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TEMPORAL ANALYSIS OF LAND USE AND OCCUPATION IN THE MUNICIPALITY OF ITABERABA, BAHIA, BRAZIL

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RESUMO
O presente trabalho se propõe, em face das expressivas alterações de uso e ocupação da terra no semiárido brasileiro analisar as modificações espaciais dos principais tipos de uso e ocupação da terra no município de Itaberaba, numa escala temporal de 40 anos, considerando as datas de 1980, 2000 e 2020, a fim de contribuir nas tomadas de decisão quanto ao planejamento e ordenamento territorial. Para tanto foi elaborada uma revisão bibliográfica dos trabalhos que abordam o uso e ocupação da terra no município em questão, com uma breve síntese da formação histórica, econômica e social, assim como a aquisição e processamento de imagens de satélite Landsat-TM nos três períodos históricos com registros das classes de uso e ocupação desenvolvidas através do uso de SIG. Nesse sentido, no transcurso histórico-espacial de 40 anos, verificou-se que houve um aumento considerável das áreas de cultivos agrícolas e pastagens (com aumento de aproximadamente 400% da área coberta no município), de solo exposto e áreas urbanizadas em detrimento das áreas que correspondem à vegetação nativa do bioma caatinga local (as quais diminuíram mais do que 68% da cobertura no período analisado). Tais mudanças expressivas podem ser justificadas em consequência da expansão do cultivo de abacaxi (*Ananas comosus*) e pela implementação de indústrias no território municipal a partir dos anos 2000.

Palavras-Chave: Uso das terras; Abordagem histórica; Geoprocessamento.

ABSTRACT
The present work proposes, in face of the significant alterations of land use and occupation in the Brazilian semiarid region, to analyze the spatial modifications of the main types of land use and occupation in the municipality of Itaberaba, on a temporal scale of 40 years, considering the dates 1980, 2000 and 2020, in order to contribute to the decision making process regarding the planning and land use planning. To this end, a bibliographic review of the works that addresses land use and occupation in the municipality in question was elaborated, with a brief synthesis of the historical, economic and social formation, as well as the acquisition and processing of Landsat-TM satellite images in the three historical periods with records of the use and occupation classes developed through the use of GIS. In this sense, in the historical-spatial course of 40 years, it was verified that there was a considerable increase in the areas of agricultural crops and pastures (with an increase of approximately 400% of the area covered in the municipality), exposed soil, and urbanized areas to the detriment of the areas corresponding to the native vegetation of the local caatinga biome (which decreased more than 68% of the coverage in the analyzed period). Such significant changes can be justified as a consequence of the expansion of pineapple cultivation (Ananas comosus) and the implementation of industries in the municipal territory from the 2000s.
KEYWORDS: Land Use; Historical Approach; Geoprocessing.

INTRODUCTION

The alteration of natural environments by anthropic activities interferes directly and indirectly with their dynamics as a system, considering their flows of energy and materia CHRISTOFOLETTI, 1999). Such alterations, when they occur without the proper territorial planning, can cause consequences to the society that lives there in its physical, historical, cultural, and economic aspects in the long term, designating cause and effect relations on a wide space-time scale (ROSS, 2006; MEIRELES et al., 2007).

By considering the recognition of natural, social, economic, political, and cultural factors in a given territory, which dialectically reflect the operational vectors of land use and land cover dynamics, it is possible to use these as planning tools in different areas and scales of approach (VITOUSEK et al., 1997; SOUZA; REIS, 2020).

In the scenario in question, considering the geoenvironmental context of the Brazilian tropical semi-arid region, the compromise of natural environments for the benefit of areas dedicated to cultivation and livestock grazing or urban environments potentiate the effects of deforestation actions, the discharge of domestic and industrial effluents in intermittent and perennial river courses, as well as their silting, interfering with the balance between the fragilities and potentialities of the natural resources present (LIMA, 2018).

It should be added that the degradation of Brazilian semi-arid environments becomes even more striking in face of the level of population occupancy, associated with its natural evolutionary aspects. Given all the above, it was chosen to study the municipality of Itaberaba, located in the Mesoregion of Centro-Norte Baiano, Northeast region of Brazil. It is worth mentioning that the population of this municipality is estimated at 64,646 inhabitants, in a territory of 2,386 km² (IBGE, 2020).

