Nortox (Paraná state, PR), Agroquisa S.A. (SP), Defensa (Rio Grande do Sul state, RS) and CNDA (RS), the latter of mixed capital.

Table 3: Projects implemented in the scope of the PNDA

Agrochemical (Active ingredient)	Enterprise group	Location of installation	Installed production capacity (tons per year) after PNDA (1980)	Cost (investment foreseen in the PNDA)
BHC	Indústrias Matarazzo S/A	São Caetano do Sul (SP)	10,800	Not informed
Toxaphene	Agroquisa S/A (ex-Vertamat)	São Caetano do Sul (SP)	7,200	US$1,630,000 (72% own resources, 28% financed)
DDT	Hoechst	Suzano (SP)	8,600	Not informed
Monocrotophos and dicrotophos	Shell Química S/A	Paulínia (SP)	3,600	US$6,430,000 (100% own resources)
Parathion ethyl and methyl	Bayer do Brasil Indústrias Químicas S/A	Belford Roxo (RJ)	7,360	US$2,340,000 (50% own resources, 50% financed)
Malathion	Cyanamid Química do Brasil Ltda	Resende (RJ)	6,800	US$13,000,000 (17% own resources, 83% financed)
Dimethoate	Nortox Agro-Química S/A	Arapongas (PR)	Note: The effective production of dimethoate had not yet started at the end of PNDA	US$6,620,000 (25% own resources, 75% financed) Note: total cost of Nortox project (dimethoate + trifluralin)
Maneb/Mancozeb	Du Pont	Barra Mansa (RJ)	4,500	Not informed
	Rohm & Haas	Jacareí (SP)	8,700	US$2,200,000 (24% own resources, 76% financed)
Copper oxychloride	Sandoz do Brasil S/A	Resende (RJ)	13,200	US$3,300,000 (100% own resources)
Ziram/Thiram	Rhodia Indústrias Químicas e Têxteis S/A*	Santo André (SP)	624	Not informed
Trifluralin	Nortox Agro-Química S/A	Arapongas (PR)	6,000	Note: see cost of "Dimethoate" project
Triazines	Companhia Nacional de Defensivos Agrícolas (CNDA)	Novo Hamburgo (RS)	3,500	US$1,100,000 (30% own resources, 70% financed)
2,4-D	Dow Química S/A	Aratu (BA)	9,000	US$19,000,000 (27% own resources, 73% financed)
Paraquat	Companhia Imperial de Indústrias Químicas (ICI)	Paulínia (SP)	1,000	US$4,000,000 (60% own resources, 40% financed)
Diuron	Du Pont	Barra Mansa (RJ)	3,500	Not informed

* The project was transferred and carried out by Companhia Nacional de Defensivos Agrícolas.

Source: Prepared by the authors based on Carrara Jr. (1979) and Brasil (3 abr. 1981).

During the period of the PNDA implementation, other projects also occurred that led to the production of new compounds. In the category of insecticides and acaricides, Bayer do Brasil S/A organized the start of the production of the organophosphates coumaphos, fenithrothion and fenthion in its production unit in Belford Roxo (RJ), whereas the Union Carbide planned to start producing carbamate aldicarb in Cubatão (SP) in 1982. In its turn,

Monsanto S/A had started the production of glyphosate herbicide in 1979 in São Paulo (operating with capacity of 4,600 tons per year).

The PNDA proposal to divide the production market among large enterprise groups contributed to the creation of an oligopolistic structure in the agrochemicals market. In 1983, the eight largest enterprises in the Brazilian agrochemical market (all of them branches of transnational corporations) aggregated 61.6% of the industry's total revenues (Terra, 2008, p.68).

The National Association of Agricultural Defensives (Associação Nacional de Defensivos Agrícolas, Andef),[4] a class organization representing the agrochemical manufacturers created one year before the start of the plan's activities (1974), strengthened its actions as the industry's lobbyer. Andef was composed mostly of the branches of transnational companies (like Bayer and Basf) and had a direct interlocution with Geca. One of the main issues that the organization sought to articulate was the maintenance of the mechanism of rural credit financing, reinforcing the argument that the model of rural credit created in 1965 was one of the elements that leveraged the use of agrochemicals in the country.

