desenvolvimento em QUESTÃO

MULTIDIMENSIONAL INDEX OF TERRITORIAL HERITAGE ACTIVATION: The Natural Dimension and its Components[1]

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ABSTRACT

The natural dimension is just one of the dimensions inherent to the development theme, considered as multidimensional by definition. Thinking and acting in territorial development processes requires multi/interdisciplinary teams, to avoid false and mistaken interpretations that assume development as a synonym for economic growth. The text proposes to shed light, clues, on a set of components and variables pertaining to the natural dimension, which can guide development processes in territories. To this end, a bibliographical review and systematization of the experiences of the research team were used. In approaching the natural dimension, the team proposed five components: (Bio)Geodiversity, Agroecosystems, Urban Environmental Vulnerability, Basket of Goods and Territorial Services, State Policy for Sustainability. Each component consists of a set of variables, with their respective data collection instruments and classification scale. The effort undertaken moved towards proposing a matrix of components and variables for measuring an Index that represents the Natural Dimension (IDN) in territorial development processes.

Keywords: (Bio)Geodiversity, Agroecosystems, Urban Environmental Vulnerability, Basket of Territorial Goods and Services, State Policy for Sustainability.

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ÍNDICE MULTIDIMENSIONAL DA ATIVAÇÃO DO PATRIMÔNIO TERRITORIAL: A DIMENSÃO NATURAL E SEUS COMPONENTES

RESUMO

A dimensão natural é apenas uma das dimensões inerentes ao tema desenvolvimento, considerado multidimensional por definição. Pensar e agir nos processos de desenvolvimento territorial requer equipes multi/interdisciplinares, para evitar falsas e equivocadas interpretações que assumem o desenvolvimento como sinônimo de crescimento econômico. O texto propõe lançar luzes, pistas, sobre um conjunto de componentes e variáveis pertinentes à dimensão natural, que podem orientar processos de desenvolvimento nos territórios. Para tal, valeu-se de revisão bibliográfica e sistematização das vivências da equipe de pesquisadores. Na abordagem da dimensão natural a equipe propôs cinco componentes: (Bio)Geodiversidade, Agroecossistemas, Vulnerabilidade Ambiental Urbana, Cesta de Bens e Serviços Territoriais, Política de Estado para a Sustentabilidade. Cada componente consiste em um conjunto de variáveis, com seus respectivos instrumentos de coleta de dados e escala de classificação. O esforço empreendido caminhou em direção à proposição de uma matriz de componentes e variáveis para a mensuração de um Índice que representa a Dimensão Natural (IDN) nos processos de desenvolvimento territorial.

Palavras-chave: (bio)geodiversidade; agroecossistemas; vulnerabilidade ambiental urbana; cesta de bens e serviços territoriais; política de estado para a sustentabilidade.

INTRODUCTION

The emerging notion of territorial development is, by definition, multidimensional and is opportune for thinking about alternatives and strategies for development in rural and urban spaces. A development that does not allow the degradation of ecosystems, nor the expansion of social inequalities. In territories with socioeconomic weaknesses, it is not convenient to treat development as synonymous with economic growth, a perspective that aggravates and accelerates the processes of social and environmental inequalities (DENARDIN, 2016).

Conceived from the perspective of actors and resources, development rediscovers the path of the territory, which had been abandoned with the emergence of "globalization", which led to the simplification, homogenization, of the development model in the territories (CAMPAGNE; PECQUEUR, 2014).

Territorial development presents itself as a new focus, still under construction (VIEIRA *et al.*, 2010), and must be thought of in a way to articulate the rural and the urban (JEAN, 2015). Theoretical clarity about which development, territory and sustainability we are referring to is necessary and useful to think about alternatives that aim to reduce and combat social and environmental inequalities, present in the economies of the South.

Thus, territorial development must be thought of as a model that reduces social inequalities and the environmental impacts of production and consumption activities. Practices that aim at solidarity, cooperation and encourage trust between actors should be prioritized. On the other hand, the use of natural resources, for the production of raw materials and agro-industrialization, must observe the physical limits of ecosystems (DENARDIN; SULZBACH, 2019).

The analysis of economic and social systems has been increasingly rethought based on their environmental connections, as part of a new systemic and multidimensional understanding of development, in which the different sciences have contributed to the interpretation of issues that can capture aspects of improvement quality of life and well-being of populations, in favor of sustainability and territorial development.

In this way, it is widely recognized that environmental issues are fundamental to compose the different dimensions that characterize the development of a region, and conservation and environmental management figure as an important pact for any experience of territorial development, which must engage those involved in public management, third sector organizations, organized civil society and business entities.

Nature (renewable and non-renewable resources) enters the production and consumption system as raw material - nature as a provider - but also as a "cesspool" receiving waste, matter and energy (DENARDIN; SULZBACH, 2012). However, nature provides important, irreplaceable ecosystem services that allow the continuity of human and non-human life on the planet. Inherent to the territorial development process, the natural dimension can be operationalized through sustainable production and consumption practices in the relationship between human society and nature.

Required in territorial development processes, sustainability should not be based on the approach of eco-efficiency and ecological modernization - a perspective of weak sustainability, which is primarily guided by two questionable attributes (HAUWERMEIREN, 1998, p. 112): 1) "possibility of almost perfect substitution between natural capital (nature) and manufactured capital (produced by human beings); and 2) technical progress must be continuous, overcoming the limitations that impede economic growth due to the scarcity of resources". Contrary to the above, strong sustainability refutes the almost perfect replacement of natural capital by manufactured capital, understanding them as strongly complementary. Turner *et al.* (1994) and Harte (1995) point out that some ecosystem services are indispensable for human survival and are not replaceable.

Thus, it is possible to show that there are biophysical restrictions, which limit economic growth and can support territorial development processes committed to the use of natural resources in the long term, and it is recommended (HAUWERMEIREN, 1998) that renewable resources be exploited at a rate not exceeding their rate of regeneration; non-renewable resources must be gradually replaced by renewable ones, respecting the support capacity of ecosystems to assimilate and recycle waste and the conservation of its diversity is imperative.

Development is, by definition, multidimensional. The natural dimension, therefore, is inherent to territorial development processes and cannot be neglected. It is up to the actors (public, private and associative), but mainly to the researchers, to highlight the importance of such a dimension to guide the human-nature relationship and think of strategies for true development.

This text proposes to shed light, clues, on a set of components and variables inherent to the natural dimension, which can guide the process of territorial development. This proposition is the result of an initial exercise and, consequently, does not intend to exhaust the subject.

In this perspective, it is proposed: (i) to think of geosites and geological heritage as strategic, which can and should be used as guidelines for the promotion of territorial development; (ii) think of agroecosystems as the main locus of expression of sustainable development, where concerns about ecological sustainability and social equity are internalized; (iii) think of urban environmental vulnerability as a way of guaranteeing the right to the city, quality of life and well-being of urban populations; (iv) thinking about the basket of territorial goods and services as a theoretical-methodological approach to guide the processes of valuing resources and territorial assets undertaken

by multi-actors in the territory, which contribute to development with sustainability; and (v) think the state policy for sustainability, considering the variables local environmental legislation and the environmental monitoring and inspection system.

Such contributions, duly deepened, may come to support the construction of a "Multidimensional Index of Territorial Heritage Activation - IMAP", which results from the calculation of the activation index of a set of dimensions of territorial heritage.

THE NATURAL DIMENSION AND ITS COMPONENTS: EVALUATION PROPOSITION

Table 1 presents, for each component of the natural dimension listed by the researchers, a set of variables and their respective collection instruments, in addition to a scale to express their importance.

