https://dx.doi.org/10.22161/ijaers.6734 ISSN: 2349-6495(P) | 2456-1908(O)

Evaluation of Environmental Impacts in Semi-arid Caatingas of Brazil

Clecia Simone G. Rosa Pacheco[1], Reinaldo Pacheco dos Santos[2]

[1]Department of Technology in Food of the Federal Institute of Sertão Pernambucano, Brazil
[2]Department of Geography of the University of Pernambuco/Brazil

Abstract *— The Caatinga is a biome rich in endemic species, both fauna and flora. There is, however, no influence suffered on the impacts, some of them being irreversible. Despite being a fragile biome and requiring care due to vulnerability, the issues related to climatological aspects, this is a very resilient ecosystem. This is not important anthropogenic impact, and this case, approach in the impact of the provocation of the activity of mining, is this case in the environment of illegal environment. In this sense, this article aimed to evaluate socioenvironmental impacts through mining activities, caused by the implementation of the Red Mine in the Curaçá Valley, in the State of Bahia. This research is applied in nature, quantitative, bibliographical and field. The methodology is based on the Tricart (1977) ecodynamic method, on the GTP Theory of Bertrand and Bertrand (2007), on the method of walking of Filgueiras et. al. (1994) and in Bardin Theory (2011). The research findings were the main risk factors for Caatinga surface recovery (PRC).*
Keywords *— **Mining; Degradation; Semi-arid.***

I. INTRODUCTION

Today Bahia is the most sought after location in Brazil by large mining companies. The state has iron, nickel, gold, bauxite and about 40 other minerals. It is the largest national producer of uranium, chromium, salgema, magnesite, talc and barite, ranking second in the production of copper, graphite and silver, and the third largest in gold, ornamental stones and natural gas. Also in Bahia is the Mineração Caraíba S/A warehouse that was discovered in 1874 and, in 1944, the National Department of Mineral Production (DNPM) identified its productive potential.

In 1979, under the name of Caraíbas Metais S/A, the company began operating the mine at Cielo Aberto, and in 1986, with the entry into operation of the Underground Mine, the copper ore was withdrawn simultaneously from both sources (FRÁGUAS, 2013).

According to Fráguas (2013, page 3), in 1988 the former Caraíba Metais, now Mineração Caraíba S/A, started the privatization process and in 1994 entered the National Privatization Program, now known as Mineração Caraíba S/A. "In 2006, the leaching plant began operations to extract copper from the oxidized ore, which has been stored since the beginning of operations."

The mining company is located in the north of Bahia, more precisely in the Pilar District, in the municipality of Jaguarari, with more than 1300 direct employees and almost 2000 in total (FRÁGUAS, 2013).

The present article evaluates the main environmental impacts caused by the ore flow in the Curaçá Valley, presenting causes and consequences, as well as suggesting mitigating aspects to solve the socioenvironmental damages. The methodology used is based on the Ecodynamic Method of Tricart (1977), on the GTP Theory of Bertrand and Bertrand (2007), on the Method of Hiking Filgueiras et. al. (1994) and in Bardin Theory (2011).

The research findings indicate a strong environmental degradation caused by anthropic agents (in this case the mining company), signaling the need to reconstitute the area from the insertion of a Caatinga Recomposition Plan (PRC).

II. STATE OF THE ART OF RESEARCH

2.1 IMPACTS FROM MINERAL EXTRACTION

According to Filho (2011) Mineração Caraíba concentrates (12.1%) of the country's annual copper exploration is 1.1 million tons of sulfide, and 70 thousand tons of concentrate, with an average content of 37% copper. However, anyone who knows the mining company knows that it, even though it has been granted exploitation by the Union, is not in the habit of acting clearly and with respect to the environment.

It attempts to convince residents of areas with mineral deposits to be rewarded with simplistic works and no legitimate value, not making the environmental compensations required by the legislation. In addition, the mining company has not acted in a respectful way in relation to the existing flora, removing the vegetation to open roads for the drainage of its production.

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

One of the questions of Fráguas (2013), is about the environmental licensing issues, where according to him:

> A factor that has become important and sometimes limiting to the feasibility of mining projects are the constraints of the TC (commitment terms) assumed in public hearings during the environmental licensing processes, forcing the Mining companies to have a sometimes expressive cost for activities together communities that should be the role of the state or municipalities (FRÁGUAS, 2013, p. 8).

In the municipality of Juazeiro, in the region known as Vale do Curaçá (Mineral Province so named by Mineração Caraíba S/A), the "Red Project" was created (figure 1), an underground mine with an estimated capacity of 3.2 million tons of copper sulphide and started operations in 2016, generating almost 800 jobs (direct and indirect) until the actual production of the ore. Such an enterprise can last more than five years (BLOG CARLOS BRITO, 2015).

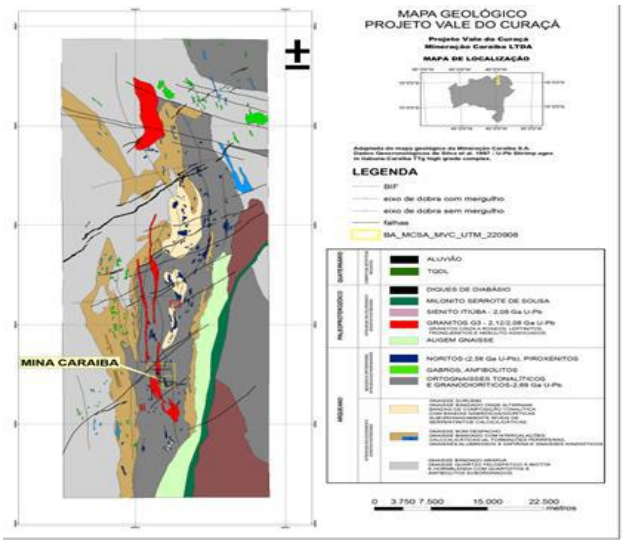

Fig.1: Simplified geological map of the Curaçá Valley
Source: MCSA Geologia (2009)

Copper is the third most used metal in the world, behind iron and aluminum. It is a malleable, recyclable mineral, resistant to corrosion and high temperatures, being used in the generation and transmission of energy, in spinning mills and in practically all electronic equipment, for example, in television and cellular telephones.