As for the recognition of the natural factors of the municipality of Itaberaba, we highlight that its territory is inserted in the semi-arid morphoclimatic domain, whose climatic characteristics reach average annual temperatures around 24.6 °C, at an altitude of 265 meters, and rainfall ranging between 600 and 800 mm/year, distributed irregularly, with rainfall concentrated in April through July, with occurrences of relatively long periods of water deficit (INMET, 2021).

Such climatic aspects attribute to the hydrographic network a predominance of intermittent watercourses, especially in the west of the municipality, with the highest altimetric quotas and predominance of native vegetation. Among the perennial rivers we can mention the Paraguaçu the rivers Paraguaçu, Tupim, Santa Isabel, Piranhas, Espírito Santo, and Capivari. Yet in the municipal territory, the climatic factors directly influence the need for the construction of dams and reservoirs in order to enable agricultural and industrial economic activities, such as the Itaipu lake, inserted in the urban area. lake,

In studies by Lima et al. (2008) it is pointed out that the geomorphological aspects of Itaberaba are predominantly characterized by pediplains, marginal mountains located to the west of the territory, in addition to the mountains and plateaus of the middle Paraguaçu River, in the bordering territory to the southeast. Finally, on the pedological aspects, Red Latosols, Red-Yellow Argissols, and Vertissols predominate in the municipal territory (GAMA; JESUS, 2020). In general, such soils are deep, well developed, with medium to high clay content, without restrictions on use and management, except for the Vertissols, which tend to be poorly permeable, which restricts their drainage (EMBRAPA, 2021).

Given the aforementioned, the objective of this work is to analyze the spatial changes of the main types of land use and occupation in the municipality of Itaberaba, on a temporal scale of 40 years, considering the dates 1980, 2000 and 2020. Furthermore, this work is justified by the need to recognize the forms of occupation of space in decision making regarding the planning of use and occupation, seeking to promote the adequacy of uses to the natural aspects of the areas, an indispensable socioeconomic principle provided for in Brazilian legislation (BERNARDES; FERREIRA, 2003; SOUZA, 2015). As an example, it is worth mentioning the instruments of the National Policy for Protection and Civil Defense (PNPDEC), constituted by Federal Law 12.608/2012 (BRASIL, 2012), which has, among its fundamental principles, prevention actions and mapping of areas of use and occupation, as well as their integration with other sectoral policies, such as those of territorial planning, urban development and environment.

METHODOLOGY

To achieve the objectives proposed in this work, it was divided into three main stages: the first one consists of a bibliographic review of land use and occupation in semi-arid environments, such as those carried out in municipalities of the Center-North of Bahia, as well as a brief historical, agricultural and socioeconomic overview of the municipality in question. To this end, we used works by authors such as Brandão (2009), Santos (2010), Souza Júnior (2015) and Sodré (2018).).

The second stage of the work was composed of the acquisition and digital processing of Landsat-TM images with records of the existing land use and occupation classes, in a GIS environment, with the use of ArcGIS software (version 10.3) and the final writing of this work. The Land Use and Occupancy Maps of the Municipality of Itaberaba were made on a scale of 1:400.000. In order to establish comparative parameters, three satellite images were selected, and provided by the Image Generation Division (DGI-INPE, 2021), whose selection criteria corresponded to images that were captured in the same season of the year, in this case, winter, in order to avoid misinterpretation between the classes, since the vegetational characteristics change according to the seasons of the year (SILVA; CRUZ, 2018). The characteristics of the selected images are presented in Table 1.

