

**Discussions on the value of nature from the perspective  
of political ecology: Castrian logic as Latin American  
socio-metabolic potential and negentropic productivity as  
territorialization for live**

**Discussões acerca do valor da natureza na perspectiva da  
ecologia política: a lógica Castriana como potencial  
sócio-metabólico Latino-Americano e a produtividade  
negentrópica como territorialização pela vida**

**Discusiones sobre el valor de la naturaleza desde la perspectiva  
de la ecología política: lógica Castriana como potencial  
socio-metabólico latinoamericano y productividad  
negentrópica como territorialización para la vida**

João Francisco de Oliveira Neto  
<https://orcid.org/0000-0003-4175-9142>  
chicocontat@gmail.com

*Mestre em Geografia pela Universidade Federal de São João del-Rei, UFSJ, São João del-Rei, MG, Brasil*

Ivair Gomes  
<https://orcid.org/0000-0002-5897-5084>  
ivair@ufsj.edu.br

*Professor do Programa de Pós-Graduação em Geografia da Universidade Federal de São João del-Rei,  
UFSJ, São João del-Rei, MG, Brasil*

Arlon Cândido Ferreira  
<https://orcid.org/0000-0003-0075-7989>  
arloncf@gmail.com

*Pós-Doutorando em Geografia pela Pontifícia Universidade Católica de Minas Gerais, PUC-Minas,  
Belo Horizonte, MG, Brasil*

**Abstract:** The proposed text synthesizes the urgency, challenges, and alternatives for the ecological turn in terms of Political Ecology. Thus, drawing support from the recent works of Enrique Leff (2021), we investigate the theoretical-political conditions for the consolidation of environmental rationality. With this purpose, we turn to Josué de Castro's tragic work, "Geography of Hunger," to witness the potentialities of the re-existence of Latin American peasantry as an alternative socio-metabolic 'sentipensante' to the object-world proposed by the matrix of economic rationality. We highlight the category of Social Metabolism as a socio-environmental cartographic practice of communities that enables the analytical denaturalization of

technical power relations. Viewed as a process of territorialization for life, negentropic productivity, also known as negative entropy or syntropy, complexifies the notion of socio-metabolism, promotes the re-valorization of nature, and enables its social re-appropriation. In this way, we hope to highlight the necessity of social and cultural emancipation of territorial insurgencies by peasants as fundamental precepts for addressing contemporary environmental challenges.

**Keywords:** Nature, Political Ecology, Peasantry.

**Resumo:** O texto proposto sintetiza a urgência, desafios e alternativas para o giro ecológico nos termos da Ecologia Política. Assim, apoiamos nos recentes trabalhos de Enrique Leff (2021), investigamos as condições teóricas-políticas para a consolidação da racionalidade ambiental. Com esse propósito, buscamos com a obra de Josué de Castro e sua trágica Geografia da Fome, testemunhar as potencialidades da r-existência do campesinato latino-americano como socio-metabolismo sentipensantes alternativos ao do mundo-objeto proposto pela matriz da racionalidade econômica. Assinalamos a categoria de Metabolismo Social como prática cartográfica socioambiental de comunidades que possibilitam a desnaturalização analítica das relações técnicas de poder. Encarada como processo de territorialização pela vida, a produtividade negentrópica, também conhecida como entropia negativa ou sintropia, complexifica a noção de socio-metabolismo, promove a re-valorização da natureza e permite sua re-apropriação social. Deste modo, esperamos destacar a necessidade da emancipação social e cultural das insurgências territoriais campesianas como preceitos fundamentais para a resolução dos desafios ambientais contemporâneos.

**Palavras-chave:** Natureza, Ecologia Política, Campesinato.

**Resumen:** El texto propuesto sintetiza la urgencia, desafíos y alternativas para el giro ecológico en términos de la Ecología Política. Para ello, nos basamos en los trabajos recientes de Enrique Leff (2021) y examinamos las condiciones teórico-políticas para la consolidación de la racionalidad ambiental. Con este propósito, buscamos en la obra de Josué de Castro y su trágica Geografía del Hambre, testimoniar las potencialidades de la r-existencia del campesinado latinoamericano como socio-metabolismo "sentipensante" alternativo al mundo-objeto propuesto por la matriz de la racionalidad económica. Destacamos la categoría de Metabolismo Social como una práctica cartográfica socioambiental de las comunidades que permite la desnaturalización analítica de las relaciones técnicas de poder. Considerada como un proceso de territorialización de la vida, la productividad negentrópica, también conocida como entropía negativa o sintropía, complejiza la noción de socio-metabolismo, promueve la revalorización de la naturaleza y permite su reapropiación social. De este modo, esperamos resaltar la necesidad de la emancipación social y cultural de las insurgencias territoriales campesinas como preceptos fundamentales para abordar los desafíos ambientales contemporâneos.

**Palabras clave:** Naturaleza, Ecología Política, Campesinato.

## INTRODUCTION

The relationship between society and nature is ontological, as different peoples, cultures, and identities represent their space and time. This environment - eco - constantly interacting with the individual in their incompleteness, certainly makes its study - logy - and the establishment of laws - nomics - necessary to use and to appropriate nature socially. Thus, ecology and economy are etymologically related.

However, the hegemony of economic rationality and its self-referenced temporal/spatial meaning movement has undermined the judgment and understanding of environmental reference points for the social translation of its laws. This economization of ecology, as demonstrated by the principle of scarcity in the logic of economic value, prioritizes life over the values of modern reason.

According to Porto-Gonçalves (2002, p. 5), the idea of politics emerged in ancient Greece as synonymous with boundary, initially used to separate the polis - city - from its exterior beyond the walls - rural areas - and later to define and negotiate other arrangements through which society is organized. Therefore, politics is the “art of defining boundaries”.

In this sense, the ecological turn proposed by Political Ecology not only suggests a different motive but also an epistemological shift towards the ecologization of the economy, where the value of nature should stem from social, political, cultural, and ontological construction. It involves establishing boundaries that subject economic logic to the reproduction and valorization of life (Leff, 2021).

The revaluation of nature in the construction of environmental rationality, according to Political Ecology, is based on the ontologically relational experiences of humanity, which, in constant motion, deviate from rigid and structural value systems found in theories of mechanistic representation of the modern world. Political Ecology emerges from social movements that are increasingly engaged with ecological and environmental issues.

As Leff (2021) argues, the ecological crisis is, above all, a civilizational crisis, as it expresses the lack of consistency of the dominant economic model in proposing a mediation of space and time that allows for the ontological conditions for the reproduction of human life on the planet. However, unlike apocalyptic perspectives of the human future on Earth, subalternized geo-geographies dominated by models imposed by economic rationality ‘r-exist’ as matrices of alternative rationality and announce ecological potentials for social transformation centered around life reproduction (Porto-Gonçalves, 2004).

The thinkers who had privileged positions for translating socio-environmental announcements of r-existence, such as Josué de Castro (1908-1973), preceded the environmentalism influenced by the American counterculture of the 1960s and 1970s. Influenced by the tragic logic of Latin American hunger, the metabolic humanism in Castro’s works unveiled the political, ontological, and cultural dimensions of endemic hunger in underdeveloped countries.

