



Demystifying agroecology in Brazil

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ABSTRACT: *This paper reflects on the controversy between agroecology and modern conventional agriculture. As a counter-paradigm, agroecology criticizes and resists advances in agricultural sciences, including biotechnology. But does not offer concrete answers to the challenge of increasing food production in the world in a sustainable way. It is a view that denies the importance of modern agriculture to solve the problems of scarcity and food security and does not recognize the potential of genetic modification to decisively to promote sustainable agriculture, accelerating the overcoming of the so-called “chemical reductionist paradigm”. The principal argument is that agroecology, despite being an area of knowledge that can contribute to recovering natural resources and helping nature’s resilience, is not an alternative to modern conventional agriculture and has been trying to prevent advances in genetic engineering, a fundamental area for sustainability and for the low carbon agriculture. In the end, based on the importance of the controversy in the History of Science, presents the reasons why agroecology does not fulfill the requirements to be an agricultural science.*

Key words: *agroecology, agricultural sciences, sustainability, food security.*

Desmistificando a agroecologia no Brasil

RESUMO: *Este artigo reflete sobre a controvérsia entre a agroecologia e a agricultura convencional moderna. Como um contra-paradigma, a agroecologia critica e resiste aos avanços nas ciências agrícolas, incluindo a biotecnologia. Mas não oferece respostas concretas ao desafio de aumentar a produção de alimentos no mundo de maneira sustentável. É uma visão que nega a importância da agricultura moderna para resolver os problemas de escassez e segurança alimentar e não reconhece o potencial da modificação genética para promover decisivamente a agricultura sustentável, acelerando a superação do chamado “paradigma reducionista químico”. O principal argumento é que a agroecologia, apesar de ser uma área do conhecimento que pode contribuir para recuperar os recursos naturais e ajudar a resiliência da natureza, não é uma alternativa à agricultura convencional moderna e vem tentando impedir avanços na engenharia genética, uma área fundamental para a sustentabilidade e para a agricultura de baixo carbono. Por fim, com base na importância da controvérsia na História da Ciência, explora as razões pelas quais a agroecologia não preenche os requisitos para ser uma ciência agrária.*

INTRODUCTION

According to contemporary science historians and philosophers, in the passage of a millennium it usually reappears beliefs and anti-scientific positions that are classified either as anti cult or as ‘counter-cult’ movements one secular and the other sectarian. The end of the 19th century was preceded by eschatological beliefs and the rescuing of ideas that were then considered overcome. Among these own events of *fin du siècle*, many deny the advances of reason. The passage from the following century to the 21st century was no different, with typical manifestations of obscurantism, seen as a

problem determined by various crises of the end of the century and potentialized by the anxieties and the feeling of boredom in most wealthy societies (INTROVIGNE, 1995).

In Milan, in 1993, during the event that brought together Nobel laureates - “10 Nobel Prizes for the future” - the researcher Rita Montalcini, winner of the Nobel Prize for Medicine in 1986, referred to the need around the world for certain social groups to find a new “scapegoat” for this type of malaise, which would have led to a certain disbelief in science as an institution and the emergence of a paradigm shift, such as the belief in witch doctors and adherents of extrasensory perceptions. Other evidences of an

emergent obscurantism would be the prestige of certain studies that, in a dilettante way, questions the scientific method, the expansion of sects and associations that worship fanaticism and anti-science (INTROVIGNE, 1995; NUZZACI, 1993). In Brazil it was no different. When they reverberated, the scientific community officially didn't worry about them, except about isolated manifestations of some of its members. These irrational manifestations that took place under the mantle of neo-obscurantism gradually evolved to an almost hysteria in relation to genetic modifications, with condemnation of researches in modern biotechnology in their discourse, not being, in essence, anything different from those in which theological thought attempted not take into account the discoveries of Copernicus, Galileo, Descartes and Darwin (BAIARDI; MENDES, 2005).

The hysteria against research in genetic engineering imposes the clarification of facts and contradicts obscure positions of the so-called 'green fundamentalism', inspired by the works of J. Rifkin (1995; 1998) and the 'Neo-Luddism', represented by João Pedro Stédile's pronouncements (2011) and the depredations caused by the hordes organized by the messianic movement called "Via Campesina", in some cases with the presence of the French Neo-Luddite activist, Joseph Bové. These positions not only consider transgenesis as potentially dangerous and poisonous, but also for the end of research activity in this area, accuse geneticists who perform genetic modifications of lacking with ethics. In this extrem simplification, concepts are confused and injustice is made to the contributions of genetic engineering in terms of health and well-being (BAIARDI; MENDES, 2005).