However, CBPM points out that the semi-arid region accounts for more than 90% of the production of metallic minerals produced in the state of Bahia, with emphasis on the following municipalities (CBPM, 2013):

i. Jaguarari - the largest copper production in Brazil;

ii. Campo Formoso, Andorinha and Santa Luz - the largest Brazilian production of chromium;

iii. Brumado - greater production of magnesium and talc in Brazil;

iv. Caetité and Maracás - the only uranium and vanadium mines in the largest production in Brazil;

v. Santa Luz and Jacobina - gold mining;

vi. Vitória da Conquista - produces bentonite, sand and clay.

In this sense, the state of Bahia has promising areas for mineral production in the Bahian semi-arid region, highlighting potentials for the exploitation of iron ore, gold, clays, kyanite, zinc, nickel and ornamental rocks.

The IMM (2019) brings a table highlighting the main mineral goods exported in March 2019, their destinations worldwide and their respective dollar values (see figure 3).

Bem mineral	Valor (US$ - Mar /2019)	Acumulado (US$ - Jan a Mar/2019)	Principais Destinos
Ouro	22.875.924	73.441.988	Bélgica, Canadá, Índia, Suiça
Vanádio	19.444.184	98.812.350	Canadá, Coreia do Sul, Estados Unidos, Japão, Holanda
Outros Metais Preciosos	9.786.318	37.818.442	Alemanha, Canadá, Holanda, Suíça
Magnesita	4.388.378	18.075.120	Alemanha, Argentina, Bélgica, Canadá, China, Colômbia, Costa Rica, El Salvador, Equador, Estados Unidos, Índia, Japão, México, Holanda, Reino Unido, Rússia, Turquia, Tailândia, Uruguai, Venezuela. Romênia
Pedras Preciosas	674.358	1.230.314	Alemanha, Arábia Saudita, Bélgica, Chile, Equador, Estados Unidos, França, Índia, Itália, Portugal, Quênia, Suíça
Rocha Ornamental	616.428	1.552.867	Albânia, Alemanha, China, Espanha, França, India, Itália, Polônia, Suíça
Talco	534.902	1.051.966	Argentina, Chile, Colômbia, Estados Unidos, Itália, México, Paraguai, Peru, República Dominicana, Uruguai
Quartzo	206.363	525.553	China, Espanha, Estados Unidos, Itália, Hong Kong, República Tcheca
Manganês	195.317	2.103.198	China, Emirados Árabes, Estados Unidos, Índia
Cromita	96.505	180.100	Alemanha, China
Outros	27.031	69.910	Diversos
Diamante	0	5.570.770	Emirados Árabes, Estados Unidos
Cobre	0	37.383.840	África do Sul, China
Total	**58.845.708**	**277.816.418**	

Fig.3: Main mineral goods exported in March 2019
Source: IMM/SDE (2019)

It can be seen in figure 3 that copper was the last one on the list and its main destination is South Africa and China, accumulating a total of US $ 37,383,849 from January-March, which suggests that the companies that are leaders in the world market for this mineral had in 2018 cumulative profits, despite all the socio-environmental impacts generated.

Therefore, it is known that the state of Bahia has an area of 564,692,669 km², with the largest territorial extension of the Northeast, occupying approximately 37.7% of the region. In this immense area, there are three Brazilian biomes: the Caatinga, the Atlantic Forest and the Cerrado, besides the Coastal Zone, with its ecosystems that are repeated all along the coast - like beaches, dunes, restingas, rupestrian fields, lagoons and mangroves. Thus, Bahia has a great diversity of ecosystems, leading to the reflection of how much has been lost of this natural biodiversity, with mineral

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

exploration in several parts of the state, with the consent of governments and environmental agencies (SDE, 2019).

2.2 DEVELOPMENT OF ORE AND ENVIRONMENTAL DAMAGE

The implementation of the Red Project and the approval of the Municipality of Juazeiro, has been committing countless environmental damages in the Paredão pasture fund area, through the execution of a public road for the production of the Projeto Vermelhos to Pilar (municipality of Jaguarari, where it is the matrix of the mining company), this road that connects BA 210 (Curaçá) to BR 235 (Pinhões).

The mentioned road measures approximately 12 meters of width, being able to transit at least three paired carts. This road was licensed by the Department of Environment and Urban Planning (SEMAURB) of Juazeiro, in the typology "simplified environmental license", published in the Official Gazette (see figure 4).

OFICIAL
Prefeitura Municipal de Juazeiro

PREFEITURA MUNICIPAL DE JUAZEIRO - BAHIA
SECRETARIA DE MEIO AMBIENTE E ORDENAMENTO URBANO

RESOLUÇÃO SEMAURB Nº 144/2018

Concede Licença Ambiental Simplificada em favor da Pessoa Jurídica ***CSSA Construtora São Salvador EIRELI*** *e dá outras providências.*

O SECRETÁRIO DE MEIO AMBIENTE E ORDENAMENTO URBANO DO MUNICÍPIO DE JUAZEIRO, ESTADO DA BAHIA, no uso das atribuições que lhe confere a Lei Complementar nº 020/2016, e tendo em vista as disposições contidas na Lei Municipal 1.873/2005 e Lei 1.703/2003 Código Municipal de Meio Ambiente, regulamentada pelo Decreto Municipal 366/2005, e tendo em visto o que consta no processo administrativo nº **10213/2018**, resolve:

Art. 1º - Conceder a **Licença Ambiental Simplificada,** válida pelo prazo de **03 (três) anos**, ao **CSSA Construtora São Salvador EIRELI**, Pessoa Jurídica de Direito Privado, inscrita no CNPJ sob nº 11.129.119/0001-85, para atividade de **Construção de Estrada**, situado na Av. Anísio Moura Leal, nº 76, A (AV. CEAP), KM 2, Petrolina - PE.

Fig.4 - Official Gazette - Road Licensing

Source: Official Gazette of the Municipality of Juazeiro - Issue 1,264 - Year 6 of July 16, 2018. P. 88-91.

However, in the eyes of the Brazilian legislation, any and all construction works must pass through an Environmental Impact Assessment (EIA) and an Environmental Impact Report (RIMA) that must be made available for access by the interested company. In addition, the municipal government explains in the license document that the road is of "public utility" to the communities, which had to build it (road), the degradation of the soil, the scaring of the fauna, the suppression of flora of the caatinga biome, the destruction of stretches of native vegetation, among other environmental damages.

