Public Policies for Geodiversity in Brazil

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Abstract
Ensuring the legal protection of geosites, or areas that have relevant geodiversity, and obtaining resources for the development of programs and actions in these territories are two of the great challenges in Brazil. This article presents an analysis of Brazilian legislation, seeking to identify the responsible bodies, sources of funds, and how each specific policy can relate to the protection and promotion of geodiversity. In addition, the proposed public policy for geodiversity, geotourism, and geoparks in the state of Mato Grosso is presented and discussed. For this, documentary research of national legislation was carried out, and existing records in the Legislative Assembly of Mato Grosso were analyzed for the Thematic Sectorial Chamber to debate the Geopark Project of Chapada dos Guimarães. The information was discussed based on a bibliographic survey with national and international references. The results show that although some geodiversity elements, such as fossils and caves, have specific legislation, there is no articulated national public policy on geodiversity that guarantees the identification, protection, and continuous management of geosites or even structural and financial support for the development of geoparks in Brazil. The creation of policies at the state or national level, aimed at establishing a managing body and permanent sources of funds, can be an important step to enable the development of actions related to the protection and dissemination of geodiversity, linked or not to geopark proposals. At the international level, the creation of a United Nations Educational, Scientific and Cultural Organization (UNESCO) convention that establishes clear bases for the dissemination and protection of geodiversity could encourage the development of policies in different countries as an international framework to guide themes.

Keywords Geoparks · Legislation · Geodiversity · Brazil · Mato Grosso

Introduction

Geodiversity encompasses the abiotic components of nature, such as minerals, rocks, fossils, soils, landforms, and the active geological processes that give rise to them (IUCN 2021). These elements have a direct relationship with biodiversity since geodiversity is the basis for all forms of life on Earth (Bruschi 2007). Similarly, if we compare two regions under the same climatic conditions, the place with the highest geodiversity will also have greater biodiversity (Pereira et al. 2008). Despite being seen as resistant and lasting, geodiversity is threatened due to its finite extent and locational immobility and because it is not a renewable element (De Lima and Vargas 2014).

When talking about geodiversity policies, it is impossible not to mention and consider the concept of geoparks, since the conservation of geoheritage, the popularization of geoscience, and the sustainable development of local society...
are linked to the UNESCO Global Geopark concept (Cai et al. 2019).

Geoparks are geographically well-defined territories where a sustainable development strategy is carried out, together with the population, based on geoconservation, geotourism, and education, along with other forms of heritage, such as cultural, architectural, ethnographic, and gastronomic heritage, among others (Brilha 2009, 2012). According to Brilha and De Carvalho (2010), geoconservation is defined as the set of initiatives that involve the inventory and characterization of geological heritage, aiming at conservation and management, to ensure the proper use of geosites for scientific, educational, or tourism purposes.

The development of an integrated international policy on geodiversity is fundamental for the protection of geosites or even for promoting and supporting the creation and maintenance of geoparks.

Several authors have studied the importance of developing policies focused on the protection, use and promotion of geodiversity, geoconservation, geotourism, and geoparks in several countries around the world, such as Spain (Carcaviglia et al. 2009; Planaguma and Martí 2018), Chile (Benado et al. 2019), Indonesia (Bachry 2019), the Netherlands (Stoffelen et al. 2019), Mexico (García-Sánchez et al. 2021), Thailand (Singtuen et al. 2019), New Zealand (Gravis et al. 2020), Iran (Pourfaraj et al. 2020), Ukraine (Yaholnyk and Manyuk 2017), France (De Weyer et al. 2015), Egypt (Abdelmaksoud 2020), Hong Kong (Guo and Chung 2017), Australia (Joyce 2010; Percival 2014), Slovakia (Lukác et al. 2021), Ecuador (Moreno Vallejo et al. 2020), Angola (Tavares et al. 2015), and Brazil (Piranha et al. 2011).

Although it is increasingly common in several countries and regions to carry out geoheritage inventories, in countries such as France, this tool has no legal value (De Weyer et al. 2015). In Brazil, according to the principle of legality, everything that is not prohibited in the current legal framework is legally permitted to individuals. On the other hand, the various state bodies carry out their functions based on the attributions provided for by law and other infralegal normative documents (Marrara 2014). In other words, according to the Brazilian legal framework, the protection of geological heritage or the development of public policies also requires the existence of a legal basis that supports such actions.

Only the state has the legitimacy and capacity to build and implement forms of regulation that ensure the public interest (Duarte et al. 2020). Conservation and the promotion of geodiversity are related to geoconservation, geotourism, and geoscientific actions. In all cases, the development of public policies plays an important role in the implementation and maintenance of the sustainable use of geodiversity resources.

According to Beretel et al. (2019), sustainable tourism policies in a territory are related to long-term provision and evaluation. For Gonzáles-Mantilla and León (2020), the construction of tourism management, with political and administrative processes, contributes to sustainable development. For geotourism to be sustainable, these activities must be very well planned and managed (Ólafsdóttir and Dowling 2014). Ólafsdóttir and Tverjonaite (2018) point out that popular geotourism destinations face challenges that include overcrowding, with negative effects on geoheritage, vegetation, and wildlife. Authors such as Duarte et al. (2020) identified through bibliographic research that it is necessary to develop more research related to public policies for geotourism.

In the same way that policies are fundamental for the promotion of geotourism, they also become essential in carrying out pedagogical activities. According to a survey carried out by Catana and Brilha (2020), the educational actions of geoparks are generally funded with their own resources or by the regional/state administration. This demonstrates the importance of funding sources for scientific dissemination in these territories.

