

Transdisciplinary Praxis in the construction of an environmental rationality

Práxis transdisciplinar na construção de uma racionalidade ambiental

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ABSTRACT

What are the obstacles to sustainability? The answer largely hinges on understanding the nature of existence, the relationship between society and nature, and the focus on certain metabolic functions given by the capitalist economy. A new environmental rationality must think and act differently from the current hegemonic rationality. To this end, it will be necessary to mediate processes of dialogue and conflict among interdisciplinary, intercultural, and inter-ontological knowledge, in which different subjects need to make decisions and act in reality. This paper addresses the theoretical formulation and some results of a research project that follows three socio-environmental ventures in the three sectors of the economy to design how this Transdisciplinary Praxis would take place. Action-reflection for the construction of a Circular and Solidarity Bioeconomy.

Keywords: philosophy of praxis; transdisciplinarity; environmental epistemology; popular engineering; ontology.

RESUMO

Quais os obstáculos para a sustentabilidade? Boa parte da resposta reside na compreensão da natureza da existência, da relação sociedade-natureza e no foco dado a algumas funções metabólicas pela economia capitalista. Uma nova racionalidade, que seja ambiental, deve pensar e agir de forma diferente da racionalidade hegemônica vigente. Para tanto, será necessário mediar processos de diálogo e conflitos entre conhecimentos interdisciplinares, interculturais e interontológicos, em que diferentes sujeitos precisam tomar decisões e agir na realidade. Este trabalho apresenta a formulação teórica e alguns resultados que estão sendo desenvolvidos em projeto de pesquisa que acompanha três empreendimentos socioambientais nos três setores da economia para desenhar como se daria essa práxis transdisciplinar. Ação-reflexão para construção de uma Bioeconomia Circular e Solidária.

Palavras-chave: filosofia da práxis; transdisciplinaridade; epistemologia ambiental; engenharia popular; ontologia.

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Introduction

As observable in the environmental-ecological-health and economic and socio-geo-political spheres, we start from the analysis that the current crisis is systemic and structural. The Intergovernmental Panel on Climate Change (IPCC, 2021), in a recent report, was emphatic about the urgency of changes to be made in the economy,

It is unequivocal that human influence has warmed the atmosphere, oceans, and land. [...] Global warming of 1.5°C to 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide and other greenhouse gases occur in the coming decades (IPCC, 2021, p. 1).

The United Nations launched Agenda 2030, with the Sustainable Development Goals, which are 17 goals that point to the main issues facing humanity. However, with less than five years remaining before the deadline, the outlook is not encouraging, according to UN (2025) and the Luz Report, which has been assessing the progress or regression of the SDGs in Brazil since 2017 (GTSC, 2023).

Leff (2001) revives Weber's concept of social rationality as

a system of rules of thought and behavior of social actors [...] within specific economic, political, and ideological structures, legitimizing a set of actions and giving meaning to the organization of society (Leff, 2001, p. 121).

to defend environmental rationality over capitalist rationality.

For him, environmental rationality would be one that

would allow the systematization of the material and axiological principles of environmentalist discourse, thus organizing the constellation of arguments that support environmental knowledge, and would also allow the analysis of the consistency and effectiveness of a set of actions for the success of its objectives (Leff, 2001, p.123).

Therefore, part of the change necessary to achieve the Sustainable Development Goals lies in transforming how today's society thinks and acts to form an environmental rationality. Another aspect of achieving sustainability is understanding the history of nature transformation by society.

The first industrial revolution (1750–1840) accelerated the pace of nature transformation. This historical process is thought to have increased the scale of environmental impacts (Marques, 2018). Concern about environmental issues, the impacts of human activities on nature, and the limits of growth (Meadows et al., 1972) increased significantly during the 20th century.

Since then, evidence of environmental collapse, the onset of the Anthropocene (Marques, 2018), the approach to a point of no re-

turn (Bologna and Aquino, 2020), and the fact that we have exceeded six of the nine planetary boundaries (Richardson et al., 2023) have only intensified.

The integrity of the biosphere, climate change, changes in land use, changes in freshwater, biogeochemical flows, and “novel entities” (chemical pollution, etc.) are the six limits that have already been exceeded. Ocean acidification is close to exceeding the safe operating limit. Only ozone layer depletion and atmospheric aerosol are still considered to be within safe limits (Richardson et al., 2023).

The term Society-Nature Metabolism Breakdown has been addressed since the time of Liebig (1803–1873), the father of agricultural chemistry:

the concentration of land ownership in the hands of a few leads to a gradual decline in the agricultural population, creating a stark contrast with the ever-growing industrial population concentrated in urban areas. This results in a potentially irreparable rupture within the context of social metabolism, governed by the natural laws of life. This rupture consequently leads to the dissipation of the earth's inherent strength, a phenomenon that, through the medium of trade, is propagated far beyond the geographical confines of the nation itself (Liebig *apud* Marx, 2017, p. 762).