This requirement is made by CONAMA Resolution No. 01/86 and by Article 2 of CONAMA Resolution No. 237/97. Such studies are necessary to assist in the assessment of the environmental feasibility of the project, so that the environmental agency (in this case, SEMAURB) can issue the Previous License (LP). It is important to emphasize that the LP does not authorize the beginning of construction, it only signals its viability.

The Environmental Impact Assessment (EIA) is the detailed technical study that mainly involves the following questions:

a) Characterization of the enterprise - describes the enterprise to be licensed, considering its installation and operation, and gathers information on how, in the entrepreneur's view, it will work;

b) Environmental Diagnosis - describes the region where the project intends to be installed and its adjacent areas, gathering environmental and socioeconomic data of the area before construction;

c) Assessment of Environmental Impacts - crosses the socio-environmental characteristics of the area and the characteristics of the proposed project, evaluating the effects of the construction and operation of the project;

d) Environmental Prognosis - considers the negative or positive effects on the physical, biotic and anthropic resources associated with the installation or not of the future enterprise.

e) Environmental Impact Monitoring and Monitoring Programs - suggest measures to avoid, mitigate and/or compensate for the negative impacts of the project and enhance the positive ones (obligations of the entrepreneur when he/she receives the Previous License);

All this information and the main conclusions of the EIA should be summarized in the Environmental Impact Report (RIMA), in clear, direct and accessible language for public consultation, which did not occur in the case described here, since until now the Paredão community has did not have access to the EIA and to the RIMA of said road.

Also, the Area of Influence (AI) is one that will somehow be influenced by the implementation of the enterprise, whether in the physical, biotic (fauna and flora) or socioeconomic aspects. In this way, it is possible to identify the AI by defining specific areas of influence for the environmental analyzes, according to the interferences that occur. The Area of Influence can be divided into Directly Affected Area (ADA), Direct Influence Area (AID) and Indirect Influence Area (AII), as shown below.

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

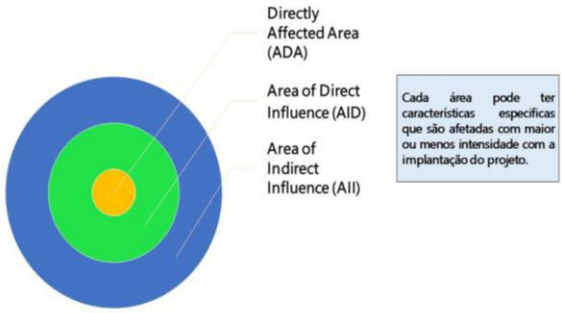

Fig.5 – Sketch of an AI

Source: Elaboration Authors (2019)

Each of these subspaces receives impacts in the construction and operation phases of an enterprise, with direct or indirect causal relations, and hence the name, besides the ADA where the enterprise itself is located, often called the intervention area.

In terms of the applicable legislation, according to Article 2 of CONAMA Resolution 349 - the Area Directly Affected - ADA - is considered the area necessary for the implementation of the enterprise, including its support structures, private access roads that need to be built, expanded or reformed, as well as all other unit operations associated exclusively with the project infrastructure, that is, private use of the project (CONAMA, 2012).

The Direct Influence Area (AID) - is the geographic area directly affected by the impacts arising from the project/project and corresponds to the contiguous and expanded territorial space of the ADA, and as such, should suffer impacts, both positive and negative.

Such impacts must be mitigated, compensated or enhanced (if positive) by the entrepreneur. The impacts and effects are induced by the existence of the enterprise and not because of a specific activity of the same.

Finally, the Indirect Influence Area (IIA) - covers a territory that is affected by the enterprise, but in which the impacts and effects of the enterprise are considered less significant than in the territories of the other two areas of influence (ADA and AID). In this area, the analytical objective is to provide an evaluation of the regional insertion of the enterprise. It is considered a great context of insertion of the area of study itself.

These territorial configurations, in fact, are syntheses of repercussions of impacts that can occur in the physical, biotic, socioeconomic, cultural and institutional environments. More than that, there are situations in which a given area of influence, for example AID, differs for each environment in the local and/or regional environment, drawing its own contours, thus having more than three overlapping areas.

In the case analyzed here, the ADA is the Red community (Figure 6), where the enterprise is situated (the copper mine). However, the Paredão community is located in the Area of Indirect Influence (AII), which, although considered by the legislation as an area less impacted than the ADA, suffers numerous impacts, not only environmental but also socioeconomic impacts.

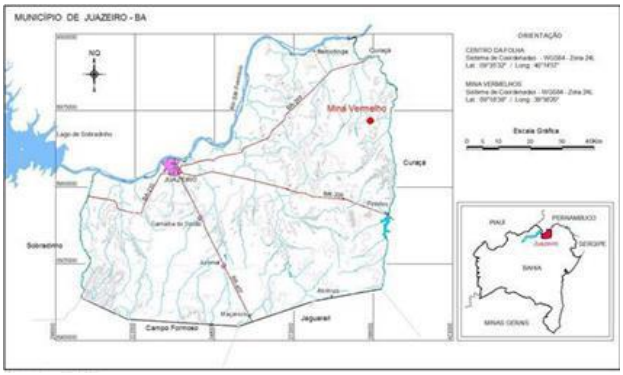

Fig.6 - Map of the Red Mine

Source: INSTITUTO HABILIS (2017)

Still in relation to the Reds Project, the Municipality of Juazeiro, along with SEMAURB (Secretariat that "zela" for the environmental licenses at municipal level), understood that the opening of the road was "public utility" as described in the document published in the DOU.

§ 1º. Todas as coordenadas aqui descritas estão georreferenciadas ao Sistema Geodésico Brasileiro, e encontram-se representadas no Sistema UTM, referenciadas ao Meridiano Central 39° EGr, tendo como o Datum o SIRGAS2000, sendo todos os azimutes e distâncias, áreas e perímetros calculados no plano de projeção UTM.

§ 2º. Respectivas áreas de Servidão Administrativa será em favor do Município de Juazeiro, para fins de ampliação, recuperação e execução de obras da Estrada Vicinal Municipal de ligação entre a BA-210 e a BR-235 e, encontram-se na posse de proprietários diversos.

