



The post-modern condition of agroecology

A condição pós-moderna da agroecologia

Rodrigo de Souza FERREIRA^{1*}, Irene Maria CARDOSO²

¹Independent Researcher, Viçosa, MG, Brazil.

² Universidade Federal de Viçosa (UFV), Viçosa, MG, Brazil.

* Contact e-mail: rsouzafer@yahoo.com.br

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ABSTRACT: Postmodern thought identifies a crisis in contemporary society, which, among other areas, is also evident in the scientific domain. Within this context, various indicators suggest a movement of epistemological rupture across multiple scientific fields, which can be interpreted as the emergence of a postmodern science. This article argues that Agroecology, due to its principles and methods, constitutes an epistemological rupture and can be understood as a manifestation of postmodern science.

Keywords: modern agriculture; alternative agriculture; paradigm revolution; epistemological revolution.

RESUMO: O pensamento pós-moderno identifica um cenário de crise na sociedade contemporânea, que, entre outras instâncias, se manifesta também no campo científico. Partindo desse referencial, pode-se perceber que um conjunto de sinais sugere um movimento de ruptura epistemológica em diversos campos científicos, o que pode ser interpretado como a emergência de uma ciência pós-moderna. A tese defendida neste artigo é que a Agroecologia, por seus princípios e métodos, representa uma ruptura epistemológica e pode ser pensada como a manifestação de uma ciência pós-moderna.

Palavras-chave: agricultura moderna; agricultura alternativa; revolução paradigmática; revolução epistemológica.

1. Introduction

The era in which we live should be considered a transitional period between the paradigm of modern science and a new paradigm, whose emergence is gradually becoming evident, and which, for lack of a better term, I call post-modern science. (Boaventura de Souza Santos, *Introdução a uma ciência pós-moderna* [Introduction to a Post-Modern Science], 1989).

Time is proving that the environmental crisis is, indeed, a civilizational crisis, and that the agroecological movement is part of what can be described as a major transformation, which may potentially reverse the processes and inertia that led to the ecological holocaust through the notion of [sic] progress and unlimited growth. (Enrique Leff, *Agroecologia e saber Ambiental* [Agroecology and Environmental Knowledge], 2002).

If there is one common thread among post-modern authors, it is a critical interpretation of the historical phenomenon known as modernity. One of the precursor texts of modernity is the book *New Atlantis*, written by Francis Bacon and published posthumously in 1627. In this work of fiction, Bacon attributed the prosperity of the island of Bensalem to the existence of an institution called the House of Salomon, which brought together scholars and sages responsible for advising society and governments on their organization and work techniques. Modernity draws from this inspiration to articulate its entire institutional apparatus (especially the State) and its structures of knowledge (especially science). Thus, modernity is constituted (and, to a certain extent, sustained) by a promise

of institutional organization capable of enhancing security, predictability, and certainty for human life.

Rooted in the Enlightenment thought of the 17th and 18th centuries, the modernity project is therefore based on the idea that the constant expansion of scientific knowledge is essential for promoting human well-being; in other words, the advancement of rational knowledge necessarily leads to the improvement of living conditions. Thus, the modern image of science “plays a decisive and determining role in shaping the idea of progress.” (Rossi, 2000, p. 49). Progress, as is well known, refers to indefinite progression, relentless growth, and advancement in a favorable direction. Thus, within the context of the Enlightenment movement, the idea of progress in knowledge does not appear as a mere transformation at the intellectual level but is directly linked to the broader perspective of positive societal transformation. There was, as can be noted, a clear sense of optimism driving this movement, underpinned by unrestricted confidence in the construction of a new world (Cassirer, 1994).

The turn of the 20th century profoundly shook this optimism. The horrors of the two world wars, the disparities between nations and social classes that prevent even a minimal balance between opulence and misery, the growing process of environmental degradation caused by industrial transformation, along with several other contradictions, seemed to highlight that, despite all scientific advances, humanity still could not envision a near future of peace, security, and social justice.

Thus, post-modern critique fundamentally focuses on the modern promise of stability, which remains unfulfilled. On the contrary, modernity offers human beings a world that is increasingly

unpredictable. Zygmunt Bauman, a well-known post-modern author, warns that humanity currently lives “under a condition of uncertainty that is permanent and irreducible” (Bauman, 1998, p. 32). This condition of uncertainty would therefore be the very essence of the post-modern condition.

This sense of uncertainty regarding the future of humanity and even of planet Earth gained significant momentum from the 1960s onward worldwide. Technological advances and the relentless expansion of industry, on the one hand, affirmed the values of modernity and the possibility of promoting people’s well-being, but on the other, were increasingly identified as responsible for a frivolous way of life and the persistent degradation of the natural environment. Counter-cultural movements of various kinds helped expose the risks of the development model that had been imposed on humanity to public opinion. These mobilizations, collectively known as countercultural movements, reached several countries, with protests peaking in 1968. Despite their multifaceted agenda, these movements shared a common dissatisfaction with the modern world. Therefore, Harvey (2005, p. 44) asserts that the countercultural movement can be considered the “cultural and political harbinger of the subsequent turn” toward post-modernity.

Given the diversity of influences, post-modern thought permeates various fields of knowledge and political action, such as the arts, literature, architecture, science, and the environmentalist movement. According to Harvey (2005), the meaning of the term is related to the proposal of reaction or departure from modernity fostered within each of these fields. Therefore, more than a historical periodization, post-modernity refers to currents of

thought that are critical of modernity, which became especially prominent from the 1970s onward.