Table 1 - Methodological proposal for the study of the natural dimension of the territory in research about Territorial Heritage

Natural dimension			
Component	**Variables**	**Data collection instruments**	**SCALE (1 TO 5)**
(Bio) Geodiversity, expressed in the presence of geosites	Geological attributes	i) Bibliographic survey ii) On-site visits iii) Mappings iv) Interviews	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Infrastructure and surroundings	i) Bibliographic survey ii) On-site visits iii) Mappings iv) Interviews	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
Agroecosystem, as an expression of rural sustainability	Productive diversity	i) Field survey ii) Bibliographic survey iii) Interviews	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Productivity (production in relation to area)	i) Field survey ii) Bibliographic survey iii) Interviews	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Plant and animal health	i) Field survey ii) Bibliographic survey	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Agroecological transition level	i) Field survey ii) Bibliographic survey	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)

Urban Environmental Vulnerability	Housing and Urban Infrastructure Vulnerability	i) Systematic literature review ii) Secondary data	5: Very high (terrible) 4: High (bad) 3: Intermediate (regular) 2: Low (good) 1: Very low (great)
	Pressure on the natural environment	i) Systematic literature review ii) Secondary data	5: Very high (terrible) 4: High (bad) 3: Intermediate (regular) 2: Low (good) 1: Very low (great)
	Food and nutrition insecurity	i) Systematic literature review ii) Secondary data	5: Very high (terrible) 4: High (bad) 3: Intermediate (regular) 2: Low (good) 1: Very low (great)
Basket of Territorial Goods and Services	Private goods and services and scenario of quality public goods	i) Bibliographic and document review ii) Interviews with key actors iii) Focus group with territorial actors	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Governance system	i) Bibliographic and document review ii) Interviews with key actors iii) Focus group with territorial actors	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
State Policy for Sustainability	Local Environmental Legislation (Law No. 6.938/81)	i) Documents from the Ministry of the Environment ii) National Environmental Legislation iii) Municipal Environmental Legislation IBGE data	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)
	Local environmental monitoring and inspection system (Law No. 6.938/81)	i) Documents of the National Environmental System ii) National Environmental Legislation iii) Municipal Environmental Legislation IBGE data	5: Very high (great) 4: High (good) 3: Intermediate (regular) 2: Low (bad) 1: Very low (terrible)

Source: Elaborated by the authors (2023)

COMPONENT (BIO)GEODIVERSITY, EXPRESSED IN THE PRESENCE OF GEOSITES

Geoconservation seeks to preserve the natural diversity – or geodiversity – of important geological (rocky substrate), geomorphological (landforms) and pedological (soil) features and processes (SHARPLES, 2002). Thus, geodiversity encompasses the varieties of rocks, sediments,

minerals, fossils, landforms and soils, as well as their formation processes, on scales that vary from microscopic to continental.

According to Sharples (2002), geodiversity has three values: (i) *intrinsic* (or "existential") – something can have value of its own, independent of human purposes or those of other species; (ii) *ecological* (or "natural process") – importance in maintaining natural systems and ecological processes of which it is a part; and (iii) *human* (anthropocentric or geoheritage) – has significant value for human beings with non-depleting purposes (e.g.: research, education, aesthetics, recreation, tourism, etc.), contrary to the notion of resource (extraction, processing, etc.). In addition to *educational*, *aesthetic* and *cultural values*. Brilha (2016) also highlights the *scientific* value of geodiversity, which is related to its importance for current and future knowledge about the functioning of the geosphere and its interactions with other Earth systems – biosphere, hydrosphere and atmosphere. Initially, this author defined geosites as the places where one or more elements of geodiversity are found with the mentioned values or others (BRILHA, 2005). However, subsequently, it starts to restrict the application of the term only to areas with geological occurrences of high scientific value, in order to avoid the inappropriate use of the concept, due to its popularization (BRILHA, 2016). It is noteworthy that, in the present work, the original definition of the referred author is adopted, since it is understood that all values have equal importance in the identification of geosites. Finally, another relevant concept is that of *geological heritage*, consisting of the set of geosites in a given area.

The inventory and quantitative assessment of sites are the first steps towards defining areas of geodiversity or geosites (BRILHA, 2016). The inventory aims to gather information about potential geosites and their uses, based on the bibliography and specialists in the study area. Such information is checked through field work, which seeks complementary data for the characterization of these places. Then, a quantitative assessment is carried out, focusing on the values and the risk of degradation, which will underlie the appropriate management of the listed geosites. The criteria must be limited in terms of quantity and can be adapted to the local reality – such as population density, which has little representation in the analysis of exceedingly small areas (BRILHA, 2016).

In summary, geosites of high educational or tourist value must present several distinct geological features or visual beauty appreciable by the majority of the public, which can be easily understood by students of all educational levels or by non-specialists, with comfortable and fast access, in addition to of good safety conditions and low risk of degradation. When analyzing these criteria, it is necessary to consider the average age of most people who will visit the site, as there are differences in physical capacity, cognition and other characteristics between the different age groups (e.g.: children and university students).

In proposing the Multidimensional Index of Territorial Heritage Activation (IMAP), some components of the quantitative assessment of geosites are selected[7], and they are grouped into two variables: (i) *geological attribute* ; (ii) *infrastructure and surroundings*. The first refers to the characteristics inherent to the geosite, which consist of uniqueness, didactic or interpretative

[7] The detailed description of each component of the quantitative assessment can be found in the annexes of the following paper: DENARDIN, VF; ALVES, CLB; CAZELLA, AA; FETT JUNIOR, N.; LOPES, PR *Territorial approach to development: natural dimension and contributions to the diagnosis and prospecting of scenarios*. Brazilian Journal of Management and Regional Development, Taubaté, v. 18, No. 1, p. 61-83, Jan./Apr. 2022.

potential, geological diversity and risk of degradation. The second variable consists of elements built and/or external to the geosite, covering accessibility, security, population density and association with other values. For the two evidenced variables, i) *geological attributes* and ii) *infrastructure and surroundings,* we proposed the following evaluation scale:

5 - Very high (optimal): (i) geosite with very unique features and easy understanding for all audiences, with very high geological diversity and very low risk of degradation; (ii) easily accessible geosite, very safe, in an area with a very high population density and very close to other ecological and cultural values.

4 – High (good): (i) geosite with unique features and relatively easy understanding for all audiences, with high geological diversity and low risk of degradation; (ii) accessible, safe geosite, in an area with high population density and close to other ecological and cultural values.

3 – Intermediate (regular): (i) geosite with relatively unique features and easy understanding for certain audiences, with medium geological diversity and risk of degradation; (ii) relatively accessible and safe geosite, in an area with medium population density and relatively close to other ecological and cultural values.

2 – Low (poor): (i) geosite with common features and difficult to understand for most audiences, with low geological diversity and high risk of degradation; (ii) geosite with difficult access, not very safe, in an area with low population density and far from other ecological and cultural values.

1 – Very low (very bad): (i) geosite with very common features and understanding restricted to specialists, with very low geological diversity and very high risk of degradation; (ii) geosite with very difficult access, very little security, in an area with very low population density and very far from other ecological and cultural values.

COMPONENT AGROECOSYSTEMS , AS AN EXPRESSION OF RURAL SUSTAINABILITY

According to Denardin *et al.* (2022), in recent decades, the effects and consequences of externalities arising from the established economic model, such as the Brazilian agribusiness, have been widely discussed and problematized. The pandemic scenario experienced from 2020 onwards, with the new Corona virus; facing the worst drought in the last 90 years, in 2021; the decrease and absence of pollinating insects, especially the different species of bees that are dying and disappearing from ecosystems and agroecosystems; dwindling global food stocks; the high level of poverty and hunger; the increase in Earth's temperature, among many other events, are intrinsically related to this predatory economic model. It is known that the deforestation of our forests, the loss of fauna and flora habitats, the extinction of thousands of species, erosion and loss of the fertile layer of the soil, the use of pesticides, the contamination of groundwater and other sources of drinking water, as well as climatic adversities (droughts, frosts and more frequent hailstorms) have a cause and effect relationship.

Currently, one of humanity's greatest challenges is to find regenerative paths, strategies and models, with new technological, political, economic, social and environmental bases, which consider our high dependence on ecosystem services and natural resources. Thus, such models

should be able to recover ecosystems and biomes that have been largely degraded in recent decades, as well as conserve biomes, traditional management systems and their water, faunal, floristic and edaphic resources (DENARDIN *et al.*, 2022).

In this sense, Denardin *et al.* (2022) proposed to rethink the current model of agriculture, based on agribusiness, which advocates wrong forms of arrangements (monoculture), technologies for managing insects, wild herbs and microorganisms (pesticides), genetic technologies (transgenics) and management of the soil (plow and leveling harrow), and has been the object of studies, extension and teaching, mainly in the last 50 years. Perhaps the greatest challenge is the construction and multiplication of resilient agro-food systems, on a planetary scale, to feed and supply the current requirements for fiber and food, in its entirety, without compromising future generations, because the modernization of agriculture, also known as "green revolution" - which would end hunger in the world - has failed, given the existence of almost 1 billion people in a situation of food insecurity and poverty. In this chapter, we present four indexes (Productive Diversity, Productivity, Plant Health and Agroecological Transition), which contribute to measuring the sustainability of agroecosystems.