Liebig (1865) highlights the concentration of population in cities and the interruption of the return of organic matter to the soil:

It cannot have escaped you that during the last twenty-five years I have strenuously endeavored to draw attention to the source of our existence, to show that the art of agriculture does not consist only in making the earth produce, but also in rendering its productiveness permanent, and that of the various means for doing so there is only a single one on which can be safely relied on to secure the perpetual fertility of our fields, viz. The utilization of the Sewage of Towns (Liebig, 1865, p. 24).

If criticism of metabolic rupture is present in the *oeuvre* of the person primarily responsible for industrial agriculture, we cannot claim ignorance of the path taken. Researchers and philosophers argue that the emergence of the Modern is linked to the alienation of nature, to the separation of humans from nature (Hösle, 1996; Saito, 2021). Therefore, to change this path, presidential decrees or individual changes are not enough, but rather a systemic process of transformation.

“Economic behavior should develop as an extension of living systems, subjecting the economy to the broader system of human ecology, and reconstructing economic rationality based on the principles of ecol-

ogy and thermodynamics” (Leff, 2006, p. 184). Leff (2001) then points to the construction of ecotechnological, or negentropic productivity:

Environmental rationality and ecotechnological productivity thus emerge from the productive potential generated by the ecosystemic organization of resources and the innovation of new ecological technology systems. This rationality generates and radiates new productive forces through ecological planning, territorial distribution, and the social reorganization of productive activities. This process necessarily affects the quantity, quality, and distribution of wealth through the socialization of nature, the decentralization of economic activities, the social management of ecological productivity and technological means, respect for the cultural diversity of peoples, and the promotion of sustainable development projects (Leff, 2001, p. 89).

The depth of the change proposed by Leff (2001) for the formation of a sustainable society echoes the systemic formulations of Marx, but also those of Morin, a leading authority on complexity. A basic difference between them lies in how to bring about these changes. At first, Morin (2005) describes gradual changes based on culture, education, politics, and economics; while Marx and Engels (2017) emphasizes the need for a class revolution with the seizure of power.

Despite the visible differences between their strategies for transforming reality, these authors do not contradict each other in their basic principles. Since both deal with systemic approaches based on critical realist premises (Bhaskar, 2013), with references to scientific objectivity and historical-dialectical materialism, the school of complexity can be found in what is called Transdisciplinary Praxis.

Which praxis and which transdisciplinarity?

Antonio Gramsci, considered a cultural Marxist, takes a more measured view of the process of changing social reality. Defending the centrality of the category of Praxis, he refers to historical-dialectical materialism as the Philosophy of Praxis. Semeraro (2006, p. 10) states:

By encompassing both objective and subjective dimensions, the construction of the philosophy of praxis becomes a particularly difficult, complex, and long-term task because, based on concrete historical processes, it proposes to recreate ‘from top to bottom’ the entire existing order: the economy, politics, science, culture, education, and individual and social power relations.

The transformation of the existing order to create a sustainable society also involves changes in the way of thinking, because the environmental crisis is also a crisis of knowledge (Leff, 2024). Those involved

in socio-environmental causes must ask themselves, in their daily practices, whether they are in fact constructing another rationality, another productivity, and another mode of production.

These individuals comprise a group that has been deprived of rights, like students, workers, researchers, traditional and indigenous peoples, peasants, as well as people organized into groups, communities, associations, cooperatives, unions, social movements, foundations, laboratories, and universities. Paulo Freire (2013) highlights the importance of praxis in his career:

Man, who cannot be understood outside his relations with the world, since he is a “being-in-situation,” is also a being of labor and transformation of the world. Man is a being of “praxis;” of action and reflection. [...] man is marked by the results of his own action (Freire, 2013, p. 25).

Praxis is key to overcoming the split between theory and practice, which in bourgeois society culminated in technique (Vázquez, 2011). Instead of technique, praxis encompasses a philosophical aspect of activity; it is action-reflection. The use of the term praxis here does not follow its original use by Aristotle, of praxis as “action as an end in itself.” If we did so, we would use the term *poiesis*, with the same root as some other words, such as poetry, distorting the practical meaning of the word into “objective conscious activity” (Vázquez, 2011, p.30).

Regarding the scope of the Philosophy of Praxis,

fundamental philosophical problems must be formulated in relation to practical human activity, which thus takes precedence not only from an anthropological point of view—since man is what he is in and through praxis—but also from a historical — since history is, definitively, the history of human praxis — but also gnoseological [sic] — as the foundation and end of knowledge, and criterion of truth — and ontological — since the problem of the relations between man and nature, or between thought and being, cannot be resolved outside of practice (Vázquez, 2011, p. 54).

According to Kosik (1976, p. 114), “Human praxis [...] is the setting where the metamorphosis of the objective into the subjective and of the subjective into the objective takes place; it becomes the active center where human intentions are realized and where the laws of nature are unveiled;” it “merges causality with purpose.” The objectivity contained in excellence through practice in a non-alienated relationship with theory brings the Philosophy of Praxis closer to Pragmatism¹ (Peirce, 1977; Semeraro, 2006).