Among post-modern authors, some understand post-modernity precisely as the moment when awareness arises about the precariousness of the modern condition, when it becomes clear that the modern promise remains unfulfilled. This view carries a strong sense of fatalism, and its recommendation is to live with uncertainty, without expecting significant changes. Bauman (1998; 1999) is one of the proponents of this perspective. Harvey (2005) identifies the emergence of a scenario of significant changes in cultural, political, and economic practices, especially from the 1970s onward, which can be associated with the rise of post-modern cultural forms. However, according to the author, “these changes, when contrasted with the basic rules of capitalist accumulation, appear more as transformations of surface appearances than as signs of the emergence of some entirely new post-capitalist or post-industrial society” (Harvey, 2005, p. 7).

Beck (2011) agrees with this interpretation but criticizes the use of the term “post-modernity,” precisely because he believes that the rupture marking this historical moment occurs “within modernity,” signifying a transition from classical industrial society to a later form, which the author calls the (industrial) risk society. According to Beck (2011, p. 15), “whereas in industrial society the ‘logic’ of wealth production dominates the ‘logic’ of risk production, in the risk society this relationship is reversed.” Thus, “in late modernity, the social production of wealth is systematically accompanied by the social production of risks” (Beck, 2011, p. 23). Giddens (1991, p. 13) also

disagrees with the term “post-modernity” and asserts that, in fact, “we are entering a period in which the consequences [sic] of modernity are becoming more radicalized and universalized than before,” within the context of globalization.

However, there is another current of post-modern authors who identify that this perception regarding the failures of modernity may be foreshadowing structural transformations in the global order. This is the case, for example, of Boaventura de Souza Santos (1989).

Santos (1989) identifies a scenario of crisis in contemporary society, which manifests itself, among other areas, in the scientific field. The author perceives a set of signs that seem to foreshadow a movement of epistemological rupture across various scientific disciplines, giving rise to what he calls post-modern science. The thesis defended in this article is that Agroecology, through its principles and methods, constitutes itself as a post-modern science and, as such, can be understood within the framework of Santos’s (1989) theory. Therefore, the central objective of this essay is to position Agroecology as an expression of post-modern science, with the method employed to achieve this goal being bibliographic research.

2. The rise of modern agriculture and ecologist critique

The presence of science in agricultural production has, since the 19th century, developed in close alignment with the interests of industry, as the technologies generated by science have largely been appropriated by private enterprise and subsequently commercialized. This appropriation

began in Europe and the United States but occurred unevenly and in segments, consistent with the agrarian conditions and scientific and technological advancements that characterized each region during that century. While in the United States the vast expanse of land and labor shortages spurred the development of agricultural mechanization, in Europe, soil degradation from intensive and prolonged use prompted the creation of technologies focused on chemical fertilization. Thus, until World War I, agro-industrial structures linked to mechanical and automotive engineering and the chemical industry followed independent trajectories. However, with the development of Mendelian genetics in the early 20th century, the industry gained the ability to appropriate biological processes as well, opening up possibilities for more complex interactions with the chemical and agricultural equipment sectors (Goodman *et al.*, 1990).

Crop hybridization techniques and the possibilities of genetic manipulation not only allowed for the private appropriation of seeds but also enabled the standardization of crops for the purposes of agricultural mechanization and the creation of varieties positively responsive to fertilizers and other agrochemicals. “Although it is possible to identify separate trajectories, the dominant trend has been the convergence of mechanical, chemical, and genetic innovations to form a complementary technological ‘package’ of increasing integration” (Goodman *et al.*, 1990, p. 26). This integration, rooted in agricultural science research, quickly consolidated with the formation of agro-industrial corporations, which began to control the market for agricultural inputs. According to Bombardi (2017), in 2016, 10 agro-industrial corporations controlled

91.7% of the global agrochemical market.

Thus, the private appropriation of modern agricultural technologies, combined with strong state incentives and subsidies, created the conditions for a specific model of agricultural production to expand worldwide after World War II, in a process known as the Green Revolution. According to Jesus (2005, p. 25), the application of this set of technologies worked to overcome environmental constraints, “enabling the practice of intensive and extensive monoculture agriculture, which would be impossible without this industrial apparatus.”

In the Brazilian academic space, the rise of this model of scientific and productive rationality marked a turning point in the development of agricultural sciences, transitioning from the phase of “science-experience” to the phase of “science-experiment.” According to Coelho (2005), the “science-experience” phase characterized the early days of agricultural sciences in the country, and its methods bore significant similarities to the practices of observing agricultural phenomena carried out by rural populations. However, it gained in systematicity by seeking to record observations, establish regularities, and define optimal conditions for cultivation and work techniques. The “science-experiment” phase began to take shape with the return of Brazilian professors who had completed graduate programs in the United States in the late 1930s. From the 1960s onward, with the agricultural modernization process already underway, the “science-experiment” phase became firmly established through the training of more Brazilian professors abroad. These individuals began implementing in Brazil the research methods advocated in North American universities,

particularly using the theoretical frameworks of genetics and statistics. Thus, with increasingly rigorous quantitative analyses, research began to be conducted more frequently in controlled environments and oriented toward the generation of marketable technologies.