In a letter to Geca's secretary-general, Andef presented a study with the average costs for the application of "defensives" for what it considered the "11 of the most expressive economic cultures:" coffee, soybean, wheat, sugar cane, cotton, rice, pasture, corn, potato, citruses, and tomato. Together with the Union of Agricultural Defensives Industries of São Paulo (Sindicato da Indústria de Defensivos Agrícolas do Estado de São Paulo), Andef requested that "the current financeable values be adjusted to the real needs according to the economic conditions of each of the considered cultures" (Andef, 30 mar. 1977, p.7). The study listed the main difficulties faced (such as the delay in the liberation of resources and approval of proposals) and made suggestions that would facilitate the use of rural credit for the purchase of pesticides (such as extending the validity term of invoices, ensuring credit destined to rural activity costing, decentralizing the registration of input suppliers at bank agencies, and facilitating the access to costing financing in periods of "unexpected outbreaks of pests and diseases").

Andef also sought to articulate, in partnership with the Ministry of Agriculture, campaigns for "adequate use" of "agricultural defensives." These campaigns contributed to establish the perception that risks associated with the use of those substances in agriculture would be "controlled" when the manufacturer's instructions were followed (Andef, 1976). The framework adopted in the campaigns imputed to the agricultural producer the responsibility for whatever case of intoxication, because it did not address the inherent toxicity of those products (Pereira, 2016, p.193-194).

Courses provided and manuals destined to the agriculture producers comprised general guidelines about the application (some with controversial aspect, such as to apply "defensives" when the agricultural producer evaluated that the attack of pests was prejudicial) and draw on the premise that effects on health and environment would result solely from the "misoriented use" (Andef, 1976, p.1-3; Defensivos... 13 jul. 1975). The notion of "safe use" became the central axis of the argument used by the manufacturers, erasing the controversial permission for the use of pesticides that were already prohibited in other countries (Fabricantes..., 10 jun. 1979).

As demonstrated by Alves Filho (2002, p.62-64), Andef's work by means of campaigns and actions promoted in partnership with public agencies sought to combat the presence of a "critical mass," which was already consolidated at the time and performed strong opposition to the indiscriminate use of agrochemicals in Brazil. Pereira (2016) explores one of those conflicts held between the environmentalist movement and Andef, analysing telegrams sent to the latter and letters published in the press by Lutzenberg and Agapan, denouncing episodes of contamination caused by the use of chemicals in agriculture. These groups also accused the Ministry of Agriculture of maintaining close relationship with Andef and criticizing the openness of the ministry to the interests of agrochemical manufacturers.

However, it is a mistake to circumscribe the relationship of the civil-military dictatorship with the agrochemical industry solely for its institutional character and mediated by Andef. Representatives (military and civil) of the Brazilian government occupied positions in agrochemical companies, among whom the most well-known was General Golbery do Couto e Silva. Minister-head of the Civil Cabinet in the administrations of General Geisel and General Figueiredo, Couto e Silva was a theorist of the national security doctrine, participated in the creation of the National Information Service (Serviço Nacional de Informação, SNI), and was one of the directors of Dow Chemical's branch in the country. The link between the Brazilian dictatorship and those companies was consolidated drawing on the exchange of mutual interests and can explain the permanence, for such a long period, of a lagged and insufficient legislation for the regulation of manufacturing, commercialization and use of agrochemicals (Franco, Pelaez, 2017; Pereira, 2016, p.202-203).

Expansion of new agrochemicals use and insufficiency on technical goals

According to the evaluation of the Ministry of Agriculture (through the Secretariat of Vegetal Sanitary Defence) the physical goals proposed by the PNDA were achieved. Apparently, the increase of agrochemicals internal manufacturing had reduced imports dependency. In 1974, 77% of the total amount purchased in Brazil were imported, whereas in 1979 this amount was reduced to 50%. The manufacturing increase was led by the greater production of fungicides, but mainly herbicides (Figure 2).