§ 3º. A Servidão Administrativa ora constituída e declarada está demonstrada conforme áreas representadas nos mapas anexos, que integram este Decreto para todos os fins e efeitos.

Art. 2º. Em decorrência da constituição da presente Servidão Administrativa, ficam declaradas de Utilidade Pública a parte ideal dos imóveis identificados neste Decreto implantação dos serviços públicos de abertura, ampliação e melhoria da estrada vicinal municipal de ligação entre a BA-210 e a BR-235.

Art. 3º. A Servidão Administrativa de que trata este Decreto será registrada no Cartório de Registro de Imóveis desta Comarca, mediante assentimento dos proprietários e possuidores.

Art. 4º. Este Decreto entra em vigor na data da sua publicação.

GABINETE DO PREFEITO MUNICIPAL DE JUAZEIRO, ESTADO DA BAHIA, em 26 de junho de 2018.

Fig.7 - Publication in the DOU - Public Utility Road

Source: DOU - Juazeiro City Hall, Edition 1.251 - 1 Year 6, of June 20, 2018, p. 14-17.

It is public and notorious the misconception that said road is of public utility, since its main objective is the disposal of the copper ore of the Project Red to the matrix of the Caraíba Mining in Pilar, Jaguarari. Thus, it is obviously a private interest, not a public interest, since the understanding of "public utility" means the convenient transfer of private property to the Administration. There is no essential character in this transfer, because it is only

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

timely and advantageous for the collective interest. Decree-Law 3.365/41 provides in Article 5 the hypotheses of necessity and public utility without differentiating them, which can only be done according to the criterion of urgency (MEIRELES, 2007).

The most blatant misunderstanding on the part of the municipal public authority was to issue the license for the suppression of native vegetation (according to figure 8) for the construction of this road, not controlling the terrible damages caused to the caatinga biome and its biodiversity.

DIARIO OFICIAL
Prefeitura Municipal de Juazeiro

RESOLUÇÃO

RESOLUÇÕES

PREFEITURA MUNICIPAL DE JUAZEIRO - BAHIA
SECRETARIA DE MEIO AMBIENTE E ORDENAMENTO URBANO

RESOLUÇÃO SEMAURB Nº 152/2018

Concede Autorização de Supressão de Vegetação Nativa em favor da Pessoa Jurídica CSSA CONSTRUTORA SÃO SALVADOR EIRELI dá outras providências.

O SECRETÁRIO DE MEIO AMBIENTE E ORDENAMENTO URBANO DO MUNICÍPIO DE JUAZEIRO, ESTADO DA BAHIA, no uso das atribuições que lhe confere a Lei Complementar nº 020/2016, e tendo em vista as disposições contidas na Lei Municipal 1.873/2005 e Lei 1.703/2003 Código Municipal de Meio Ambiente, regulamentada pelo Decreto Municipal 366/2005, e tendo em visto o que consta no processo administrativo nº **10214/2018**, resolve:

Art. 1º - Conceder Autorização de Supressão de Vegetação Nativa, **válida** pelo prazo de **01 (um) ano,** a Empresa **CSSA Construtora São Salvador EIRELI,** Pessoa Jurídica de Direito Privado, inscrita no CNPJ sob nº **11.129.119/0001-85**, para atividade de **Construção de Estrada Pública Municipal**, situado na Estrada Vicinal Rural de Ligação entre a BA 210 e BR 235, Município de Juazeiro-BA.

Fig.8 - Vegetation Suppression License

Source: DOU - Juazeiro City Hall, Edition 1.271 - Year 6 of July 25, 2019, p. 57-74.

Impacts can be viewed with a "naked eye", and any lay people in environmental matters can point out the aforementioned damages caused by the construction of said road, as described later. However, once a simplified environmental license is endorsed, the road is deemed to be of public utility (even if it is of private interest) and that the right to suppression of native vegetation is granted (in one of the most vulnerable biomes such as Caatinga), said company feels protected from any and all legal damages that may be filed by the company, which is harmed and affected by the construction of the rural road.

At that time it is possible to affirm that at the time when the MC S/A accumulates a history of devastation to the Caatinga ecosystem, the environmental authorities of the affected municipalities and the state of Bahia accumulate the impotence to deal with the crimes of this company, since they record facts that it has suffered any penalty or that it has been forced to recompose any affected area.

2.3 ENVIRONMENTAL DAMAGE IN THE PASTE BACKGROUND OF THE COMMUNITY PAREDÃO IN THE SEMIÁRIDO BAIANO

In the Paredão community, it is one of the rural areas that has suffered the impacts punctuated above. Located in the interior of the municipality of Juazeiro, the first expeditions and mineral demarcations also arrived with the "Pignatari", which with government support sought to search areas throughout Bahia to explore copper, gold, or any other mineral. Subsequently, Caraíba Metais (CM), currently, Mineração Caraíba S/A, continued its relentless pursuit.

The Paredão community has been suffering from the environmental impacts of the implementation of the Red Project in the Curaçá Valley, which has the company Mineração Caraíba S/A. At the beginning of the project, all the daily traffic of cars, trucks, buckets and other vehicles was done inside the said community, which began to suffer from the dust promoted by the transport and the high speed of the same, and with the risks of accidents, both with humans and with animals, which during the night period is sheltered near the homes of their owners.

The Community Association of Riacho do Mari/Paredão (ACRM) sought, without success, to dialogue with the company, in an attempt to minimize the risks that were being produced to the community. However, as the company has a habit of respecting only its private interests, it never sought to sit down and dialogue with the ACRM to seek an agreement that would benefit both parties.

In turn, Mineração Caraíba S/A sought support from the municipality, aiming to achieve partnership and irreconcilably intending the simplification of licenses and deadlines, which summarily achieved according to the document inserted in this work.

However, the granting of licenses does not guarantee that the society around the exploration area and the "pasture fund" areas will no longer experience the consequences of socio-environmental damage caused by mineral exploration, on the contrary, it worsens the relationship between man and nature, placing the caatinga as a hostile and inhospitable environment [...] (MARQUES, 2016).