From the 1960s onward, the main Brazilian agronomy schools (ENA, ESALQ, UFP, UFRGS, and UFV), in partnership with North American institutions (Wisconsin, Ohio, Purdue, North Carolina), restructured their curricula, organizational frameworks, and teaching and research methodologies. These changes prioritized fields and disciplines directly or indirectly involved in the adaptation and validation of the agricultural model that had already become conventional in North America, Europe, and Japan (Ehlers, 1999, p. 37).

This shift in perspective, which was not unique to Brazil, marked a departure from traditional knowledge and the affirmation of the primacy of modern scientific rationality, a movement that Santos (1989) refers to as an epistemological rupture.

Despite enjoying strong political and economic support both within and outside academic spaces, the model of rationality prevalent in agricultural sciences has never been universally accepted. Thus, as early as the beginning of the 20th century – when industrial agriculture was emerging as the hegemonic model in agricultural research and being widely disseminated in Western European countries and the United States – alternative technical propositions opposing this perspective were already being developed. Examples include biodynamic agriculture (founded by Austrian Rudolf Steiner in 1924), organic agriculture (advocated by

Englishman Sir Albert Howard starting in 1925 and popularized in the U.S. from the 1940s by Jerome Irving Rodale), natural agriculture (promoted in Japan from 1935 by Mokiti Okada), and biological agriculture (inspired by the work of German Hans Peter Rusch and disseminated in France by Claude Aubert from the 1970s onward) (Ehlers, 1999; Jesus, 1996; 2005). By challenging assumptions of industrial agriculture, such as chemical soil fertilization, and emphasizing the use of organic matter and other biological processes, these agronomic schools of thought are referred to by Ehlers (1999) as “rebel movements.”

For diverging from the hegemonic propositions of agronomic science, these movements were marginalized within academic spaces, frequently labeled as “backward” and questioned regarding the scientific validity of their recommendations (Ehlers, 1999). However, from the 1960s onward, the prevailing model of rationality in agricultural sciences also began to face severe criticism worldwide, particularly from strands of thought linked to ecological movements, which denounced the harmful social and environmental consequences brought about by the Green Revolution. In Brazil, these critical trends began to gain momentum in the mid-1970s and became consolidated in the 1980s.

Ehlers (1999) highlights, among others, two publications that had a significant impact on public opinion regarding the environmental threats emerging at the time: *Silent Spring*, published in 1962 by marine biologist Rachel Carson, and *The Limits to Growth*, published in 1972 by the Club of Rome. In *Silent Spring*, Rachel Carson exposed the use of pesticides in American agriculture and the risks they posed to the natural environment and

public health. The widespread attention her book received sensitized public opinion and prompted numerous questions about pesticide use. Meanwhile, *The Limits to Growth* presented simulations on global population growth trends, natural resource consumption, and pollution rates, highlighting a scenario of concrete and imminent environmental threat. According to Ehlers (1999), the significant interest sparked by these and other works with similar themes stemmed from a particular dissatisfaction with the modernization process and the consumerist tendencies that characterized that historical moment.

In the 1960s and early 1970s, a climate of contestation emerged, prompting a significant shift across various segments of society in many countries: the so-called “counterculture.” This movement called into question several behavioral aspects of modern societies, particularly consumption patterns. The hypothesis was debated that it might be possible to drastically reduce consumption levels by adopting simpler or more “natural” lifestyles (Ehlers, 1999, p. 69).

As can be seen, there was a strong affinity between the propositions of the countercultural movement and the agricultural production ideals of the rebel movements. For the alternative society advocated by the counterculture, agricultural production methods were expected to provide an alternative to industrial agriculture. Perhaps for this reason, in the early 1970s, the movements opposing industrial agriculture began to be collectively referred to as *alternative agriculture*. “It was this movement that introduced the term ‘conventional agriculture’ to describe the then-dominant agricultural model” (Ehlers, 1999, p. 69-70).

3. From alternative agriculture to agroecology

The main trends of alternative agriculture reached Brazil in the 1970s, precisely at the time when the agricultural modernization project of the Green Revolution was being implemented in the country under the military government (Ehlers, 1999; Jesus, 2005). According to Vilar *et al.* (2013), influenced by the international movement of alternative agriculture, some Brazilian researchers published significant works challenging conventional practices, such as: José Lutzemberger (who published *Manifesto Ecológico Brasileiro: Fim do Futuro?* [The End of Future? A Brazilian Ecological Manifesto] in 1976), Adilson Paschoal (who published *Pragas, Praguicidas e Crise Ambiental* [Pests, Pesticides, and Environmental Crisis] in 1979), and Ana Primavesi (who published *O Manejo Ecológico do Solo* [The Ecological Management of Soil] in 1980). At that time, these initiatives did not resonate widely among Brazilian researchers; however, “the idea of an alternative agriculture began to gain adherents, especially among agronomy professionals and students” (Vilar *et al.*, 2013, p. 40). This engagement culminated in the organization of four Brazilian Meetings on Alternative Agriculture (EBAAs): in Curitiba/PR (1981), Petrópolis/RJ (1984), Cuiabá/MT (1987), and Porto Alegre/RS (1989). Such effervescence stimulated the creation of dozens of non-governmental organizations and study groups on alternative agriculture in Brazil from the 1980s onward, giving rise, for example, to the PTA Network (Alternative Technologies Project), with nationwide reach. Later, in 2002, the convergence of these initiatives led to the

establishment of the National Agroecology Articulation (ANA) (Vilar *et al.*, 2013).