The editorial of February 17th, 2019, entitled "O Escândalo da pseudociência na universidade pública" and published in the journal "Questão da Ciência", (2019) refers to something that has been observed within Brazilian agronomy: the attempt to disqualify all efforts made by modern conventional agriculture to become increasingly friendly to environment and various initiatives to enhance agroecology as a proposal capable of replacing it. These attempts have been made, however, without a draft for a comparative experimental program or even without any microeconomic feasibility study.

OBJECTIVE AND METHODOLOGY

The objective of this research was to demonstrate that agroecology does not meet the requirements to have a complete statute among the

agricultural sciences, which are normally applied aiming to address food shortages and provide food security. Agroecology is not characterized as knowledge based on hypothesis tests with statistical support (BARRY, 1997). Therefore, it should not be defined as agricultural science, but as a way to cultivate flower gardens, orchards and small vegetable gardens without the use of chemical inputs.

Some of those who defend agroecology as a science do so cautiously, defining agroecology as: i) an integrative discipline that includes elements of agronomy, ecology, sociology and economics; ii) a separate discipline, distinguishable from existing and parenting disciplines such as agronomy, ecology and socioeconomic; iii) a differentiated discipline from normal or official science, because it anticipates the manner and direction in which the social position of science is changing; iv) a differentiated discipline as it promotes integration between different disciplines and different scales; v) a participatory science, emerging alternatives to the practice of technological innovation and rural extension and vi) it is a vehicle of contributive justice (GLIESSMAN, 1997; GLIESSMAN et al, 2007).

As a *methodological* approach, the analytical category of scientific controversy was used, which focuses on attempts, according to KHUN (1970), for a given paradigm to try to replace another one. Controversy is important in sociology and in the history of science. Harry Collins (1981; 1992), for example, understands that it allows to follow the moment in which knowledge is being built, that is, while the controversy is being resolved. The procedures were a systematic review of the literature, which consists of compelling relevant studies on a question formulated, in this case a controversy, using the database of literature that deals with that question as a source and research methods. Throughout, the text arguments are opposed, demonstrating the controversy. Bibliometric research was also carried out by means of a non-probabilistic and saturated sample.

Agroecology lacks a scientific statute and a clear concept

The defense that agroecology is a science is based on bibliometric research and, even so, defines it not only as science, but also as movement and as a practice (WEZEL, 2009). There is also an attempt to define it as a particular science, as a non-agricola science, but as a science of sustainable agriculture, which is not dissociated from the idea of holistic systems be participatory and transdisciplinary (ALTIERI, 2018). And yet another definition is that agroecology is a science of natural

resources, managed by poor farmers and marginal environmentalists (ALTIERI, 2002).

Experiments that included comparisons between the performance of agroecology with other production systems with strict statistical control and economic and productivity tests, stochastic frontier estimates and even cost benefit analysis and design economics for testability are not designed and even less performed to assess the efficiency of agroecology. Even when comparative studies are carried out, analyzes are not carried out on production levels, but only on ecological impacts. Therefore, the conclusions are not definitive. According to some defenders of this type of research, the results are not easily “measurable” in scientific terms and agroecological systems are difficult to model due to their high complexity and their non-linear dynamic behavior (GOMIERO, 2011).

In order to investigate the scientific bases of agroecology, the authors of this article conducted a web search with the words “agroecology, research with an experimental approach”. Twenty-eight thousand two hundred titles were found. A non-probability saturation sample with 300 titles was estimated, composed of articles in periodicals, book chapters, books and papers presented at scientific events and websites, with 40% variability, 95% confidence interval and margin error 5.5%. The research revealed that only one paper contained experimental results, but not exactly in agroecology. It was about crop rotation, which is a recommendation legitimated for many decades by agronomic science. Another paper presented only an economic comparison between conventional and organic systems, concluding what is obvious: they have a higher market value. But, organic products are not necessarily ecological. Two other articles referred to the methodological difficulties of conducting agroecological studies from a statistical perspective (DELATE, 2002; DELATE 2003; BIANCONI et al, 2013; OLESEN, 2005).

The advantages of agroecology are not related to the variables productivity and production cost, but with variability, sustainability, allelopathy, sovereignty, social participation, agricultural multifunctionality, innovative education and even a pact with God and nature. Conversely, this approach removes agroecology from the field of applied sciences, being close to political praxis. It reinforces the concept that “agroecology” is in the field of meanings, symbolism and the desire to develop a radically different pattern of agricultural production. In fact, it is easy to find the statement that agroecology is “another agriculture that fuses agronomy and

ecology” through “a new form of science”. This is a highly romantic and idealized discourse that conditions the replacement of conventional agriculture to the occurrence of “structural changes” in society, economy and, obviously, to a radical transformation of the conventional modern agriculture’s productive system (NAVARRO, 2013).