In the history of thought, the search for a science of totality has been heavily attacked, as in Smuts’ Holism or Engels’ Scientific So-

¹ Peirce prefers to call his school of thought pragmatism to differentiate it from Dewey’s pragmatism. However, to facilitate communication, Peirce’s line of thought will be referred to simply as pragmatism.

cialism (Popper, 2007). However, questioning the tendency toward hyper-specialization and compartmentalization of knowledge and integrating knowledge without reducing it to crude generalizations are genuine efforts that help solve complex problems of the 21st century.

The Philosophy of Praxis was largely restricted to researchers in the social sciences. On the other hand, advances in General Systems Theory, Cybernetics, Complexity, and Transdisciplinarity (Td) were more restricted to researchers in the natural sciences.

Morin (2005, p. 199) defines praxis as “the set of activities that effect transformations, productions, performances based on an intercompetence,” establishing a physical basis for a concept derived from the antropossocial domain, arguing that “a machine is therefore a physical praxic being.” Unlike the philosophers of praxis, Morin (2005, p. 198) advocates a new view of the machine, not only as an instrument, but as an “organizing physical being.”

Other authors who contribute to the field (Maturana and Varela, 2001) seek the Greek root *poiesis* to construct the concept of autopoiesis as the capacity of life to produce and maintain itself. Although developed in the natural sciences domains, it enables dialogue with the concept of praxis in the social sciences, given its relationship with the autonomy of being and the creation of reality, whether social or biological.

The term praxis is used as action-reflection, a conscious activity that seeks to integrate objectivity and subjectivity and practice and theory, critically, with the development of ultra-specialized and commodity-focused technology. Moving on to Td, there is not just one concept. The ideal Td, mode 1, was conceived by Piaget (1972, p.170):

Finally, in the phase of interdisciplinary relations, we can expect to succeed in a higher phase that would be ‘transdisciplinary’, which would not be content with achieving interactions or reciprocities between specialized research, but would situate these connections within a total system without stable boundaries between disciplines.

The Td advocated here is considered a real Td, mode 2, which aspires to the efficient use of knowledge by relating different *epistemes*² to deal with relevant problems of reality (Scholz and Steiner, 2015).

Problems, such as overcoming the divide between natural and social sciences (Morin, 2005) and the metabolic rupture between society and nature (Saito, 2021), are complex and revolutionary praxis alone, as in the example of the Soviet Union, has proven to be insufficient to resolve the contradictions between the economic and socioecological pillars of sustainability (Foster, 2022).

A more open epistemology that respects differences and enables interaction between scientific, popular, and traditional knowledge, as well as between ontologies such as scientific and indigenous worldviews, can provide more integrated answers and solutions to prevent environmental collapse.

Environmental rationality and ecotechnological productivity point to *what* we need to build, but Leff does not describe in detail *how* these processes should be carried out. This article seeks to develop what Leff (2006, p. 242) calls a “praxeology that guides social action towards the construction of environmental rationality.” It is, therefore, something greater than developing techniques and technologies to address environmental collapse, but also overcoming the theory, practice, and premises of the current hegemonic rationality.

“Every theory of knowledge is implicitly or explicitly based on a particular theory of reality and presupposes a particular conception of reality itself” (Kosik, 1976, p. 27). What we believe to be real (ontology) and true (epistemology) implies how we act in reality (praxiology). The realignment of these three pillars is fundamental to the construction of Environmental Rationality.

Transdisciplinary Praxis is, therefore, a new epistemology with constructive criticism of materialistic ontology, which reverberates in a new way of being, existing, and acting in reality. It integrates the fruits of interdisciplinarity with the demands of society. It reconciles practical excellence with theoretical foundations. It positions the producers of formal knowledge in the face of the challenges of the 21st century with an open attitude towards other forms of knowledge. It paves the way to break down the divide between the natural sciences and the humanities to join forces for the common good.

Figure 1 illustrates the scope of the Transdisciplinary Praxis effort in theoretical terms. Next, to discuss Transdisciplinary Praxis, we will present the epistemological and ontological bases for integration between these schools of thought, which can be of great value for the construction of Environmental Rationality.

Environmental epistemology

Based on the study of environmental epistemology, Leff (2001) warns about the risks and pitfalls of using General Systems Theory (GST) (Bertalanffy, 1977), arguing that “there is no metalanguage capable of merging or unifying, through a general level of formalization, the conceptual specificities of each science” (Leff, 2001, p. 39). He also warns about “the ideological character [of] the unifying project of sciences” (Leff, 2001, p.31) of GST and interdisciplinary practices.

At the same time, Leff (2001, p. 37) conceptualizes transdisciplinary practice as “the application of methodologies from one science to another scientific field, the mathematical formalization of the natural and social sciences, or the transplantation of concepts and theories from one scientific object to another.” It is possible to observe that his critical stance deals with a type of ideal Td (Scholz and Steiner, 2015). Despite this, he does not rule out that “epistemological strategies for articulating the sciences in the environmental field and the processes of

² In Greek, the plural of *episteme* is *epistemai*.