In the 1970s, Agroecology emerged as a new science, presenting a theoretical-methodological framework capable of analyzing the sustainability of agroecosystems (EMBRAPA, 2006; GLIESSMAN, 2005; ALTIERI, 2002), of communities and territories, in a systemic and multidimensional way (CAPORAL; COSTABEBER, 2002; MASERA *et al.*, 1999). In addition to the analysis of agroecosystems, Agroecology, as a science, presents principles, bases, technologies, models and sustainable management practices (CAPORAL; COSTABEBER, 2004; ALTIERI, 2002; GLIESSMAN, 2005; KHATOUNIAN, 2001), capable of recovering and conserving agrobiodiversity, ecosystem services, cultures and traditional knowledge, enabling the transition to sustainable systems (DENARDIN *et al.*, 2022)

Masera *et al.* (1999 apud DENARDIN *et al.*, 2022) proposed a methodological framework for natural resource management systems, incorporating sustainability indicators (MESMIS) and revolutionizing the assessment bases of agroecosystems. Among the main structural characteristics of the MESMIS method, the following stand out: 1) the concept of sustainability is based on five general attributes of agroecosystems (productivity, stability, reliability and resilience, adaptability, equity and self-dependence or self-management); 2) the dimensions of sustainability are incorporated and linked to these attributes; 3) sustainability indicators are constructed and used for diagnostic or evaluation processes in a participatory and dialectical manner; 4) it is a method that expresses analytical, pedagogical and political care, in addition to covering the evaluative gaps of other methodological proposals; and 5) presupposes the participation of an interdisciplinary team, effectively including subjects from local communities (MASERA *et al.*, 1999 apud DENARDIN *et al.*, 2022).

According to Masera *et al.* (1999 apud DENARDIN *et al.*, 2022), MESMIS initially points to the need to define the systems to be evaluated, their characteristics and socio-environmental context. Second, the critical points that interfere with systemic sustainability are determined. The third step is the definition of diagnostic criteria and strategic indicators. Next, the analysis instruments are built, such as parameters, for measuring and monitoring the systems. Fifthly, the analysis of the results is foreseen, comparing the sustainability of the agroecosystems and directing attention to the obstacles, obstacles and points that favor the sustainability of the

system. Finally, a conclusive synthesis is carried out, with proposals for overcoming the problems and/or highlighted points, aiming to achieve the sustainability of the system (Figure 1).

Gliessman (2005, p. 584 and 585) presents several parameters related to agroecosystems, which can be used to measure the sustainability and functionality of productive systems managed by human beings. The methodological ways of analyzing and diagnosing the management of agroecosystems and their surroundings (natural ecosystems), the questioning of local realities and the planning of the agroecological transition, with the adoption of sustainable social technologies over time, and processes of sustainable territorial development can be observed in the works of Miguel Altieri (2000, 2002), Ana Maria Primavesi (1997), Carlos Armênio Khatounian (2001), Stephen R. Gliessman (2005), Masera *et al*. (1999), Sosa *et al.* (2012), Embrapa (2006), among others.

Scholars point to three main steps to achieve the sustainability of agroecosystems (EMBRAPA, 2006; ALTIERI, 2002; GLIESSMAN, 2005): (i) reduction in the use of chemical inputs, such as pesticides and synthetic fertilizers; (ii) substitution of chemical inputs for inputs of organic and biological origin; (iii) redesign of agroecosystems, with a significant increase in biodiversity, articulation and integration of subsystems, seeking greater levels of resilience, self-sufficiency, balance and adaptability.

Based on this gradual proposal to increase the sustainability of agroecosystems, the use of four variables is proposed, as shown in Table 1: (i) productive diversity; (ii) productivity (production in relation to area); (iii) plant and animal health; and (iv) level of agroecological transition.

Below is an evaluation scale between 1 (very low – very poor) and 5 (very high – excellent) for the Agroecosystems component:

5 - Very high (optimal): (i) presence of several species in the agroecosystem and its subsystems, preferably in agroforestry arrangements (herbaceous, shrubby and tree species) and silvopastoral species (herbaceous, shrubby and tree species of plants, as well as animal species); over 40 species; (ii) 100% above the national average (weight of biomass/hectare) in relation to any monoculture; (iii) absence of incidence of pests/parasites and diseases; presence of natural enemies (with high abundance and diversity); absence of nutritional deficiencies (vigor); (iv) use of biodiverse productive arrangements (agroforestry systems); absence of application of pesticides and synthetic fertilizers; communities with a majority presence of peasant family agriculture; family units linked to associations and cooperatives, with an organic production seal; it has environmental adequacy, the Legal Reserve and the permanent preservation areas are well preserved.

4 - High (good): (i) presence of several species in the agroecosystem , preferably in agroforestry and silvopastoral arrangements and/or minimally in consortia that advocate the greatest possible diversity, between 10 and 30 species; (ii) 50% above the national average (weight of biomass/hectare) in relation to any monoculture; (iii) low incidence of pests and diseases; presence of natural enemies (with high abundance and diversity); absence of nutritional deficiencies (vigor); (iv) use of biodiverse productive arrangements (agroforestry systems); absence of application of pesticides and synthetic fertilizers; communities with a majority presence of peasant family agriculture; family units linked to associations and cooperatives,

in the process of organic certification; it has environmental adequacy, the Legal Reserve and the permanent preservation areas are well preserved.

3 - Intermediate (regular): (i) presence of consortia or productive mosaics, with 5 to 10 species; (ii) 10% above the national average (weight of biomass/hectare) in relation to any monoculture; (iii) median incidence of pests and diseases; presence of natural enemies (with low abundance and low diversity); low percentage of plants and animals show signs of nutritional deficiencies (vigor); (iv) use of productive arrangements in consortia; absence of application of pesticides (SAT); still uses synthetic fertilizers, but has begun the process of replacing organic fertilizers; family units without ties to associations and cooperatives, without organic certification; it has no environmental suitability.

2 - Low (poor): (i) consortium between 2 and 3 species; (ii) national average (weight of biomass/hectare) produced in a monocultural arrangement; (iii) high incidence of pests and diseases; absence of natural enemies; high percentage of plants and animals show signs of nutritional deficiencies (vigor); productivity losses (up to 20%); (iv) use of simplified productive arrangements (monoculture); use of pesticides and synthetic fertilizers; medium and large production units (area), without ties to associations and cooperatives; it has no environmental adequacy and presents considerable levels of soil degradation.

1 - Very low (very bad): (i) monoculture; (ii) below the national average (weight of biomass/hectare) produced in a monocultural arrangement; (iii) high incidence of pests and diseases; absence of natural enemies; high percentage of plants and animals show signs of nutritional deficiencies (vigor); plant and animal deaths; considerable losses in production (above 20%); (iv) use of simplified productive arrangements (monoculture); use of pesticides and synthetic fertilizers, medium and large production units (area), without links to associations and cooperatives; it has no environmental suitability and presents a high level of soil degradation, with the presence of erosion in furrows and gullies.

URBAN ENVIRONMENTAL VULNERABILITY COMPONENT

The expansion of the urban network in the last decades of the 20th century and the new movements to shape the city system in Brazil accentuate the asymmetries of economic spaces, with strong pressures on the provision of services in regional hub cities and natural systems, increasing socio-environmental vulnerabilities and demanding action from different social actors, especially from the public sector, in favor of guaranteeing the right to the city and a better quality of life for the populations.

In this sense, it has been found that "[...] with the accelerated growth of large cities and with the processes of conurbation that often occur in them, certain urban problems are potentiated and acquire a character of environmental vulnerability, prone to anthropogenic induced processes." (BARCELLOS; OLIVEIRA, 2008, p. 2).

These contradictions are perceived in the very production of urban space, which is reflected in the socio-spatial organization of cities. As a result of the dynamics of capital accumulation, the capitalist urban space is "fragmented, articulated, a reflection, a social condition, full of symbols and a field of struggles", it is a social product, "the result of actions accumulated over time, and engendered by agents that produce and consume space" (CORRÊA, 2000, p. 11).

It is in this sense that, for Costa (2009, p. 147), city spaces constitute "[...] objects of economic interest, material comfort, material or symbolic reproduction and social distinction. Therefore, they identify with certain social groups – dominant or excluded". As a consequence, the unequal production of urban space, according to the logic of the market, exposes growing levels of populations to socio-spatial segregation and situations of vulnerability.

Thus, for Sposito (2006), it is imperative to understand the spatial interactions and social, economic, political or cultural relations that are established between an area and other larger or smaller portions of the territory. Additionally, concerns are growing "[...] with environmental problems and with the definition of urban policies that consider the city as an environment that is, at the same time, natural and social" (SPOSITO, 2006, p. 149).