The difference between the two visions is that, while the first admits a transition towards “sustainable modern agriculture”, or a gradual movement of passage from intensive formats to other technological standards that absorb smaller amounts (in volume and in value) of agroindustrial inputs, the second model defends substitution of the modern-conventional pattern and the adoption of agroecology

Brazil, according to the Food and Agriculture Organization of the United Nations (FAO, 2019), unlike other countries, has a very flexible definition of agroecology pushing it into the field of science. In this country, the initial attempt to demonstrate the lack of scientific statute in agroecology, was stated by the rural sociologist Zander Navarro, by means of one article that there is a detailed study on this activity in Brazil and its curious idiosyncrasies (NAVARRO, 2013). It is a sociological study that helps to understand how something that is not science achieves so much space in Brazilian public policies. The article analyzes the epistemological failures of word agroecology, suggesting that the union between ecology and agronomy has happened throughout history; however, it does not require this illegitimate power of presumed authority. Subsequently, the same researcher organized a set of articles and wrote several researches for the official journal of the Brazilian Society for the Advancement of Science (BAIARDI, 2017).

Agroecology, in fact, does not have a precise and scientifically accepted definition because as a “particular science”, so as defined by its leaders, depends on external conditions to the world of science and, at the same time, it is defined as a non-agrarian science, as a science of sustainable agriculture, not dissociated from the idea of holistic. So, when a definition is so imprecise, there is no definition (FAO, 2019). There is, at most, a definition of a pretense area of knowledge that comprises a network composed of countless non-governmental organizations (NGOs). In their discourse, this group conceptualizes agroecology as a “particular scientific knowledge” which incorporates two additioned dimensions, a political movement and a social practice, a *praxis* (ABA, 2019).

This kind of approach suggests that agroecology has no real (or solid) support for anchoring

its foundations; therefore, it must be a tripod in which simple recipes of universal knowledge-based gardens are associated with political dogmas and social dynamics, of which it could have a transformative force in the rural world. This type of approach would be unthinkable in other fields such as virology and ophthalmology, for example, but as it does not involve greater risks, except for personal sublimation of its adherents (or waste of public resources) it is allowed in agroecology. As a result, public policies have been invaded by non-scientific narratives full of fairy tales and elves.

However, an honest and fair criticism of conventional or modern agriculture is welcome and extremely necessary. Researchers have been striving to achieve a higher level of sustainability in all commercial crops (with special focus on soil conservation and reduction of water and energy consumption). The methods of agricultural sciences have long been trying to overcome chemical reductionism. Investigations in these areas incessantly seek for production systems with less impact on the environment through a multidisciplinary view, supported by advanced scientific innovations, among genetic modification, which offer varieties less dependent on chemical inputs and also the development of more sustainable pest, soil and water management techniques. Agricultural science pursues new productive paths aiming to achieving “more with less”. More food production and raw materials of agricultural origin, with quality, less use of land water, nutrients, energy, labor, and capital (PEDROSO, 2018).

Agroecology is not part of the history of agricultural sciences

Since the third century BC, it is possible to find written and authored concepts, models and theories later incorporated into the science of Agronomy. Two hypotheses are presented who did the initial incursion: the first, the pioneer would be the Greek philosopher Socrates (469 BC – 399 BC) in the known dialogue with Ischomachus, in *Oeconomicon* of Senofonte. The second, so it is argued, indicates that the pioneer would have been Mago (Magão) of Cartago, in his agronomy treaty, which is referred by Pliny the Elder (23 – 79 A.D.), in his book *Naturalis Historia* (GIORDANI, 1969; BAIARDI, 2017). Both suggestions are difficult to prove since Socrates and Mago were contemporary and also because there is no accuracy in the references. In favor of Mago, there is a recent research that rebuilds and expands the historiography of the Punic Wars (264 BC and 146 B.C.), authored by GOLDSWORTHY (2009), who writes:

“Trade was not the only source of prosperity in the city. It is important not to forget that the wealth of Cartago was also derived from an extremely organized and efficient agricultural base. The manual on agriculture written by a Carthaginian nobleman named Magão, probably at the end of the fourth century B.C., would exert an enormous influence on the rest of the world after translated into Greek and Latin later than 146 B.C. “ (GOLDSWORTHY (2009, p.32).

With such a retreat in time, and accepting the perspective espoused by historians of science who advocate the continuity of contemporary science in relation to philosophy and ancient knowledge, it may be possible that agronomy has arisen as an art resulted knowledge that is born committed to the balance with nature, maintaining itself this way until external problems to this relationship impose the adoption of other paradigms, the second agricultural revolution, strongly influenced by the researches of Justus Von Liebig, according to Foster (2005).