For the case of insecticides, the small increase in manufacturing (which in 1979 was approximately 18 thousand tons) did not reflect on import rates (the national manufacturing corresponded to 42% of the consumption). At the time, there was in Brazil a transition to the use of organophosphates and carbamates insecticides in substitution to organochlorines, but the national production still concentrated on the latter group. In the early 1980s, regulatory frameworks started to forbid the use of different organochlorines in agriculture, resulting in a strong consumption reduction of this category of poison. To illustrate, although the installed capacity of BHC production in Brazil reached 10,800 tons per year in 1980, the effective production in 1979 had been only 3,230 tons (Brasil, 3 abr. 1981, p.2), which indicates a reduction in the demand for this product (a fall also observed in the purchase of other organochlorine insecticides, such as DDT and toxaphene).

Therefore, imports were necessary to ensure the supply of organophosphates, while the internal production was not yet capable of meeting the increasing demand.

Indisputably, the PNDA leveraged the production of fungicides and herbicides in the country. The national production of fungicides soared from 7,558 tons per year to 14,905 tons per year (representing 67% of the total consumption). Meanwhile, herbicides increased from 828 tons per year to 9,633 tons per year (from inexpressive 6% to 48% of the total amount consumed by the national agriculture) (Figure 2). The new categories of pesticides followed the expansion of commodities crops, such as wheat, orange, and especially soybean. These three products presented the highest percentage production increases in the period between 1967 and 1979 (approximately 10%, 15% and 27%, respectively) (Galvão, 1979, p.9). As stressed by Klein and Luna (2019, p.59), among agricultural commodities, it was soybean that best represented the "new era" of Brazilian agriculture. In the first half of the 1970s, this crop reached a highlight and became one of the pillars of Brazilian economy based on the agro-export model. This growth was closely linked to the use of herbicides.

Another change related to the PNDA is the role of Brazil as exporter of agrochemicals to other countries (Silveira, Futino, 1990, p.143). In an interview to *Jornal do Brasil*, Régis Nei Rahal, Andef's president, celebrated the fact that Brazil, which previously exported to Bolivia and Paraguay only formulated products, had become also exporter of active ingredients such as copper oxychloride, toxaphene and trifluralin, and not only to those two countries, but also to Colombia, Uruguay and African countries (Indústria..., 22 dez. 1977).

Though the production goals were achieved, the same did not occur with the so-called "technical goals." Measures that had as objective the improvement of the inspection of pesticides use in the Ministry of Agriculture were not consolidated:

> If from the industrial point of view the goals of PNDA have been achieved, the same cannot be stated in relation to the institutional goals expected for 1980. The installation of the necessary infrastructure for the inspection of production, commercialization and application of defensives in the field has not been contemplated, in the same measure, with human and financial resources (Galvão, 1979, p.3-4).

The PNDA initially planned the installation of five phytosanitary stations, five laboratories of defensives and residues analysis, installation of 25 posts of vegetal sanitary defence, and the hiring 385 technicians for laboratory and field activities. By the end of 1979, only four "laboratories of vegetal reference" had been installed, in Porto Alegre, Recife, Goiânia and Pinheiral, but the last two lacked technical staff. In a scenario of economic crisis and shortage of funds, the federal government was incapable of investing in the adequate inspection of agrochemicals production and consumption, finding as solution the establishment of partnerships with state research institutes (such as with the Biological Institute of São Paulo) (Pessanha, Menezes, 1985, p.14-15).

On the other hand, the technical goals related to the health area were limited to the transfer to Fiocruz of the Central Laboratory of Drugs, Medications and Food Control (Laboratório Central de Controle de Drogas, Medicamentos e Alimentos, LCCDMA), starting in 1978. In the period of the PNDA implementation, the definition of technical norms related to pesticides in the Ministry of Health occurred in two forums. One working

group of the National Service of Medicine and Pharmacy Inspection (Serviço Nacional de Fiscalização de Medicina e Farmácia) was responsible for the definition of norms for manufacture and commercialization of sanitizing products and insecticides for household use (Paulo Barragat participated in this group indicated by Fiocruz). Another working group, within the National Commission of Food Norms and Standards (Comissão Nacional de Normas e Padrões de Alimentos), defined norms related to the presence of pesticide residues in food.