Tabela 1 – Characterization of selected satellite images

Capture date	Satellite	Band Composition True Color
10/06/1980	Landsat 2	6, 5, 4
06/06/2000	Landsat 7	3, 2, 1
24/06/2020	Landsat 8	4, 3, 2

After selecting the satellite images in accordance with the proposed criteria, the land use and existing occupation classes in the municipality of Itaberaba were defined, adapted from the Technical Manual of Land Use of IBGE (2013), as follows: Urbanized Areas, Agricultural Crops/Grazing, Arboreal Caatinga, Bushy /Herbaceous Caatinga, Dams/Reservoirs, and Exposed Soil, as well as the cartographic conventions of color and description of each type of use and Afterwards, the digital processing of the Landsat-TM images was followed by the Maximum Likelihood Supervised Classification (MAXVER) method, in which the images were classified according to the reflectance values, obtained from training samples, of the different land cover types to be classified (SILVA; RODRIGUES, 2009). It is worth mentioning that such method was chosen in the absence

of the unsupervised classification method, due to the greater reliability of the results for the analyses. Given the above, to perform the supervised classification, the Image Classification toolbar was used; identification values (Id) were assigned; the Use Classes were named; finally, the attribute table was created and the respective values in area were calculated.

RESULTS AND DISCUSSION

Brief historical, social and economic considerations of the municipality of Itaberaba - Bahia

In order to understand the socioeconomic and historical formation of the Itaberaba municipality, it is necessary to briefly refer to the Brazilian colonial history and the process of occupation of the territory over the centuries by the Portuguese, especially regarding the Bahian sertão, given that the town still maintains, even today, in its socioeconomic conformation and in its cultural practices, activities that indicate links with this historical period.

After the consolidation of Portuguese settlements in the coastal regions in the first decades of colonization and the institution of an extractive policy with the creation of agricultural crops that would sustain the colonial expedition, there was an interest on the part of the Portuguese Crown to promote a widening of the Lusophone territorial borders beyond the Treaty of Tordesillas and explore the areas located west of the coast called sertão - a polysemic denomination sometimes used in a pejorative and stigmatized way to designate a social, economic and politically backward place -, something that was only possible decades later, around the middle of the 17th century, as a State policy (SOUZA JÚNIOR, 2015).

With the use of navigability through the Paraguaçu River, it was possible for the Portuguese to reach the current municipality of Cachoeira, which was the last navigable stretch in the lower Paraguaçu and was forged as a central point for incursions into the interior. As reported by Santos (2010), in 1657 instructions were passed from the governor-general to Pedro Gomes, sergeant major, to coordinate the process of building a path that would connect Cachoeira with the Serra do Orobó, which is located in the middle Paraguaçu. The purpose of this road was to build fortresses to defend against indigenous threats to the local parishes, as well as to allow the passage of ox carts carrying supplies.

However, this movement of exploration and occupation of the interior regions was only effectively consolidated in the nineteenth century, and at the beginning of this century that the resident farmer of the village of Porto de Cachoeira, Antônio de Figueiredo Mascarenhas and his wife Francisca Maria de Jesus acquired the land where today is located the old center of Itaberaba, calling it Fazenda São Simião, located southeast of Serra do Orobó. According to Brandão (2009, p. 62), "in those decades of the early nineteenth century, the settlement was beginning to grow and it was estimated to have less than ten houses with a population also estimated between thirty and fifty inhabitants".

With the initiative of the farmer to build a temple in honor of Our Lady of the Rosary, to which he was devoted and that gave the name to the parish, it was possible the local growth through the donation of small properties around the chapel, agricultural cultivation and cattle breeding, establishing a spatial configuration where the centrality was the hermitage square. In 1877 the parish was raised to the category of Village of N.

Sra. Do Rosário do Orobó and in 1897 received the toponym of Itaberaba being raised to the category of city (BRANDÃO, 2009).

It is important to emphasize that the process of land occupation of the city of Itaberaba until the end of the 1980s was due to its geographical location, which strategically received investments in infrastructure, with the construction of highways such as the BR-242, constituting a regional connection point between the Chapada Diamantina and the Recôncavo Baiano. However, with the introduction of pineapple cultivation under the model of family farming, still in this time frame, which had a great adaptability to the climatic and soil conditions of the region, the local spatial structure began to be modified, thus attracting new investments from the state (LIMA et al., 2008).