The environmental appeal that came to characterize the confrontations with conventional agriculture and the science supporting it, along with the perspective of building a more just and solidarity-based society stemming from the counter-cultural movement, served as a stimulus for the growing mobilization of academics toward the alternative agriculture movement from the 1970s onward. In Brazil, these academics began to connect with rural populations in various places, primarily through Rural Workers’ Unions (STRs) and the so-called Base Ecclesial Communities (CEBs). In the context of a military dictatorship that intimidated social organization initiatives in both rural and urban areas, STRs and CEBs were crucial for the initial articulation of the alternative agriculture movement within Brazil, as they provided opportunities for reflection on the realities of communities and the possibilities for transformation. The popular education perspective fostered by these organizations was strongly influenced by Paulo Freire’s thought, which “highlights the role of the educator-political figure, advocating social change through conscientization” (Silva, 2020, p. 71). Even today, within the context of the Brazilian agroecological movement, interpretive frameworks mediated by Freire’s (1982) so-called dialectic of conscientization remain highly present, articulated around the denunciation-announcement duality.

From the 1980s onward, the term “alternative agriculture” was gradually replaced by “Agroecology,” particularly following the publication in 1984 of the book *Agroecología: Bases Científicas de la Agricultura Alternativa* [Agroecology: Scientific

Foundations of Alternative Agriculture], edited by Miguel A. Altieri. Although this term had already been applied in the 1930s to express the idea of ecology applied to agriculture (EMBRAPA, 2006), it was from the 1970s onward that Agroecology began to be affirmed as a specific scientific field. Within the agroecological perspective, studies related to low-environmental-impact agricultural production techniques began to also address the sociocultural issues permeating the rural world and seek closer alignment with traditional knowledge systems.

According to Hecht (1999), the emergence of Agroecology was the result of scientists recognizing the importance of traditional rural community knowledge in understanding ancestral agricultural techniques based on a more harmonious relationship with the environment. It is interesting to note that this proposal for interaction between science and popular knowledge bears great similarity to the second epistemological rupture advocated by Santos (1989). For this author, such a rupture would define the configuration of knowledge in a post-modern science, where theory and practice would be interconnected, creating conditions for the social appropriation of knowledge.

The publication of the aforementioned book, edited by Miguel Altieri, became a landmark for the agroecological movement, as it introduced the fundamental conceptual frameworks that positioned Agroecology as a scientific field. From then on, various trends of alternative agriculture were gradually incorporated into the agroecological approach.

According to Norgaard (1984), the philosophical and conceptual foundations of Agroecology are radically different from most Western sciences. While Western sciences isolate specific questions

for study, analyzing biological phenomena through controlled experiments and ecological phenomena in human-untouched spaces, Agroecology studies ecosystems altered over time in their immediate relationship with humans. In this sense, for Agroecology, social systems are as important as ecological systems.

Altieri (1984) emphasizes that traditional agricultural sciences do not study the complex relationships between the various components of an agricultural system (soils, animals, plants, and crops) but rather focus only on the effects each of these elements has on a specific crop. According to the author, this immediate cause-and-effect relationship promotes a simplification in understanding the system as a whole and, as a consequence, generates technologies aimed at specific aspects of cultivation (such as fertilization, pest control, or irrigation), guided strictly by the economic aspects of agricultural activity. However, according to Altieri (1984), what may initially appear economically viable can prove unsustainable in the long term. This perception, according to the author, constitutes the “driving force” of Agroecology.

According to Hecht (1999), the formation of Agroecology as a science arose from the convergence of a set of intellectual currents that historically had little dialogue with agronomy. Thus, while agronomy can be considered the maternal discipline of Agroecology, contributions from the environmentalist movement of the 1960s–70s, ecology (with its holistic principles of environmental analysis), native production systems (understood through anthropological studies), and development studies (especially for their critiques of the consequences

of the Green Revolution) were also fundamental to the development of this field of knowledge.

4. The assertion of Agroecology as a scientific paradigm

The so-called first epistemological rupture was the result of the convergence between scientific knowledge and the logic of capitalist production. In this sense, the epistemological rupture meant the transformation of scientific knowledge and its associated technologies into market-valued products. According to Santos (1989), the epistemological rupture, which marked the separation between scientific thought and popular knowledge, affirmed the emergence of a paradigm guided by instrumental rationality, which is exhaustively oriented toward the production of technical artifacts but disregards various risks inherent in the application of this technical knowledge, as if the assessment of these risks were the strict responsibility of those who apply it. Consequently, scientists ended up distancing themselves from the principle of prudence – a philosophical principle so peculiar to popular knowledge. Wallerstein (2002) highlights that the knowledge structures of the modern world are characterized by the separation between science and philosophy. Established at the end of the 18th century, this separation aimed to distinguish the pursuit of truth (attributed to science) from the pursuit of good (attributed to philosophy). This led to a certain indifference of science toward ethical issues and a distancing from the principle of prudence.

To break this dichotomy between science and philosophy, truth and good, Santos (1989) advocates

for a reconnection of science with popular knowledge. By defending an approximation between the theoretical potential of science and the practical orientation guided by the responsibility of popular knowledge, the author suggests overcoming the original epistemological *rupture through a rupture with the epistemological rupture* itself, or rather, through a *double epistemological rupture*.