As Barragat (19 out. 1976, p.3) clarifies in a letter to Fiocruz's president, Vinícius Fonseca, "none of the two agencies has laboratories prepared to conduct the determined studies, works and controls." For this reason, he suggested to use the opportunity of the transfer the LCCDMA to Fiocruz, so that the activities of inspection and establishment of pesticides specifications would be centralized there. As the LCCDMA already assessed the insecticides for household use, Barragat expected that it would also assess the "agricultural defensives" (p.3). Created in the 1950s with the objective of conducting the quality analysis and defining standards of pharmaceutical products, this laboratory linked to the Ministry of Health also acted in the area of food quality since 1961 (Costa, Rozenfeld, 2000, p.30).

Fiocruz, in its turn, after a period of depletion of its national relevance, discontinuity of activities, and political persecution (of which the landmark was the disfranchisement of political rights of ten researchers in 1970, an episode known as the Massacre of Manguinhos), was again seen as an important element in the scientific and technological policy of the military government. The indication of Vinícius Fonseca to the foundation's presidency, an economist coming from the Secretariat of Planning of the President Office, was an indicative sign of a more technocratic view for research activities, which should be attached to the economic and social demands (Hamilton, Azevedo, 2001). The transfer of LCCDMA occurred in 1978; three years later, the laboratory became the National Institute of Quality Control in Health (Instituto Nacional de Controle de Qualidade em Saúde).

Framing agrochemicals in the sanitary surveillance, by conducting quality tests on produced food and commercialized pesticides, sought to ensure the circulation of products within standards defined as "acceptable." The restricted focus of actions in the health area, however, is the key to a critical analysis of the construction of the concept of "safe use" proposed in the PNDA. This framework did not include, for example, the study of the biological consequences of the use and ingestion of agrochemicals, an epidemiological approach of intoxications by means of an amplified monitoring of the population, as well as research that investigated the effects of environmental contamination. The absence of these investigative approaches and the deficient inspection by public agents resulted in rural workers' intoxication, cases of environmental pollution, and contamination of consumed food (which presented residues of forbidden pesticides or in higher levels than those allowed) (Pessanha, Menezes, 1985, p.16-19; Ruegg et al., 1987, Carvalho, Nodari, Nodari, 2017, p.88).

The post-PNDA period

Despite the considerable increase of agrochemicals production in Brazil, with the productive capacity virtually doubling in a period of five years (from 22,838 tons in 1974 to 42,263 tons in 1979) (Galvão, 1979, p.18), the PNDA results were partial regarding the nationalization of the production. Besides the small number of projects carried out with exclusively national capital, there was a continued need to import raw materials and intermediary compounds for the synthesis of agrochemicals, which were not synthesized by the country's fine chemical industry (Silveira, Futino, 1990, p.143). In values of the time, the import costs of those reagents increased from approximately US$6 million in 1974 to US$90 million in 1980 (Brasil, 1982, p.56-59).

What was confirmed, therefore, was the internalization of one of the last stages of agrochemicals production, making evident the strategy of large transnational groups of the chemical industry: to concentrate in their countries the investment in innovation research and patent registration, and to install intermediary or final stages of the agrochemical production process in "developing" countries. Therefore, active ingredients that had their use restricted in several developed countries continued to be produced and commercialized by their branches in countries like Brazil, using gaps in the legislation and state incentives (Pelaez et al., 2015, p.160).

We sustain in this article that the PNDA also represented a transition in the profile of agrochemical usage in the national agriculture; this statement can be corroborated by the comparison of commercial products liberated for use before and after the implantation of the program (Table 2). In 1972, of 659 commercial products registered for use as insecticides and acaricides, 71% involved contained some organochlorine in their composition, an amount that dropped to 48% in 1983.