Meanwhile, the municipality of Itaberaba continued to develop as a result of the high productivity of the cultivation of pearl pineapple (Ananas comosus) and other agricultural products, perpetuating in cultural practices elements that recall its origins, such as the Cowboy Festival, which is held annually, and the June festivities, being the figure of the cowboy an element of great representation of the local identity of the countryside. In 2008 the municipality became the largest producer of pineapple in Bahia, being popularly nicknamed the "Capital of Pineapple", with a harvest of 86,420 thousand fruits, marked as the year of highest production volume (SODRÉ, 2018; IBGE, 2021).

According to Oliveira (2013), in 2005 an industrial plant of the Dass Group was built in Itaberaba, which is responsible for the outsourced production for Fila, Nike, and Umbro brands, which stimulated a transformation in the local production structure, creating more than a thousand jobs and attracted other industrial and commercial investments to the city. Currently, with the strength of the commercial and industrial branches, the agricultural sector presented an expressive decrease in its production, given that in 2019 the smallest amount of pineapple fruits the historical records were registered, being a total of 18,000 thousand fruits (IBGE, 2019). Such historical-social and economic realities reflect directly and indirectly in the dynamics of land use and occupation in the municipal territory, in a dialectical relationship, as addressed below.

Dynamics of Land Use and Occupancy in the Municipality of Itaberaba, over a time scale of 40 years

According to the spectral response resulting from the image classification, detailed in the methodology, it was possible to evaluate, on a temporal scale, the predominant land use and land cover types in the municipality of Itaberaba, as well as to measure the amount of area occupied by each pre-defined class, in order to understand how the historical contexts reflected on the land use and occupation in the territory. The results were spatialized in Figures 1, 2 and 3.

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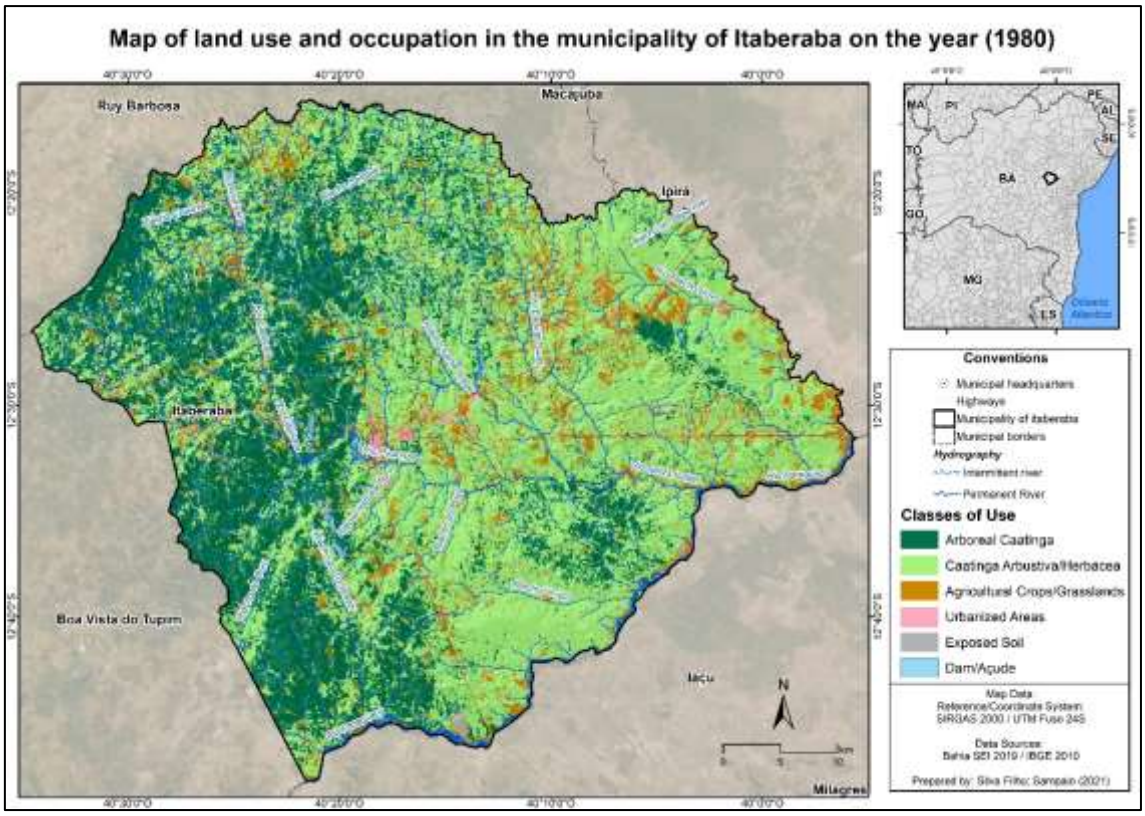

Figure 1: Map of land use and occupation in the municipality of Itaberaba on the year 1980
Source**:** research authors.