Brazil has a rich geodiversity and continental size (Schobenhaus 2008). These factors contribute to the existence of many geosites and territories with potential for the development of geopark projects. In the country, there are 31 areas where geopark projects are developed, 2 aspiring geoparks and 3 UNESCO geopark (Nascimento et al. 2021; Unesco 2022). For Piranha et al. (2011), geoconservation strategies in Brazil need to involve education, law, and public policies that can improve the management of geological heritage.

Geoheritage conservation policies need to involve local communities, authorities, planners, and decision-makers. In this way, it is possible to build long-term strategies (Németh et al. 2021). For Bachry (2019); public policy must connect several components, such as the input, the process, the results, the impact, and the benefits for communities. The authors suggest the use of George Edward III’s (1980) model, with the interrelationship between components such as communication, resources, disposition, and bureaucratic structure.

From the above perspective, this article aims to carry out an analysis of public policies related to the theme of geodiversity and geoparks in Brazil. The work aims to identify mechanisms that help in the legal protection of geosites, as well as institutional tools to promote the sustainable use of geoheritage, as well as identify possible sources of resources for geoconservation activities. Additionally, the proposed legislation prepared to debate the creation of the Chapada dos Guimarães geopark project was discussed.

**Methods**

To identify the existing legislation related to geodiversity, a survey of laws and decrees was carried out on the federal government website (http://www4.planalto.gov.br/legislacao/) using the keywords geology, fossils, cavities, and other terms that are part of the concept of geodiversity.
Words related to zoning, land-use planning, tourism, and sustainable development were also used. In parallel, research was carried out in academic databases, such as Scopus, Google Scholar, and Web of Science, using geodiversity or geoconservation or geotourism or “geological heritage” or geopatrimony + politics or politic as keywords, both in Portuguese and English.

The public policy of geodiversity, geotourism, and geoparks proposed in the state of Mato Grosso (Fig. 1) was analysed based on documents, video records, and reports developed within the scope of the Thematic Sectorial Chamber (TSC) of the Legislative Assembly of Mato Grosso (LAMT) to discuss the creation of the Chapada dos Guimarães geopark. The results were discussed based on bibliographic and document analyses.

Results and Discussion

Policies on Geodiversity in the World

Policies related to geodiversity are at different levels of development worldwide. In Portugal, since 2008, Decree-Law no. 142/2008 has promoted the protection and conservation of geosites (Brilha and De Carvalho 2010). In England, there are different categories of classification of sites, dividing them into local sites (LGAPS), regional sites (RIGS), sites of special scientific interest (SSSIs), and special protection areas (SPAs), each of which have specific protection measures (Dias and Ferreira 2018). Yaholnyk and Manyuk (2017) considered Ukraine’s legislation to be imperfect, as terms such as “geological park” and “geological heritage” are absent. For the authors, the biggest obstacle to the creation of a geopark in the country is the absence of a legislative-normative framework.

Another European country with a law that addresses geological heritage is France. French Law 2002–276 grants formal recognition to geological heritage. In addition, the French Ministry of the Environment has been involved in the inventory of geological heritage. According to the legislation in force in the country, the various administrative spheres of the country need to take into account the presence of exceptional geological sites in the preparation of planning documents (De Wever et al. 2015).

According to Carcavilla et al. (2009), in Spain, the first studies related to geological heritage took place in the 1970s.

Fig. 1 Map with the location of the state of Mato Grosso and the positioning of existing UNESCO projects, aspirants, and geoparks in Brazil (Modificado de Nascimento et al. 2021; Santos-Pinto et al. 2021; UNESCO 2022)
In Spain, in 2007, three laws were approved, Law 5/2007—Network of National Parks (LRPN); Law 45/2007—Sustainable Development of Rural Media (LDSMR); and Law 42/2007—Natural Heritage and Biodiversity Law (LPNB), which explicitly and separately address geodiversity and biodiversity and provide a legal basis for the protection of geological heritage (Dias and Ferreira 2018).

According to Planaguma and Martí (2018), in addition to the existence of public policy, the involvement of local actors related to municipal power and public and private entities is important to overcome budget cuts or even to exert effective pressure to reverse possible cuts in resources.

Lukac et al. (2021) discusses Slovakia state policy related to geoparks, the concept of which was adopted by Government Resolution no. 740/2008. This resolution created three categories to classify territories with the development of geoparks: (A) operated (Banská Štiavnica Geopark); (B) built (Banská Bystrica Geopark, Novohrad, Nógrád Geopark); and (C) proposed. According to the authors, in 2016, the Slovak Republic Geoparks Network was created to organize these territories.

In some countries, such as China and Germany, in addition to the UNESCO World Geoparks, there are also national geoparks governed by the same general principles (Henriques and Brilha 2017). Although UNESCO does not encourage the creation of geoparks outside the organization’s auspices, this type of structure can help in the development of territories for future integration worldwide.

According to Benado et al. (2019), the lack of public policies related to geoconservation in Chile negatively impacts the number of registered geosites. For the authors, it was the existence of public policies that enabled the advancement of geoconservation and geopark projects in Europe. García-Sánchez et al. (2021), when analyzing two geopark projects in Mexico, identified that despite the support of experts, there was no interest from authorities. This lack of official support can cause a project to lose credibility.

Bachry (2019) cites the existence of conflicts in the implementation of space policy in the Rinjani Geopark area in Indonesia, such as land use conflicts and conflicts of authorities between institutions. For the authors, the construction of policies needs to consider communication, bureaucratic structure, disposition, and resources, as proposed by George Edward III.