The denaturalization of technical power relations, as seen in the works of Castro, encompasses José Quintero Weir’s proposal to promote epistemological openings as socio-political-environmental strategies of “making community” through ‘sentipensante’ (feeling-thinking) metabolic practices (Quintero, 2019), a “sentient” reason in the terms of Arturo Escobar, capable of consciously re-appropriating nature while shaping territories (Escobar, 2016).

These characteristics are manifested primarily in rural areas of countries with colonial heritage, as demonstrated by indigenous and peasant r-existences in Latin America. Thus, the revaluation of nature should be based on its social reappropriation, which, through the technical power relations of different matrices of rationality, becomes territorialized.

As a practice of r-existence, the territorialization for life articulates eco-techno-cultural strategies for the affirmation of nature in its negentropic potentials (Leff, 2021).

The principle of negentropy, also referred to as syntropy or negative entropy, is proposed as a theoretical-political operational category that opposes and complements the entropic principles of matter and energy dissipation. This principle represents the metabolic dialectic of nature's dis-re-ordering (Leff, 2019).

Thus, with this work, we aim to contribute to the discussions that seek, through the study of geo-geographies (Porto-Gonçalves, 2002), to highlight the struggle for territorial autonomy of Latin American rural communities and the dignity of "writing" the land according to their values, techniques, and customs, as protagonists in the construction of environmental rationality.

Initially, we present an analysis of three works considered theoretical-political landmarks for the consolidation of ecological issues in the global political debate. We highlight how Marx's book *Capital: Critique of Political Economy* (1867) revealed the fetish - spell - of capital by pointing out the limitations of value/commodity expressed in Classical Political Economy. We then discuss *The Limits to Growth* by Meadows *et al.* (1972), the main theoretical basis for ecological debates that guided the United Nations' Stockholm Conference on the Human Environment (1972). Finally, we suggest Leff's recent work (2021) *Political Ecology: From the Deconstruction of Capital to the Territorialization of Life* as a theoretical-political landmark in the movement toward the construction of environmental rationality. Thus, we hope to provide a contextualization of the emergence and consolidation of Political Ecology.

Next, we demonstrate the potentialities and analytical considerations of social metabolism, one of the main categories that have guided hermeneutic movements in the search for a Marxian ecology. For this purpose, we analyze, based on Foster (2000) and Boltvinik (2016), the difficulties of Marxist theory of value in addressing the labor particularities of the peasantry. In doing so, we aim to move away from excessive mechanical interpretations of the social metabolism category, which is an inheritance from classical thermodynamics and its mathematical codification of nature within Marxism.

Later, we draw from Nietzsche's tragic thought to discuss how Castrian geography reveals the potentialities of Latin America in dissolving the hyper-reality of the economy. By considering hunger as a tragically strange geography, Josué de Castro advanced the dichotomous relationship between reason and life in modernity/coloniality, which allowed for the creation of a metabolic humanism as an ecopolitical model for the interaction between society and nature.

Lastly, we analyze 'sentipensamento' as a conscious action of community building through principles rooted in the matrices of environmental rationality (Escobar, 2016). Among these principles, Leff (2019) highlights negentropic productivity as a creative principle of ordering and organizing nature, as well as a reversal of the entropic acceleration caused by economic rationality and its technicist belief in shaping the world as an object/resource within an anthropocentric framework.

We consider, in conclusion, the relevance of the ecological movement proposed by political ecology and reaffirm the ideas of Leff (2021) that point out the necessity of social reappropriation for the revaluation of nature. In this regard, ecotechnological strategies of r-existence and territorial emancipation should take center stage in the movement towards the ecologization of nature, life, and the economy.

## THE VALUE OF NATURE? IN POLITICAL ECONOMY AND POLITICAL ECOLOGY

The Enlightenment and its anthropocentric logic of the world/object emerge as models of self-referential representation of the relationship between society and nature. The naturalization of technical-scientific relations is limited to conceiving nature as an object and resource, which has made scarcity the cornerstone of valuing the natural dimension.

On the other hand, the lack of growth required by the economistic production model has accelerated the entropic processes of nature degradation, such as the burning of hydrocarbons, deforestation, and monoculture farming. As an object, natural limits such as scarcity are mistakenly resolved by the human capacity to control the environment through technical-scientific advancements.

Francis Bacon and John Locke, in their critiques of the theory of divine power, already advocated the idea of property as the human capacity to appropriate the available raw materials in nature, which, combined with the division of labor as proposed by Adam Smith, would result in a constant source of productivity and enrichment for nations (Altvater, 2006).

In the field of classical political economy, authors like Adam Smith, Thomas Malthus, and David Ricardo sought to create universal economic laws through mathematical and mechanical models. Smith considered scarcity as a self-regulating principle of the market in the supply and demand relationship. Malthus, in turn, maintained and interpreted the objectification of nature by economic entities as an excess of demand, resulting in a dehumanized economic naturalism. Ricardo, under the mechanisms of economic rationality, considered the qualities of land as a passive factor in measuring value/commodity (Altvater, 2006).

Elmar Altvater describes how nature is “transformed from an ecological entity into an economic organism,” even though it “remains external to the economic discourse and its rationality” (Altvater, 2006, p. 361). As nature becomes entangled in the productive dynamics, a hyper-reality of the world-object emerges, over-determined by the mechanical models of economic rationality (Leff, 2021). According to Leff (2006):

With the advent of modernity and the rationality of the Enlightenment, nature was not only fractured and fragmented, but the concept of pure nature simply failed. Without an ontological order that encompasses being, without a cosmological order of the world, without a nature capable of providing precise referents to knowledge,

laws translatable into norms of life, and existential meanings, the symbolic order was displaced and fell into delirium (Leff, 2006, p. 123).

The symbolic valorization of economic reason, without limits and referents from the natural dimension, has distanced humans from the natural conditions of human existence. Therefore, the value of nature established by Classical Political Economy is merely that of a raw material resource, a passive distributive passivity economically protected by the right to property and its market regulation.

## CRITIQUE OF POLITICAL ECONOMY AND MARXIST THEORY OF VALUE

In the book *Capital: Critique of Political Economy* (1867), Marx identifies the symbolic delusion of the theory of value in classical political economy by pointing out the commodity fetish. As Grespan (2019) helps us understand, the concept of fetish used by Marx has its etymological origin in the word 'feitiço' (spell), which was widely used as a derogatory accusation by the Portuguese colony against the lifestyles of African peoples. While adapted to French and retained in the original German in Marx's work, the commodity fetish was one of Marx's main contributions to the critique of the capitalist mode of production, particularly regarding value/commodity.

While Marx, in his Theory of Classical and Neoclassical Political Economy, considers class struggle as the driving force of social structure, the historical foundation of measuring value/labor is made possible by the contradictions that exist between use value and exchange value.

The questioning of political economy in Marx allowed for the recognition of the commodity as a symbolically overdetermined delusion, dominated by exchange value at the expense of use value. Thus, Marx injects historicity into the measurement of value by conceiving it as "socially necessary labor time" (Leff, 2006, p. 96).

However, the characteristics of historical materialism remained tied to anthropocentric and Enlightenment logics of objectification, as a source of raw material available for socially contradictory appropriation within capitalist/socialist accumulation. Despite consolidating the concrete as the "synthesis of multiple determinations," Marx's theory of value sought to explain the one that sustains the capitalist structure and, consequently, would enable its socialist transformation (Leff, 2021, p. 176).