Organophosphates, on the other hand, represented in 1983 more than half of the poisons intended to combat insects and acaroids (51% of the total, including mixtures made with other active ingredients). Agrochemicals produced exclusively based on organophosphates, which represented 20% of insecticides and acaricides in 1972, became 37% in 1983 (Table 2). Changes in the range of pesticides also involved an increase in the number of carbamates, besides the emergence of pyrethroids among the available poisons.

In a very slow rhythm, the use of organochlorines was legally restricted in the country. After the prohibition of the use of chlorinates on pastures in 1971, the Ministry of Agriculture did not renew the permission for the use of various insecticides of this category on vegetables in 1980 (Bull, Hathaway, 1986, p.175); but only in 1985, in José Sarney's administration (1985-1990), the agricultural use of organochlorines was prohibited. Ordinance n.329, issued by the same ministry, read in its first article the following text:

> To prohibit, in the entire national territory, the commercialization, the use and the distribution of organochlorine agrochemical products, destined to agriculture, among them: Aldrin, BHC, chlorinated camphene (toxaphene), DDT, dodecachloro, endrin, heptachlor, lindane, endosulfan, metoxichlor, nonachlor, pentachlorophenol, dicofol and chlorobenzilate.

> Sole paragraph: constitute exceptions to the prohibition contained in this article:
> a) The use of formicide baits based on Aldrin and Dodecachloro;
> b) The use of termiticide based on Aldrin for use on afforestation;
> c) The use of the referred products when applied by competent public agencies, in public health campaigns against vectors of etiological agents of diseases;
> d) Emergency use in agriculture, at the discretion of the National Secretariat of Agricultural Defence of the Ministry of Agriculture (Brasil, 3 set. 1985).

Despite the exceptions included in the text, it is indisputable that the ordinance prohibiting the use of organochlorine in agriculture had advances and presented positive aspects, (partially) meeting social demands collectively constructed during the previous years. The 1980s marked the consolidation of a movement of criticism regarding agrochemicals in Brazil, initiated in the 1970s, to which contributed environmentalist movements (e.g., Agapan), as well as researchers' groups (in areas like agronomics and toxicology).

A first positive aspect to be highlighted was the use of the term *agrotóxico* ("agrchemical")[5] in the ordinance text. The expression was proposed by the agronomist Adilson Paschoal in 1978, attempting to stress the inherently biocide characteristic of the products, which put at risk not only human life, but also that of other living beings and of the ecological interactions they establish (Paschoal, 2019, p.85-87). Groups of agricultural producers, agronomists and extensionists, drawing on the observation of intoxication cases and loss of efficiency of some pesticides (and influenced by the cultural context), changed their perception and adopted a more critical view in relation to agrochemicals, making the term popular among those who considered the importance of making evident the negative effects of their use (Carvalho, Nodari, Nodari, 2017).

In this way, they opposed the concept of "agricultural defensive" (with positive connotation and associated with innocuousness) widely disseminated by agrochemical companies and the military government, which adopted it in its main program for the industry. Therefore, it is meaningful that ordinance no.329, issued during the democratic opening, used the term *agrotóxico* as a way to counterpose the understanding of the dictatorship period and its PNDA. As opposed to ordinance no.357, of 1971, which presented in its text only economic considerations, the 1985 ordinance justified the prohibition "considering the need to safeguard human and animal health and the environment from the action of agrochemicals, demonstrably of high persistency and/or dangerousness" (Brasil, 3 set. 1985).

Paschoal took part in a movement critical to the agribusiness model, which gained strength as from the end of the 1970s, gathering several actors mobilized for the environmental cause and the agrochemicals issue, especially among agronomists. Names as Ana Primavesi and José Lutzenberger proposed the adoption of alternative production methods, without the use of chemical fertilizers and agrochemicals (Alves Filho, 2002; Pereira, 2016; Carvalho, Nodari, Nodari, 2017).[6] Besides the popularization of the term *agrotóxico*, this movement had already resulted in the adoption of agronomic prescription and the elaboration of state legislation (such as the one approved in Rio Grande do Sul state in 1982) that included the prohibition of organochlorine use. The ordinance no.329 also

sought to organize, on the federal level, prohibitions that occurred on state level, based on the promulgation of state legislation, which had their constitutionality contested by Andef (Pereira, 2016, p.241-246).