In Thailand, the Thai Department of Mineral Resources is creating policies to support the creation of geoparks and acting in geopark project management (Singtuen et al. 2019). The most successful case was the Satun UNESCO Global Geopark, but other geoparks such as the Pha Chan-Sam Phan Bok Geopark did not advance due to the lack of partners in the region. In cases like this, the publication of books, courses, and initiatives with the population can help in future engagement (Singtuen et al. 2019).

Gravis et al. (2020) discuss the lack of protective legislation related to geoheritage in New Zealand and the existence of conflicts between development and protection. For the authors, the recent discovery of geoheritage values in some places in the country unfolded in legal battles between interested parties, demonstrating the need to develop a policy to mediate conflicts of geoconservation.

In Iran, in recent decades, the identification of geosites and the development of geotourism suggest that it is necessary to create mechanisms for geoheritage management (Pourfaraj et al. 2020). For the authors, the government’s role is to formulate policies and make decisions linked to the development of an agenda that involves the planning, organization, guidance, and supervision of geotouristic attractions.

In Egypt, despite the large number of scientific publications on geology and geosites, geological heritage is still not covered by legislation dealing with nature conservation and management (Abdelmaksoud 2020).

Tavares et al. (2015) mention that, as in many countries, there are no specific legal instruments in Angola for the protection of geological heritage. In this case, geoconservation and geosite management actions follow a generic model that involves the assessment, conservation, and management of territories.

The articles described above suggest that the development of public policies for the management of geodiversity is important both for preserving geological heritage and for the development and maintenance of geoparks. In the field of sustainable development, these policies favor the consolidation of management structures and the development of geoconservation, geotourism, and geoeducation initiatives.

### The Protection of Geodiversity and International Programs and Conventions

At the international level, some of the main existing mechanisms for policy development are the conventions, agendas, and programs of the United Nations and its sectoral agencies.

Aware of the need to protect elements of cultural value and natural areas on a global scale, the United Nations Educational, Scientific and Cultural Organization (UNESCO) is the entity that promotes the protection of world heritage. In 1972, this institution organized the “Convention for the Protection of World Cultural and Natural Heritage.” As a result, a treaty was ratified that seeks to identify, protect, and preserve cultural and natural heritage around the world, considering its exceptional value to humanity (Couto and Figueiredo 2019).

UNESCO currently has three programs aimed at protection: “Man and the Biosphere,” “World Heritage Convention,” and the “UNESCO Global Geoparks” programs. The first two appeared in the early 1970s, and the last appeared in 2015.
The Global Geoparks Network appeared in 2004, but the officialization of the UNESCO Global Geoparks took place only in 2015, when the 195 member states of UNESCO, during their 38th General Conference, ratified the importance of geoparks in the conservation of exceptional geological heritage in a holistic approach (Rocha et al. 2017).

The Man and the Biosphere Program (MAB) is an intergovernmental scientific program that aims to establish scientific bases for the improvement of relationships between people and their environments (Henriques and Brilha 2017). The actions related to the MAB are carried out in regions of interest classified as biosphere reserves, whose global network already reaches 714 locations in 129 countries (UNESCO 2021a).

The designation of Protection of the Cultural and Natural World Heritage is given to heritage sites that have an Outstanding Universal Value, evaluated based on ten cultural and natural criteria (Henriques and Brilha 2017). As of August 2021, 1164 properties from 167 countries were included in the World Heritage List, of which 218 (approximately 20% of the total) were classified according to the importance attributed to natural heritage (UNESCO 2021a).

Assets declared as world heritage can be classified as such according to cultural values such as historical, esthetic, archeological, scientific, ethnological, or anthropological values; or natural as physical, biological, or geological formations considered exceptional, endangered animal and plant habitats, and areas that have scientific, conservation, or esthetic value (Moreira 2014). Although it may also recognize geological heritage, in practice, the number of sites inscribed on the list due to this factor is small (Boylan 2014).

Once listed as world heritage, the country’s commitment is required to ensure the protection and conservation of the declared assets. In this way, the program for the Protection of the Cultural and Natural World Heritage was created together with a UNESCO convention and was later adopted as legislation in the member countries. In Brazil, for example, the convention was enacted by Decree No. 72,312 of 05/31/1973 (Brasil 1973).

On the other hand, the UNESCO Global Geoparks, despite having well-established general guidelines, has no convention that establishes a common legal basis for all UNESCO member countries. Each country is responsible for drawing up its own rules based on good practices and global jurisprudence but adapted to the local reality. In this way, the evaluation of geoparks is carried out not only from an evaluation form but also from the subjective opinion of the evaluation team.

Internationally, there are still few documents that specify the importance of geodiversity and that provide tools for policies related to geoconservation. When analyzing agendas, such as the Sustainable Development Goals (SDGs), the elements linked to the biotic environment are explicit, while the issues related to the abiotic environment are not so clear. In this way, the geoscientific community is able to identify the role of geodiversity in the search for the SDGs, which is not as evident for public managers or for the population in general. It is necessary to emphasize that geodiversity is the result of the entire evolutionary history of our planet in that mineral resources are not renewed at the same speed that we consume, the destruction of a fossil or a relic is something irreparable, and soil damage can affect ecosystem services for decades or centuries.

Biodiversity, on the other hand, had its own convention proposed in 1992 and in force since 1993, which addresses “the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetics.” Currently, 196 nations have ratified this international legal framework (UN 2022). The existence of a convention for biodiversity and the lack of a similar document for geodiversity make apparent the differences in political, diplomatic, and public policy treatment between these two fields of natural heritage, as already mentioned by authors such as Crofts (2014).