Marx's work did not manage to break away from economic rationality, but it allowed for a deeper understanding of the functioning of capitalist accumulation. Although it was not extensively explored by his successors, it gave rise to concepts that could contribute to the systematization of environmental rationality, such as social metabolism, which has been reclaimed by eco-Marxism and political ecology (Leff, 2006).

However, traditional historical materialism and its Marxo-positivist hermeneutics, in their attempt to establish an objective and universal scientific-epistemological validation, resulted in the distancing of their potential Marxian contributions to the development of environmental rationality, at least until the first half of the 20th century (Leff, 2006).

## THE LIMITS TO GROWTH: APOCALYPTIC ANTHROPOCENE OR CRISIS OF CAPITALOCENE?

According to diplomat André Corrêa do Lago, it is in the wake of the negative consequences of industrialization that the 1960s witnessed the inclusion of ecological debates in the global political agenda. Environmental issues were no longer exclusive to the peoples marginalized by modernity; ecological concerns began to be part of the social concerns of the First World as well, as seen in the countercultural movements in the United States (Lago, 2007).

Cases such as the mercury poisoning of fishermen and their families in Minamata, Japan (1950-1970), and the consequences of the Torrey Canyon oil spill (1967), which affected the coasts of France and England, gained global attention. However, the Stockholm Conference (United Nations Conference on the Human Environment, 1972) is considered a milestone in the internationalization of the environmental agenda (Lago, 2007).

According to Lago, the theoretical foundation of the Stockholm Conference was largely influenced by the report *The Limits of Growth* (Meadows *et al.*, 1972), commissioned by the Club of Rome and prepared by the Massachusetts Institute of Technology (MIT). This report had a significant impact on the scientific and political communities of the time. Although it approached the issue from a neo-Malthusian perspective, it aimed to propose alternatives to the environmental consequences of the economic and political spheres of capitalist society (Lago, 2007).

Despite being a pioneer in connecting economic, social, and environmental growth and in promoting sustainability as a subject of debate, *The Limits of Growth* had a somewhat 'apocalyptic' stance, containing drastic proposals for political action, such as population control and reduction in the use of natural resources (Lago, 2007, p. 29).

Associated with the Third World, a global political arena concerning sustainable development, problems considered responsible for environmental crises were closely linked to the underdeveloped efforts of progress. Thus, environmental safeguarding would require the prevention of growth in poor and underdeveloped countries, which could not be negotiated due to the tension between zero-growth policies and growth-at-all-costs policies (Lago, 2007).

Porto-Gonçalves already pointed out the impacts of logical positivism as epistemological limits of modernity in promoting ecological policies. *The Limits of the Growth* did not encompass the centrality of social emancipation and wealth distribution in the construction of a sustainable production model (Porto-Gonçalves, 1985).

By serving as a simulacrum in which the discourse of capitalist sustainable development sunk, *The Limits of Growth* was used as a guide for the hegemonic economic order. Its neo-Malthusian stance supported a technical paradox that functioned as an update of economic hyper-reality, where the technical-environmental consequences of development would be overcome through further development and more sophisticated technologies (Lago, 2007).

Ecological issues on the global geopolitical agenda were unable to articulate a valuation of socially constructed nature, despite significantly contributing to its visibility and, consequently, to the emergence of the environmental debate. Thus, the relationship between society and nature became known as the ‘apocalypse’ of the Anthropocene, which was only avoided through technical-scientific salvation.

The Anthropocene, as argued by atmospheric chemist Paul Josef Crutzen, marks the disruption of the climatic stability of the Holocene period by conceptualizing human history as a geological force equivalent to phenomena such as weathering, erosion, and tectonic movement. The idea is that the Anthropocene was conceived because of accelerated anthropogenic degradation through human appropriation of nature (Barcelos, 2019).

Without disagreeing with the effects that the fossil and industrial revolution had on the Earth’s geological dynamics, Moore (2017) suggests the notion of Capitalocene as more appropriate for the current climate instabilities. Moore’s proposal differs from apocalyptic perspectives because it considers the existence of modes of human life production capable of establishing alternative metabolic dynamics between society and nature. In this sense, Barcelos (2019) states:

Even though the narrative of the Anthropocene is important for marking and measuring phenomena and effects on the Earth system, it still overlooks addressing humanity in terms of power, inequality, and justice. By portraying the “human experience” (anthropogenic activities) as an uncontrollable force, “above” nature, the idea of environmental collapse triumphs as a product of human greed (Barcelos, 2019, p. 8).

According to the author, the narrative of the Anthropocene leads to a “fatalistic view of the ecological crisis” that abandons the metabolic potentials of the relationship between society and nature, a consequence of the flattening of human experience by the world-object of economic rationality (Barcelos, 2019, p. 14).

At the same time, while it is a semantic discussion, the notion of the Capitalocene is a critique of the apocalyptic Anthropocene and its homogenization of humanity. It also opens space for decision-making, previously confined to technical-scientific spheres of society, to social construction of the ecological debate, where ontological, political, and cultural dimensions are considered in promoting environmental rationality.

## **POLITICAL ECOLOGY AND ENVIRONMENTAL RATIONALITY: THE VALUE OF NATURE AS A POTENTIAL FOR SOCIAL CHANGE**

The book *Political Ecology: From the Deconstruction of Capital to the Territorialization of Life* written by Mexican philosopher Leff (2021), summarizes 40 years of research in which the author has devoted his work to the theoretical-political construction of environmental rationality. Leff emphasizes cultural, social, and political emancipation, including economic emancipation, as instances for breaking free from economic hyper-reality and for the social revaluation of nature.



The author argues that it is within the insurgencies of subaltern protagonisms, on the margins of universally imposed economic rationality, that intimate experiences with the environment emerge. In these experiences, the reference points of value and reality surpass the epistemological simulacrum of economic hyper-reality. In Political Ecology, the articulations between social struggles and ecological agendas serve as important tactics for both emancipation and re-existence, as well as for the construction of alternatives to economic rationality and the potential for the revaluation of nature (Leff, 2021).

Thus, the idea of sustainability becomes intertwined with the need for survival through strategies of re-existence in the face of economic rationality and the objectification of nature. Political Ecology, which is based on the interaction between human geography, cultural ecology, and ethnobiology, is an area of study that explores social conflicts and their connections with human intervention in the environment (Leff, 2021).

According to Leff, Political Ecology arises from the 'social reaction' to the neglect of nature by political economy," and therefore, it is not only a field of theoretical investigation but also socio-environmental transformation through political practice (Leff, 2021, p. 332). This is demonstrated in Leff's transcription of Marcuse's considerations (1972):

What is happening is the discovery (or rather, the rediscovery) of nature as an ally in the struggle against exploitative societies, in which the violation of nature leads to the violation of humankind. The discovery of the liberating forces of nature and its vital role in the construction of a free society becomes a new force for social change (Leff, 2021, p. 332).

By assuming that the knowledge of Political Ecology lies in social reaction as an ally in the struggle for re-existence, Leff analyzes the theoretical-operational paths that allow for the displacement of established reference-laws-limits by economic rationality, to embrace other rationalities that have been stigmatized as primitive or destined for disappearance (Leff, 2021).