A prominent concept of Grassland Communities is described by Diamantino (2007), where he says:

> One of the most striking features of Fundo de Pasto communities refers to institutional mechanisms for access and use of native lands and pastures created from discursive and customary combinations of rules of use and hospitality reinforced in situations of adversity and pressure exerted on the group, ruling principles of vital utility and shared

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

> sociocultural organization (DIAMANTINO, 2007, p.9).

Thus, it is important to mention that the Pasture Fund system is established not by collective intention to define an area of communal use, but by means of common land use regime that develops according to the utility of that portion of the space for survival of the sheep and goat herds and, consequently, of the peasant family itself (MARQUES, 2016). However, in the Paredão community, one of the pasture land areas has suffered several impacts, with the construction of the road (Figure 9) linking BA 210 to BR 236 for the MC S/A copper ore runoff.

Fig.9 -Vicinal Road

Source: Google Earth (2018)

The community has about 4,000 hectares of land, including legal reserves and pasture funds. The whole area is home to the Caatinga ecosystem, with native vegetation and species almost extinct. It also has great diversity of fauna, which has o habitat the dry areas of the white forest. About 12 families live in the community (these are the target of the research), most of them elderly, all descended from the same family tree, which inhabited these lands for more than 200 (two hundred) years.

III. MATERIAL AND METHODS

The present research is classified according to Gil (1999), Andrade (2006), and Cervo et al. (2007), according to their nature, their technical procedures, the approach to the problem and the objectives. Thus, from the point of view of nature, it is an applied research, since it aims to generate knowledge for practical application directed to the solution of specific problems. The approach of the problem is a qualitative research, considering the existence of a dynamic relationship between the real world and the subject, being descriptive and using the inductive method, and the data obtained are analyzed inductively.

With regard to technical procedures, this is a bibliographical one, since it was elaborated from written material already published, consisting mainly of books, e-books, reports and periodicals made available on the Internet. It is also a participant research, where it develops from the interaction between the researcher and the members of the situations investigated, from the direct contact of the researcher with the phenomenon observed to acquire information about the reality of the social actors in their own contexts.

As for the objectives, this research is exploratory, because it involves a bibliographical survey and a dialogue with people who have had practical experiences with the researched problem, and it is also descriptive because it involves the use of standardized techniques of data collection, such as systematic observation, where the facts are observed, recorded, analyzed, classified and interpreted, without the interference of the researcher.

In addition, such research is essentially based on the GTP Theory (Bertrand, Bertrand, 2007) in the Ecodynamic Method (Tricart, 1977), the Walk Method (Filgueiras et al., 1994) and the Discourse Analysis Contents of Bardin (2011).

Field research began in June 2018, with weekly visits in the first two months in loco, for observation, recording, analysis and interpretation of the data. Subsequently, for safety measures visits were sporadic every two months, and were completed in december 2018.

In order to carry out the research, the following materials were used: pen, notepad, Global Positioning System (GPS), camera, community map, and Informed Consent Term (TCLE) of the Riacho do Mari Community Association, authorizing the research.

IV. RESULTS AND DISCUSSIONS

The first impacts of the construction activity of the vicinal road for mineral flow were the suppression of native vegetation causing unprecedented damage. In the results of the research will be observed images that will demonstrate some of the damages caused in the Paredão pasture area due to the opening of the road that, besides Paredão, "cut" innumerable other small localities and areas of pasture belonging to surrounding communities.

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

Fig.10 – Visão da Estrada em Área de Fundo de Pasto do Paredão

Source: Authors (2018)

Figure 10 demonstrates how exaggerated the opening of this road, which in reality is higher than the standard of any highway, whether state or federal, since it measures approximately 12 meters wide.

CONAMA Resolution No. 001 of January 23, 1986, in its article 2 says that:

> It will depend on the elaboration of an environmental impact study and its environmental impact report - RIMA, to be submitted to the approval of the competent state body, and of IBAMA and on a supplementary basis, the licensing of activities modifying the environment, such as: I - Roads with two or more rolling tracks (BRASIL, 1986).

As shown in figure 11, the aforementioned road has a capacity for 4 bearing ranges, which is essential for the EIA-RIMA, with no simplified license, since it has a high impact. Figure 20 will show synthetically other biota damage.

Fig.11 - Mata native of the caatinga biome that was suppressed

Source: Authors (2018)

Figures 11 A, B, C and D show the chaotic situation of the caatinga biome, which had trees that took years to keep alive and resistant to the extreme temperatures in the semiarid, and which were decimated in a few seconds. In A it is possible to see "logs" of wood originating from the catingueira; in B and C wood derived from the fall of umburanas; and, in D pear wood, all species native to the biome. The vegetation that was not cut was knocked down by the root to make room for the road.

A total of 113 small mounds of wood were cut, stacked and stacked on an 18-km stretch of road, within the Paredão pasture. The finding led to the following questions: 1. Will the wood mounds from the suppression be marketed? 2. If so, who has control over them?; 3. Who will benefit from the sale or donation of the same?

It should be emphasized that Article 2 of Resolution No. 001 of CONAMA (1986) states that the licensing of activities that modify the environment, such as "XIV - Economic exploitation of wood or firewood, in areas over 100 hectares or less, when it reaches significant areas in terms of percentage or importance from an environmental point of view "(BRASIL, 1986).

However, in the case in point, the Paredão community did not benefit from the amount of wood heaped on the roadside, which were gradually being driven by strangers or people passing through the area.

In these affected areas, the society-nature relations are present in the communities, and the lands are in common use, considering the maximization of the use implemented by the free grazing of goat breeding sheep and extensive bovinocultura.

The very conditions of adversity in the semi-arid environment gave conditions so that the interdependence between the subjects and the feeling of territoriality were very present in the daily life of the communities, a territoriality that is now threatened by mining.

It is crucial to understand the areas considered "Background of grass" as:

> [...]an experiment in land appropriation typical of Bahian semi-arid, characterized by the

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

> production of animals on land in common use, articulated with the use of land and raising goats, sheep or cattle in the communal area, as well as subsistence crops in individual and practical areas of vegetal extractivism. […] (ALCÂNTARA; GERMANI, 2009, pp. 13-14).

There have been countless accidents with animals that cross the road and have their lives cut down by the cars that daily travel at high speed.