The demographic increase and the growth in the consumption pattern of the global population demand the development of an in-depth debate on the management of natural resources such as water, minerals, rocks, and soil, aiming at harmonious and sustainable development. This can only be achieved through the popularization of knowledge related to geodiversity and the construction of geoconservation policies at the local, national, and global levels, as well as in horizontal initiatives, such as geoparks. In this sense, it is possible to say that an international convention that determines the basic guidelines related to the management of geodiversity and geological heritage would have a fundamental function to ensure the global use of these nonrenewable resources in the most sustainable way possible. The convention paves the way for the construction of international sectoral agendas, in addition to establishing common legal bases between the countries.

**Brazilian Legislation**

Although there have been efforts for decades to protect geosites, in Brazil, there is no consolidated public policy related to geodiversity, geoheritage, geoconservation, geotourism, and geoparks. The work carried out by the Brazilian Commission on Geological and Paleobiological Sites (SIGEP), which was created in 1997 with the aim of identifying Brazilian paleobiological and geological sites (Piranha et al. 2011), is an example of these efforts. Despite this, the scientific inventory of these geosites has
proven to be a fragile instrument of protection, as it is not clear in the laws what measures need to be taken after the definition of a geosite.

In 2021, the Brazilian geological community needed to mobilize to ensure that public works interventions in two important geosites, namely, the Araguainha Dome (SIGEP 001) and White Coluna, Serra do Rio do Rastro, SC (SIGEP 024), affected the geological heritage existing at the site as little as possible. In the case of the Domo de Araguainha, in addition to registration with the SIGEP, there is also a proposal for a geopark prepared by the Geological Survey of Brazil (CPRM) for the site. This situation demonstrates the legal fragility of geoconservation management in Brazil and indicates the need to consolidate legal frameworks that ensure the protection and management of geological heritage.

Among the causes for the gaps in the legal instruments of geoconservation according to Piranha et al. (2011) is the lack of general knowledge about geological heritage.

Unlike biosphere reserves, which have clear and explicit regulations in the National System of Nature Conservation Units (SNUC) (Law No 9.985/2000), the Geopark Program does not have any type of national regulation. According to Santos-Pinto et al. (2021), not even the National Geoparks Committee, as provided for in the UNESCO Global Geoparks guidelines, exists in the country. According to the authors, civil entities such as the Brazilian Society of Geology (SBG) have made efforts to establish such a space.

The creation of legislation for geoparks is a controversial subject. According to Boggiani (2010), the fact that there is no specific legislative imposition is positive because it does not restrict the creation of geoparks and allows a wide range of management forms and may even be an entirely private initiative. Other authors, such as Alvarenga et al. (2018) and Silva & Assumpção (2009), defend the need for a dialogue between geosciences and law, aiming to build a legal architecture to insert geoparks into the legal system in legislative, administrative, and jurisprudential bases to guarantee the protection of geoconservation.

Despite not having a geodiversity policy established and articulated in the country, there are several legislations, public bodies, and sources of resources that can be used for the management and protection of geosites or even for geopark territories.

The preservation and conservation of geoconservation have been carried out in Brazil mainly through the SNUC (Brazil 2000) and through legislation on historical and cultural heritage (Decree-Law n° 25 of November 30, 1937) (Brazil 1937). In this way, the two main instruments for official recognition of geosites in Brazil are the conservation units (with significant emphasis on the natural monument category) and the listing as natural heritage (Couto & Figueiredo, 2019). Both the creation of conservation units and the tipping of geosites can be carried out in the three administrative spheres of Brazilian public power (federal, state, and municipal).

According to Mansur (2010), “natural monument” is the name that has been particularly used to frame geological heritage, a category created by article 12 of the SNUC law at the federal, state, and municipal levels. In Brazil, there are, for example, the natural monument of Pontões Capixabas in Espírito Santo; the natural monument of Fossilized Trees in Tocantins; the Vale dos Dinossauros natural monument in Paraíba; the Geiseritos de Anhembí natural monument in São Paulo; the Rocky Coasts natural monument in Rio das Ostras, RJ; the natural monuments of the Pão de Açúcar and Urca Hills in Rio de Janeiro; the Geodesic Center of Latin America natural monument in Mato Grosso; and the Morro de Santo Antônio natural monument in Mato Grosso. Although some of these sites were not created with the specific purpose of protecting geoconservation, da Silva et al. (2020) argue that the geoscientific narrative is a way of attributing heritage value to the property.

At the federal level, tipping is another possible instrument for the protection of natural heritage. Since its creation, the Instituto do Patrimônio Histórico e Artístico Nacional (IPHAN) has been the protagonist of tipping at several properties, such as Dois Irmãos and Pedra da Gávea in Rio de Janeiro, RJ; Finger of God in Teresópolis, RJ; and Morro do Curral in Belo Horizonte, MG (Delphim 2009).

In some cases, it is necessary that the legal classification given to the geosite allows sustainable use of geoconservation. Along with the SNUC, the compatibility of the conservation of geological heritage elements with the sustainable use of natural resources is best served by the conservation units of the Sustainable Use Group, in particular the classifications of Environmental Protection Area (APA), Sustainable Development Reserve (RDS), and Private Natural Heritage Reserve (RPPN). Despite the compatibility of sustainable conservation units with geoconservation objectives, the predominance of biological bias in the description and scope of the units is notable, as indicated in Law 9,985/2000 (Brasil 2000).