The rediscovery of nature as an ally in the social struggle is intertwined with the new multi-scalar dynamics through which power relations articulately network in a globally interconnected world embroiled in a new world dis-order. Porto-Gonçalves and Haesbaert (2006) clarify that every dis-order is a re-ordering, a process of de-reterritorialization that traverses periods of temporal/spatial adjustment through social power relations.

The 1990s marked both the progress of capitalism toward the nation-state and the struggle against subalternized territories. In this crisis of liberal democracy, characterized by tension between the unity of the sovereign nation-state and the neoliberal model, social movements, which have been fighting to strengthen Political Ecology, increasingly stimulate the consolidation of Political Ecology. Regarding ecological tactics, Leff understands that:

Space and place are constructed as georeferential categories to root strategies of reappropriation of nature in ecological processes and local identities, attributing a cultural meaning to the construction of sustainable territories. Place and space as geographic referents are being shaped by lived time as an existential condition that anchors ecological potentials in cultural imaginaries and practices (Leff, 2021, p. 65).

There were several Latin American movements of territorial insurgency in the 1990s that adopted eco-cultural strategies of re-existence and social emancipation, and thus became references for the consolidation of Political Ecology. Among them are the Zapatista Insurgent Movement of Chiapas (1994) and the Landless Rural Workers Movement (MST), which, although created in 1984, gained international strength in the 1990s by articulating with Via Campesina, an international movement that supports peasant organizations. However, these strategies can also be observed in specific practices at smaller political scales, common to the hybrid reality of Latin American re-existence, such as agroecology, solidarity networks, and local markets.

Table 1: From Economic Rationality to Environmental Rationality: Synthesis of the works *Capital: Critique of Political Economy*, *Limits to Growth*, *Political Ecology: From Capital Deconstruction to Territorialization of Life*.

Epistemological Validation	Economic Rationality		Environmental Rationality
Work	Capital: Critique of Political Economy (Marx, 1867)	Limits to Growth (Meadows et al., 1972)	Political Ecology: From Capital Deconstruction to the Territorialization of Life (Leff, 2021)
Temporal/Spatial Context	Consolidation of Capitalism and the industrial production model, Germany's affirmation as a world power	Post-World War II, the crisis of scientific and technological legitimacy and the consolidation of the welfare state	World disorder, crisis of the welfare state and liberal democracy, insurgent territories, and revaluation of nature
Theoretical Foundation	Historical Materialism	Neo-Malthusianism and Thermodynamics	Human Geography, Cultural Ecology, and Ethnobiology
Measurement of Value	Socially necessary labor time	Flows and decompositions of matter and energy	Affirmation of life in its natural and cultural diversity
Principle of valorization	The contradiction between use value and Exchange value (class struggle)	Principle of entropy	Principle of negentropy
Value/limits of nature	Resource/scarcity	Resource/scarcity	Power/significance of life

### SOCIAL METABOLISM AND THE PRINCIPLE OF ENTROPY: POTENTIALS AND THEORETICAL-OPERATIONAL CONSIDERATIONS

Unlike the Marxist-positivist hermeneutics, which defrauded the potentialities of Marxist theory by encompassing the ecological dimensions of the society/nature relationship in exchange for the validation of historical materialism as a scientific method, more progressive perspectives of Marxism, from which part of the theoretical scope of Political Ecology emerged, sought to reactivate underexplored concepts from Marx's work, as they needed to address the worsening socio-environmental crisis.

The environmental crises, both in theoretical-analytical terms and in practical-political articulations, led to a rethinking of the critiques of capitalist development, encompassing the social issues of nature degradation as well. Some theorists sought to create new operational categories and concepts, while others sought to develop eco-Marxist hermeneutics. Jonh

Bellamy Foster, for instance, proposed the category of metabolic rift as a key element for an eco-Marxist conception (Foster, 2000).

In *Capital*, Marx used the concept of metabolism (*Stoffwechsel*) to define the labor process as a process between human beings and nature, a process through which humans mediate, regulate, and control the metabolism between themselves and nature. However, an “irreparable rift emerged in this metabolism because of capitalist relations of production and the antagonistic separation between the countryside and the city” (Foster, 2000, p. 141).

According to Foster (2000), Marx uses the laws of classical thermodynamics and its entropic principles to develop the idea of a metabolic rift between the rural and urban production dynamics of the capitalist mode of production, which, when articulated with technical and industrial systems, generates an unsustainable model of material and energy flows.

Among the Marxists who recognized a theoretical-operational gap in Marx’s understanding of ecological dimensions, the Mexican economist and politician Julio Boltvinik diagnosed a confusion in the Marxist theory of value in explaining socially necessary labor time when applied to the reality of peasantry and its functional interdependence with the capitalist mode of production.

The objective of Boltvinik (2016) is to create a “general theory of value” to measure the labor of peasants under specific environmental conditions and different yet interdependent market dynamics from the capitalist model. Among the professional characteristics of the peasantry, the author focuses on factors such as seasonality and long periods of drought. Although still limited by a universalist conception of value, his reformulation marked an important movement of epistemological openness in the theory of value, which, as pointed out by Leff (2021), made a significant contribution to the theoretical field of ecomarxism.

In Boltvinik’s (2016) general theory of value, the functional interdependence between the peasantry and the capitalist mode of production is explained by poverty and the persistence of the peasantry. This perspective suggests that the poverty of the peasantry is explained by capitalist exploitation, and therefore, their persistence is explained similarly to the class struggle in Marxist theory – value measured as socially necessary labor time capable of adjusting to the environmental conditions of seasonality and the Earth’s energy cycles, in a functional interdependence hidden by traditional value theory (Leff, 2021).

However, as Leff (2021) points out, the issue of poverty and the persistence of the peasantry requires conceptions of “more original and fundamental reasons, such as attachment to the territory, to their identities, and to the ways of production within their living conditions” (Leff, 2021, p. 214).

Although it does not acknowledge the ecological dynamics between the countryside and city as described by Foster (2000) in Marx’s work and recognizes the need for a more adequate measurement of the labor value of peasantry in economic terms as proposed by Boltvinik (2016), Leff (2021) warns that the construction of an environmental rationality is not limited to a metabolic theory of value/energy, solely focused on the recognition of entropic degradation inherent in capitalist production (Foster, 2000), or even on the entropic measurement expressed in seasonal terms (Boltvinik, 2016).

Leff's concern lies in the limits of the theoretical formulation of social metabolism as a positivist model representing nature as an object. Drawing on the entropic principles of classical thermodynamics, the "physical area of economic value" understanding of social metabolism is confined to its entropic principles of technical-scientific control of overflows and the degradation of matter and energy. According to Leff, "the law of entropy is a product of economic and technological rationality, driven by the imperative to increase productivity and reduce energy loss" (Leff, 2006, p. 175).

## **IN SEARCH OF ALTERNATIVE RATIONALITY FRAMEWORKS: CASTRO'S METABOLIC HUMANISM AND THE TRAGIC LOGIC OF GEOGRAPHY OF HUNGER**

As pointed out by Porto-Gonçalves and Haesbaert (2006, p. 105), "... there is no society without rational knowledge, a society that does not adjust means to ends through technique. What does exist are different forms of rationality". The reason is that the critique of technoscience should not be understood as a movement of denial, but as a questioning of the intentions behind its uses.