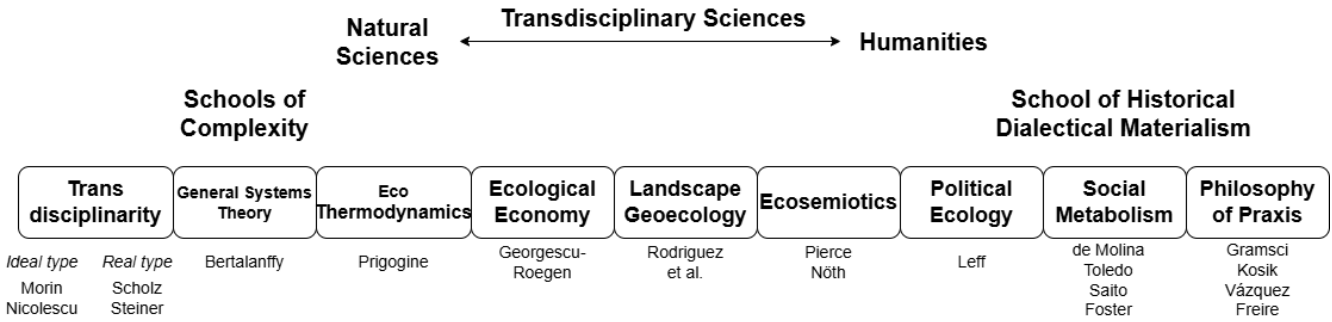


Figure 1 – Main areas of knowledge on the path to overcoming the divide between the humanities and natural sciences.

interdisciplinary and transdisciplinary fertilization of knowledge offer a more concrete explanation of the environmental crisis generated by economic rationality” (Leff, 2001, p. 82).

Leff’s attack refers to the ideal type of Td, which stems from Piaget’s initial attempt to seek a system of total integration of areas of knowledge, without boundaries and with consistency, that is, the unity of knowledge (Scholz and Steiner, 2015). The real type of transdisciplinarity, on the other hand, consists of a “facilitated process of mutual learning between science and society that relates interdisciplinary research and multi-actor discourses to develop socially robust orientations to real-world problems” (Scholz and Steiner, 2015, p. 531).

The benefits of real Td in the university context are enormous, from bringing the university and society closer together to counteracting extreme specialization and departmentalization, which generate distorted and fragmented views of reality. In the coexistence of disciplinarity and Td, the former is based on advances in specific areas, while the latter is guided by the real demands of society, which are complex.

Leff (2001) points to an economy that does not standardize the fruits of production exchange values and does not exert pressure beyond the carrying capacity of ecosystems, anticipating their capacity for regeneration. Those who benefit from profit maximization at the expense of environmental quality and social well-being would not accept such changes.

Universities are of fundamental importance to nurture and foster experiences driven by other principles, developing critical schools of the rationality that allows and drives environmental collapse. The association between universities and socio-environmental movements plays a key role in overcoming the crisis of knowledge that fuels the environmental crisis.

Pointing to the formation, organization, and development of transdisciplinary research, teaching, and extension projects carried out by interdisciplinary and multidisciplinary groups, with multiprofessional profiles, in contact with society, aiming to overcome real-world problems, is an epistemological contribution of Transdisciplinary Praxis.

But when the issue goes beyond the sphere of knowledge theories and reaches an ontological sphere, how should we act? Let us posit a stakeholders meeting composed of a Christian, a scientist, and an indigenous person. Would their different worldviews or ontologies prevent the resolution of an environmental problem?

If the Christian believes that rising sea levels are the result of divine punishment, a flood, the only way to get him to act against this increase would be to justify that anthropogenic environmental degradation is a sin that must be combated, or to convince him of another ontology. If the scientist is a consummate positivist, to the extent of denying indigenous ontology, that is, not recognizing their ways of life and worldview, would it be possible to carry out a transdisciplinary process? Because of situations like this, it is necessary to enter the field of Ontology.

Environmental ontology

Ontology is understood as the study of being and existence, or the study of the nature of existence. Etymologically, the environment would be the surroundings of being. It would not be possible to think of a being existing concretely if not inserted into an environment, but does it make sense to speak of an “environmental ontology?”

The field of environmental sciences can be understood as the interdisciplinary study of the interaction between humans and the environment (Botkin and Keller, 2012). Reigota (2009, p. 36) defines the environment as “a specific and/or perceived place where natural and social aspects are in dynamic relation and constant interaction.”

An environmental ontology would then be a more philosophical approach to human-nature interaction, countering the Western tendency to focus on the entity to the detriment of the environment. However, some researchers in this new field have been working on disambiguating and standardizing concepts to aid data integration and computational modeling (Buttigieg et al., 2013).

Political Ecology delves into ontology by critically examining how different worldviews relate to each other. Complementarily, a political ontology would be a critical perspective to question the ontological bases that underpin unsustainable development models (Leff, 2024).