The geopark concept and its legal flexibility allow conservation units and cultural and natural heritage assets to coexist in the territory with economic activities, such as mining. Thus, the protection and use of geosites must be governed by laws that allow flexibility to adapt each case according to the particularities of each location, with the understanding of a local committee, safeguarding the guidelines and guidelines of national and UNESCO policies. As stated by Silva and Assumpção (2009), there must be a dialogue between economic mineral exploration and the need to implement geoconservation. This program must be developed by the government in cooperation with companies, the community, and researchers.
Brilha (2009) highlights the relationship between geoconservation and nature conservation and spatial planning policies, as the management of a geosite necessarily implies the establishment of restrictions and planning for the use of the Earth’s surface. Thus, in addition to the relationship already established with policies for the protection of geological heritage, it is also necessary to establish links between territorial planning policies and geodiversity. In this way, the geopark model proposed by UNESCO has proven to be a potentially valuable strategy to reconcile different approaches to the occupation and management of territories (Piranha et al. 2011).

In addition to conservation units, the development of geoparks is largely benefited by their integration into territorial planning policies so that, by inserting the concept into the legal system, a legal basis will be created that allows the discussion of the subject in socioeconomic zoning and regional territorial management plans or even municipal master plans, according to Law 10,257 from 2001 (Statute of Cities) (Brasil 2001). In this case, since 2002, Brazil has, in its legislation, presented guidelines for the Ecological-Economic Zoning of Brazil (ZEE) (Brasil 2002), which establishes rules and methodologies to enable this zonal structure in the most diverse specificities of the national territory.

In a geopark territory, an important initiative would be to establish specific measures and restrictions considering geological and geomorphological characteristics. For example, this type of legal framework can establish guidelines and procedures for works that are being planned in a particular geological unit where fossils occur or else establish limitations of uses for regions that have fragile geological elements. For this to occur, two paths are suggested: the creation of an APA or the construction of master plans considering existing geological heritage. Such a measure would guarantee legal protection and proper management of these sites.

The zoning, master plans, and management plans of the APAs are public instruments that establish which and how activities must be carried out in the territory according to the characteristics of the physical, environmental, and social environment. In this way, they can validate public actions to encourage, recognize, and implement policies for the study and implementation of geosites and even geoparks. The construction of a management plan or a municipal master plan, carried out in a participatory and democratic way, with public hearings and debates guided by technical–scientific knowledge, can be an important instrument for the consolidation of a local strategy, protection of geodiversity, and the promotion of tourism and pedagogical practices. These documents can and should be updated periodically, which allows for the continuous improvement of this legal framework. On the other hand, if geological heritage is not adequately considered in the construction of a municipal master plan, for example, this can foster the development of legal and social conflicts.

To advance in the conservation of geodiversity and in the promotion of geoconservation, Brazil needs to update and strengthen its legal instruments, aiming to build a state policy that enables the management of geosites, the guarantee of financial inputs and human resources for the development of actions, and the necessary support for the consolidation of geopark proposals.

Legislation Applied to the Protection and Management of Geodiversity

In addition to the aforementioned law of the SNUC and Law of Tombamento (Decree-Law nº 25/1937), there are other legal instruments that are directly or indirectly related to the themes of geodiversity, geological heritage, and geoconservation. More specifically, there are specific laws in Brazil that deal with fossiliferous heritage, underground cavities, national artistic and historical heritage, mineral resources, water resources, the environment, the national system of conservation units, and issues of territorial planning, urban land use, and others (Table 1).

Source: authors’ survey (Brazil 1937, 1942, 1967, 1973, 1981, 1990, 2000, 2002, 2007, 2008, 2010, 2012, 2015).

In Brazilian legislation, there are different governmental bodies that carry out the regulation and/or inspection of activities related to geological heritage. For example, artistic and historical heritage is supervised by the National Historical and Artistic Heritage Institute (IPHAN); mineral activity, research, and fossil extraction are linked to the National Mining Agency (ANM); the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) carries out the inspection of natural cavities; and the Chico Mendes Institute for Biodiversity Conservation (ICMBio) manages and monitors national conservation units (Table 2).

With regard to geodiversity, the Geological Survey of Brazil (CPRM-SGB) works in geological and geotechnical mapping, in the inventory of geological heritage, and in the promotion of geopark proposals, among other areas. However, as it is a public company, it does not have a regulatory or supervisory nature. In this way, the protection or management of geodiversity in Brazil, when provided for by law, occurs in a dispersed way between agencies and regulations, which can generate institutional conflicts and, in many cases, obstacles to the temporal dynamics of the analysis of procedures.

It is also worth noting the role of the Federal and State Public Prosecutor’s Office, which, amidst the diversity of bodies and ways in which the state acts in the conservation of geological heritage, is responsible for overseeing the performance of public authorities and the maintenance of the legal order. In a scenario of the still timid performance
Table 1  Main legislation that may be related to geodiversity in Brazil

| Policies and laws                        | Legislações                                                                 |
|------------------------------------------|------------------------------------------------------------------------------|
| Land-use planning                        | Law No. 10, 257/2001—Statute of Cities                                      |
|                                          | Decree nº 4.297/2002—Ecological-Economic Zoning of Brazil—ZEE                 |
|                                          | Decree nº 6.288/2007—Establishes cartographic scales of the products generated as a result of the territorial and political amplitude of the zoned areas |
|                                          | Decree nº 7.378/2010—Approves the Ecological-Economic Macrozoning of the Legal Amazon—MacroZEE of the Legal Amazon |
|                                          | Law nº 12,608/2012—Institutes the National Civil Defense and Protection Policy—PNPDEC |
|                                          | Law No. 13.089/2015—Establishes the Statute of the Metropolis                |
| Marine platform                          | Law nº 8617/1993. Provides for the Brazilian territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf, among other provisions |
| Natural cavities                         | Decree 99.556/1990 and Decree 6.640/2008—Establishes legislation for the protection of natural underground cavities |
| Fossils                                  | Decree-Law 4146/1942—Establishes that fossils are federal heritage          |
| Geology and mining policy                | Decree-Law No. 1,985/1940 and Decree-Law No. 227/1967—Code of Mines         |
| Water resources policy                   | Decree No. 24,643/1934                                                       |
|                                          | Water Code                                                                  |
|                                          | Law No. 9.433 of January 8, 1997—National Water Resources Policy (PNRH)       |
| Conservation units policy and environmental policy | Law No. 9,985/2000—Establishes the National System of Conservation Units—SNUC |
|                                          | Law 6.938/1981—Creates the bases for the National Environmental Policy        |
| Tourism                                  | Law 11,771/08—National Tourism Policy                                       |
| Cultural policy                          | Decree-Law No. 25/1937—Deals with artistic and historical heritage, including natural monuments of remarkable features |
|                                          | Decree nº 72,312 of 05/31/73—Promulgates the convention on the measures to be adopted to prohibit and prevent the import, export and transfer of illicit properties of cultural goods (UNESCO) |