Given all these concerns, studies that analyze environmental aspects and problems in the urban context become relevant, especially from the perspective of environmental vulnerabilities. In a generic context, vulnerability can be understood as a condition resulting from not meeting the individual's basic survival needs, due to poor access to public services, such as housing, health, education, basic sanitation and income, and the impossibility of changing the condition it is in (GRIZENDI, 2003; CARARA, 2016).

Despite the multiplicity of interpretations, the theoretical matrices of environmental vulnerability point to a first block of contributions, in which vulnerability is intrinsically associated with the physical characteristics of the environment, and the approaches in the literature initially recognize three vectors that characterize the phenomenon: (i) risk exposure; (ii) (in)ability to react; and (iii) difficulty adapting to risks. Thus, vulnerability is constantly associated with the degree of susceptibility of a system to intrinsic or extrinsic factors that exert pressure on it.

In a way, in these contributions, residents in precarious physical environments and exposed to greater risks are more vulnerable. At the same time, the responsiveness of individuals or groups to changes in the natural environment influences the vulnerability of such individuals or social groups (TOMINAGA; SANTORO; AMARAL, 2009). These elements indicate the greater or lesser sensitivity of individuals, places, infrastructures and ecosystems to experience, in some way, particular types of harm (ACSELRAD, 2006).

In another line of contributions, the ability to respond to situations of environmental change is determined by more systemic factors, varying according to the possibilities and environmental, social, economic, cultural and political conditions of the populations (ADGER, 2006). It is intrinsically associated with the effective and institutional presence of the State in promoting adequate conditions that interfere in the quality of life and interaction of populations with the natural environment (GAMBA, 2010). Therefore, vulnerable people would be less able to take advantage of the opportunities offered by the market, the State and society. This ability to take advantage of opportunities, referred to by Kaztman *et al.* (1999) by "ownership or control of assets", links vulnerability to the social dimension of populations.

In Hogan and Marandola (2006, p. 27), "[...] vulnerability is associated with the social disadvantages that produce and, at the same time, are reflections and products of poverty". And the social character of vulnerability is also emphasized by Deschamps (2004, p. 140), who draws attention to the close relationship "[...] between the spatial location of groups that

present social disadvantages and those areas where there is a risk of occurrence some adverse event, that is, socially vulnerable populations are located in environmentally vulnerable areas".

Despite recognizing the multidimensionality of urban environmental vulnerability, this work opted for an approach in three groups of variables, which concern: (i) housing and urban infrastructure vulnerability: it tries to infer about adequate housing conditions, capture the exclusion of the population in regarding services and public goods considered essential to urban life and measuring vulnerability based on surrounding conditions and infrastructure deficiencies that result in increased environmental risks; (ii) pressure on the natural environment: aims to capture the risk arising from pressure from human activities on the natural environment, which manifests itself in the loss of well-being due to the reduction or absence of conserved environments; and (iii) food and nutrition insecurity: seeks to point out how vulnerability can be captured through access or stability of families in accessing food.

The construction of a partial index of urban environmental vulnerability, which will compose the natural dimension of the Multidimensional Index of Territorial Heritage Activation, requires standardization of secondary variables, so that scale differences do not cause distortions in the analysis. Thus, the variables can be standardized on a scale of one to five. Such standardization takes into account the relationship between the values of the different territories under analysis, which can be micro or macro regions, immediate or intermediate regions, municipalities, states, among others, where the lowest value of the standardized variable would correspond to 1 on the scale (less vulnerability), being the optimal situation, and the highest value would be 5 (greater vulnerability), equivalent to the worst situation.

Below is an evaluation scale between 1 (very high – excellent) and 5 (very low – poor) for the Urban Vulnerability component:

5 – Very high (very bad): (i) between 80% and 100% of the municipalities (or another investigation scale) are in terrible and completely inadequate sanitary and property occupation conditions; (ii) poor conditions of water supply and management of rainwater, which can lead to risk of flooding and landslides, as well as the structure being very vulnerable to face these problems; relative to the pressure on the natural environment, this percentage of units are at very high risks inherent to pollution, fires and contamination by chemical substances or biological agents; (iii) the percentages of food insecurity represent that populations have very high patterns of precarious income, unemployment, inequality and poverty.

4 – High (poor): (i) between 60% and 80% of the municipalities (or another investigation scale) are in inadequate and bad sanitary and property occupation conditions; (ii) water supply conditions and rainwater management are poor, which can lead to the risk of flooding and landslides, as well as poor structure to face these problems; relative to the pressure on the natural environment, this percentage of units are at high risks inherent to pollution, fires and contamination by chemical substances or biological agents; (iii) the percentages of food insecurity represent that populations are at high levels of vulnerability, considering high precarious income, unemployment, inequality and poverty.

3 – Intermediate (regular): (i) between 40% and 60% of the municipalities (or another scale of investigation) are in intermediate sanitary and property occupation conditions and the conditions of water supply and management of rainwater are regular, which may entail the risk of flooding and landslides, as well as regulating the structure for dealing with these

problems; (ii) regarding the pressure on the natural environment, this percentage of units are under intermediate risks of exposure to pollution, fires and contamination by chemical substances or biological agents; (iii) the percentages of food insecurity represent that populations are at intermediate levels of vulnerability to income, unemployment, inequality and poverty.

2 – Low (good): (i) between 20% and 40% of the municipalities (or another investigation scale) are in good sanitary and property occupation conditions and the vulnerability related to water supply conditions and management is low rainwater, which can pose a risk of flooding and landslides, as well as a good structure to face these problems; (ii) regarding the pressure on the natural environment, this percentage of units is at low risk of exposure to pollution, fires and contamination by chemical substances or biological agents; (iii) the percentages of food insecurity represent that the populations have good levels of income, occupation, with low inequality and poverty, configuring low vulnerability.

1 – Very Low (optimal): (i) between 0% and 20% of the municipalities (or another investigation scale) are in excellent sanitary and property occupation conditions and the vulnerability related to the conditions of water supply and the management of rainwater, which can pose a risk of flooding and landslides, as well as the optimal structure for dealing with these problems; (ii) regarding the pressure on the natural environment, this percentage of units are at very low risk of exposure to pollution, fires and contamination by chemical substances or biological agents; (iii) the percentages of food insecurity represent that the populations are at excellent levels of income and occupation, with very low inequality and poverty, configuring a very low vulnerability pattern.

BASKET OF TERRITORIAL GOODS AND SERVICES COMPONENT[8]

The theoretical-methodological approach of the Basket of Territorial Goods and Services (CBST) was originally formulated from empirical research on territorial development, carried out in French rural areas considered “disadvantaged” from the socioeconomic point of view. The definition of this type of zone is intrinsically associated with the action of the public power which, based on this categorization of physical geography, provides subsidized public policies for these regions. In general terms, they correspond to mountain areas, or areas with rugged terrain, far from urban centers and which suffered a strong population exodus, especially after the Second World War. The topographical and climatic characteristics made it difficult, to a great extent, to promote the model of productivist agriculture advocated from the 1950s onwards.

This process of productive exclusion is directly linked to the focus of this chapter. Ecosystems, landscapes, traditional crops and knowledge, and agrobiodiversity in areas considered less favored were less impacted by the productivist model of agriculture and

[8] The elaboration of this topic is based on the contributions of the following research projects: 1) *Sustainable territorial development: interfaces between the basket of goods and services, markets and territorial brands*, financial support from the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (Fapesc), Fapesc Public Call No. 12/2020, Universal Research Program; 2) *Innovation and sustainable transition: basket of goods and services in Amazon territories*, financial support from Fapesc, Confap public call No. 003/2022, program to support research projects +10 Amazon Initiative; 3) *Development sustainable territory: the basket of goods and services, markets and territorial brands*, CNPq Research Productivity Scholarship Notice – PQ 2022.

livestock. What was a "hindrance" in the past for the dissemination of this model, today represents an enormous repository of specific territorial resources, allowing the social construction of a development style more in line with the precepts of sustainability. The CBST approach is, therefore, strongly correlated with rural areas unsuited to the productivist ideals, which guided the so-called "green revolution" or the modernization of agriculture that began in the 1950s.

Another relevant aspect, highlighted by Campagne and Pecqueur (2014), lies in the family nature of rural establishments engaged in Sustainable Territorial Development (DTS) initiatives. The greater adherence of this type of enterprise to DTS actions is explained, in large part, by the multifunctional character, especially of family agricultural units, which differentiate them in several aspects from productive units based on the salaried workforce (CAZELLA; BONNAL; MALUF, 2009).