This dual transformation aims for an enlightened common sense and a prudent science, or better yet, a new configuration of knowledge that approaches Aristotelian *phronesis*, that is, a practical knowledge that gives meaning and direction to existence and creates the habit of making good decisions (Santos, 1989, p. 41).

It is interesting to note that the agroecological debate acts to deconstruct the idea that scientific knowledge is the only valid form of knowledge and points to the need to articulate scientific knowledge with popular wisdom. Cardoso & Ferrari (2006, p. 28) emphasize that, in the agroecological approach, “the production of knowledge is not an activity exclusively dominated by science professionals but should involve the active participation of farmers”; Petersen *et al.* (2009, p. 11) argue that, “as an emerging science, Agroecology carries concepts and methods that create bridges for establishing dialogue between popular and scientific knowledge.”

Considering the epistemological and methodological innovations presented by the agroecological approach, several authors have asserted Agroecology as a new scientific paradigm, alternative to modern science. Jesus (2005, p. 40) treats Agroecology as “an emerging paradigm, replacing

industrial or conventional agriculture”; according to EMBRAPA (2006, p. 36), Agroecology “has grown as a new paradigm capable of seeking the scientific foundations of agricultural sustainability through interdisciplinary integration”; Sousa & Martins (2013, p. 87) state that “Agroecology is emerging as a new field of knowledge, broader than a scientific discipline”; Costabeber *et al.* (2013, p. 177) point out “Agroecology as a science, scientific discipline, emerging paradigm, or field of knowledge guided by the ideals of sustainability in agricultural and rural development processes”; Caporal *et al.* (2006, p. 7) argue that “since the beginning of the construction of the agroecological approach in recent years, a ‘paradigmatic revolution’ has been occurring.”

To evaluate this perspective of the “paradigmatic revolution” advocated by proponents of Agroecology, it is convenient to refer to Thomas Kuhn’s work, *The Structure of Scientific Revolutions*. According to the author, paradigms are “universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners of a science” (Kuhn, 1991, p. 13). In this sense, the paradigm constitutes the domain of what is called normal science and thus guides the fundamental interpretations of a field of knowledge.

Furthermore, according to the author, occasionally interpretive novelties emerge within scientific communities that deviate from the propositions predominantly accepted in normal science. Therefore, such novelties assume the character of anomalies within the dominant paradigm and, as a result, face vehement attacks from the established scientific body, often being suppressed or framed

within the dominant interpretive model before causing significant repercussions. However, under certain circumstances, these anomalies raise questions that cannot be answered within the conceptual frameworks of normal science, provoking destabilization of that model of thought, generating a crisis scenario. With this, “extraordinary investigations begin that ultimately lead the profession to a new set of commitments, a new basis for the practice of science” (Kuhn, 1991, p. 25), in a process typically marked by strong resistance. Kuhn (1991) calls this phenomenon a scientific revolution.

Taking Kuhn’s (1991) interpretive framework as a reference, it is possible to infer that Agroecology initially emerged as an anomaly within the agricultural sciences, questioning their fundamental assumptions, but as it gained adherents, it began to position itself as a new paradigmatic perspective. Costabeber *et al.* (2013, p. 160) highlight that the disruptive element of the industrial agriculture paradigm “was the rupture of the elasticity of agroecosystems, that is, the drastic reduction of their resilience, which triggered processes of exhaustion and even transformed some of these agroecosystems into sterile areas.” In this sense, Agroecology emerges as a disciplinary matrix, whose main object of study is the agroecosystem and which advocates for low environmental impact and sustainable agricultural management over time. Subsequently, the field of Agroecology studies expanded to encompass the entire agri-food system (Francis *et al.*, 2003).

In the postscript to his work, published in 1969, seven years after the original writing, Thomas Kuhn himself admitted that what he called a scientific revolution did not necessarily refer to a broader

interpretive transformation in science but could occur on a much smaller scale, such as within the strict scope of a disciplinary matrix. According to him, “a revolution is a kind of change involving a certain type of group commitment reconstruction. But it does not need to be a major change, nor does it need to appear revolutionary to researchers who are not part of the community” (Kuhn, 1991, p. 225). Therefore, for Kuhn (1991), scientific revolutions are not necessarily linked to social revolutions.

The recognition of Agroecology as a scientific paradigm is evident. Indeed, there is a community of practitioners who identify this field of knowledge as scientific and guide their theories and research accordingly. There are scientific entities (such as the Brazilian Association of Agroecology – ABA Agroecologia) and numerous study groups based in universities that organize themselves around the theme of Agroecology. There are periodic publications (such as the *Revista Brasileira de Agroecologia* [Brazilian Journal of Agroecology]) and scientific events (such as the *Congresso Brasileiro de Agroecologia* [Brazilian Congress of Agroecology]) aimed at disseminating the scientific research and theoretical reflections of the field. Additionally, the acceptance of Agroecology in the realm of sciences is witnessed by the creation of various undergraduate and graduate programs.¹ Therefore, the projection of Agroecology in relation to alternative agriculture movements seems to correspond to its affirmation as a new disciplinary matrix or as a new scientific paradigm.