Table 2  Main public bodies related to sectoral policies

| Policies and laws                        | Instituições Gestoras da Política                                          |
|------------------------------------------|----------------------------------------------------------------------------|
| Land-use planning                        | Policy Management Institutions                                             |
|                                          | Municipal and state secretariats related to land use and occupation and civil defence |
|                                          | State and municipal councils                                               |
| Marine platform                          | Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) |
|                                          | Brazil’s navy                                                            |
| Natural cavities                         | National Center for Research and Conservation of Caves (CECAV)             |
| Fossils                                  | National Mining Agency (ANM)                                               |
| geology and mining policy                | National Mining Agency (ANM)—Oversight body                                |
|                                          | Geological Survey of Brazil—policy enforcement agency                      |
| Water resources policy                   | National and State Water Resource Councils                                 |
|                                          | National Water Agency (ANA)                                                |
|                                          | Basin Committee                                                           |
|                                          | National Water Agency (ANA)                                                |
|                                          | Environmental Departments                                                  |
|                                          | State and municipal councils                                               |
| Conservation units policy and environmental policy | National, State and Municipal Environmental Councils                       |
|                                          | Chico Mendes Institute for Biodiversity Conservation (ICMbio), Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) and state and municipal secretariats |
| Tourism                                  | Ministry of Tourism, Brazilian Tourism Company (Embratur), municipal and state secretariats |
|                                          | State and municipal councils                                               |
| Cultural policy                          | Ministry of Culture, state and municipal secretariats for the sector       |
|                                          | State and municipal councils                                               |
| Public authority inspection              | National Historical and Artistic Heritage Institute (IPHAN) and state and municipal councils |
|                                          | Federal and State Public Prosecutors                                       |

Source: authors’ survey.
of Brazilian institutions in the sphere of geoconservation, the interference of the Public Ministry can be a catalyst to promote a more active response in relation to the responsibilities of each government entity. The set of existing legislation can impose limitations on the use of different geosites and guarantee the protection or even the creation of territorial management strategies protected by national legislation. However, the existence of specific policies also presents the possibility of obtaining resources for the development of specific actions in certain geosites according to their characteristics (Table 3).

The set of information presented in Tables 1, 2 and 3 can be summarized in the form of a flow analysis (Fig. 2), which seeks to identify which laws apply and how to ensure sources of funds and the preservation and correct management of areas with relevant geodiversity. In this way, it is possible not only to identify the best legal strategy for the protection of the geosite but also to obtain resources for the development of geotourism and education programs.

To build a geodiversity policy that articulates the various bodies, it is necessary to create specific legislation. In the country, there are bodies that can serve as the executor of the policy (Geological Survey of Brazil—CPRM) and a regulatory and inspection body related to the mineral sector (National Mining Agency—ANM) in addition to specific bodies that manage environmental policies through the environment; that is, there is already a public structure built that could develop the main actions of the policy.

**Chapada dos Guimarães Geopark Project**

**Social and Institutional Mobilization**

In the state of Mato Grosso, the creation of the Thematic Sectorial Chamber (TSC) was the result of debates held in two public hearings and during a working group made up of institutions interested in the topic. The first hearing was held on April 12, 2016, in Cuiabá at the Legislative Assembly of Mato Grosso, and the second on June 17, 2016, at the Chamber of Aldermen of Chapada dos Guimarães (Fig. 3).

The working group discussed the need to create legal instruments for managing the geopark and therefore suggested the creation of the TSC. Another referral was the need to build an inventory to adapt the proposed geopark area to the perimeter of the municipality of Chapada dos Guimarães and to describe the geosites related to Paredão Grande Formation magmatism, dinosaur fossils and rocks from the Cambambe Basin, and the diamond deposits in the region.

| Policies and Laws                  | Resource sources                                      | Comments on the application in geopark territories                                           |
|-----------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Land-use planning                 | Disaster fund, Secretariat-specific budgets           | Zoning or municipal or metropolitan master plans may establish specific procedures and limitations considering local geodiversity |
| Geology and mining policy         | Environmental compensations                           | Applicable for spatial planning of geoparks covering marine areas                           |
| Natural cavities                  | Environmental compensations                           | Applied to geoparks that have natural cavities                                             |
| Fossils                           | Environmental compensation for projects that affect areas with fossil content | Some regions of the country have adopted specific legislation related to the obligatory nature of paleontological studies in civil works (Ex. Uberaba) |
| Geology and mining policy         | Percentage of resources from Financial Compensation for Mineral Exploration (CFEM) | In cases of municipalities that have mining, methodologies such as the participatory application of the CFEM can be created |
| Water resources policy            | Water resource funds and environmental compensations and environmental programs for projects and works | Especially in geoparks that have relevant aquifers, joint action with the basin committee is essential for obtaining resources and territorial management |
| Conservation units policy         | Environmental compensation, ecological ICMS and others | The use and management of geosites located within conservation units is subject to these laws |
| Tourism                           | Tourism fund, specific notices                        | Creation of APA in the geopark project area, development of environmental zoning of the territory, and management of the area through the APA management council |
| Cultural policy                   | Culture funds, specific notices, notices from the Brazilian Institute of Museums (IBRAM) | A source of resources for training staff and structuring attractions and geosites |
| Several                           | Diffusion of Rights Defense Fund                      | This legislation can be used to enable initiatives related to cultural heritage, in particular fossiliferous heritage and to protect natural monuments, among other initiatives |

**Table 3** Use of public policies to obtain and apply resources in the territory of a geopark

Source: authors' survey.
The resources for the new inventory were made available through a parliamentary amendment.