All these areas of knowledge can contribute to the construction of an Environmental Rationality. Some key concepts will then be presented to demonstrate compatibilities between the philosophical premises of Praxis and Td.

Nicolescu (2018, p. 30) states that reality is “that which resists our experiences, representations, descriptions, images, or mathematical formalizations.” Marx, in turn, adopts materialism as an ontology that

considers the existence of an objective reality independent of human subjectivity (Foster, 2022). Both can therefore be considered realists.

From its Greek root, complex means “woven together,” that is, reality is complex because its various spheres (physical, chemical, biological, psychological, anthropological, social, historical, planetary) are all interconnected. This concept dialogues extensively with Marx’s (2013) concept of “concrete” as a synthesis of multiple determinations, or reality as a concrete totality (Kosik, 1976; Bottomore, 1988).

Dialectics can be understood as a method, logic, or set of principles that govern reality, or the movement of history (Bottomore, 1988). In a reversal of Hegelian dialectics, “The dialectic of things [phenomena, the world, nature] produces the dialectic of ideas, and not the reverse” (Lenin, 1961, p. 196).

Dialectical logic questions the principle of non-contradiction in formal logic. In turn, dialogical logic (Morin, 2005; Nicolescu, 2018) questions the principle of the excluded middle, arguing that at different levels of reality, something can be and not be at the same time.³

Materialism starts from the premise that matter is the fundamental substance of existence and the basis of all phenomena. All other things that exist are direct or indirect manifestations of this fundamental substance. Although widely adopted as an ontology in science and the philosophy of praxis, it is criticized by Leff (2006, p. 92) for being reductionist and monistic.

When defining historical-dialectical materialism, the inherent nature of movement in matter and the historical inherent nature of human events are affirmed (Engels and Marx, 2010). Thanks to the contributions of non-equilibrium thermodynamics and environmental history, it is also possible to speak of a historicity of nature (Georgescu-Roegen, 1971; Prigogine, 1978; Carvalho, 2016; González de Molina and Toledo, 2023).

The second law of thermodynamics, or the law of entropy, imprints an “arrow of time,” showing that spontaneous processes can only increase the entropy of a system. An extensive debate on the scope and limitations of this law has reached the field of living beings (Schrodinger, 1944). To carry out processes of local entropy reduction, dissipative structures must perform work, increasing total entropy (Kondepudi and Prigogine, 2014).

The development of the Dialectics of Nature school (Engels, 1979) was discontinued in the West between 1930 and 1970 (Foster, 2022) due to political and ideological factors. An important figure responsible for this event was Lukács, who is opposed by Gramsci (1999) when he questions his thesis that the dialectical method should be limited to historical-social reality:

One must study Prof. Lukács’s [sic] position in relation to the philosophy of praxis. It seems that Lukács asserts

that one can only speak of dialectics in relation to human history and not to nature. He may be wrong, and he may be right. If his statement presupposes a dualism between nature and man, he is wrong, since it falls into a conception of nature typical of religion and Greco-Christian philosophy, as well as idealism, which cannot unify and relate man and nature more than verbally. But if human history must also be conceived as the history of nature (also through the history of science), then how can dialectics be separated from nature? (Gramsci, 1999, p. 167).

Lukács inaugurates a tradition in the social sciences that relegates the dialectical materialist interpretation of nature solely to Engels (Foster, 2022). Together with the idealistic regression and secondary role given to the anti-imperialist struggle promoted by the Frankfurt School, the foundations are laid for a biased Western Marxism (Lorsurdo, 2019).

Without pretending to resolve whether “a single ontology could encompass nature and humanity” (Bottomore, 1988, p. 106), we point to a search for ontological overlaps (Ludwig, 2016) between the scientific, the traditional, and the popular to address the reality of environmental collapse and implement changes that have positive effects through dialogue, practice, and learning.

In this sense, overcoming the dichotomy between schools of historical-dialectical materialism and post-structuralist, naturalist-scientific, or decolonial schools may arise from a science of movement and flows, based not on the monism of matter, but on a triad of categories: energy-matter-information (Baleeiro, 2025).

Current sciences have already developed fields of mass and energy balance, but with the advent of Information Theory, the nature of information is increasingly being questioned. Considering it as something that causes change in a probability assignment (McIrvine and Tribus, 1971), information resides between matter and energy, and reducing it to one of these does not seem feasible to information ontology researchers (e.g., Wheeler, 1992; Emmeche and Kull, 2011).

Other differences between the Philosophy of Praxis and real Td are not in their ontologies, but in their historical interpretations, for example, in the premise of class struggle as the driving force of history. Td does not use this premise, yet this does not imply there is a contradiction that precludes Transdisciplinary Praxis.