Indeed, this realization allows for the understanding of technology as a social relation of power, which represents the metabolism between society and nature in the adjustment of means towards a particular goal. Just as every reason expresses techniques that make sense within their temporal and spatial contexts, other sources of rationality, beyond economic rationality, allow for different worldviews and projections of ends for which it is necessary to appropriate the means to achieve them.

Under this perspective, the local scale stands out as a center for socio-metabolic techniques of nature usage, closely linked to the lived environment, representing a potential for the shaping of environmental rationality. Thus, the search for alternative principles of rationality involves analyzing their manifestations in time and space, expressed, in turn, in local socio-metabolisms. According to Porto-Gonçalves (2002), this reflects the diversity of rationality matrices.

Indeed, the most specific aspect of each culture is the way it measures and weighs things, the way it establishes its reasons and proportions, which, thus, before being mathematical reasoning (Measuring, Weighing, Reasons, and Proportions), are of a political and cultural nature (Porto-Gonçalves, 2002, p. 22).

Porto-Gonçalves (2002) investigates geo-graphies, and marks in space/time, among which technique is understood as relations of ordering and political and cultural appropriation. Thus, the insurgence of subalternized geo-graphies as a reflection of the environmental crisis shows, through social and political claims, the socio-environmental limits of financial rationality. Therefore, issues such as poverty and the persistence of peasantry and policies that explicitly express re-existence, constantly challenge the limits of the hyper-reality of the world-object, which causes discomfort with theories of value/commodity measurement, value/labor, and their thermodynamic version of value/energy.

Although considered a strength of the weak by Santos (1994), tropical flexibility, as well as slow time, are characteristics of the environment constructed in Latin American countries that can resist hegemonic rationality. Adapted to “incomplete or inherited infrastructures, to opaque spaces of opposition to anthropocentric enlightenment,” the strength of the poor lies not in the precision of economic rationality but in “approximation and openness, through slowness rather than acceleration” (Haesbaert, 2021, p. 147).

Latin America, in this way, constitutes a starting point for the creation of alternatives to economic rationality through the socio-environmental r-existence of the peasantry, historically subordinated by colonial/capitalist/patriarchal modernity. These localities influence values, measurements, and reasons. Epistemologies forged in conditions of extreme conflict, exploitation, and hybridism denounce the consequences of economic rationality and point to other possible paths of metabolic relations that escape the objectification of nature and anthropocentric.

In Brazil, intellectuals and activists have become internationally recognized for articulating ecological issues and the struggles for the socio-environmental r-existence of the peasantry. Josué de Castro, as a socio-environmental activist, is an example of how the tragic experiences of Latin American r-existences become practical-political reference points for the theoretical and analytical elaboration of Political Ecology.

By engaging with the Peasant Leagues in the Brazilian Northeast, a social movement advocating for land rights founded in Engenho da Galileia (1955), which later evolved into the Landless Workers’ Movement (MST), Josué de Castro recognized the boundaries of hunger and the power relations that intersect with nutrition and the ontological relationship of metabolic exchange between humans and nature (Fernandes & Porto-Gonçalves, 2007).

In *Geography of Hunger*, Castro proposes an analysis of the ecological issue through the tragic metabolic experience of hunger in Brazilian society (Davies, 2019). *Geography of Hunger* is a “tragically strange geography that, instead of describing the land as nourishing man, presents man as serving only to nourish the land” (Castro, 1957, p. 32).

Friedrich Nietzsche, in his works on tragic thought, already demonstrated how the hyper-reality of modern reason sought to distance tragedy as a human condition in favor of positivist objectives. In Nietzschean thought, nature is intimately connected to tragedy, as in the reflections of the pre-Socratic philosophers, thinkers whose thoughts were not yet dominated by the world of ideas. For Nietzsche, Platonic philosophy, which created the ‘logos’, inaugurates modern rationality and establishes the conflict between reason and life (Silva, 2009). In the same vein, Porto-Gonçalves (2002) points out that:

Thus, truth or reason would not dwell among mortal men and women, but rather would be brought from outside as if anointed by a sage from the heavens (Theoria). This was the path that led philosophy to refer to a whole set of thinkers (such as Democritus, Epicurus, Heraclitus...) as pre-Socratics, by the name of a thinker they never even knew (Socrates). The so-called pre-Socratic philosophers did not construct philosophical and doctrinal systems, as would be characteristic of the good philosopher from the crisis of Greek democracy onwards, and thus their thoughts were open for interaction with their interlocutors (Porto-Gonçalves, 2002, p. 6).

The epistemological openness present in pre-Socratic philosophy focuses primarily on the capacity of tragic thought to break through the hyper-reality of the modern world system. The importance of nature in Castrian tragic geography, when faced with a land that feeds on men, different from the economic conception of nature as a resource, reveals the ecological crisis that, as perceived by Natoli (2004, apud Silva, 2009, p. 13), contemporary man faces today in a 'hyper-tragic' situation, where he ceases to be protected by nature as in pre-Socratic philosophy and becomes its protector.

According to Leis (2005), technology becomes a tragic element in modernity because, as an attempt to adapt the environment to man, it engenders a paradoxical movement in the relationship between society and nature. The feeling of "unpredictability of events, contingency, and fragility of our actions", a tragedy renounced by modern rationality, paradoxically produces a hyper-tragedy in the collapse of the hyper-reality sustained by the worship of technology (Assmann, 2007, p. 222).

Indeed, these tragic experiences in Latin America demonstrate a reconciliation between man and nature, a relationship of interest not only for Political Ecology but also for current discourses on environmental tragedies, which are closely linked to the political and productive issues of third-world countries.

In a scenario of a worsening environmental crisis, the Latin American tragic perspective reveals the current tensions between reason and life through a different lens. It moves away from the neurotic logic of control imposed by economic rationality based on principles of entropy and scarcity. Instead, it helps us to think, as Josué de Castro suggests, about the principles of the life of the men and women who cultivate, produce, and transport food while starving.

Castro (1957) had already warned that "Hunger is in a hurry," just like the tragic logic, where space is here and time is now, which exacerbates the modern tensions between reason and life. Here, the struggle for the survival of the Latin American peasantry is expressed through strategies of re-existence while pointing out the potential for the construction of environmental rationality. Regarding the potential of subalternized re-existences and alternatives to modern rationality, anthropologist Segato (2019) considers Latin American tragic thought as:

Our logic, the logic that allowed us to survive centuries of massacre on our continent, is not a monologic, monopolistic logic governed by the neurosis of coherence and control, the monotheistic and white neurosis of Europeans. Our logic is tragic, in the sense that it can coexist with inconsistency, with incompatible truths, with the equations as a and non-a, opposites and true at the same time. And therefore, always, always endowed with the vital intensity of disobedience. A para-consistent logic to preserve life and ensure its continuity and greater well-being for more people, to keep the open horizon of history without pre-determined destiny, to keep space and time in motion (Segato, 2019, p. 329).

By taking a tragic stance from a Latin American perspective, Segato helps us understand how Castro's geography contributed to the reconciliation between society

and nature. Given the Castrian tragedy, as the experience of the hungry body, the tragic logic challenges economic rationality by pointing out that hunger is a problem of enclosure, not drought (Castro *apud* Fernandes & Porto-Gonçalves, 2007).