The Thematic Sectorial Chamber held 12 meetings (ALMT 2018) during the second half of 2017 and the first half of 2018 (Fig. 4). Representatives of the Federal University of Mato Grosso (UFMT), Federal Institute of Mato Grosso (IFMT), Chico Mendes Institute for Biodiversity Conservation (ICMBio), State Secretariat for Economic Development (SEDEC), Mato Grosso Center for Geological Survey (CEMATEGE), Civil House (State Government), Legislative Assembly of Mato Grosso, State Department of Education (SEDUC), Mato Grosso Mining Company

Fig. 2 Flow analysis of the application of public policies to geoparks

Fig. 3 Hearing held at the Chapada dos Guimarães City Council to discuss the creation of the Chapada dos Guimarães Geopark Project (Source: ALMT collection https://www.almt.gov.br/midia/)
(METAMAT), Union of State Tourism Guides (SINTUR-MT), Legislative Assembly of Mato Grosso (AL-MT), Office of Regional Development (GDR), Geological Survey of Brazil (CPRM), National Department of Mineral Production (DNPM), a representative of the Consortium of Vale do Rio Cuiabá, Association of Ecotourism Guides and Drivers of Chapada dos Guimarães (AGCE), Municipality of Chapada dos Guimarães, Ecosystems and Traditional Populations Institute (ECOSS), Rural Workers Union of the municipality, representatives of the Council of Tourism of the Municipality of Chapadas dos Guimarães, and representatives of the various communities, such as Rio da Casca and Jangada Roncador, also participated in meetings, in addition to the participation of the Municipal Consortium of the Southern Region and the Municipal Consortium of Rio Cuiabá.

A Proposal for the Creation of a State Policy on Geodiversity

A proposal to create a state policy related to geological heritage was presented by the Thematic Sectorial Chamber (TSC) at the Legislative Assembly of the state of Mato Grosso. The TSC sought to find a solution to the lack of legal support discussed at the national and international levels. The Constitution of the State of Mato Grosso was used as a legal basis, which establishes in article 299:

*The product of the financial resources collected from the State, resulting from its participation in mineral exploration, under the terms of the federal legislation, carried out in Mato Grosso or of the corresponding financial competence, will be applied, preferably, in the programs of development of the mineral sector and to minimize the ecological costs and social consequences* (MATO GROSSO, 1989).

The application of part of the Financial Compensation for the Exploration of Mineral Resources (CFEM) to promote geoconservation, geotourism, and geopark activities is also a way of reducing society’s resistance to mining activities, as well as helping to preserve the geodiversity that has exceptional value in the state.

The sectoral policy proposal does not conflict with UNESCO guidelines and does not stifle the management model of geopark proposals; that is, it allows different forms of organization, ensuring what is proposed by Brilha (2012), encouraging the construction of multidisciplinary teams, with specialists in several areas such as geology, management, tourism, education, and communication, among others.

The interaction between the different sectors of society is a way to foster integrated socioenvironmental governance. This form of construction represents social learning linked to the exercise of citizenship to seek to solve common problems through the use of democratic instruments, to find solutions and to develop sustainable development practices (Dos Santos & Bacci, 2017).

In this sense, the proposal built by the sectorial chamber interconnects, on a state and local scale, the main institutions of organized civil society, ranging from community to business leaders, and other institutions presented by the scientific community and public bodies.

**Fig. 4** Installation meeting of the Thematic Sectorial Chamber. Composing the table, representatives of the State Representative Saturnino Masson and representatives of the Federal Institute of Mato Grosso (IFMT), Federal University of Mato Grosso (UFMT), National Department of Mineral Production (DNPM), Geological Survey of Brazil (CPRM), and the Chico Mendes Institute for Biodiversity Conservation (ICMBio). (Source: ALMT collection https://www.almt.gov.br/midia/)
Drafting Draft Legislation

In the first 6 months of TSC activities, in the second half of 2017, debates were held on what the legal mechanisms could be to support the creation of a geopark in Mato Grosso. As a result, five project draft laws were presented (Table 4), which can be divided into two groups: (a) proposals I, II, and III related to the creation of a state policy on geodiversity, geotourism, and geoparks; and (b) proposals IV and V focused on the municipality of Chapada dos Guimarães and the creation of the geopark.

The first bill addresses the proposal of the state fund for the promotion of geodiversity, geotourism, and geoparks, linked to the State Secretariat for Economic Development (SEDEC), with the objective of promoting state policy in the sector through the financing of actions and projects managed by the SEDEC and on the initiative of nonprofit individuals or legal entities governed by public or private law.

The resources for the fund would come from 10% of the Financial Compensation for the Exploration of Mineral Resources (CFEM) destined for the state, in addition to transfers from the Union, agreements or similar instruments, parliamentary amendments, aid, subsidies, and other contributions from public or private, national, or foreign entities.