MAZOYER & ROUDARTEM (2009), in their research about the history of agriculture, argued that agricultural systems are born and maintained as an evolutionary process that are constituted in the memory and culture of the populations involved.

“As J. R. Harlan (1972) wrote, ‘Agriculture has never been discovered or invented.’ In the current state of knowledge, it appears as the result of a long evolution process that affected many Homo sapiens societies at the end of prehistory, in the Neolithic era. The predator societies that turned into farmer societies were among the most advanced of the time. They had sophisticated stone instruments, exploited the abundant plant resources to allow them to live in a sedentary way grouped in villages, undoubtedly practicing the worship of their ancestors” (MAZOYER; ROUDARTEM, 2009 p. 126).

Therefore, it is logical to propose that this evolutionary process is not uniform, that is, it was not located also in all the centers of agricultural systems irradiation proposed by Mazoyer and Roudart (2009). Moreover, it should be acknowledged that in the Greek-Hellenic and subsequently Hellenistic world (latter spread in much of the Mediterranean basin), the expansion of agricultural systems was accompanied by rational interventions that were already part of agronomic knowledge obtained from systematic observation and interventions conducted on empirical bases, with attempts and error. At this stage of the agronomic thought, it was immanent to the practices of naturalist philosophers to conceive methods and experiments that were harmonic with the rhythm and

the cycles of nature. The totality of agronomists of the classical period, Greeks and Romans, and by extension also the Carthaginians, not only from North Africa, but from their colonies in Hispania, were guided by this broad knowledge, which has recorded in the works of Demócrito, Crateuas, Chartrodas, Clidemo, Epicarmo and Teofrasto, during the Greek-classical phase, and by Cato, Varão, Lucrecio, Columella and Pliny, in the Roman phase (BAIARDI, 2017).

In classical time these proto agronomists aimed to improve agricultural practice, because problems that compromised the food supply were already found - some resulting from poor land use, some from the lack of recommended management - besides their convictions in relation to a more efficient management that led to greater productivity. In addition to repeated observations, they were also based on the reading of the oldest cannons and adopted a common guideline during the late Hellenistic period, which is roughly between 200 years B.C. and the beginning of the Christian era. Covering more than two centuries, the school of Alexandria operated as a cultural center that irradiated knowledge and methods of obtaining them.

The knowledge generated in the ancient agronomy was useful until the middle of the nineteenth century, when the scientific method after scientific revolution was improved and imposed. This is the moment in which the passage of classical agronomy to modern and contemporary models of Agronomy begins, with various metamorphoses induced by science in all fields and driven by the enlightenment and industrial revolution (KUNZMANN; BURKHARD WIEDMANN, 1993) (BAIARDI, 2008; 2017).

Beyond the most difficult period for scientific practice in the west, from the fall of the Roman Empire to the Renaissance, the philosophers of nature researching agronomy began to benefit from a series of advances occurring in biology, chemistry, geology, in physics and mechanics, due to the use of a method that was made canonical after scientific revolution. This method brought a new type of philosophical/scientific rationality and presented itself as an alternative to the previous forms of rationality, considered more “theological”, since they resorted to transcendental explanatory elements.

Although, incorporating elements of accepted epistemology, the new method for science advanced in many aspects to the point of being considered a turning point of what science would truly be. Given the numerous definitions of what science is, which varied throughout history, in the geographic

space and depending on cultures, the very world of science proposed that scientific activities should be those ones to which, *mutatis mutandis*, applied the same methods of observation and inference used for natural and social phenomena knowledge.

The consensus or (or near consensus) among those who defended the method as a science marker, did not come easily. The unequivocal signs of scientificity have been asserted and consolidated from the contributions of Francis Bacon (1997) concerning the exercise of objectivity, expressed in the absence of prejudices and in the purification of data, followed by those of Galileo, who in successive actions, withdrew the privilege of the mathematics use from the rationalists. This use of mathematics was beyond the mathematization of natural philosophy, practiced by Copernicus and Kepler, and founded the experimentalism, that is, the fusion of mathematics resources with experiment, all this potentialized by the use of scientific instrumentation, which allowed, according to Galileo himself “... to perceive that the matter presents only quantitative and spatiotemporal determinations” (PALMARINI, 1992; BACON, 1997; RANDALL Jr, 1940).

With the birth of the modern science method proposed by Galileo, successive advances in scientific knowledge became possible from the eighteenth century onwards. The scientific knowledge improved epistemologically over the years, due to the continuous effort to seek greater distancing from the doxa in the production of knowledge, allowing greater validity of results.