With this statement, Castro denounces the principle of scarcity (drought), which is the foundation of economic rationality (Leff, 2006), and highlights power relations (enclosure) as the main issue behind endemic hunger in underdeveloped countries. According to Fernandes & Porto-Gonçalves (2007):

Josué de Castro was able to perceive these subtle connections between borders, that is, between politics and ecology, the destinies of the planet's species. Perhaps that is why he sought in geography, which is precisely the art of graphing (*graphein*) the Earth and of attributing meaning to it (Fernandes & Porto-Gonçalves, 2007, p. 20).

In another instance, Porto-Gonçalves (2002) describes the Frontier as the "consecration of a specific correlation of political forces" that "tends to hide the front (struggle) that engendered it" (Porto-Gonçalves, 2002, p. 22). By analyzing the geo-graphies of nutrition, Castro perceives how the fence delimits the borders between reason and the affirmation of life, synonymous with tragedy from the Nietzschean perspective (Silva, 2009).

Castro's reflections (1957) not only precede environmentalism, whose temporal milestone is the Stockholm Conference (1972), but also present perspectives that continue to deepen the construction of environmental rationality today. The power of Castro's thinking is evident in his comments on the *Limits to Growth* inquiry while serving as the president of the FAO (Food and Agriculture Organization of the United Nations), in an interview with Mundo Unido in 1972:

"...it constitutes an abstract mathematical model in which five parameters were considered as fundamental factors of growth: 1. Natural resources; 2. Agricultural production; 3. Industrial production; 4. Population growth; 5. Pollution. The computer was fed with data on these five factors and the relationships that could exist among them... And it led the MIT (Massachusetts Institute of Technology) to draw false conclusions! Why? Because in all the research, not a single reference was made to the social, economic, and political structures" (Fernandes & Porto-Gonçalves, 2007, p. 60).

Thus, the Castrian perspective not only breaks away from the principle of scarcity embedded in the value/commodity or value/labor of economic rationality but also challenges its entropic updating of economic value proposed by MIT, translated into the mechanical theory of value/energy, a positivist residue, and a theoretical-conceptual trap of the socio-metabolism category. Castro expands the category of social metabolism by conceiving hunger not only in terms of its caloric levels but also in terms of vitamins, minerals, proteins, culture, identity, and sociability (Davies, 2019).

According to Leff, the value of nature as a potential for life lies in its diversity, and therefore its appreciation should be based on social, cultural, and political emancipation (Leff, 2021). Castro's metabolic humanism, by deconstructing the centrality of scarcity as the main ecological problem, presents a tragic perspective of social metabolism, where

hunger becomes an affirmation of life and serves as a cornerstone of political ecology and environmental rationality.

Castro fought for the Brazilian peasant movements for social transformation and the conservation of life, qualities of tragic thought in Segato's terms (Haesbaert, 2021), who affirms life as the ultimate goal of the metabolic relationship between society and nature. Regarding the ecological turn and the question of values, the Castrian perspective understands that:

In this new culture, science and technology will certainly play a significant role, but they cannot be the only components of this culture. There are many other values that are equally important. It is necessary not to forget that science is not wisdom. Science is knowledge. Wisdom involves knowledge and judgment. And on this point - the judgment of values - we are far from having a clear idea of the hierarchies of factors to be activated in order to build a global strategy of knowledge that does not separate the economic from the human, but instead considers humanity, human groups, and all of humanity as the ultimate goal of development (Fernandes & Porto-Gonçalves, 2007, p. 39).

In terms of economic rationality, the value of nature as an object/resource is transferred to the human body, at which point the economic inversion of ecology is tragically discarded by the senses. What Castro centrally demands (Fernandes & Porto-Gonçalves, 2007) is the centralization of humanity in its relationship with technology, which suggests the shift towards the ecologization of the economy as the goal of development, a denunciation that is embraced by Political Ecology, as advocated by Leff (2021).

Castro's metabolic humanism remains necessary even today. According to the survey conducted by the Brazilian Network of Research on Food Sovereignty and Security (PENSSAN), the estimated number of Brazilians experiencing hunger increased from 19.1 million at the end of 2020 to 33.3 million in 2022. On the other hand, the National Supply Company (CONAB) forecasts a record grain production in Brazil for 2021/2022, referring to the 2020/2021 harvest, with a total of 271.4 million tons and a 5.8% increase in planted area to 73.8 million hectares (CONAB, 2022).

Considered a return of Brazil to the Hunger Map, if the UN's research method regarding food security and nutrition is applied, these data show a period of strong constitutional intervention by the ruralist caucus. The latest survey by the Agribusiness Observatory of Brazil (2022) shows that the ruralist caucus in the Brazilian Congress, represented by the Parliamentary Front for Agriculture (FPA), follows the guidelines of the Agro Thinking Institute (IPA), which functions as a financing mechanism for councilors and deputies by multinational corporations to influence constitutional changes such as the 'Poison Bill' mining in indigenous lands, and land grabbing in the Amazon. In this scenario, the explicit capture of national decision-making on environmental policies by multinational companies producing agrochemicals (Bayer, Basf, and Syngenta), soybean processors (Cargill, Bunge, ADM, and Louis Dreyfus), meatpacking companies (JBS and Marfrig), and food industry companies (Nestlé and Danone) reveals the ecologization of the economy.



## NEGENTROPIC SOCIO-METABOLISM: TERRITORIALIZATION FOR LIFE

A recognition of the technosphere, a concept described by Santos (1994) that encompasses the dimension of power relations mediated by technology, distorts the understanding of its uses by treating it as an end itself. This self-referential technical-scientific approach, created by economic rationality as a condition of the hyper-reality of the world-object, conceptualizes social metabolism through economically measured thermodynamic models (Leff, 2021).

Once a technical relation of power, thermodynamics has been used as a principle of control over material and energy resources, a social relation of appropriation of nature globally imposed by economic rationality. The category of social metabolism, used as a means of controlling nature, has become epistemologically fixed in the principles of entropy.

Perspectives such as Castrian metabolic humanism have, among their theoretical-operational merits, the concern to dissolve the current tensions between reason and life. This ability demonstrates the breaking of the dichotomous relationship between body and mind upheld by the discourse of modernity, which extends and shapes other dichotomies, such as practice and theory.

Indeed, Orlando Fals Borda and Eduardo Galeano refer to this merit as a 'sentipensante' stance, which implies the ability to not separate the mind from the body, or reason from emotion (Quintero, 2019). In these terms, theory is conditioned by experiences that allow its interaction with the world. Pure and self-referential theory, devoid of the senses that validate it, leads to a detachment from reality and the naturalization of the technosphere while denaturalizing nature. It results in an economization of ecology, an economy based on the commodification of objects and resources, reducing them to mere objects and resources within the framework of economic rationality.

'Sentipensamento', as a junction of reason and emotion, has the potential to shape other matrices of rationality and other technical relations of power in the appropriation and meaning of nature. As Santos (1994) points out, every technique is perfect, made beforehand, through which reason aims to control actions in space and time. Thus, it is in the diversity of experiences in space and time that different matrices of rationality are delineated through technical relations of appropriation of the environment.