Still in the pasture area, 72 catingueiras (*Caesalpinia pyramidalis Tul*) were counted, because of an on-site visit; 08 umbuzeiros (*Spondias tuberosa L.*) felled and/or buried; 22 pinnacle brave (*Jatropha molíssima*) banished; 07 pears (*Aspidosperma pyrifolium*) broken down, according to figure 12 (A, B, C and D).

Fig.12 - Deleted Species
Source: Authors (2018)

In addition, species such an aroeira (Schinus terebinthifolius) and umburana cambão (Bursera leptophloeos), with a considerable stem (with a diameter of up to 1 meter), were also cut to make a profit, to wild capitalism (according to figure 13 A and B). About 23 umberanas were destroyed. The umburana is a typical tree of the Northeast of Brazil, with a variable size of 2 to 6 meters. It has soft and lightwood, much used in crafts. The period of flowering is between September and December, where its leaves and fruits serve as refrigerators for animals in the hinterland.

As Santos says (2010), usually in pasture lands, "common use" areas are surrounded and are close to the foothills and to the water resources, such as rivers and ponds - the refreshments -, ensuring fresh pasture and abundant for the herd that is collectively allocated" (SANTOS, 2010, p.91).

Already aroeira is a deciduous plant, heliófita, selective xerófita, characteristic of dry and rocky terrains; occurs in dense clusters, both in open and very dry formations (caatinga) even in very humid and closed formations. It occurs in the areas of the sertão of Bahia where the rainfall is low (less than 800 mm) and the physiological formation of caatinga or maté acaatingada, always in high lands, being deciduous. It reaches up to 20 meters high in favorable conditions (APN, 2015).

Figura 13 – Madeiras "de Lei" da Caatinga

Source: Authors (2018)

Other species, such as the cacti, known as xique-xique (Pilosocereus gounellei), a species of endemic cactus of the semiarid, and mandacaru (Cereus jamacaru), were also cut off from nature, as figure 14 (A and B).

Fig.14 – Plantas cactáceas da Caatinga
Source: Authors (2018)

The two species of cacti conserve water inside to survive in the dry periods. The small farmer generally uses this species to feed the cattle in times of low rainfall, however, the use of the same occurs in a balanced way, aiming not to decimate the species, since in the drought periods to come, it will need the plant again.

However, it was not only these damages demonstrated to date, the only ones, in the context of the construction of said road, considered a "vicinal road" by the municipal agencies. The following figure (Figure 15 A and B) shows the removal of material (sands) in a stream in the community of Paredão, and the total alteration of the course of the same, aiming at overlapping the road.

https://dx.doi.org/10.22161/ijaers.6734 ISSN: 2349-6495(P) | 2456-1908(O)

Fig.15 - Course of a creek altered by the removal of sands

Source: Authors (2018)

Removal of material from backhoes, excavating the existing sands in the course of the stream, called "Mari Creek", and placing the material removed on the road, will consequently alter the flow of the waters of its sub-fluids during the floods, and provoke erosion at the edges of it. To make matters worse, not only the material from the streams, but also from areas completely covered with vegetation was removed, as shown in the following figures (16 A and B).

Fig.16 - Extraction of material for road burial

Source: Authors (2018)

All the excavated material leaves "open skies" where the soil remains bare and the particulate material is left in place when it is not removed and intended for road works. The countless open craters, in addition to causing soil/subsoil erosion, fill with water in the rainy season, and cause small and medium-sized jams and animal deaths, causing even more damage to small local farmers.

Altogether there were 20,945 hectares of suppressed vegetation, an incalculable damage, and impossible to be valued environmentally, given the rich flora lost. What was not visualized by the researchers in any consulted document were the constraints listed by the environmental agency of the municipality of Juazeiro, regarding the environmental compensation concerning the damage caused to the caatinga biome.

The company that causes all the impacts demonstrated (Mineração Caraíba S/A) does not show concern for the reparation of environmental damage, but rather, to compensate for environmental damages with social actions, which differs from what the legislation says. It is valid to clarify that one thing is environmental compensation, another is social compensation, or social compensation.

After verifying the environmental damage caused by the implementation of the road under discussion, the Riacho do Mari Community Association implemented a formal invitation to the legal representative of Mineração Caraíba S/A requesting plausible justifications regarding the absence of dialogue with the Paredão community, victim of the Red Mines Project.

Two meetings were held with representatives of the company, where it was questioned: 1. The reasons why the ACRM was not consulted or informed of the possible socio-environmental damages that would be suffered by the construction of the road; 2. Why did the company not formally inform the objective of aerial monitoring carried out on the community, from aerophotogrammetry with probes? 3. Why was the company looking for individual owners for "exchange of favors" and/or social, non-environmental, and collective compensation?

These and other inquiries were not appreciated by the company, which decided to no longer dialogue with the representatives of the Community Association, implying that it had no intention of bearing the environmental consequences, much less, to carry out a PRC Caatinga) in the Paredão pasture area.

By refusing to continue dialogue with the residents, legally represented by the association, what position should the Paredão community take? 1. Seek dialogue (only formal - legal and via association/representatives); 2. To leave aside the exchanges of individual favors (environment is patrimony and the people who inhabit it have a duty to care); 3. To revoke any and all informal authorization by signing documents of one or the grantees (the territory that is surrounded is of each owner, however, what is not surrounded is common to all, and of collective use, thus characterizing area of grass background); 4. Avoid accepting "individualized improvements", so as not to strengthen the spirit of competitiveness and territorial disagreements; 5. Finally, understand that environmental damage cannot be "compensated only by social actions", but rather, should follow environmental legislation.

In this sense, activities and undertakings that use environmental resources, as well as those capable of causing environmental degradation, depend on prior environmental licensing, in accordance with the provisions of Law 10,431 of December 20, 2006 and its regulations. The exploitation of deposits (rock, sand and special soils) should be considered in the analysis of the

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

road or highway project and when not contemplated in said project will be subject to specific licensing.

It is worth mentioning that the main socioenvironmental damages caused to the population of Paredão and its surroundings were:

1. To health (dust / soot);
2. Security (proximity to strangers who travel inside the inhabitants' lands);
3. Malaise of the population (due to dissatisfaction and lack of respect for a centennial community in the region);
4. As atividades sociais e econômicas estão prejudicadas (pecuária – caprinos, ovinos e bovinos afugentados);
5. To biota (accidents involving domestic and domestic animals);
6. Birds scared by the noise and movement of cars;
7. The aesthetic and sanitary conditions of the environment (in calamity - vegetation covered by dust, without photosynthesis, without evapotranspiration) as it is possible to see in figure 26;
8. Risks of erosion and silting during and after the operation;
9. The quality of environmental resources is totally compromised.