As an example of this improvement in the field of health, one may refer to the evaluation of drugs, where there is the introduction of double-blind method, which would reduce the patients ‘suggestive and the therapists’ subjectivity. In the field of agricultural sciences, an equivalent procedure was the introduction of the control plot, or the different treatment of the other plots. The method was also improved in the design of the experiment, in the previous step to the analysis, which with statistical resources would make the choice of objects more representative and, if convenient, random. The development continued with the progress of modeling and simulation, which brought expressive resource savings. In the scientific field, the 21st century began with more uncertainties than in previous centuries, but with less chances to incur in mistake. If this happens with sciences in general, it also happens with agricultural sciences.

The theories, the shared paradigms, the available human resources and the ones in

development, the libraries, the research infrastructure, the tacit knowledge, the results obtained in terms of dissemination of knowledge and impacts generated, among other facets, showed contemporary agronomy as an applied science that, in Brazil's case, fulfilled its role by guaranteeing food security for domestic supply and generating exportable surpluses that are leveraging the entire economy. A look at the main research centers in agricultural sciences –universities, public administration and in the private sector – reveals its unique competence. Its researchers incessantly seek productive systems with less impact on nature, through a multidisciplinary view, supported by current scientific knowledge, among them genetic modification, which provides less dependency on chemical inputs varieties, and the industrial-scale development of biocides, insecticide and biological fungicides. The main objective was to increase production of food and raw materials of agricultural origin with quality, but with less use of land, water, nutrients, energy, labor and capital. It is the commitment to protect nature, which has never been neglected.

To the extent that new advances occur in genetic modifications and population changes and/or consumption of food and fuels, which involve demand reduction for food and raw materials, and that further studies leading to greater total factor productivity (TFP) become available, agricultural sciences will accelerate the pace of conception of more sustainable and closed production systems, with less entropy.

This incursion in agricultural sciences history clearly denotes that agroecology is not a trajectory product of this area of knowledge, nor as a strand concerned with resolving the dramatic problems of food shortages and not least has bonds of origin with the precepts aiming to approach nature to agriculture.

Agroecology in Brazil and public policies

Although, agroecology is not, properly speaking, a science, in Brazil it has had numerous opportunities in public policies in recent years, either directly or indirectly. Events for its militants were widely sponsored, “research” notices and the use of this term multiplied, after several technical undergraduate and graduate courses were established with support of public funds. The main instruments of the Brazilian State to support agroecology are the National Policy for Agroecology and Organic Production (Pnapo) and the National Plan for Agroecology and Organic Production (Planapo), known as “Brasil

Agroecológico”. They are operationalized by means of public notices that publish rules for obtaining research resources, for setting up vegetable gardens, organizing high school courses, offering technical assistance and promotion of events.

The main institution that promotes science in Brazil, the Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq (Brazilian National Council for Scientific and Technological Development), not only has supported events, but also encouraged “research” about agroecology. There are several examples like i) Chamada 21/2016 for projects that integrate teaching, research and extension focused on the construction and socialization of knowledge and techniques related to agroecology; ii) Government announce on its website that it would allocate US \$ 2, 5 million destined to CNPq for projects aiming agroecology and organic food production; iii) Education in courses centered on agroecology has gained growing space between professional education institutions and universities with this specific emphasis; iv) Although, technology is the main factor associated with rural poverty (or rather, the lack of technology), public policies of technical assistance and rural extension to the poorest of the countryside have been strongly inspired by agroecology; v) As expected, the public policy of food procurement has not been left out of this topic, see as example the initiative of the municipality of São Paulo, which included agroecological products in municipal school meals (MEC, 2020).

These are some evidences that agroecology began to be part of public policies in a direct way. Indirectly, it draws attention to its political action against Brazilian agriculture. How this action can be explained? For agroecology, modern agriculture corresponds to a “technological package”, a productive protocol that combines chemical, biological and mechanical factors, which are universally applied and intended to maximize crop yields in profoundly ecological distinct situations. The protocol aimed to increase the potential capacity of crops by eliminating competitors and natural predators, enhancing them with synthetic fertilizers. The logic is to control natural conditions through simplification and the maximum artificialization of the environment, in order to adapt it to the improved varieties so that it can maximize all its yield potential.

However, what would be the origin of this reaction against modern agriculture? It is possible to affirm that it was born particularly from the decades of 1960 and 1970, when several countercultural movements emerged in the most advanced countries of

the West and the emergence of different initiatives that presented themselves as a “technological counterpoint” to modern agriculture commonly literature. For these initiatives, that modern pattern began to be named “conventional” and the set of groups that proposed to build a distinct via in those years began to be called “alternative”, roughly leading to two strands of analysis and proposals (EHLERS, 1999).