However, this assertion has been and continues

to be marked by strong resistance in academic spaces. The development of agricultural sciences in Brazil, as mentioned earlier, was strongly influenced by the process of agricultural modernization that characterized the so-called Green Revolution. Thus, a productivist and economistic ideology predominates in this scientific field, offering significant resistance to the emergence of other perspectives, especially the agroecological perspective, which carries a strong social and ecological appeal. Drawing on Pierre Bourdieu’s theory of social fields, Borsatto et al. (2022, p. 7) emphasize that “the university field is constituted as a hierarchical space and a site of disputes over legitimacy and authority regarding the knowledge produced within it.” Analyzing the case of Agricultural Sciences, there is a clear hegemony of the conventional paradigm, linked to large production chains, which implies privileged access to financial resources, recognition, and decision-making power for those aligned with this perspective. This predominance hinders the projection of other paradigms, such as Agroecology, within the field of agricultural sciences.

Nevertheless, the social field is subject to external influences. Since the 1960s, environmentalist and alternative agriculture movements had already been denouncing the ills of conventional agriculture and proposing forms of agricultural management more friendly to the natural environment. Borsatto et al. (2022) highlight the importance of groups that, under this influence, formed within Brazilian universities, especially from the 1980s onward. Currently known as Agroecology Study Nuclei (NEAs),

¹ In Brazil, there are currently at least twenty-four undergraduate programs and twenty-one graduate programs in Agroecology (Guia do Estudante, 2023).

these groups “have since been trying to carve out spaces to research, debate, and promote processes of knowledge construction that seek to combine academic and popular knowledge” (Borsatto *et al.*, 2022, p. 6). Composed mainly of students but also including professors and researchers, the NEAs functioned (and continue to function) as important mechanisms for the propagation of Agroecology both within and outside universities. In this sense, these nuclei decisively contribute to the creation of “agroecological spaces” in the university field, promoting the ongoing education of their members and increasing the recognition of Agroecology in the academic context and among other social circles where they develop their activities, such as small farmers and rural extension technicians.

Borsatto *et al.* (2022) emphasize that the work of the NEAs has decisively contributed to the institutionalization of Agroecology in the university field. By constituting themselves as study and university extension groups and applying for public funding, these nuclei often secure physical structures to host their activities, as well as plots of land to establish demonstrative units of agroecological production. Also, through the articulation of these nuclei, undergraduate and graduate courses have been created in various universities. The organization of events and the publication of academic and informative works also contribute to increasing the recognition of these nuclei, as such activities are highly valued in the university field. It is characteristic of the NEAs’ policy to seek interaction with local farmers, whether through participatory research or through training and exchange activities. Such initiatives also contribute to expanding the recognition of

these nuclei, both within and outside the university space, as they denote a commitment to fulfilling the social role of universities. Therefore, “it is possible to affirm that the NEAs have fulfilled the role of strengthening the construction of knowledge in agroecology and stimulating arrangements that contribute to the inseparability of teaching, research, and extension” (Souza *et al.*, 2017, p. 414).

Thus, the work of the Agroecology Study Nuclei exemplifies how structures of scientific revolution are formed through Agroecology. Groups of students articulated around the theme of alternative agriculture began to proliferate throughout Brazil from the 1980s, influenced by counterculture movements. Critical of the agricultural modernization processes that characterized the Green Revolution, these groups found a completely hostile academic environment for their ideas and were therefore perceived as anomalies within the dominant paradigm of agricultural sciences. Despite this, such groups (now called Agroecology Study Nuclei – NEAs) managed to establish themselves in universities across Brazil and, in collaboration with professors engaged in the cause of Agroecology, secured resources, conducted research, executed extension projects, and promoted agroecological training processes both within and outside universities. Despite all the resistance, these initiatives contributed to consolidating Agroecology as a recognized field of knowledge in the academic context, effecting a process of paradigmatic revolution.

5. The postmodern condition of Agroecology

Although the establishment of Agroecology as a scientific paradigm is, in itself, meritorious, it is

essential to recognize the still marginal character of the interpretations proposed by the agroecological paradigm in relation to the modern paradigm. According to Santos (1989), while the hegemony of the modern science paradigm persists, it manages to establish the limits under which investigations must occur, defining the model problems and solutions admitted in teaching and research programs. This prominence in knowledge management implies an authority to determine what should be inside and what should be outside the scientific field. However, during periods of paradigmatic crisis, such as the present, the boundaries imposed by hegemonic science become more tenuous, and debates related to the scientific field begin to be influenced by external contexts and actors. Furthermore, according to the author, two conditions are necessary for the second epistemological rupture to occur. The first can be interpreted through Thomas Kuhn's theory and concerns the emergence of crises within the hegemonic scientific paradigm, whose attempted solutions, rather than resolving issues, end up deepening the crisis scenario. According to Santos (1989), this first condition can already be identified in embryonic form in the current scientific landscape, with the rise of Agroecology within the field of agricultural sciences serving as an example. The second condition for a new epistemological rupture relates to the surrounding social context, as it involves bringing to light issues that were marginalized or rendered invisible within the hegemonic modern paradigm but survive in discourses originating and holding meaning beyond the scientific environment. For the author, "theoretical conditions will be of little or no efficacy if certain social conditions are not met" (Santos, 1989, p. 147).

Considering these social conditions for the second epistemological rupture, there is a notable growing social perception of the risks associated with the Western civilizational process, historically based on the depletion of natural resources and excessive energy consumption. This makes environmental issues some of the most relevant topics today, serving as a significant factor for social mobilization worldwide. According to Costabeber et al. (2013, p. 160-161), "the increase in ecological footprint and negative externalities determines greater collapse risks and fosters understanding of the importance of social, economic, and environmental changes represented, at the end of the 20th century, by the emergence of the sustainability paradigm." Similarly, Gomes & Assis (2013, p. 30) argue that "the need to consolidate the transition to more sustainable systems arises from and is a product of the proven unsustainability prevailing not only in agriculture but also in society itself."