Despite the advances produced by the prohibition of organochlorine insecticides for agricultural use, our study proposes that it occurred only when other compounds (such as organophosphate and carbamate herbicides and insecticides) had their use expanded, stimulated by state investment through the PNDA. In an important work already mentioned here, Davis (2014) argues that the prohibition of organochlorines in the United States motivated the increase of the use of other products (such as organophosphates). For the Brazilian case, those processes occurred in reverse order. Largely motivated by the restrictions imposed by countries that import agricultural products, the "modernization" of the agrochemical market was a necessity imposed on the dictatorship technocracy for the consolidation of the agribusiness model. The existing contradiction is that this "modernization" sought to ensure the permanence of the use of "obsolete" pesticides, even though their environmental impacts had been already widely recognized. There was an actual implementation of the idea that pollution was the cost of "progress."

Final considerations

From the analysis of the PNDA, we believe that we have been able to demonstrate how pesticides have been a crucial element for the consolidation of the agribusiness model promoted by the civil-military dictatorship. On the one hand, the program stimulated the installation of industries that produced organochlorine insecticides that were prohibited in other countries, and had their use allowed in Brazil. On the other hand, it consolidated a change in the profile of agrochemicals production and use in the country, with stimulus to organophosphate insecticides and herbicides, so that the advances obtained with the legal frameworks of restrictions to the use of organochlorines, in the early 1980s, should be relativized.

Along the years, Brazil became one of the largest consumers of agrochemicals in the world. Data of 2013 place the country as the largest world consumer in absolute values, and the seventh when considered the use of agrochemicals per cultivated area (Vasconcelos, set. 2018). Only in the year 2019, more than 479 agrochemical products became commercialized in the country, the largest liberation in 14 years (Moreira, 28 dez. 2019; Grigori, 16 jan. 2020).

The promise to put an end to agricultural "pests" with the use of "modern pesticides" that existed in the 1970s was not fulfilled. Species that caused losses at that time and were cited in the PNDA, such as *cigarrinhas-da-cana-de-açúcar* and coffee rust, continued to cause economic problems.[7] Impacts on health and on the environment produced by the intensification of agrochemicals application take us to view with criticism the attempt to establish a "safe use" of those poisons and the notion of "controlled risk" of the effects, which, ultimately, make the agricultural producer responsible for the intoxication cases. Though today dependence on the use of agrochemicals makes a complete prohibition practically not-feasible, it is urgent to conceive a transition to an agricultural model that is less dependent on its use and consequently more sustainable.

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NOTES

[1] In this article we use the concept "agrochemical" in reference to synthetic organic compounds extensively used in the post-war period (the emblematic case of this process is dichlorodiphenyltrichloroethane, or DDT). These are substances with a structure based on carbon chains produced in laboratory, which can be subdivided into chemical categories, such as: organochlorines (e.g., DT, BHC, aldrin, endosulfan), organophosphates (e.g., parathions, malathion), carbamates (e.g., aldicarb), among others. Substances obtained from plant extracts (such as pyrethrins, obtained from plants of the former genus *Pyrethrum* – presently *Chrysanthemum*) and inorganic substances (as copper acetoarsenite and copper sulphate, respectively, the insecticide "Paris green" and the fungicide "Bordeaux mixture") that were used before the diffusion of synthetic organics. At a first moment, within the context of post-war technological optimism, these pesticides were associated to a lower toxicity to human beings and to an effective control of undesired species, which made invisible the negative impacts associated to their use (Peres, Moreira, Dubois, 2003, p.24-26).

[2] According to Decree n.4074/2002), which regulates the Agrochemicals Act (Lei dos Agrotóxicos) (Law n.7802/1989), "active ingredients" are chemical substances with biocidal property (e.g., DDT, BHC, parathion and glyphosate). These compounds are available in the form of "technical products", produced from raw materials and containing a certain content of the active ingredient, but can present other substances (e.g., isomers, stabilizers or even impurities). From those elements are produced the "formulated products", which are those actually commercialized and vary in the concentration of the active ingredient and the way of using (dry powder, wettable powder, suspension etc.).