One of them led to the criticism of modern agriculture’s technological model and the pursuit of scientific improvement, which stimulated research on production methods capable of reducing the use of industrialized inputs and the consumption of fossil energy. It consisted on efforts by researchers to focus on the development of technologies aiming to increase productivity, continually preserving more resources. Some would call these approaches “greening of modern agriculture”, which have as its central goal the resilience of the agro-food system in the long term, which can be called “sustainable modern agriculture”. Common sense and rationality suggested a look at sustainable modern agriculture, as it is an evolution that establishes better management of natural resources and the assembly of “eco-efficient” production systems (KEATING; CARBERRY, 2010).

Technological advances have become more concrete towards a more sustainable (or less unsustainable) agriculture due to the continuous advance of knowledge in agricultural sciences. One of the greatest advances in modern agriculture towards sustainability is the use of transgenic cultivars that avoid pesticides. Global economic gains brought by transgenic crops over two decades (1996-2016) have reached US \$186.1 billion in economic benefits for a bit more than 16 million farmers, of which 95% working in developing countries. Biotechnological cultures have contributed to food security, sustainability and lower climate change effects. These and additional details organized by the International Service for the Acquisition of Agri-Biotech Applications, (ISAAA, 2019) which suggest that: a) increase in agricultural productivity by 657.6 million tonnes in the amount of US \$186.1 billion in 1996-2016; b) biodiversity conservation in 1996 to 2016, with the saving of 183 million hectares of land and 22.5 million hectares in 2016; c) environmental improvement saving 671 million kg of pesticides in 1996-2016; d) reduction of EIQ (Environmental Impact Quotient) by 18.4% in 1996-2016; e) reduction of CO2 emissions by 2016 in 27.1 billion pounds, the equivalent of taking 16.7 million of cars from the streets for one year and f) increase of the economic situation from 16 to 17

million of smallholder farmers and their families, totaling more than 65 million people.

In 1995 Brazil established biosafety standards to enable the development of biotechnology and regulated the genetic engineering application and the release of transgenic variety. Thus, the Comissão Técnica Nacional de Biossegurança (CTNBio). National Technical Commission on Biosecurity - was created, giving Brazil an institutional matrix to regulate the biosafety of transgenics. Soon after, some international and national NGOs launched the “campaign for a free transgenic Brazil” which persists to these days. Since its creation, this campaign has had a strong narrative against transgenics. The core of the main arguments of this “campaign” has been exhaustively repeated since its inception in the mid-1990.

These arguments are related to supposedly (as they have never been empirically proved) environmental, social, cultural and economic problems. Incidentally, it is interesting to note that in January 2019, an article published in *Nature* stated that a survey, based on a nationally representative sample of US adults, reported that as the opposition and concern with genetically modified food increase, the objective knowledge about science and genetics decreases. That is, extreme opponents to transgenics know the least about the subject, but they have the presumption that they are well informed (FERNBACH, 2019).

In 1998, CTNBio analyzed the application for the release of the transgenic soybean Roundup Ready (RR soybean) of Monsanto - a herbicide, resistant to glyphosate, known as “Roundup” - and authorized to be sold in the country. Environmental risks were analyzed based on their reproductive biology. It is worth highlighting that soybeans are an autogamma species (the rate of cross-fertilization is less than 5%). It is an exotic species with no sexually compatible wild or exotic relatives in Brazil, and it is not possible to cross-pollination in the Brazilian natural environment, which decrease the possibility in almost 100% of “gene contamination” occurring. However, the “Instituto de Defesa do Consumidor - IDEC (Consumer Defense Institute), helped by Greenpeace, and also by the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Renewable Natural resources) – IBAMA (which later withdrew from the legal injunction), filed for “Precautionary Innominate Measure” against the State, aiming to prevent the use of RR soybean without the previous presentation of the Estudo de Impacto Ambiental – EIA (Environmental Impact Study). When the

injunction was obtained in 1998, the first varieties of RR soybean had their records suspended by judicial determination (...)” (CUNHA, 2007).

A lawsuit seeking authorization for the commercial use of a transgenic bean developed by Empresa Brasileira de Pesquisa Agropecuária - Embrapa was submitted to CTNBio in 2011 and was approved in the same year. However, also in that year the “campaign” against genetically modified organisms invested strenuous efforts to position itself against this technology, arguing that the native seeds would be the best alternative for farmers. In July 2011, Conselho Nacional de Segurança Alimentar - Consea (National Council on Food Safety), sent an Embrapa’s suggestion of “prohibition of the commercial release of the transgenic bean” to President Dilma Rousseff. It is worth recalling that CTNBio had approved the commercial use of the transgenic bean developed in Brazil in 2011. Although, Consea has no veto power until today (March 15, 2020), despite its emptying, farmers have not had access to this product. The decision not to release this technology was widely celebrated by the “contrary” groups to the transgenics.