Leff (2024, p. 98), in his most recent works, points to the need to deepen political ontology, which “can be thought of as the disjunctive root and the joining of *physis* (nature), *logos* (logic), and *polis* (city). Ultimately, it is about the relationship between the Real, the Symbolic, and Power.” The “restoration of the sovereignty of life over the overwhelming

³ The necessity for a new principle may be called into question. Nicolescu (2018) cites the wave-particle duality in quantum physics as an example of such a need; however, this had already been explained by Niels Bohr’s dialectic with the principle of complementarity. Bohr, N. 1928. *The quantum postulate and the recent development of atomic theory*. Good Press.

power of Capital in the conflict for the appropriation of nature” (Leff, 2024, p.77) involves understanding the nature of existence, working with ontological overlaps (Ludwig, 2016) to broaden dialogue and concrete actions in defense of life, combating ontological views that deny the other, justify social inequality, and cause environmental collapse.

Integrating environmental ontology and epistemology

Leff (2006, p. 96) states that “dialectical reason [...] can guide, but does not predict or predetermine what is generated by praxis. The potentiality (creativity and indeterminacy) of praxis transcends thought.” Thus, it can be concluded that he does not dismiss the employment of dialectics in the evolutionary process of nature. To understand the relationship between human beings in society being nature, according to Marx (2004, p. 84):

The universality of man appears in practice precisely in the universality which makes all nature his inorganic body – both inasmuch as nature is 1) his direct means of life, and 2) the material, the object, and the instrument of his activity. Nature is man’s inorganic body – nature, that is, insofar as it is not itself human body. Man lives on nature – means that nature is his body, with which he must maintain in continuous interchange if he is not to die. That man’s physical and spiritual life is linked to nature simply means that nature is linked to itself, for man is a part of nature.

Notwithstanding the limitation of “nature as an inorganic body,” given that the knowledge of the time did not allow us to see that all nature on Earth is permeated with life, Marx approaches the indigent thinking that “the earth does not belong to us, we belong to it” (Chefe Seattle, 1854). Society and the economy are subsystems contained within the system of nature, or the environment.

The “continuous interchange” between humans and nature in order “not to die” is the socio-ecological metabolism itself (Saito, 2021; Foster, 2022; González de Molina and Toledo, 2023). It is essential to understand that this metabolic view of reality is found in embryonic form in Marx and Engels’ debate on the philosophy of nature. It starts from the category of labor, which is “first and foremost a process between man and nature, a process in which man, through his own action, mediates, regulates, and controls his metabolism with nature” (Marx, 2013, p. 255).

If all societies have their existence in nature mediated by labor, that is, in productive material praxis, it is natural to deduce that the need

for labor is inherent to existence and greatly influences conceptions of being, existence, and knowledge.⁴ Ontological overlap (Ludwig, 2016), therefore, allows interontological dialogues (Rist and Dahdouh-Guebas, 2006) to reach common coefficients, since knowledge reflects, in its own way, a facet of the concrete existence of nature.

The categories of labor and praxis locate a node between environmental ontology and epistemology, since they mediate the entity-environment relationship and are activities common to any society. The broader concept of work in physics encompasses the energetic transformations, intentional or not, of animals, plants, and dissipative structures, allowing for a connection with the study of nature.

In order not to contribute to the division between society and nature and not to close our study to the possible discoveries of the sciences,⁵ instead of reducing matter as objective reality itself, why not adopt a triad of Matter-Energy-Information intertwined as Peirce’s Firstness, Secondness and Thirdness (Baleeiro, 2025)? These basic categories can serve as a starting point for various sciences, both natural and social, allowing conceptual connections in a dispositional manner, without reducing the symbolic to the real or the real to the symbolic.

Coherent syntheses between the school of Dialectics of Nature and GST and notes on the essentiality of Energy, Matter, and Information have already been made, as is the case with Landscape Geocology (Rodríguez et al., 2022), Environmental History (González de Molina and Toledo, 2023), Ecological Economics (Ruth, 2013), and the Unified Theory of Ecology (Ulanowicz, 2001).

By combining natural and social worlds, the integration of scientific knowledge to manage the planet, in its flows of energy, matter, and information, would no longer use the mechanism model, but rather a metabolic model. In this model, not only would the functions of appropriation, transformation, circulation, and consumption be important, as observed in capitalist rationality, but the functions of excretion, regeneration, and reproduction would also be integrated, respecting the carrying capacity of ecosystems.

Combining philosophical openness and scientific robustness with conscious socio-environmental activity may be the key to preventing environmental collapse (Bammer et al, 2020). Using practice as a criterion of truth is the way to complement the advances of controlled-condition laboratories (disciplinarity) with socio-environmental laboratories (Td).

The Transdisciplinary Praxis proposal stems from this context, from the urgent need for action-reflection between science and society, with epistemological openness to intercultural dialogues and ontological overlaps approaches that aim to overcome the environmental collapse imposed by capitalist rationality: changing the relationship between the countryside and the city; transforming production relations; slowing

⁴ Even though Indian culture developed Ayurvedic medicine with a logic based on patterns in nature, and Western medicine was developed based on a logic of causality, both converge in effectiveness in various health treatments.