Therefore, an Environmental Impact Assessment (EIA) is indispensable, which is defined as a set of procedures capable of ensuring, from the beginning of the process, a systematic examination of the environmental impacts of the project and its possible alternatives, as well as, that the results thereof are presented in a manner appropriate to the public authority and society (CUNHA; GUERRA, 2009).

Fig.26 - State of the tree due to the dust of the car flow
Source: Authors (2018)

In this sense, art. 20, inc. IX, of the Federal Constitution, affirms that mineral resources are Union assets, and that research and development of such resources can only be made through its authorization or concession (article 176, paragraph 1), being common competence of the Union, States, Federal District and Municipalities, to register, monitor and supervise the concessions of rights of research and exploitation of mineral resources in their territories (article 23, XI, CF).

Based on this, the Mining Code (Decree-Law No. 227 of February 28, 1967), in relation to the environment, provides in its art. 47, that it is incumbent on the mining company to respond for damages and losses to third parties, resulting directly or indirectly from mining (inc. VIII), and to avoid pollution of the air or water that may result from mining work).

Therefore, it is incumbent upon the municipality of Juazeiro, which granted the license for the construction of the road, to follow up and inspect the damages, aiming at the implementation of a PRAD that will mitigate all damages caused in the focus area of this study. To the community harmed by the environmental damages practiced by the mining company, it is the role of understanding that it is everyone's duty to take care of the environment, for the healthy quality of life.

V. FINAL CONSIDERATIONS

This research, aiming to meet the objectives and based on the adopted methodology, comprised the ecodynamics of the studied landscape in the Paredão Community in the north of the State of Bahia, identifying the processes of environmental degradation provoked by the mineral exploration, besides analyzing the levels of stability of the system environmental, discussing forms of conservation of this biome, which is a representative of the climatic characteristics of the Brazilian semi-arid.

Regarding the observations and analyzes made, it was verified that the studied area is highly degraded, considering the environmental impacts present in the investigated geosystem, based on the precepts of Tricart (1997), where, in turn, it was verified that the research area is classified in the stable, intergrades and highly unstable areas and, because of this, it is necessary an urgent awareness regarding the management and territorial planning of the area.

Finally, this research does not have a conclusive character and it is not intended to exhaust all the debate on the subject in focus, considering the relevance of this discussion in the present days and in the scope of the management and organization of the environmental territories, taking into account that ecosystems, especially those of caatinga, are changeable both by their natural dynamics and by the social dynamics that surround it. Therefore, research and debate continue beyond the end of this article.

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

REFERENCES

[1] BRASIL. Departamento Nacional de Produção Mineral. Anuário Mineral Brasileiro: Principais Substâncias Metálicas/Coord. Geral Wagner Fernandes Pinheiro, Osvaldo Barbosa Ferreira Filho, Carlos Augusto Ramos Neves; Equipe Técnica por Marina Dalla Costa... [et. al.]: – Brasília: DNPM, 2018. 33 p. Disponível em: http://www.anm.gov.br/dnpm/. Acesso em: 14/04/2019.

[2] FRÁGUAS, Sérgio. Reflexos do Novo Marco da Mineração nas Mineradoras com lucratividade marginal. Rio de Janeiro, 2013. Disponível em: < http://www.adimb.com.br/site/palestras/09ago_manha/03_ SergioFraguas.pdf>.Acesso em: 21/09/2018.

[3] TRICART, J. Ecodinâmica. Rio de Janeiro. IBGE-SUPREN, 1977.

[4] BERTRAND, G.; BERTRAND C. Uma Geografia Transversal e de Travessias: o meio ambiente através dos territórios e das temporalidades. Maringá: Mossoni, 2007.

[5] FILGUEIRAS, T. S.; NOGUEIRA, P. E.; BROCHADO A. L.; GUALA II, G. F. Caminhamento - um método expedito para levantamentos florísticos qualitativos. Cadernos de Geociências, 12: 39-43, 1994.

[6] BARDIN, L. Análise de Conteúdo. SP: Edições 70, 2011.

[7] FILHO, André Danderfer. Quartzito azul com dumortierita e fosfatos de alumínio do Espinhaço setentrional, Bahia: mineralogia e petrogênese. Revista Brasileira de Geociências, volume 42(2) 2011; 2012. Disponível em: < http://www.ppegeo.igc.usp.br/index.php/rbg/article/viewFile/7895/7322 >. Acesso em: 21/09/2018.

[8] BLOG DO CARLOS BRITO. Mina de cobre descoberta em Juazeiro pode injetar cerca de R$ 400 milhões na economia da cidade (2015). Disponível em: https://www.carlosbritto.com/mina-de-cobre-descoberta-em-juazeiro-pode-injetar-cerca-de-r-400-milhoes-na-economia-da-cidade/.Acesso em: 13/04/2019.

[9] CBPM. Companhia Baiana de Pesquisa Mineral. 2013. Memórias de 40 anos de Sucesso. Coord. Hélio C. Azevedo. Salvador: CBPM.

[10] INFORMATIVO MENSAL DE MINERAÇÃO (IMM) - ANO 8 Nº 03, 2019. Secretaria de Desenvolvimento Econômico da Bahia (SDE). Disponível em: http://www.cbpm.ba.gov.br/arquivos/File/Sumario_Mineral_da_Bahia/2019/Marco.pdf. Acesso em: 20/04/2019.

[11] SECRETARIA DE DESENVOLVIMENTO ECONÔMICO DA BAHIA (SDE). Panorama do Setor Mineral Baiano. 2008. Disponível em: http://www.cbpm.ba.gov.br/modules/conteudo/conteudo.php?conteudo=35. Acesso em: 21/04/2019.

[12] DIARIO OFICIAL DO MUNICIPIO DE JUAZEIRO/BA. Resolução n. 144/2018. Edição 1.264 — Ano 616 de julho de 2018 p. 88- 91. Concede Licença Ambiental Simplificada em favor da Pessoa Jurídica CSSA CONSTRUTORA SÃO SALVADOR EIRELI e dá outras providencias. Disponível em: http://doem.org.br/ba/juazeiro/diarios/previsualizar/8wVw9ea6?filename=DOE-ba_juazeiro-ed.1264-ano.6.pdf&_cb=20180716170858.Acesso em: 06/06/2019.