In March 2015, there was an invasion of the room where the members of CTNBio were discussing transgenic eucalyptus. There were verbal aggression and threat to the scientific societies’ indicated members. Another invasion had already occurred when the president of CTNBio was Dr. Walter Colli. But in this time, there was the depredation of the auditorium where the meeting was held (JORNAL DA CIÊNCIA, 2019) (PRATOS LIMPOS, 2019). On the same day, in Itapetininga, São Paulo, an invasion and destruction of the facilities and equipment occurred, in addition to the destruction of the transgenic eucalyptus plants, after 14 years of research by Futura Gene company.

Two facts drew much attention between the years 2007 and 2015. The first: The films “O veneno está na mesa I” (2011) and “O veneno está na mesa II” (2014) (The poison is on the table), which condemn the use of pesticides and transgenics and which were sponsored by the Brazilian Government, the Ministry of Culture, Fiocruz and Petrobrás. The second: the former Ministry of Agrarian Development (MDA) published five books written by militants opposed to transgenics. One of them reproduces a report published in a flyer by the Movimento dos Trabalhadores Sem Terra (Landless Workers Movement) where there are names of CTNBio members, accusing them without any evidence, claiming they would have “dangerous links” (FERMENT; ZANONI, 2007; FERMENT, 2008;

FERMENT and ZANONI, 2011, 2008; FERMENT, ZANONI, NODARI, 2010; FERMENT et al., 2015).

RESULTS AND DISCUSSIONS

The above considerations have the purpose of suggesting that this notion that is called agroecology has neither primacy nor legitimacy when proposing itself as a new and main determinant linking humans and nature. In fact, this relation can only be found and is immanent to the genuine agronomic thought and also integrates its roots. It would be, in a literal free construction, thus inserted in the DNA of the agronomic history. If we accept that agricultural sciences have obtained scientificity statute throughout history, to the alleged “knowledge” called agroecology that seeks scientific recognition, the following questions are raised: is agroecology following an epistemological trajectory of a science? If yes, which one? Is it proposed as a branch of the agricultural sciences, or, as announced by their proponents is it something different, really new, which does not recognize itself as a part of established scientific narratives?

Obviously, those who advocate agroecology as a science may argue that principles and precepts proposed for agriculture before the Industrial Revolution, to adopt a clear temporal milestone of modern agronomy, was appropriate by agroecological conceptions. It is also reasonable to argue that agroecology can be benefited by agronomic knowledge of the sixteenth and seventeenth century and had learnt from it. However, this argument ignores that the building of knowledge in agricultural sciences incorporates the medieval peasant culture, *par excellence* presented as being the most complete model of family production integrated with nature (BAIARDI, 1997). The removal of the agricultural sciences from this medieval peasant culture was caused by the industrial revolution of the 18th century, transformations that have followed to the present day. These transformations laid the foundations of industrial society, which inverts the urbanization rate compared to the Middle Ages. In less than three centuries the urban population goes from 10% to 90% of the total population, demanding from the proportion that remains in rural regions to produce for themselves and for nine more who left the countryside generating imbalances such as “metabolic failure”, according to Marx (BAIARDI; DULLEY, 2012).

Incessant efforts to increase productivity of different crops and to industrialize agriculture, were historical responses to urbanization and concentration

of consumption in cities and came to enable industrial civilization. This has always been well informed in the context of the agricultural sciences community and has always concerned and stimulated creativity. Without deconstructing the efficiency of contemporary agriculture several initiatives aimed to conceive models which fulfill countless functions but developing progressively sustainable and low-entropy production systems. Therefore, the concern with agricultural sustainability is not exclusive of agroecology but broadly shared by agronomic thought, especially in the context of the conventional agriculture paradigm, which marks the pragmatism in solving problems of food supply and security.

The achievement of a state of art in the field of agricultural development with less impact on the environment cannot be achieved without a multidisciplinary view, supported by current scientific knowledge. Among them there are the genetic modification that enables less dependency on chemical inputs and industrial-scale development of biocides, insecticide and biological fungicides. The call on the sustainability of the planet gradually comes after the substitution of the hard path or chemical routes for soft path or biological routes in plant and animal production, with use of chemical inputs increasingly smaller.

The “Integrated Production of Fruit”, known as PIF, the increasing use of mechanical and physical innovations in the field of information technology in order to control pests and diseases, confirmed that the conventional chemical reductionist farming paradigm will soon come to an end. Plant and animal production of post-industrial society will have a hegemonic paradigm that will gradually depart from conventional reductionist chemical farming, but it will not be inspired by agroecological precepts. From this strand, nothing can be expected, but a vague notion about the imperative of sustainable agriculture. The plant and animal production of post-industrial society will be a result of an evolution in agricultural sciences, which follows a clear tendency to be more biological, more systemic and more intercropped, without prejudice to efficiency in terms of income, productivity and quality (BAIARDI; MENDES, 2010). To assert itself as part of the science, agroecology should not only seek inspiration in the history of agronomic thinking, but generate empirical evidence of equivalent efficiency in the food supply at a scale compatible to the needs of Industrial Society, as did the paradigm of modern agriculture.