[3] [Translation note] In this and other citations of texts from Portuguese, a free translation has been provided.

[4] Later, the entity changed its name to National Association of Vegetal Defence (Associação Nacional de Defesa Vegetal) in a first attempt to detach from the term "agricultural defensives" and reinforce a broader scope of activity. Since October 2019, Andef fused with the Brazilian Association of Companies of Biological Control (Associação Brasileira das Empresas de Controle Biológico), the Association of Companies of Biotechnology in Agriculture and Agroindustry (Associação das Empresas de Biotecnologia na Agricultura e Agroindústria) and the Council of Biotechnology Data (Conselho de Informações sobre Biotecnologia), originating CropLife Brasil.

[5] [Translation note] No terms were found in the English language that corresponded to the meaning of this concept in Portuguese. The word "agrotóxico" is formed adding the prefix "agro" to the word "toxic," calling attention to the evident toxicity to human health and the environment.

[6] This group mobilized an alternative agriculture movement, which was expressed, for example, in the realization of the Brazilian Meetings of Alternative Agriculture (Encontros Brasileiros de Agricultura Alternativa), held in different Brazilian cities during the 1980s. Those meetings gathered public authorities, were consolidated as actual landmarks in the debate on the agrochemicals issue and represented instruments of pressure over the public administration for the formulation of a legislation on the regulation of the use and commercialization of those products.

[7] Organochlorines and organophosphates were replaced by carbamates (aldicarb and carbofuram) and neonicotinoid (thiamethoxan) for the control of *cigarrinha-da-cana-de-açúcar*, until the return to the bid on biological control (Almeida, Batista Filho, 2017). After the extension of the use of fungicides based on copper, the control of coffee rust started to be made with systemic fungicides, but there is increasing understanding that environmental variables also have influence on the propagation of the disease (Encontrada..., 25 abr. 2018).

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ERRATUM

In the article "The dictatorship of agrochemicals: the National Program of Agricultural Defensives and changes in pesticides production and consumption in Brazil, 1975-1985" (http://dx.doi.org/10.1590/S0104-59702022000200003), by Leonardo de Bem Lignani and Júlia Lima Gorges Brandão, published in *História, Ciências, Saúde – Manguinhos*, v.29, n.2, mar.-jun. 2022, the images on Figures 1 and 2 were switched by mistake.

- On page 6, where you read:

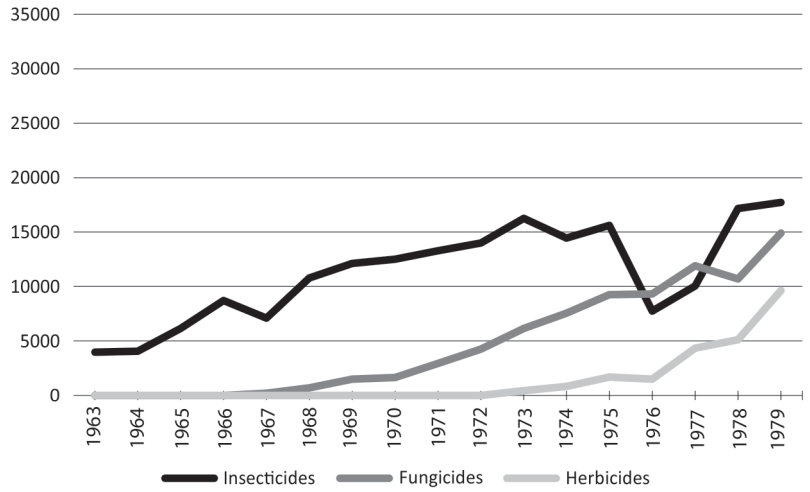

Figure 1: Graph of agrochemicals import (in tons) by Brazil, 1963-1979 (Source: Prepared by the authors with data by Alves [1973] and Galvão [1979])