[13] BRASIL. Conselho Nacional de Meio Ambiente (CONAMA). Resolução Nº 001, de 23 de janeiro de 1986. Disponível em: <http://www2.mma.gov.br/port/conama/res/res86/res0186.html>. Acesso em: 22/09/2018.

[14] BRASIL. Conselho Nacional de Meio Ambiente (CONAMA). Resolução nº 237, de 19 de dezembro de 1997. Disponível em: http://www2.mma.gov.br/port/conama/res/res97/res23797.html.Acesso em: 06/07/2019.

[15] BRASIL. Conselho Nacional de Meio Ambiente (CONAMA). Resoluções vigentes publicadas entre setembro de 1984 e janeiro de 2012. Brasilia/DF, 2012.

[16] INSTITUTO HABILIS (2017) Mapa da Mina de Vermelhos. Disponivel em: http://institutohabilis.com.br/ep/vermelhos/.Acesso em: 06/06/2019.

[17] DIARIO OFICIAL DO MUNICIPIO DE JUAZEIRO/BA. Resolução SEMAURB n. 152/2018. Concede Autorização de Supressão de Vegetação Nativa em favor da Pessoa Jurídica CSSA CONSTRUTORA SÃO SALVADOR EIRELI e dá outras providencias. Disponível em: http://doem.org.br/ba/juazeiro/diarios/previsualizar/g3aB3Lj1?filename=DOE-ba_juazeiro-ed.1271-ano.6.pdf&_cb=20180725170434.Acesso em: 06/06/2019.

[18] MEIRELLES, Hely Lopes. Direito Administrativo Brasileiro. 33 edição atualizada. São Paulo: Editora Malheiros, 2007.BRASIL. Decreto nº 97.632 de 10 de abril de 1989. Disponível em: <http://www.planalto.gov.br/ccivil_03/decreto/1980-1989/d97632.htm>. Acesso em: 25/09/2018.

[19] DIARIO OFICIAL DO MUNICIPIO DE JUAZEIRO/BA. Decreto n. 539/2018. Institui Servidão Administrativa e declara de Utilidade Pública as áreas indicadas e dá outras providencias. Disponível em: http://doem.org.br/ba/juazeiro/diarios/previsualizar/R0jOo8jM?filename=DOE-ba_juazeiro-ed.1.251-1-ano.6.pdf&_cb=20180626170743. Acesso em: 06/06/2019.

[20] MARQUES, Leônidas de Santana. As comunidades de fundo de pasto e o processo de formação de terras de uso comum no semiárido brasileiro. Soc. & Nat., Uberlândia, 28 (3): 347-359, set/dez/2016.

[21] DIAMANTINO, P. T. "Desde o raiar da aurora o sertão tonteia": caminhos e descaminhos da trajetória sócio jurídica das comunidades de Fundos de Pasto pelo reconhecimento de seus direitos territoriais. 2007. 143f. Dissertação (Mestrado em Direito) – Programa de Pós-Graduação em Direito da Faculdade de Direito da Universidade de Brasília, Brasília, DF, 2007.BRASIL. Conselho Nacional de Meio Ambiente (CONEMA). Resolução do CONAMA no 2 de 18 de abril de 1996. Disponível em: <http://www2.mma.gov.br/port/conama/res/res96/res0296.html>. Acesso em: 22/09/2018.

https://dx.doi.org/10.22161/ijaers.6734 *ISSN: 2349-6495(P) | 2456-1908(O)*

[22] GIL, Antonio Carlos. Métodos e técnicas de pesquisa social. 5. ed. São Paulo: Atlas, 1999.
[23] ANDRADE, M. M. de. Introdução à Metodologia do Trabalho Cientifico elaboração de trabalhos na graduação. 5ª edição. São Paulo: Atlas, 2006.
[24] CERVO, Amado Luiz; BERVIAN, Pedro Alcino; DA SILVA, Roberto. Metodologia Científica. 6. ed. São Paulo: Pearson Prentice Hall, 2007.
[25] ALCÂNTARA, D. M. de; GERMANI, G. I. Fundo de Pasto: um conceito em movimento. In: Encontro Nacional da Associação Nacional de Pós-graduação e Pesquisa em Geografia – ENANPEGE, 8, 2009, Curitiba, Anais. Curitiba, 2009.
[26] SANTOS, C. J. S. e. Fundo de Pasto: tecitura da resistência, rupturas e permanências no tempo-espaço desse modo de vida camponês. 2010. 290f. Tese (Doutorado em Geografia Humana) – Programa de Pós-Graduação em Geografia Humana da Faculdade de Filosofia, Letras e Ciências Humanas da Universidade de São Paulo, São Paulo, SP, 2010.
[27] ASSOCIAÇÃO PLANTAS DO NORDESTE (APN). Aroeira. 2015. Disponível em: http://www.cnip.org.br/bdpn/fotosdb/Aroeira.pdf. Acesso em: 21/04/2019.
[28] BRASIL. Lei nº 10.431 de 20/12/2006. Dispõe sobre a Política de Meio Ambiente e de Proteção à Biodiversidade do Estado da Bahia e dá outras providências. Disponível em: https://www.legisweb.com.br/legislacao/?id=121083.Acesso em: 06/06/2019.
[29] CUNHA, S.B.; GUERRA, A.J.T. Avaliação e Perícia Ambiental. – 9ª Ed. – Rio de Janeiro, Bertrand Brasil, 2009.
[30] BRASIL. Constituição da República Federativa do Brasil. 1988. Disponível em: < http://www.planalto.gov.br/ccivil_03/Constituicao/Constituicao.htm>. Acesso em: 22/09/2018.
[31] BRASIL. Decreto-Lei mº 227, DE 28 DE FEVEREIRO DE 1967. Dá nova redação ao Decreto-lei nº 1.985, de 29 de janeiro de 1940. (Código de Minas). Disponível em: http://www.planalto.gov.br/ccivil_03/decreto-lei/del0227.htm. Acesso em: 09/06/2019.