> It can also be said that territorial development processes are generally composed of forms of initiatives and modes of innovation that, in the rural world, are mainly conducted by family units. This does not mean that innovation cannot be found in large units. But the form that innovation takes in family units is, (...), very particular, as it is based on the local valuation of specific resources in the territory. In general, this does not occur in large units, which innovate to better adapt their production to the world market on which they depend (CAMPAGNE; PECQUEUR, 2014, p. 94; free translation).

The first formulations on the CBST were the works of Pecqueur (2001) and Mollard (2001), which highlighted the differential of territorial development actions capable of promoting the heterogeneous and articulated offer of quality territorial goods and services, with a marked appreciation of specific territorial resources. The deepening of the theme, with new studies, highlighted three main components of the focus: 1) private products and services of territorial quality; 2) the scenery constituted by natural, historical and traditional attributes; and 3) the territorial governance system engendered by multi-actors (HIRCZAK *et al.*, 2008; CAMPAGNE; PECQUEUR, 2014; ALVAREZ *et al.*, 2014; CAZELLA *et al.*, 2019 and 2020). The first two components have a clear correlation with environmental sustainability, as they are associated with stocks of biodiversity, landscapes and traditional expertise existing in rural territories.

The process of specifying and activating territorial resources, in turn, depends on the creativity of territorial multi-actors (public, private and associative) and on the history of adopting forms of cooperation. The inventory of resources and territorial assets with the potential to constitute a heterogeneous and articulated offer of products and services of territorial quality represents, at the same time, the starting point and the basis of the approach. It is about mobilizing environmental, landscape, historical and cultural attributes associated with localized agri-food systems and quality territorial services, with emphasis on the different modalities of rural tourism, catering and typical cuisine. The social construction of commercialization channels based on short circuits, which form the category of local and territorial markets coined by Schneider (2016), represents a basic action in the construction process of the CBST.

The purpose is not restricted to doing what other territories cannot or do not know how to do, but also to do differently and better than other territories do (PECQUEUR, 2005; GLON; PECQUEUR, 2016). To this end, the mobilization of multi-stakeholders with the purpose of creating a territorial governance system represents an environment conducive to social innovation, capable of generating income of territorial quality. This type of income is appropria-

ted, by the various productive segments or service providers, not equally, but sufficiently distributed among the different actors, in order to promote improvements in the socioeconomic and environmental sustainability indicators of rural territories. "This leads us to formulate the hypothesis that the value produced must be above all a 'use value', which must have prominence over the 'exchange value' that inscribes territories in the competition process without respect for collective well-being" (KLEIN; PECQUEUR, 2020, p. 231).

The continuity of studies on the subject, based on analysis of empirical cases, led French authors to formulate a typology of different forms of social construction of CBST, which allows dealing with different situations with elements of the approach idealized above, even if not all are present or are in an incipient stage of construction (HIRCZAK *et al.*, 2008). The coexistence of different and sometimes antagonistic models of agricultural development in the same geographic space does not represent an impediment to the enhancement of specific territorial resources, according to the precepts of the approach of the CBST.

The focus of the CBST is configured both as an analysis model to conduct research and as a methodological guide, which guides the actions of agents of sustainable territorial development. The most fragile element in most of the cases studied resides in the territorial governance system, which explains the recurrence of juxtaposed initiatives in the analyzed territories (HIRCZAK *et al.*, 2008; MILANO; CAZELLA, 2022). In these cases, the heterogeneous offer of quality products and services is present, but no social actor has taken the initiative to formulate and propose the idea of a shared offer that provides collective benefits, such as the creation of new marketing channels or the strengthening of existing ones, which consolidate the territorial market. The dispersion of actions to value territorial quality products and services weakens the ability to generate collective benefits, especially those that derive from the CBST scenario, whose basis is public goods associated with the natural environment and traditional expertise.

Reflections on the pertinence of this approach for studies of Brazilian rural territories have pointed to the need to make adaptations, due to the profound socioeconomic differences between France and Brazil. Some results of research in progress indicate the need to include, in the analysis model, the role played by the consumer of the territory - therefore, of the territorial markets - relativizing the centrality of the tourist or owners of second homes in the generation of income of territorial quality. It is a question of rethinking the strategies for obtaining this type of income through the mere increase in the prices of quality products and services, which ultimately translates into the exclusion of a significant portion of the population from the consumption of these goods and services. The "club effect", which benefits a select group of consumers, producers and service providers of territorial quality, is contrary to the precepts of sustainable territorial development.

A challenge that persists in the formulation of the CBST lies in the design of a panel of indicators, which allows both the comparison between different territories and the temporal monitoring of the process of social construction of the Basket components within a given territory (CAZELLA *et al.,* 2020; TURNES *et al.*, 2022). The discussion on the two CBST variables, collection instruments and scales shown in Table 1 is based on the study by Turnes *et al.* (2022), which formulates a first panel of CBST indicators.

For these authors, the best way to operationalize and adjust the CBST indicators is their joint construction between researchers and territorial actors engaged in processes of training sustainable territorial development agents. For this reason, the use of a participatory methodological procedure - as well as a focus group - that brings together territorial actors involved with initiatives to value specific territorial resources, but also those with the potential to adhere to these initiatives, should be prioritized in the collection of information. For the purposes of this chapter, the scale or degree of strength of each of the CBST variables is formulated based on the social actors' view of the current state and dynamics of CBST maturation over time. It is, therefore, the perception of these actors in relation to the number of initiatives, their links with the scenario (natural, historical, cultural, architectural heritage, expertise...) and, to what extent, these initiatives establish partnerships, in a way to mutually reinforce each other, and seek support from public and private services, sometimes non-existent in the territory.

Next, the details of the different evaluation scales of the two CBST variables are presented: (i) private goods and services and quality public goods scenario; (ii) governance system.

5 - Very high (optimal): (i) the main specific territorial resources are activated, with several quality services and commercialization channels, which form a dense quality territorial market; the scenario of public goods is remarkable and consumers recognize the quality differentials of products, services and scenery; (ii) the various private initiatives for valuing quality territorial products and services have collective coordination systems; (iii) these systems present dialogue mechanisms and promote joint actions, with the main public actors interacting and supporting these initiatives.

4 - High (good): (i) most of the specific territorial resources are activated, with some associated quality services and the existence of commercialization channels that point to the construction of a market for products of territorial quality; (ii) the public goods scenario is partially valued and consumers are aware of the differentiated quality of some products and services; (ii) most of the private initiatives for valuing quality territorial products and services have collective coordination systems; some of these systems have interlocution devices and promote collective actions, with some public actors interacting and supporting these initiatives.

3 - Intermediate (regular): (i) some specific territorial resources are activated, but with few associated quality services and the occasional existence of marketing channels for territorial quality products; (ii) the appreciation of the public goods scenario is incipient and consumers know little about the differentiated quality of some products and services; (iii) few private initiatives to enhance quality territorial products and services with some collective coordination arrangements, but rare ones have dialogue devices and public actors interact and occasionally support these initiatives.

2 - Low (bad): (i) ephemeral actions to activate specific territorial resources, rare associated quality services and few commercialization channels for specific territorial products; (ii) the scenario of public goods is not valued and consumers do not have access to products and services of territorial quality; (iii) rare private initiatives to enhance quality territorial products and services, lack of collective coordination arrangements and regular dialogue devices, and public actors do not interact with or support these initiatives.

1 - Very low (very bad): (i) no specific territorial resource activated, lack of territorial quality services and few commercialization channels for generic territorial products; (ii) the scenario of public goods is disregarded and consumers do not have access to products and services of territorial quality; (iii) lack of private initiatives and public actors to value territorial products and services of territorial quality.

STATE POLICY FOR SUSTAINABILITY COMPONENT

The State Policy for Sustainability component comprises two variables: local environmental legislation and the local environmental monitoring and inspection system (Law No. 6,938/81), as shown in Table 1.

To make reference to State policies for sustainability, or environmental public policies, two sets of norms are essential to serve as a reference: (i) International Treaties on the Environment[9]; (ii) National Environmental System, integrating public agencies focused on the environment and the National Environmental Policy and its legislation.