⁵ After all, if for dialectical materialism movement is an indestructible attribute of matter and energy is a measure of the movement of matter (Guerasimov et al., 1980), would subatomic particles devoid of rest mass, such as photons, be measured without substances?

down the pace of industrial metabolism; triggering dialogical and decentralized processes of knowledge acquisition and awareness-raising. These are some of the challenges of Transdisciplinary Praxis.

Praxiology of the construction of environmental rationality

Popular social movements are antagonistic forces to the exploitation of human beings and nature by the ruling classes. Despite their theoretical and practical differences, they all seek to influence global agendas, as observed in the strong correlation between the agendas of the movements and those of the Sustainable Development Goals (Salles et al., 2024). Despite the important unification of agendas aimed at fair and sustainable global governance (Marques, 2018), history happens in everyday life (Kosik, 1976).

The objective of this work was to provide a theoretical contribution to Transdisciplinary Praxis. Having fulfilled this objective, we conclude with a praxiology of the construction of environmental rationality. Figure 2 shows the concepts, tensions, and contributions of the areas explored.

Transdisciplinary Praxis is not limited to a method or technique; it assumes a way of being and existing in the world. It is not unprecedented, as these characteristics are already observable in subjects who take an active and conscious role in reality. The innovation lies in the systematization of this mode of being, which should be criticized, evaluated, and tested on a larger scale. It is already possible to analyze the differences between individuals who act in reality, as shown in Chart 1.

All of these profiles can contribute to the construction of environmental rationality in the face of environmental collapse. However, this requires changes in habits and attitudes that result in recurrent structural modifica-

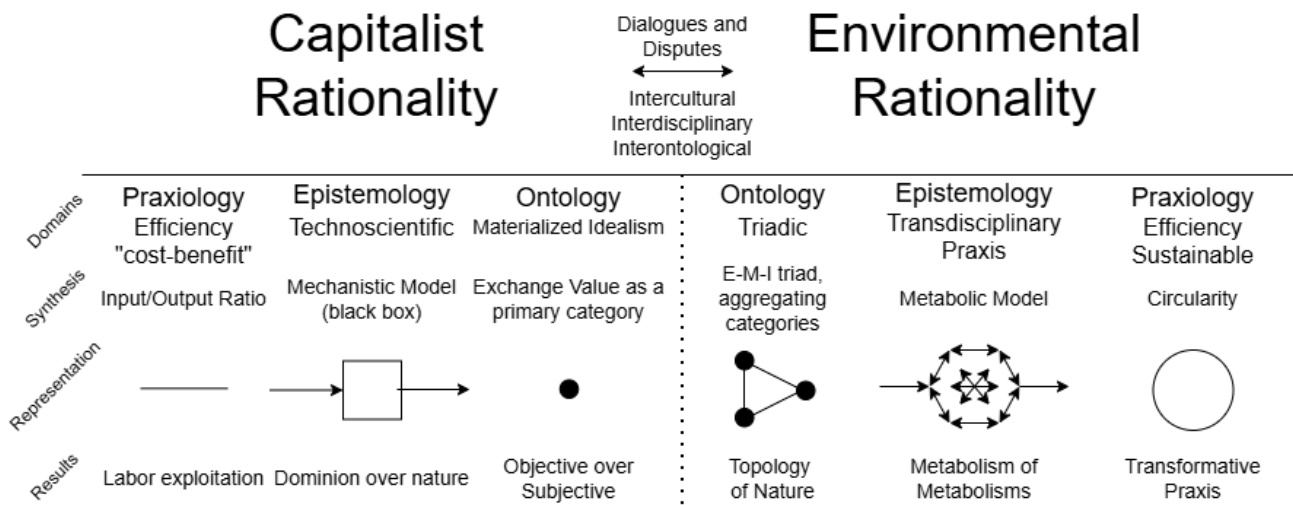


Figure 2 – Contrast between Capitalist and Environmental Rationality in the domains of Praxiology, Epistemology, and Ontology.

Chart 1 – Characterization of profiles in the context of Environmental Collapse.

Subject Profiles	Stance in the Face of Environmental Collapse	Characteristics	Examples of actions
Activist	“Doing my part”	- No strategic horizon; - Transitional condition; - Low connection between fronts.	Use less water, buy eco-friendly products, participate in environmental actions, etc.
Militant	Revolutionary praxis	- Military reference; - Ideological dispute; - Episteme of social sciences.	Organizing into political groups, raising awareness about oppression, etc.
Professional (technical)	Efficient performance of the role/ position	- Bureaucratic reference; - Academic training; - Technoscientific episteme.	Working ethically, respecting limits of authority, etc.
Entrepreneur	Meet market demand while making profit	- Capitalist reference; - Pragmatic training; - Tacit episteme.	Offering a solution in the form of merchandise, etc.
Transdisciplinary Praxis	Action-Reflection	- Ontological approach; - Integrated education; - New episteme.	Extracting the best of other profiles to build solutions that address the root causes of collapse.

tions, as profound changes are imperative to changing habits and attitudes. The methodological strategy of Action Research (Thiollent, 2025) is guided by cycles of action-reflection: 1- Problem Identification and Planning; 2- Action; 3- Evidence Collection; and 4- Evaluation of Practice.