Unfortunately, agronomic thinking has been commonly invaded throughout history by the

knowledge called pre-scientific or “mythic”. In few branches of human activity fantastic beliefs, superstitions and common sense have played a role as relevant as in agronomic thinking, and this occurs not only in the centuries preceding the establishment of experimental science, but also in recent times.

What about Agroecology? What should be said about an alleged area of knowledge that distances itself from problems such as supplying the population and obtaining exportable food balances? What is defined among its main objectives is to interfere in the correlation of forces of an imagined class struggle opposing the malicious Leviathan - which would be agribusiness - and a “peasantry”, which only acquires numerical and social expression in hypotheses never tested? Why to refuse any economic evaluation of its proposed systems of production in the light of the market and considering the cost of opportunity? These and many other questions that advocates of agroecology do not answer (BAIARDI, 2017).

Agroecology intends to define itself as a scientific endeavour aiming to support the transition from current models of conventional rural development and agriculture to rural development styles and sustainable farming. It also proposes to undertake theoretical reflections to conform a theoretical and methodological corpus to subsidize this transition even establish stages or transition that might be seen as logical and sensible. However, in practice, it is led in a very confusing way, for it gives disproportionate weight to the performance of social and economic agents in this transition, affirming that they should internalize “unshakable beliefs” in the possibilities of agroecology without questioning the principles of it.

The problem of agroecology is that it does not give the slightest clue on how it will achieve a compatible productivity to the needs of industrial society. If not, it is a merely exercise of rhetoric, a mythical narrative, much to the taste of non-science, of obscurantism associated to the scholastic paradigm and not of science, as it is widely understood.

Notwithstanding the good intentions towards biodiversity and global, agroecology is closer to a sect than to a science. In this sense, one must be tolerant, accepting that vegetable gardens, as closed systems, are self-sufficient. Likewise, the “Mandala system” can be accepted as aesthetic experiences. However, they all have an extremely limited economic impact. What should not be welcomed nor tolerated is the claim of agroecology being accepted as science and the support of the State

to these fanciful experiences of helping Brazilian agriculture, especially the poorest rural producers.

CONCLUSION

In short, agroecology has been directly or indirectly part of Brazilian public policies in recent years; although, it is not an applied science. This was demonstrated above when the influence of agroecology in Brazil on public policies was analyzed. Why is that possible? Perhaps by persisting a certain variant of magical thought as one of the most salient marks of the dominant general culture in our society. This thought is accompanied by an ideological environmentalist leftism. According Levin (2008), “an ongoing dispute about the basic facts and figures of global warming has made this easier by putting science and environmentalism on the same side for a time”. However, reality suggests “that argument subsides, and attention turns to the causes of environmental degradation and to possible solutions, the fissure between science and environmentalism will be harder to ignore.”

Although, there is a relatively diffuse admiration for technical progress, technology and “scientists in general”, this social support is not echoed in governmental decisions and in strengthening of scientific institutions. These are subjected to intense political and partisan manipulations and, in general, are also affected by the inexistence - at least in our recent history - of a strategic vision by Brazilian elites and government leaders. If this vision of future development existed, there would necessarily be a privileged place for science, because of its potential capacity to increase the economy’s overall productivity.

Finally, the immaturity and lack of consolidation of the State apparatus on canons of reasonableness and logic in its relations with the scientific field are evident. It affects, without any doubt, the chances of success of Brazil as a society and as an economy. There is also a lack of a much more intense deepening of the country’s democratization process, in order to generate real political processes able to create concret spaces of transparency and accountability as the only way to make decisions about scarce resources that, in fact, meet social aspirations. Moreover, there is still a process of democratization regarding the ability to develop full culture public debates in the country.

An illustration concerns the existence of a formal council, formally attached to the Presidency of the Republic (the Consea), which was able to confront the decisions of another council, equally

formal (the CTNBio). This is an unaccountable action because many of the Consea members are indicated for reasons of partisan imperatives and are not able to present any social legitimacy or “social basis” of some meaning. Therefore, the examples of non-reasonableness in their empirical details abound, directly affect the functioning of formal institutions in the Brazilian case.

The recent changes involving Consea and linking it to the Ministry of Citizenship and not to the Presidency of the Republic, may lead to changes in its composition, making it more open and contemporary.

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The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS’ CONTRIBUTIONS

The authors contributed equally to the manuscript.

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