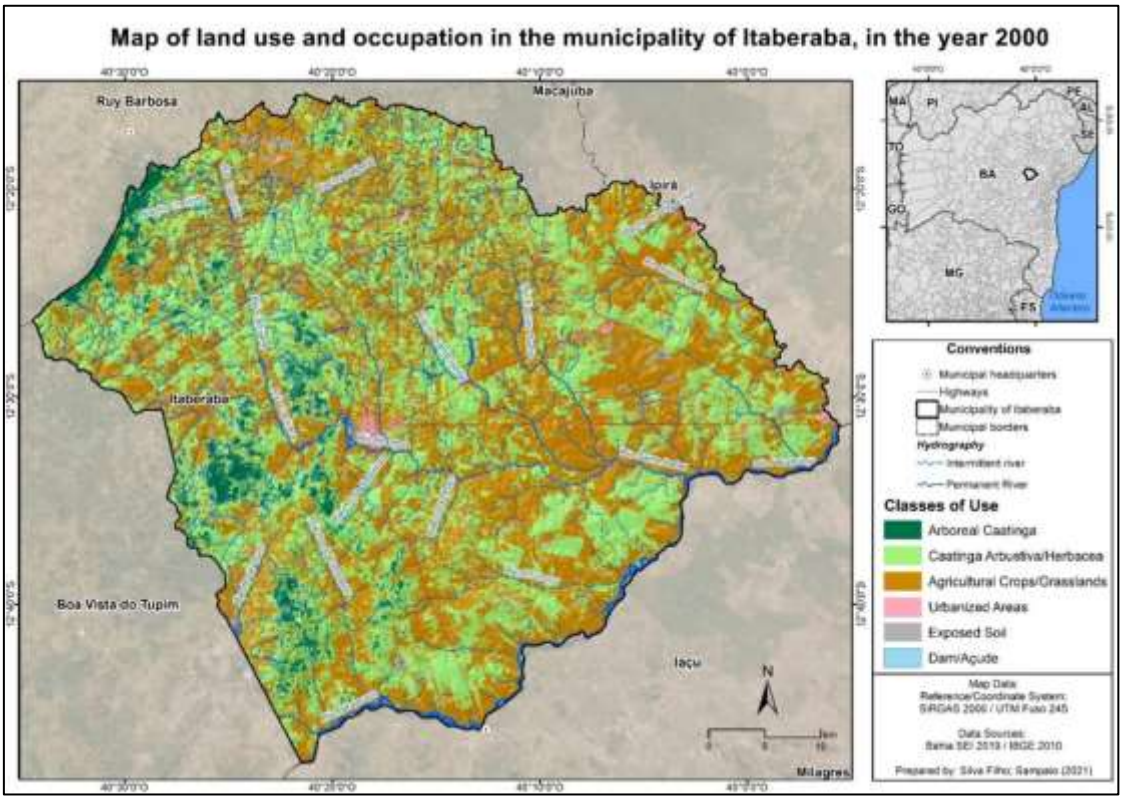

Figure 2: Map of land use and occupation in the municipality of Itaberaba, in the year 2000
Source: research authors.