The National Environmental System (SISNAMA) is composed of the structure described below. It was instituted by Law No. 6.938/1981 (BRASIL, 1981), regulated by Decree No. 99.274/1990, being formed by the organs and entities of the Union, States, Federal District, Municipalities and by the foundations established by the public power, responsible for the protection and improvement of environmental quality, with the following composition: (i) higher body: Government Council: (ii) advisory and deliberative body: National Council for the Environment (CONAMA); (iii) central body: Ministry of the Environment (MMA); (iv) executing agency: Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA); (v) sectional bodies: state bodies or entities responsible for the execution of programs, projects and for the control and inspection of activities capable of causing environmental degradation; (vi) local bodies: municipal bodies or entities, responsible for the control and inspection of these activities, in their respective jurisdictions (MMA, 2023).

Additionally, *Agenda 21* also plays a guiding role in environmental policy, being an articulated program of actions resulting from several meetings promoted by the United Nations (UN) with the theme "*Environment and its relations with Development*". This is the broadest measure adopted to try to carry out the task of promoting sustainable development around the world, that is, a form of development that aims to extract resources from nature to guarantee the sustenance of the world today, without harming future generations. This document is the result of the commitment of nations to develop their economies without harming the environment, with more than 2,500 practical recommendations to carry out this effort. In this sense, each country must prepare, maintain and update its own *Agenda 21* to guarantee the foundations of sustainability in its territories. Such elaboration must be specific to the context in which each country is inserted. The idea is that, in line with the reality of different populations, the environment is not threatened by predatory practices carried out by human beings (MMA, 2023).

[9] As the focus of this work is on the territorial dimension, this theme will not be deepened in this text. For a deeper understanding of the topic, access to MMA (2023) is suggested.

The methodological framework proposed in this work focuses on environmental micropolicies, which are considered fundamental, as they affect the territorial and/or municipal dimension. To this end, SISNAMA foresees in its organizational structure the action of Local Bodies, which are able to carry out environmental management within their territorial limits and their competence. These bodies have the power to apply appropriate sanctions, interdict or close establishments that do not comply with legal determinations.

Local action in relation to environmental policies in Brazil began to occur after the publication of Law No. 6.938/1981, which established the National Environmental Policy (PNMA), reaffirmed after the promulgation of the Brazilian Federal Constitution of 1988, which reinforces the action of citizens in the face of the local environmental issue and, finally, the publication of the Environmental Crimes Law (Law No. 9.605/1998), which regulates responsibility for environmental damage (LEME, 2010). In this sense, the municipalization of the environmental issue is pointed out as an effective action to reduce environmental impacts, which justifies the institutionalization of the presence of mechanisms, such as: (i) Exclusive Municipal Secretariat for the Environment; (ii) Municipal Council; (iii) Municipal Fund; (iv) Integrated Urban Solid Waste Management Plan and (v) Specific legislation in the environmental area (LEME, 2010; ÁVILA; MALHEIROS, 2012).

In addition to having the power/autonomy to create their own environmental legislation, Brazilian municipalities are qualified to define their environmental policy, that is, the guidelines that will lead to the protection, preservation, conservation, control and recovery of the environment (ÁVILA; MALHEIROS, 2012). According to Burstrom and Korhonen (2001), municipal environmental management involves a set of diverse activities, whose main purpose is to provide municipal services with less environmental impact. In this way, municipal environmental management is focused on natural resources in the geographic area related to municipal administration and represents the general effort to maintain local environmental sustainability.

Such an effort involves the formulation of public policies, planning, coordination and prioritization of actions aimed at the preservation and conservation of natural resources, and must provide environmental management instruments for the operationalization of municipal functions, as well as the insertion/participation of the most diverse local actors, in addition to having a qualified technical staff to implement the required measures, which initially assumes higher levels of education (SOUSA *et al.*, 2022).

Thus, in this work, the variables and criteria to be used for the analysis of the activation of the territorial heritage in the natural dimension will be those that cover the local scale, with the spatial area of the municipalities as a reference.

Next, the evaluation scales of the two variables of the State Policy for Sustainability component will be presented: (i) local environmental legislation; and (ii) local environmental monitoring and enforcement system.

5 - Very high (optimal): (i) the spatial area under analysis has the Exclusive Municipal Secretariat, the Municipal Council and the Municipal Environmental Fund, an Integrated Urban Solid Waste Management Plan and specific Legislation in the environmental area in full activity; (ii) the dynamism of the sectional bodies (municipal level) foreseen in SISNAMA is perceptible, with signs of increasing strength (hiring

and/or replacement of personnel and equipment) and operationality (increasing inspection and preservation actions).

4 - High (good): (i) the spatial area under analysis has an Exclusive Municipal Secretariat, Municipal Council and Municipal Environmental Fund, but the specific Legislation in the environmental area has gaps; (ii) despite the maintenance of the activity of the sectional bodies (municipal level) provided for in SISNAMA, a certain operational inactivity is perceived (inspection and preservation actions).

3 - Intermediate (regular): (i) the spatial area under analysis has only the Exclusive Municipal Secretariat in operation, in addition to part of the specific Legislation and management plans in the environmental area; (ii) despite the maintenance of the activity of the sectional bodies (municipal level) provided for in SISNAMA, inspection and preservation actions have decreased, or stagnated at insufficient levels for the maintenance of policies for environmental sustainability.

2 - Low (poor): i) the spatial area under analysis does not have an Exclusive Secretariat in the area of the Environment and the demands are met in part by other municipal bodies, without specific Legislation in the environmental area; (ii) despite the continued activity of the sectional bodies (municipal level) provided for in SISNAMA, inspection and preservation actions have decreased, influencing decisively in situations of increased catastrophic weather events (deforestation, fires).

1 - Very low (very bad): i) the spatial area under analysis does not have an Exclusive Secretariat in the area of the Environment and only specific issues are attended to, in addition to not having specific Legislation in the environmental area; (ii) there are significant risks regarding the maintenance of the activity of the sectional bodies (municipal level) foreseen in SISNAMA, there is demobilization of personnel and equipment for inspection and preservation, contributing to the increase of catastrophic weather events.

Procedures for building the Contribution Index for Territorial Development - Natural Dimension (ICDTN)

The estimate of the Contribution Index for Territorial Development - Natural Dimension (ICDTN) of a certain area can be carried out from the elaboration of five indexes that represent the related components: (Bio)Geodiversity Index, Agroecosystems Index, Urban Environmental Vulnerability Index, Basket of Territorial Goods and Services Index, State Policy Index for Sustainability. In analytical terms, the calculation of the ICDTN is based on the following equation:

$$ICDTN = \frac{1}{K}\sum_{p=1}^{k} I_p \quad (1)$$

Where:

$ICDTN$ = Contribution Index for Territorial Development - Natural Dimension;

I_p = value of the p-th index;

p = 1, ..., k (index).

Each index, in turn, is made up of a set of variables, as specified in Table 1. To build the ICDTN, it is decided to establish equal weights between the variables of the different components, as well as for the components of a given index.

FINAL CONSIDERATIONS

It is recognized that measurement mechanisms for problems with multiple dimensions are increasingly used, since they are important instruments for evaluating and proposing diagnoses, as well as relevant tools for interaction and communication between decision makers, policy makers, researchers and society in general. The use, therefore, of variables, indicators and indexes communicates characteristics of phenomena in an objective, relational way, revealing stages and trends that are not immediately identifiable.

This text addresses the natural dimension of territorial heritage and represents advances by a group of researchers to highlight the multidimensionality of territorial heritage and propose a set of components and variables that could guide the construction of the IMAP. For each suggested variable, some data collection instruments were indicated, aiming to guide future research and allow the researcher to classify them on a rating scale between 1 (very low - poor) and 5 (very high - great), with an inverse scale in the case of urban vulnerability.

Materialized in the form of the geological heritage of a given location, (Bio)Geodiversity is an important component of the territorial heritage. After defining the geosites of the study area, based on their inventory and quantitative evaluation, it is proposed to analyze two variables to include them in the context of the Multidimensional Index of Territorial Heritage Activation: (i) geological attributes, which comprise the characteristics local characteristics; and (ii) infrastructure and surroundings, which consist of built elements and/or exteriors. Such variables cover some criteria previously determined in the quantitative evaluation, such as singularity, accessibility and others, considered more representative for the calculation of the index. Thus, in ideal terms, geosites should have unique features, easily understood by all audiences, with very high geological diversity and very low risk of degradation. In addition, they must have easy access and a high level of security, located in areas with very high population density and very close to other ecological and cultural values. However, it is important to emphasize that these criteria need to be analyzed and interpreted carefully, otherwise they will generate contradictory and/or unrealistic results. One example refers to the relationship between risk of degradation, accessibility and population density. In general, easily accessible geosites located in densely populated areas tend to be more degraded, precisely because of the large movement of people. Thus, verification of the local reality is essential for the (Bio)Geodiversity component in the definition of the Multidimensional Index of Territorial Heritage Activation.