This explains how each person defines their measures, values, symbols, and practices through a constant metabolic 'sentipensar' to organize space/time for a specific purpose. In economic rationality, metabolic 'sentipensar' expresses the reconciliation of reason and life while complicating the entropic consequences predicted by Marxist socio-metabolism and classical thermodynamics. In addition to an imbalance of matter and energy, metabolic fracture causes the waste of experiences, knowledge, techniques, and cultures, ontological instances of relating to the world, re-existing, and territorializing oneself.

According to Haesbaert, the idea of territory is simultaneously involved in social relations of domination and/or appropriation of space, ranging from a more functional and objective perspective linked to the sense of domination to a more cultural and symbolic perspective that is more related to the idea of appropriation (Haesbaert, 2017). Lefebvre

(1986) points out that domination and appropriation should be considered inseparable, but he emphasizes that the idea of appropriation should prevail over domination.

In the context of economic rationality, relations of domination prevail, and conceptions of territory tend to be predominantly functional. In these experiences, the world-object is perceived as a process of territorialization that lacks the technical referents of domination, constructed through the dialectic between the symbolic and cultural dimensions of appropriation.

In these perspectives, the functional flattening of territory allows for the naturalization of technique in a way that stifles processes of social re-appropriation of space/time. Presented in movements of re-existences, the social re-appropriation of space/time through 'sentipensamento' promotes other rationales capable of engendering different processes of territorialization and alternative power relations to the logic of domination of the world-object of economic rationality. As clarified by anthropologist Arturo Escobar:

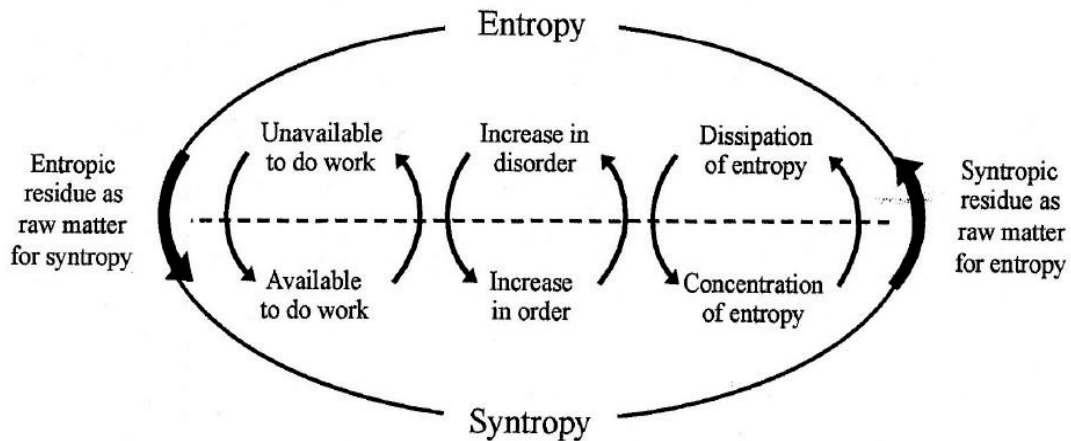
When we discuss the mountain as an ancestor or as a sentient entity, we are referencing a social relationship, not a subject-object relationship. Each social relationship with non-humans may have its own specific protocols, but they are not (or are not solely) instrumental and utilitarian relationships. Thus, the concept of community, initially centered on humans, expands to include non-humans (...). Consequently, the political terrain opens up to non-humans (Escobar, 2018, p. 103).

According to Escobar's reflections, the concept of community surpasses functionalist relations of domination and creates room for sentient rationality, a dialogic relationship between science and meaning. As pointed out by Quintero (2019), 'sentipensamento' is the cartography of community-building, a process of territorialization in the social appropriation of space/time. As clarified by Escobar (2018), it opens the political dimension to the non-human in an ontological, metabolic relationship experienced by it.

According to Leff, economic rationality has been based on entropic principles, which have served as technical relations of power in the domain of space/time through the control of the dissipation of matter and energy (disordering). Therefore, it is necessary to create a principle capable of generating technical relations that allow for the conception of the re-ordering dialectic of nature. Leff attributes this role to the negentropic potentiality of life as a mode of production based on the thermodynamic-ecological dynamics of the biosphere and the symbolic-cultural conditions of human existence (Leff, 2019).

Negentropy, also known as syntropy or negative entropy, is a fundamental principle for the social revaluation of nature. According to Stebbing, Bohr, and Szent-Gyorgyi (2016), the regulation of something requires the creation of opposing principles, and a homeostatic perspective of nature. In this perspective, the entropic principles of appropriating nature as a commodity or resource shift towards a negentropic process of organizing and ordering matter and energy.

Figure 1: Metabolic Entropic/Negentropic (Syntropy) Dialectic of Nature.



Source: Stebbing, Bohr and Szent-Gyorgyi (2016, p. 11).

Consolidated as a process of disorganization in nature, the entropic principle plays a crucial role in the dialectics of nature. However, when there are no negentropic mechanisms (syntropy), or eco-techno-cultural processes that can lead to the reordering of matter and energy into biomass, the potentiality of life is interpreted as constant deterritorialization (Leff, 2019).

Environmental rationality as a territorialization of life stems from a metabolic 'sentipensamento' through the bio-cultural reappropriation of time/space as an entropic/negentropic dialectic of productivity. In this sense, Leff (2019) asserts that:

The privileged spaces to unfold this strategy of "negentropic production" are the rural areas of the world inhabited by indigenous peoples and peasants who, in their struggles to build their autonomous territories, materialize this theoretical perspective through the reinvention of their identities and the innovation of their traditional practices (Leff, 2019, p. 252).

In this way, the author points out that the re-existence and the struggle for territorial autonomy of rural communities present socio-metabolic potentials of negentropic productivity. From this perspective, the territory ceases to be a functional structure and encompasses ontological and cultural issues of nature appropriation. Thus, the economization of ecology through technical power relations becomes possible to be denaturalized and reappropriated for an ecologization of the economy and a territorialization of life.

Furthermore, Stebbing's and others scheme (2016) shows us the difficulty of predominantly entropized systems allowing for the social reappropriation of labor. Due to the low availability of matter and energy, the technical relations of nature appropriation require large-scale operations, as exemplified by hydrocarbon extractions around the planet. Thus, it supports the hypothesis that social emancipation must be articulated with the reappropriation of nature as eco-cultural process of territorialization for life.

## FINAL CONSIDERATIONS

The main realization that we seek to highlight from these discussions is the necessary connection between social and cultural emancipation and strategies to overcome contemporary ecological challenges. In parallel, the text aimed to demonstrate the potentialities of nature for the practices of re-existence among peasant movements in Latin America. Within these issues, we had the opportunity to make some considerations that deserve to be highlighted.

As Leff (2021) points out, Political Ecology starts with the socio-environmental demands for overcoming the forgetting of nature proposed by the object-world of the techno-scientific matrix of economic rationality. Thus, it is in the processes of re-existence of subalternized peoples within the modern world-system that the potentialities of constructing environmental rationality lie. As shown by the tragic logic of the Geography of Hunger (Castro), Latin American 'sentipensamento' refers to cardiometabolic cartographies of community building that disrupt the functional smoothing of capitalist territorialization.