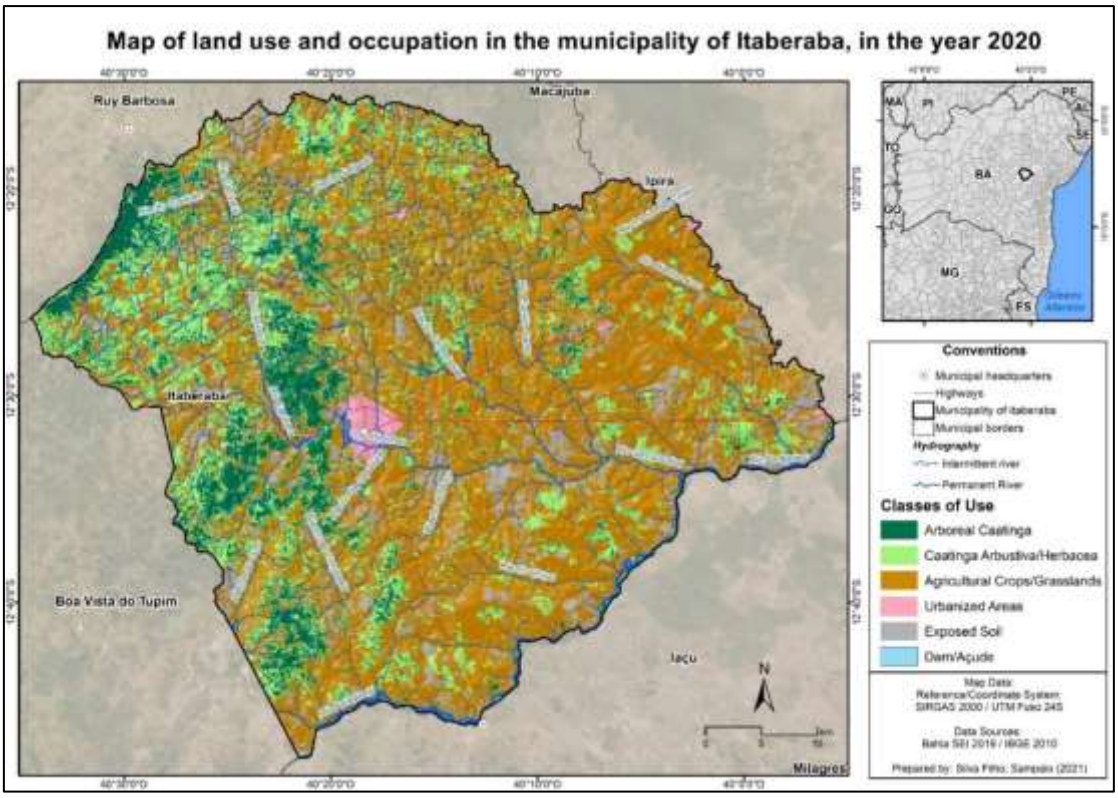

Figura 3: Map of land use and occupation in the municipality of Itaberaba, in the year 2020
Source: research authors.

In the year 1980, the predominant type of use in the municipality of Itaberaba was the Shrub/ Herbaceous Caatinga, whose characteristics range from a grassy-ligneous vegetation, dominated by herbaceous elements, with the presence of woody individuals (smaller trees or shrubs) sparse or in isolated clusters, to species up to 3 meters high (SILVA; CRUZ, 2018). In 1980, such class occupied 1,334.8 km², about 56% of the municipal territory. In 2000, its occupied area decreased drastically, due to the expansion of pasture areas and agricultural crops, totaling 1,019.8 km², or 42% of the municipality. This natural vegetation suffered an even more representative decrease when compared to the year 2020, occupying only 488.6 km², approximately 20% of the territory.

The class called Caatinga Arbórea is composed of dense vegetation, with a predominance of species larger than 3 meters, dominated by woody elements. Such class encompasses the open arboreal caatinga, if the treetops do not touch, or closed if the treetops intertwine (SILVA; CRUZ, 2018). In the year 1980, this type of vegetation was the second most representative in the study area, with 742.3 km², more than 30% of the municipality of Itaberaba. Also due to the expansion of grazing areas, this class suffered a decrease in the year 2000, reaching 113 km², only 4.7% of the municipal territory. In the year 2020, there was a recovery of the arboreal vegetation, reaching 232 km², about 9% of the total. It is inferred that this expansion occurred due to the implementation of environmental public policies for the preservation of the caatinga, as well as the new Forest Code (BRASIL, 2012). Currently, this kind is concentrated in areas with higher altimetric and slope levels, to the west of the municipal territory.