Such perceptions seem to stimulate increasing mobilization in favor of Agroecology, bolstering, on one hand, the body of researchers defending its scientific character and, on the other, rallying students, professionals, farmers, and consumers to affirm Agroecology as a political action of resistance against industrial agriculture. Due to this, Agroecology has increasingly confirmed itself both as an agricultural practice and as a political movement.

Wezel *et al.* (2009) and ABA (2015) highlight that Agroecology has been approached from three fundamental perspectives: as science, as a movement, and as practice. According to Wezel et al. (2009), as a scientific discipline, Agroecology gained popularity from the 1970s onward when

theorists began applying it as a counterpoint to the harmful effects of the so-called Green Revolution. From that moment, Agroecology became increasingly associated with the perspective of sustainable agricultural management and began addressing the broader issue of the global food system. As a movement, Agroecology owes much to environmentalist movements that, since the 1960s, positioned themselves against the deleterious effects of global industrialization and specifically the industrialization of agriculture. However, according to the authors, this identification of Agroecology as an environmentalist movement only emerged in the 1990s. Almost simultaneously, the perception of Agroecology as an agricultural practice developed. In this case, agroecological practice is identified as an alternative to modern agriculture, characterized by intensive input use – that is, Agroecology aligns with agricultural practices attentive to the conservation of natural resources and biodiversity. This insertion of Agroecology into a social context that transcends the boundaries of science demonstrates that the second condition for a new epistemological rupture is also “in the making,” as Santos (1989) states.

The example of Agroecology Study Centers (NEAs) is illustrative in demonstrating how the social conditions for the second epistemological rupture are being constructed through the articulation of agroecological science, movement, and practice. In a study conducted with four NEAs established in universities in the state of São Paulo,²

Borsatto *et al.* (2022) showed that the activities carried out by these groups, in addition to reinforcing the recognition of Agroecology within universities, significantly contributed to the territorialization of Agroecology in external spaces.

Due to their transdisciplinary profile, ability to attract people, and engagement with rural communities, the NEAs simultaneously developed interdependent actions on different fronts – for instance, organizing events, conducting environmental and food education activities, forming consumer groups, offering courses, publishing texts, conducting research, organizing farmer fairs, implementing demonstration areas for agroecological production, providing tools for achieving participatory organic certification, and carrying out environmental and food education activities with school-age children and youth (Borsatto *et al.*, 2022, p. 16).

Regarding research activities, NEAs commonly adopt an interdisciplinary approach and prioritize the methodological perspective of participatory research, seeking to implement their experiments in rural communities in collaboration with local farmers. Thus, knowledge construction occurs based on local reality, taking into account farmers’ knowledge and practices while ensuring their protagonism. In this dialogue of knowledges, technical issues emerge contextualized with the cultural, social, and economic dimensions inherent to the population’s living conditions. For students, this format allows them to experience local problems, understanding the complexity of processes

² “The universities that hosted the NEAs were: a) Universidade de Araraquara (UNIARA), located in the municipality of Araraquara, b) Universidade Estadual de Campinas (UNICAMP), whose main campus is in the municipality of Campinas, c) Universidade Federal de São Carlos, which hosts two NEAs, one at its campus located in Sorocaba (UFSCar-So) and another at its campus in the municipality of Buri (UFSCar-Lagoa do Sino).” (Borsatto *et al.*, 2022, p. 13).

and the political dimension of any intervention. For farmers, since experimentation and other initiatives arise from their realities and demands, innovations can be evaluated and implemented without breaking with their prior practices and knowledge. Thus, science and practice intertwine, articulated by the Agroecology Study Centers, which actualize the ideal of awareness and engagement fostered by the agroecological movement.

Considering the extensive reach of NEAs across Brazil, their importance for the dissemination of Agroecology nationwide becomes particularly evident. According to Cardoso *et al.* (2018), between 2010 and 2017, the federal government launched eight public calls to support Agroecology Study Centers. These resources funded 380 projects from approximately 150 centers located in universities across all Brazilian regions. These projects involved 437 professors, 449 undergraduate students, and 787 scholarship holders, benefiting about 61,000 people through the organization of 1,460 events and 312 courses. Additionally, 1,049 documents were published, including 388 scientific articles. This set of actions, besides contributing to the dissemination of Agroecology within and outside the university space, functioned as an important mechanism of counter-hegemonic education for all involved, especially for students, who were trained to act in society based on agroecological principles. “Thousands of people participated in spaces promoted by NEAs and are now inside and outside academic institutions, fostering agroecological thinking in theory and practice” (Borsatto *et al.*, 2022, p. 25).

As science, movement, and practice, Agroecology asserts itself as a counter-hegemonic force

opposing the agricultural modernization process that characterized the so-called Green Revolution – that is, Agroecology positions itself against the philosophy of progress, a central ideological element of the capitalist order (Ferreira, 2017). Thus, Agroecology defines itself through various social practices “that share the common element of the conviction of the need for an emancipatory rupture with the current development process prevailing in contemporary societies” (Silva Neto, 2013, p. 4). In this sense, the market and the relentless accumulation of capital lose ground with the rise of agroecological thinking, while the values of economic altruism and co-responsibility regarding environmental preservation and the future of human society itself are projected (Borsatto & Carmo, 2013). It is clear here that productive issues and the use of technology should not be guided by the logic of capital but by an ethic of environmental and social responsibility (Jonas, 2006).