A comprehensive evaluation of three initiatives aimed at fostering local and regional productivity and rationality was conducted for more than three years. These initiatives resulted in the provision of tons of agroecological food, the production of thousands of ecological bricks, and awareness raising among thousands of people about the importance of composting, while also systematizing processes. The experiences are shown in Chart 2.

The results of monitoring the initiatives described above are being published progressively (Baleeiro, 2025; Baleeiro et al., 2024). Understanding the subjects who practice Transdisciplinary Praxis is simpler, as shown in Chart 1. They are willing to learn new knowledge without disciplinary restrictions, respecting and appreciating traditional knowledge. They also share characteristics of the other profiles. Understanding the Epistemology of Transdisciplinary Praxis requires a complex context of collective decision-making by a subject who is willing to, in theory and practice, learn and produce knowledge, often willing to earn less as long as their activity is full of purpose, coherence, and commitment to those who most need support.

When the view of the economy structured solely into three sectors (Clark, 1940) is transformed into an economy that highlights its sociometabolic functions (González de Molina and Toledo, 2023), the need for circularity in the flows of matter, energy, and information becomes evident (Figure 3).

Studying practice means reflecting on and learning from mistakes, evaluating efficiency, and improving practice. We have never needed such thoughtful action, with strong integration between

different areas of knowledge, to decide on the biophysical paths of the society-nature relationship. Developing innovative, sustainable, and popular initiatives, while also evaluating their effectiveness to increase complexity and achieve greater scales, requires good management, techno-scientific development, political support, and epistemological openness.

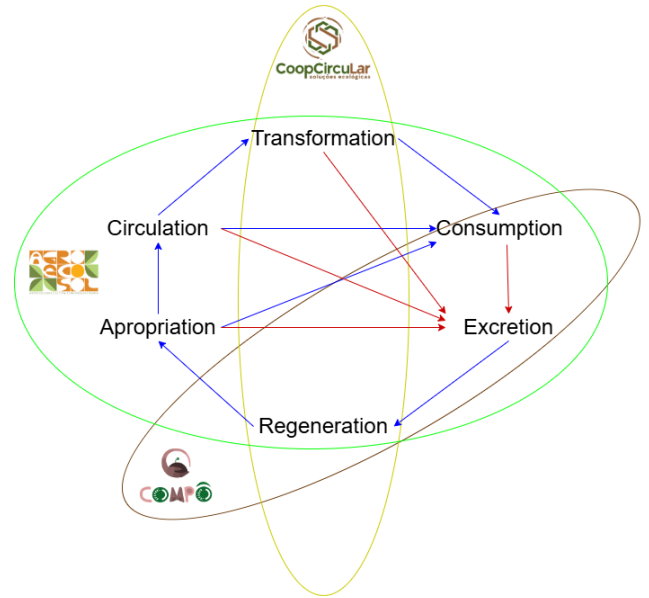


Figure 3 – Scope of the initiatives monitored according to the sociometabolic functions of the economy. The functions of excretion and regeneration are undervalued in the linear economy. Blue arrows indicate processes that require work, red arrows indicate energy losses incurred in the process.

Chart 2 – Summary of the three initiatives for a circular, solidarity-based, sustainable economy.

Initiative	Rede Agroecol	CoopCircular	Compô
Logo			
Which sectors of the economy does it belong to?	Primary Sector – Tertiary Sector	Secondary Sector – Tertiary Sector	Tertiary Sector
What is it?	Network of farmers and consumers for the direct sale of agroecological foods	A cooperative that produces ecological bricks using construction rubble	Community-based composting movement
What does it do?	Practices Circular and Solidarity Economy and encourages agroecology through a short marketing circuit	Produces bricks and develops innovative business models in circular economy and sustainable construction	Critical environmental education based on social technology composting.
What demand does it seek to meet?	Healthy food Raise awareness about agroecology A place to dispose of organic waste	Housing Recycling of construction rubble	Knowledge about waste management and composting
Follow-up period	09/2020-01/2024	06/2021-present	01/2020-present

Conclusion

Environmental Rationality may arise from human beings who understand and experience firsthand that the current hegemonic rationality is leading us to collapse. These beings have vastly different life stories and worldviews, but the common challenge imposes on us the need to work together, in meetings, assemblies, research projects, brick factories, urban fairs, and composting plants.

There are signs that this is a decisive decade (Marques, 2025). The scientific community is increasingly aware of its role (Ludwig and El-Hani, 2025), traditional peoples are organizing and fighting to preserve their knowledge and territories, managers are seeking ways to enable more sustainable processes, activists are expressing their opinions, militants are building another society, and entrepreneurs are innovating with social and environmental responsibility. Transformative transdisciplinaries are emerging.

Authors' Contributions

Baleeiro, A. V. F.: conceptualization; investigation; methodology; visualization; writing – original draft. **Echeverría, A. R.:** investigation; methodology; supervision; writing – review & editing.

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