The work of Josué Castro encompasses these reflections, as his tragic thinking allows us to unveil the ontological, political, social, and cultural dimensions of the geography of hunger. Through metabolic humanism, Castro made the issue of hunger more profound by demonstrating the power relations involved. The fight against hunger, the number one ecological problem for Castro, suggests one of the fundamental metabolic principles of Political Ecology: the potential of life for the revalorization of nature.

The potential of life lies in the entropic/negentropic metabolic dialectic of nature, as shown in Stebbing's and others scheme (2016), which refers to the mechanisms of organization and ordering of nature as the condensation of matter and energy dissipated by entropic principles, such as photosynthesis. However, negentropic principles can also be expanded to conceive culture and technology as relations with metabolic capacities for socio-environmental organization and territorialization for life.

## REFERENCES

- Altvater, E. (2006) *¿Existe un marxismo ecológico?* Buenos Aires: Teoría Marxista Hoy.
- Assmann, S. J. (2007). O ser humano como problema: por um humanismo trágico e cristão. In M.I. Rocha (Org). *Humanismo e Direitos*. Passo Fundo: Berthier.
- Barcelos, E. (2019). Antropoceno ou Capitaloceno: da simples disputa semântica à interpretação histórica da crise ecológica global. *Revista Iberoamericana de Economía Ecológica*, 3(1), 1-17.
- Boltvinik, J. (2016). *Peasant Poverty and Persistence in the Twenty-First Century: Theories, Debates, Realities and Policies*. Ciudad de Mexico: El Colegio de Mexico.
- Castro, J. (1957). *Geografia da Fome*. São Paulo: Brasiliense.
- Companhia Nacional de Abastecimento (2022). *Acompanhamento da Safra Brasileira de Grãos*. 2022. Retrieved from <https://www.conab.gov.br/info-agro/safras/graos>
- Davies, A. (2019). *Josué de Castro's 'Geografia Combatente' and the Political Ecology of Hunger*. Thesis (PhD in Geography). King's College, London, England. [https://www.academia.edu/79079390/Josue\\_de\\_Castros\\_Geografia\\_Combatente\\_and\\_the\\_political\\_ecology\\_of\\_hunger](https://www.academia.edu/79079390/Josue_de_Castros_Geografia_Combatente_and_the_political_ecology_of_hunger)

- Escobar, A. (2016). *Sentipensar con la Tierra: Las Luchas Territoriales y la Dimensión Ontológica de las Epistemologías del Sur*. *Revista de Antropología Iberoamericana*, 11(1), 11-32.
- Escobar, A. (2018). *Sentipensar con la tierra: nuevas lecturas sobre desarrollo, territorio y diferencia*. Medellín: NAULA.
- Fernandes, B.M., & Porto-Gonçalves, C.W. (2007). *Josué de Castro: vida e obra*. São Paulo: Expressão Popular.
- Foster, J. B. (2000). *Marx's ecology: Materialism and nature*. Nova Iorque: NYU Press.
- Grespan, J. (2019). *Marx e a crítica do modo de representação capitalista*. São Paulo: Boitempo.
- Haesbaert, R. (2017). Território e multiterritorialidade: um debate. *GEOgraphia*, 9, 19-45
- Haesbaert, R. (2021). *Território e descolonialidade: sobre o giro (multi) territorial/de (s) colonial na "América Latina"*. Buenos Aires: CLACSO.
- Lago, A. A. C (2007). *Estocolmo, Rio, Joanesburgo: o Brasil e as três conferências ambientais das Nações Unidas*. Brasília: IRBr.
- Lefebvre, H. (1986). *Le Production de L'Espace*. Paris: Anthropos.
- Leff, E. (2006). *Racionalidade Ambiental: a reapropriação social da natureza*. Rio de Janeiro: Civilização Brasileira
- Leff, E. (2019). Negentropic Production. In A. Kothari *et al.*, (Eds.). *Pluriverse: A Post-Development Dictionary*. Alwerpet: Tulika Books and Authorsupfront.
- Leff, E. (2021). *Ecologia Política: da desconstrução do capital à territorialização da vida*. Campinas: Ed. UNICAMP.
- Leis, H. R. (2005). *Impactos da Modernidade na Condição Humana*. Florianópolis: Insular.
- Marx, K. (1867. 2013). *O Capital - Livro I – crítica da economia política: O processo de produção do capital*. Tradução Rubens Enderle. São Paulo: Boitempo.
- Meadows, D. et al. (1972). *Limites do Crescimento: Um relatório para o projeto do Clube de Roma sobre o dilema da humanidade*. São Paulo: Perspectiva.
- Moore, J. (2017). The Capitalocene, Part I. on the nature and origins of four ecological crisis. *The Journal of Peasant Studies*, 44, 594-630.
- PENSSAN - Rede Brasileira de Pesquisa em Soberania e Segurança Alimentar e Nutricional (2022). *II Inquérito Nacional sobre Insegurança Alimentar no Contexto da Pandemia da COVID-19 no Brasil*. Retrieved from <https://pesquisassan.net.br>
- Porto-Gonçalves, C. W. (1985). *Os Limites do "Limites do Crescimento" Contribuição ao Estudo da Relação Natureza e História*. Dissertação (Mestrado em Geografia) – Instituto de Geociências, Universidade Federal do Rio de Janeiro, UFRJ, Rio de Janeiro, RJ, Brasil. Recuperado de: <https://pantheon.ufrj.br/simple-search?query=instituto+de+geociencias>
- Porto-Gonçalves, C. W. (2002). *Da Geografia à Geo-grafias: um mundo em busca de novas territorialidades*. Buenos Aires: CLACSO.
- Porto-Gonçalves, C. W. (2004). *O desafio ambiental*. Rio de Janeiro: Record.
- Porto-Gonçalves, C. W., & Haesbaert, R. (2006). *A nova des-ordem mundial*. São Paulo: UNESP.
- Quintero, W. (2019). *Fazer comunidade: notas sobre território e territorialidade a partir do sentipensar indígena na bacia do Lago de Maracaibo, Venezuela*. Porto Alegre: Deriva.
- Santos, M. (1994). *Técnica, espaço, tempo: globalização e meio técnico-científico informacional*. São Paulo: HUCITEC.
- Segato, R. (2019). Las virtudes de la desobediencia. *Revista Anfibia*, Retrieved from <http://revistaanfibia.com/ensayo/virtudes-de-la-desobediencia>

Silva, F. C. (2009). *O trágico como condição do humano: ressignificação da tragédia na civilização ocidental*. Tese (Doutorado em Ciências Humanas) – Universidade Federal de Santa Catarina, UFSC, Florianópolis, SC, Brasil. Recuperado de: <https://repositorio.ufsc.br/bitstream/handle/123456789/92261/262422.pdf?sequence=1&isAllowed=y>

Stebbing, A.R.D., Bohr, N., & Szent-Gyorgyi, A. (2016). The Unity of Opposites and the 2nd Law of Thermodynamics, with a biological outcome. *Syntropy Journal*, 1, 1-19.

*Recebido em 12/jun./2023*

*Versão corrigida recebida em 12/fev./2024*

*Aceito em 26/fev./2024*

*Publicado em 25/mar./2024*