Santos (1989) identifies technical application as the social form of applying modern science, based on the first epistemological rupture. In this case, scientific knowledge is produced separately from local knowledge, and technical application is also carried out independently of it. Thus, there is an overlap of scientific rationality over local knowledge, highlighting technical know-how at the expense of ethical know-how. According to the author, this format of technical application is inconsistent with the second epistemological rupture, characteristic of postmodern science. In response, Santos (1989) proposes edifying application as the social form of applying postmodern science. In this case, “application always takes place in a concrete situation where the applier is

existentially, ethically, and socially committed to the impact of the application” (Santos, 1989, p. 158). Therefore, edifying application does not dispense with technical know-how but subordinates it to the determinations of ethical know-how.

As noted, agroecological thinking emerges from the critique of hegemonic values and practices of modern society and advances toward proposing alternative values and practices associated with environmental preservation and social justice. In this sense, agroecological thinking finds an important interpretive key in the so-called dialectic of conscientization proposed by Freire (1982). According to the author, conscientization is a process whose original act is the denunciation of the unjust mechanisms of the dominant system, and whose subsequent act is the announcement of pathways to overcome the situation of injustice.

Unlike authors such as Featherstone (1997) and Bauman (1999), who argue that “postmodernity does not refer to the rise of a new historical moment but to a sharpening of perceptions about the imperfect assumptions of modernity itself” (Ferreira, 2017, p. 133), Santos’ (1989) postmodern perspective signals a movement toward overcoming foundational epistemological frameworks of science and modernity itself. In agreement with this author, Ferreira (2017, p. 133) highlights that “modernity only admits a satisfactory interpretation if associated with capitalism; therefore, the term postmodern, to have acceptable semantic value, must point to – or at least hint at – the advent of a period following modernity and, thus, capitalism.”

As seen earlier, agroecological thinking begins with a critique of capitalist industrial agriculture to propose an alternative form of agricultural

management and a different ethic regarding human relationships with each other and with nature. Its principles and practices align with peasant and indigenous productive rationality, as they derive from a knowledge production process that recognizes traditional knowledge, complementing it with contributions from modern science. As such, Agroecology projects itself as a quintessential postmodern science, in line with the framework proposed by Santos (1989).

Indeed, the stances of Agroecology constitute a practical example of the emergence of a new episteme. The generated techniques prioritize environmental health preservation but are culturally appropriable, offering elements of ecological management that complement (rather than replace) traditional techniques to improve the performance of the productive unit, allowing increased productivity while ensuring the system’s long-term fertility. Thus, innovation occurs without severing ties with traditional agricultural culture. Moreover, systems managed according to Agroecology principles provide a set of ecosystem services transferred as a legacy to present and future generations of humans and non-humans. In this way, Agroecology is immersed in environmental knowledge and, as such, constitutes the “vanguard for the crystallization of an ecotechnological productivity paradigm” (Leff, 2002, p. 50). Such peculiarities lead Toledo (2016, p. 45) to affirm that “Agroecology is, in itself, an epistemological revolution.”

6. Final considerations

In the wake of environmentalism, Agroecology emerges as a critique of the agro-industrial

productive model of modern agriculture, which primarily focuses on maximizing financial profitability, even at the expense of depleting natural resource bases. As such, the agro-industrial model reveals an operational logic that is “against nature.” In contrast, Agroecology advocates for the construction of a new paradigm that emphasizes the possibility of producing “with nature,” leveraging the ecological potential present in ecosystems, the cultural potential inherent in peoples, and the technological potential embedded in scientific knowledge. In challenging capitalist agriculture, proponents of Agroecology have been working to systematize and demonstrate its economic viability, identifying principles and techniques that can be applied across diverse contexts.

However, the agroecological debate seeks to broaden reflection beyond the strict scope of agricultural productivity, incorporating issues related to ecological principles, cultural values, social inclusion, as well as food security and sovereignty. In this sense, agricultural production is situated within a broader political context that encompasses the entire agri-food system.

Therefore, Agroecology not only advocates for the consolidation of an alternative agriculture to the hegemonic model but also defends the possibility of building a sustainable society. In this way, alongside productive experiences in ecological agriculture, Agroecology brings a pronounced proposal for collective social action, manifesting itself in the articulation of a broad political movement that integrates farmers, consumers, academics, and non-governmental organizations. This integration has proven decisive for the development of agroecological knowledge itself, as efforts toward its

elaboration, from its early stages, have aimed to bridge “peasant empiricism” with “scientific theory” (Leff, 2002). This peculiarity highlights that Agroecology transcends the boundaries of modern thought, constituting itself as a postmodern science.

By mobilizing diverse sectors of society for its cause, Agroecology works toward the construction of something “unprecedented yet viable,” understood as “a futurity to be built” (Freire, 1982). In this sense, it demonstrates that the utopia of a sustainable planetary society is alive. Reports – scientific, journalistic, and informal (especially via the internet and social media) – related to successful agroecological experiences are increasing, proving that the utopia is not only alive but also possible. However, for a sustainable planetary society to emerge, the collapse of the unsustainable planetary society – that is, the collapse of capitalist society – is essential. Thus, as long as capitalism persists as the hegemonic system, the central issue will continue to be the agroecological transition.

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