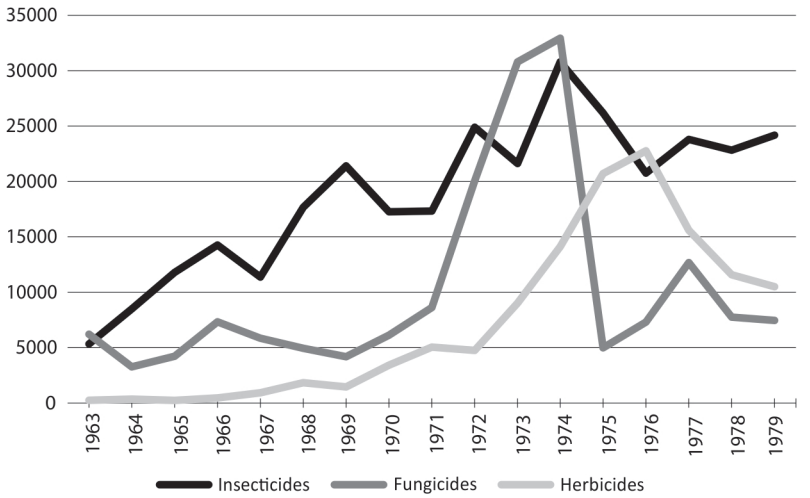

Figure 2: Graph of the national production of agrochemicals (in tons) in Brazil, 1963-1979 (Source: Prepared by the authors with data by Alves [1973] and Galvão [1979])

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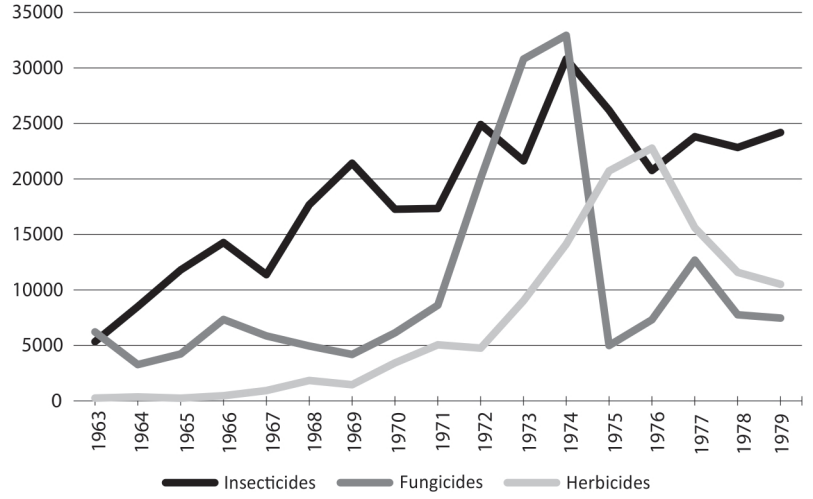

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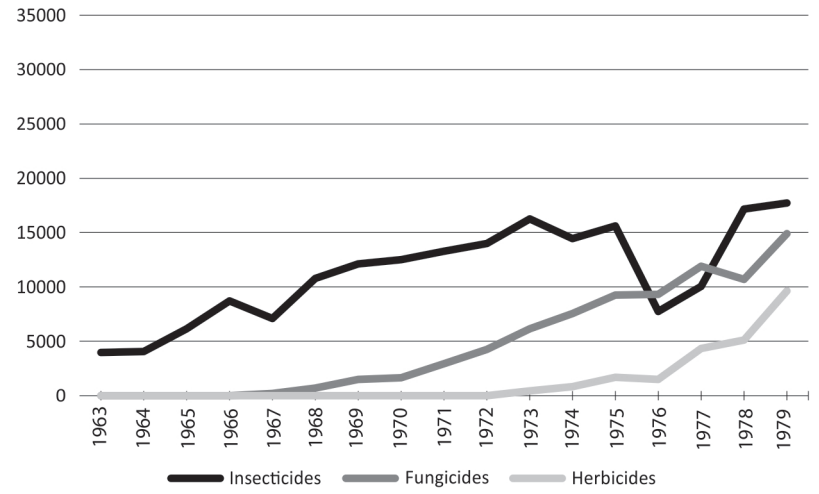

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