To carry out the decision-making regarding the state policy of geodiversity, geotourism and geoparks, the creation of a State Committee was proposed, which will have the role of an administrative body, with deliberative or executive powers, observing the current legislation. In addition, the proposals include in the state legal system a series of nomenclature related to geoparks, such as geodiversity, geological heritage, geosites, geoconservation, geotourism, and geoparks.

The State Committee on Geodiversity, Geotourism and Geoparks will have the following functions: (1) foster initiatives to promote geodiversity, geotourism, and geoparks and landscape, speleological, archeological, paleontological, and scientific purposes; (2) recognize through resolutions the geological heritage of Mato Grosso; and 3) analyze and approve projects and initiatives related to the topics dealt with in this law. To compose the committee, representation was proposed for several research and teaching entities, public agencies of the state and federal administration, and representatives of segments of organized civil society.

The State Committee for Geodiversity, Geotourism, and Geoparks would have the function of providing guidelines, performing technical analysis, and approving initiatives and projects. Fund resources would be destined to (1) support the creation of new proposals for geoparks; (2) support the maintenance of existing geoparks; (3) promote the free access of the population to geological heritage; (4) stimulate the development of educational activities related to geodiversity, geotourism, and geoparks; (5) support actions of valorisation, intervention, safeguarding, and preservation of the state’s geological heritage; (6) encourage the study and dissemination of knowledge on the themes geodiversity, geotourism, and geoparks; (7) foster geotourism and sustainable tourism; and (8) acquire movable and immovable equipment, upon prior technical assessment, which will be incorporated into the assets of the State Secretariat for Economic Development, provided they are directly linked or linked to financed cultural projects.

The committee must evaluate and approve projects submitted by individuals or legal entities governed by public or private law. These processes must take place with the help of a Qualification and Selection Technique Committee composed of members with well-established knowledge of the topic addressed. In the case of constituted geoparks, the proposal provides a specific public notice for each territory.

The proposal of the State Geodiversity Week aims to promote educational actions and popularize information regarding geodiversity.

The fourth bill of the Sectorial Chamber proposed the creation of Chapada dos Guimarães Geopark Project through state law, having the pillars of geoconservation, education, and geotourism. The management of the geopark must be developed according to the guidelines of the management council, which will be composed of representatives of local civil society and public bodies. The legislation leaves open the form of management, which can

| Minutes                  | Theme                                                                 |
|-------------------------|----------------------------------------------------------------------|
| I. Project draft laws   | They provide for the creation of the State Fund for the promotion of geodiversity, geotourism and geoparks and other measures |
| II. Project draft laws  | They provide for the creation of the State Committee on geodiversity, geotourism and geoparks and other measures               |
| III. Project draft laws | They provide for the creation of the State Geodiversity Week and other measures                                         |
| IV. Project draft laws  | They provide for the creation of the Chapada dos Guimarães Geopark Project and other measures                             |
| V. Project draft laws   | It gives the municipality of Chapada dos Guimarães the title of State Capital of Geodiversity                             |
be carried out by the Civil Society Organization of Public Interest (OSCIP), by the municipal administration itself or by research institutions through public notices. However, this bill has not yet advanced in the Legislative Assembly until approval. Considering the need to start the activities of the Geopark committee, the Municipality of Chapada dos Guimarães published a municipal decree 120/2021 creating the committee.

The bill that grants Chapada dos Guimarães the title of state capital of geodiversity has a more symbolic meaning, without effective impacts in the scope of public policy.

The public policy proposal built by the TSC for geoparks addresses a set of mechanisms that ensures both support for geopark projects that are already in progress, as well as resources to initiate new studies and actions in areas that may become a geopark, or even in places where there are only specific actions for the protection and dissemination of geodiversity (Fig. 5).

The State Fund for the promotion of geodiversity, geotourism and geoparks, if created, will play a fundamental role in providing financial resources for the development of projects, whether in the activities of the State Geodiversity Week, in the execution of projects approved by the institutional committees of geoparks and geopark projects in progress or for the approval of other projects that have been evaluated by the State Committee. Currently, draft laws are being processed in the Legislative Assembly of Mato Grosso.

Conclusions

The absence of a geodiversity policy in Brazil makes it difficult to protect geoheritage and manage geosites. The development of a national geodiversity policy linked to a percentage of the Financial Compensation for the Exploration of Mineral Resources (CFEM) could be a way to promote the preservation of geosites and contribute to the dissemination of geosciences and to the promotion of geotourism. The creation of state policies with the same purpose can represent local advances.

In the state of Mato Grosso, the TSC’s work has shown that institutional spaces can be an important way of disseminating geodiversity to society and, in particular, to managers and politicians. In addition, it facilitates the mobilization of institutions to debate the geopark proposal.

When elaborating the standardization models, it is important that the mechanisms carry out integration with territorial management, but at the same time, they do not jeopardize management possibilities or adequacy of geopark management.

In the current context, the analysis of the relationship between existing policies in Brazil and the geodiversity elements of each geosite can be an important action to improve the governance of the area, its protection, and access to financial resources for the development of actions in the territories. The use of master plans and zoning, especially the Environmental Protection Area (APA), as instruments

Fig. 5 Relationship between the instruments proposed for state policy on geodiversity, geotourism, and geoparks
for managing the geopark’s territory is the most appropriate way in Brazilian legislation to establish legal norms for areas within the territories that have to ensure the best form of management, according to the limitations and constraints imposed by geological or geomorphological characteristics.

At the international level, the creation of a UNESCO Convention on Geodiversity, to be adopted by member countries, can be an important step towards creating a global legal framework, along the lines of what was created for biodiversity.

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Declarations

Conflict of Interest The authors declare no competing interests.

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