In the Basket of Territorial Goods and Services component, two main variables were conceived as a way of monitoring the greater or lesser adherence of this focus in different territories. The first corresponds to private goods and services and quality public goods. It is about evaluating the interrelationships established between the valorization processes of quality territorial products and services with the “scenario” of the CBST, composed of a set of intangible territorial attributes, which have in the landscape, history and culture their main references. The second refers to the social construction of a governance system, which integrates territorial actors from different socio-professional categories. The focus of the CBST,

by providing for a heterogeneous but articulated offer of quality products and services, has its concreteness associated with the existence and respective degree of dynamism of spaces for interaction between public, private and associative actors, who share the purpose of acting in a cooperative way in the conception of unprecedented development initiatives.

Regarding Urban Environmental Vulnerability, it is worth noting that, among the Sustainable Development Goals, the goal 11 advocates making cities and human settlements inclusive, safe, resilient and sustainable. In this sense, the action of the State, through its monitoring and management instruments, must occur with the aim of correcting environmental injustices, acting to eliminate vulnerabilities and to promote urban well-being. For this, the instrument for measuring Urban Environmental Vulnerability proposed in this work was conceived to capture the following aspects: anthropic action and economic systems on natural capital; the performance of agents and public policies to minimize infrastructure deficiencies, combat situations of poverty, inequality and food insecurity, and also remedy the loss of well-being caused by environmental damage and lack of environmental preservation and conservation in urban spaces.

The State Policy for Sustainability component was responsible for proposing variables and criteria to be used in the analysis of the activation of the territorial heritage in the natural dimension, with a focus on environmental micropolicies, that is, on the action of the local bodies of the SISNAMA structure. It should be noted that maintaining local environmental sustainability involves formulating public policies, planning, coordinating and prioritizing actions aimed to preserving and conserving natural resources, especially at the municipal level.

The text seeks to shed light and highlight the importance of considering the natural dimension in territorial development processes. It does not intend to exhaust the subject, as other components, variables, data collection instruments and, mainly, classification scales and possible methodologies for calculating an index representative of the natural dimension can be proposed by new research. The effort undertaken moved towards proposing a matrix of components and variables for measuring the Contribution Index for Territorial Development - Natural Dimension (ICDTN). However, we warn that, for this, a complex weighting system between components and their respective variables is necessary. Whatever the spatial cut used, the index proposal requires that distinct variables have some type of standardization, in order to avoid distortions related to the values of the different territories under analysis - micro or macro regions, immediate or intermediate regions, municipalities, states, among others. When considering the proposed variables, it is possible to establish equal weights within the components that will constitute the index for the dimension or use methodologies that better capture their relative importance - such as methods of consulting specialists (e.g.: Delphi method). Still, the index calculation methodology itself can be diverse, with different levels of sophistication - from simpler standardization for the construction of synthetic indexes, to multivariate statistical methods, such as Factor Analysis, or multicriteria analysis, such as Process Analysis Hierarchical.

Finally, the natural dimension is one of the inherent and present in the development theme approach, considered multidimensional by definition. In this sense, thinking and acting in territorial development processes requires multi/interdisciplinary teams, in order to avoid false and mistaken interpretations, which assume development as a synonym for economic growth.

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REFERENCES

ADGER, W. N. Vulnerability. *Global Environmental Change*, [*S.l.*], v. 16, n. 3, p. 268-281, 2006. Disponível em: https://www.projectenportfolio.nl/images/4/41/Adger_2006.pdf. Acesso em: abr. 2023.

ACSELRAD, H. Vulnerabilidade ambiental, processos e relações. ENCONTRO NACIONAL DE PRODUTORES E USUÁRIOS DE INFORMAÇÕES SOCIAIS, ECONÔMICAS E TERRITORIAIS, 2., 2006. Rio de Janeiro. *Comunicação* [...].Rio de Janeiro: Fibge, 2006. V. 5.

ALTIERI, M. A. *Agroecologia*: a dinâmica produtiva da agricultura sustentável. 2. ed. Porto Alegre: Editora da UFRGS, 2000. 110 p.

ALTIERI, M. A. *Agroecologia*: bases científicas para uma agricultura sustentável. Guaíba: Agropecuária, 2002. 592 p.

ÁLVAREZ, E. G. *et al.* El cesto de bienes y servicios territoriales: un útil de diagnóstico aplicado a la Wilaya Argelina de Ain Témouchent. *Anales de Geografía de la Universidad Complutense,* Universidad Complutense de Madrid, v. 34, n. 1, p. 105-128, 2014.

ÁVILA, R. D.; MALHEIROS, T. F. O Sistema Municipal de Meio Ambiente no Brasil: avanços e desafios. *Saúde e Sociedade,* São Paulo, v. 21, n. 3, p. 33-47, 2012.

BARCELLOS, F. C.; OLIVEIRA, S. M. M. C. Nova fonte de dados sobre risco ambiental e vulnerabilidade social. *In*: ENCONTRO DA ASSOCIAÇÃO NACIONAL DE PESQUISA E PÓS-GRADUAÇÃO EM AMBIENTE E SOCIEDADE – ENANPPAS, 4., 2008. Brasília. *Anais* [...]. Brasília: ANPPAS, 2008.

BRASIL. Ministério do Meio Ambiente. *Lei nº 14.119, de 13 de janeiro de 2021*. Institui a Política Nacional de Pagamento por Serviços Ambientais; e altera as Leis nºs 12, de 24 de julho de 1991, 8.629, de 25 de fevereiro de 1993, e 6.015, de 31 de dezembro de 1973, para adequá-las à nova política. Brasília, DF, 2021.

BRASIL. Ministério do Meio Ambiente. *Lei nº 6.938, de 31 de agosto de 1981*. Dispõe sobre a Política Nacional do Meio Ambiente, seus fins e mecanismos de formulação e aplicação, e dá outras providências. Brasília, DF, 1981. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/l6938.htm. Acesso em: 5 abr. 2023.

BRILHA, J. *Património geológico e geoconservação*: a conservação da natureza na sua vertente geológica. Braga: Palimage Editores, 2005, 190 p.

BRILHA, J. Inventory and quantitative assessment of Geosites and Geodiversity Sites: a review. *Geoheritage*, v. 8, n. 2, p. 119-134, 2016.

BURSTRÖM, F.; KORHONEN, J. Municipalities and industrial ecology: reconsidering municipal environmental management. *Sustainable Development*, v. 9, n. 1, p. 36-46, 2001.

CAMPAGNE, P.; PECQUEUR, B. *Le développement territorial*: une réponse émergente à la mondialisation. Paris: Charles Léopold Mayer, 2014. 267 p.

CAPORAL, F. R.; COSTABEBER, J. A. Agroecologia e desenvolvimento rural sustentável: conceitos de agroecologia. *Agroecologia e Desenvolvimento Rural Sustentável*, Porto Alegre, v. 3, n. 2, p. 13-16, abr./jun. 2002.

CAPORAL, F. R.; COSTABEBER, J. A. *Agroecologia e extensão rural*: contribuições para a promoção do desenvolvimento rural sustentável. Brasília, DF: MDA; SAF; Dater; IICA, 2004. 166 p.

CARRARA, M. L. *Dificuldade de aprendizagem e vulnerabilidade social sob a percepção da comunidade escolar*. 2016. 28 f. Trabalho (Conclusão de Curso de Especialização em Educação e Direitos Humanos) – Universidade do Sul de Santa Catarina, Santa Catarina, 2016.

CAZELLA, A. A.; BONNAL, P.; MALUF, R. S. (org.). *Agricultura familiar:* multifuncionalidade e desenvolvimento territorial no Brasil. Rio de Janeiro: Mauad X, 2009. 305 p.

CAZELLA, A. A. *et al*. A construção de um território de desenvolvimento rural: recursos e ativos territoriais específicos. *Redes*, Santa Cruz do Sul, v. 24, n. 3, p. 49-74, set./dez. 2019.

CAZELLA, A. A. *et al*. O enfoque da "Cesta de bens e serviços territoriais": seus fundamentos teóricos e aplicação no Brasil. *Revista Brasileira de Gestão e Desenvolvimento Regional*, Taubaté, v. 16, n. 3, p. 193-206, set./dez. 2020.

CORRÊA, R. L. *O espaço urbano.* São Paulo: Editora Ática, 2000.

COSTA, M. C. L. Arranjo familiar e a vulnerabilidade na Região Metropolitana de Fortaleza. *In:* DANTAS, Eustógio; COSTA, Maria Clélia L. (org.). *Vulnerabilidade socioambiental na Região Metropolitana de Fortaleza.* Fortaleza: Edições UFC, 2009.

DENARDIN, V. F.; SULZBACH, M. T. O capital natural na perspectiva da economia. *In:* ENCONTRO DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM AMBIENTE E SOCIEDADE – ENANPPAS, 6., 2012. Belém. *Anais* [...]. Belém: ANPPAS; Ufpa, 2012. p. 1-16.

DENARDIN, V. F. Desenvolvimento territorial e estratégias de valorização da origem de bens alimentares. *In*: WILKINSON, J.; MASCARENHAS, G. C. C. (org.). *O sabor da origem*. Porto Alegre: Escritos do Brasil, 2016. p. 51-72.

DENARDIN, V. F.; SULZBACH, M. T. Ativação de recursos territoriais: processos de desenvolvimento no espaço rural. *In*: CURY, M. J. F.; SAQUET, M. A. (org.). *Territórios e territorialidades*: a práxis na construção do desenvolvimento. Cascavel: Edunioste, 2019. p. 67-82.

DENARDIN, V. F. *et al*. Abordagem territorial do desenvolvimento: dimensão natural e contribuições para o diagnóstico e prospecção de cenários. G&DR – *Revista Brasileira de Gestão e Desenvolvimento Regional*, v. 18, n. 1, p. 61-83, jan-abr/2022

DESCHAMPS, M. V. *Vulnerabilidade socioambiental na Região Metropolitana de Curitiba*. 2004. 192 f. Tese (Doutorado em Meio Ambiente) – Universidade Federal do Paraná, Programa de Pós-Graduação em Meio Ambiente e Desenvolvimento, Curitiba, 2004.

EMBRAPA. Empresa Brasileira de Pesquisa Agropecuária. *Marco referencial em agroecologia*. Brasília, DF: Embrapa Informação Tecnológica, 2006. 70 p.

GAMBA, C. Avaliação da vulnerabilidade socioambiental no município de São Paulo. *In*: ENCONTRO DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM AMBIENTE E SOCIEDADE – ENANPPAS, 5., 2010. Florianópolis. *Anais* [...]. Florianópolis: ANPPAS, 2010.

GLIESSMAN, S. R. *Agroecologia:* processos ecológicos em agricultura sustentável. 3. ed. Porto Alegre: UFRGS, 2005. 653 p.

GLON, E.; PECQUEUR, B. (dir.). *Au coeur des territoires créatifs*: proximités e ressources territoriales. Rennes: Presses Universitaires de Rennes, 2016. 295 p.

GRIZENDI, L. T. *Condições de moradia e risco*: representações sociais de técnicos e moradores da periferia de Juiz de Fora. 2003. 114 f. Dissertação (Mestrado em Serviço Social) – Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, 2003.

HARTE, M. J. Ecology, sustainability, and environment as capital. *Ecological Economics*, v. 15, n. 2, p. 157-164, nov. 1995.

HAUWERMEIREN, S. V. *Manual de Economía Ecológica*. Santiago: Rosa Moreno, 1998. 265 p.

HIRCZAK, M. *et al.* Le modèle du panier de biens: grille d'analyse et observations de terrain. Économie *Rurale*. *Agricultures, Alimentations, Territoires*, n. 308, p. 55-70, nov./dez. 2008.

HOGAN, D. J.; MARANDOLA JR., E. Para uma conceituação interdisciplinar da vulnerabilidade. *In*: CUNHA, J. M. P. (org.). *Novas metrópoles paulistas*: população, vulnerabilidade e segregação. Campinas: Nepo; Unicamp, 2006. p. 23-50.

JEAN, B. Le développement territorial durable: une nouvelle approche de développement rural. *Meio Ambiente e Desenvolvimento*, v. 33, p. 115-127, abr. 2015.

KAZTMAN, R. *et al. Vulnerabilidad, activos y exclusión social en Argentina y Uruguay*. Santiago: OIT, 1999. 106 p. (Documentos de Trabajo, 107).

KHATOUNIAN, C. A. *A reconstrução ecológica da agricultura*. Botucatu: Agroecológica, 2001. 348 p.

KLEIN, J. L.; PECQUEUR, B. (dir.). *Les living lab*: une perspective territoriale. Paris: L'Harmattan, 2020. 290 p.

LEME, T. N. Os municípios e a política nacional do meio ambiente. *Revista Planejamento e Políticas Públicas*, Brasília, n. 35, p. 26-52, jul./dez. 2010.

MASERA, O.; ASTIER, M.; LOPEZ-RIDUARA, S. *Sustentabilidadd y manejo de recursos naturales*: el marco de evaluación MESMIS. México, DF: Mundi-Prensa; Gira; Unam, 1999. 101 p.

MILANO, M. Z.; CAZELLA, A. A. Da governança da Indicação Geográfica à governança da Cesta de Bens e Serviços Territoriais: uma análise a partir da *Teoria dos Comuns*. *Revista Raízes*, Campina Grande, v. 42, n. 1, p. 74-92, 2022.

MMA. Ministério do Meio Ambiente. Marco legal e tratados internacionais. Brasília, DF, 2023. Disponível em: https://antigo.mma.gov.br/epanb/item/15017-marco-legal-e-tratados-internacionais.html. Acesso em: 5 abr. 2023.

MOLLARD, A. Qualité et développement territorial: une grille d'analyse théorique à partir de la rente. Économie *Rurale*, v. 263, n. 261, p. 16-34, 2001.

MORAES, J. L. A. Pagamento por Serviços Ambientais (PSA) como instrumento de política de desenvolvimento sustentável dos territórios rurais: o Projeto Protetor das Águas de Vera Cruz, RS. *Sustentabilidade em Debate*, Brasília, v. 3, n. 1, p. 43-56, jan./jun. 2012.

PECQUEUR, B. Qualité et développement territorial: l'hypothèse du panier de biens et de services territorialisés. Économie *Rurale*, n. 261, p. 37-49, 2001.

PECQUEUR, B. Le développement territorial: une nouvelle approche des processus de développement pour les économies du Sud. *In*: ANTHEAUME, B.; GIRAUT, F. (ed.). *Le territoire est mort*: vive les territoires! Une refabrication au nom du développement. Paris: IRD, 2005. p. 295-316.

PRIMAVESI, A. M. *Agroecologia, ecosfera, tecnosfera e agricultura*. São Paulo: Nobel, 1997.

SCHNEIDER, S. Mercados e agricultura familiar. *In:* MARQUES, F. C.; CONTERATO, M. A.; SCHNEIDER, S. (org.). *Construção de mercados e agricultura familiar*. Porto Alegre: Editora da UFRGS, 2016. p. 93-140.

SHARPLES, C. *Concepts and Principles of Geoconservation*. Tasmania: Tasmanian Parks & Wildlife Service, 2002. 79 p.

SOSA, M. B.; JAIME, A. M. R.; LOZANO, D. R A.; ROSSET, P. M. *Revolução agroecológica*: o movimento de camponês a camponês da ANAP em Cuba. São Paulo: Expressão Popular, 2012. 152 p.

SOUSA, J. S. *et al.* Os municípios brasileiros e a gestão ambiental: estrutura e articulação institucional. *Guaju – Revista Brasileira de Desenvolvimento Territorial Sustentável*, v. 8, 2022.

SPOSITO, M. E. B. O desafio metodológico da abordagem interescalar no estudo de cidades médias no mundo contemporâneo. *Cidades*, v. 3, n. 3, p. 143-157, 2006.

TOMINAGA, L. K.; SANTORO, J.; AMARAL, R. (org.). *Desastres naturais*: conhecer para prevenir. São Paulo: Instituto Geológico, 2009. 196 p.

TURNER, R. K. *et al. Environmental economics*: an elementary introcuction. New York: Harvester Wheastsheaf, 1994. 328 p.

TURNES, V. A. *et al.* Monitoramento de uma cesta de bens e serviços: a construção de um painel de indicadores. *Revista Raízes*, Campina Grande, v. 42, n. 1, p. 224-240, 2022.

VIEIRA, P. *et al.* (org.). *Desenvolvimento territorial sustentável no Brasil*: subsídios para uma política de fomento. Florianópolis: Aped; Secco, 2010. 488 p.