The class called Agricultural Crops/Pastures includes areas in which the soil is covered with grass and/or leguminous vegetation, whose activity is livestock raising with large

and medium-sized animals (IBGE, 2013). In the year 1980, the areas of grasslands and crops was the third most representative class of use in the municipality of Itaberaba, with 281.2 km² of area, approximately 12% of the total. Given the substitution of native vegetation environments, the areas dedicated to agriculture and cattle ranching began to occupy, in the year 2000, 1,152 km², approximately 49% of the municipality. The class became even more significant in the 2020 analysis, with 1,389.4 km², with a total area of almost 60% of the territory.

The class called Urbanized Areas represents the spaces of intensive use, structured by buildings and road system, where non-agricultural artificial surfaces predominate (IBGE, 2013). In 1980, these areas were restricted to the municipal seat and its surroundings, with little representation of other urban centers in rural areas, totaling 10.2 km², only 0.4% of the municipality. In 2000, these areas totaled 15.8 km², with an expansion of the municipal seat and creation of new districts in the rural area, representing 0.6% of the municipality of Itaberaba. In the year 2020, the urbanized areas went on to occupy 29.5 km², doubling, in relation to the year 2000 analysis, to represent 1.2% of the total. This significant increase occurred, mainly, due to the implementation of the footwear industry (in 2005), resulting in a greater demand for labor and consequent expansion of services and of the city, as mentioned in the previous topic.

Strictly related to the areas of agricultural activities, as well as urban, is the Exposed Soil class, which refers to the extensions of sand or pebbles, such as stream courses with torrential regimes, abandoned areas without vegetation cover; or areas covered by exposed bare rock. It is worth mentioning the evolution of this type of use, since its increase was significant in the time scale of analysis, also due to the environmental problems related to the loss of fertile soils, the possibility of accelerating geomorphologic processes of erosion, and sediment transport. In 1980 this class occupied 5.7 km², less than 0.2% of the municipality. In the year 2000, this area grew to about 72 km² or 3% of the total. It is inferred that the growth of this class in the last period analyzed was due to the abandonment of land in rural properties previously devoted to pineapple cultivation.

Finally, the class that encompasses lentic environments, dams, and reservoirs, has not undergone significant changes in the study area, occupying an average of 13 km², approximately 0.5%. As for the water bodies, it is worth highlighting the evidence of a decrease in forested areas around intermittent channels, mainly in the west of the municipal territory. Among its consequences, one can mention the reduction of the flow capacity of the fluvial waterways, and its systemic reflexes on the perennial channels, a potential increase in siltation, among others (CUNHA, 2003).

FINAL REMARKS

Regarding the historical process of land use and occupation in the municipality of Itaberaba highlighted in this work, it was possible to note, through the classification of the Landsat-TM satellite images, expressive alterations, especially in the classes that concern the natural physiognomies of the caatinga, where these have diminished drastically in favor of the large advance of pastures and agricultural crops. In addition, due to the spatial alterations promoted through fiscal incentives for the implantation of industries and the expansion of commercial services, there has been a doubling of urbanized areas over the last two decades.

Therefore, in view of the above, and considering that the caatinga, as well as the cerrado, are biomes that in recent decades with the expansion of the Brazilian agricultural frontier have suffered from a process of significant deforestation, culminating in several environmental problems such as soil impoverishment, desertification, and extinction of endemic fauna and flora, it is essential to seek, at the level of regional territorial planning, environmental public policies for monitoring and protection of these domains, such as legal measures of tax incentives for ecological conservation in rural properties.

REFERENCES

BERNARDES, J. A.; FERREIRA, F. P. M. Sociedade e natureza. In: CUNHA, S. B.; GUERRA, A. J. T. (Orgs.). **A questão ambiental**: diferentes abordagens. Rio de Janeiro: Bertrand Brasil, 2003. p. 17-42.

BRANDÃO, M. S. A construção do espaço: o caso de Itaberaba. **GeoTextos**, vol. 5, n.1, p. 59-87, 2009. Disponível em: https://cienciasmedicasbiologicas.ufba.br/index.php/geotextos/article/view/3569/2632. Acesso em: 15 jul. 2021.

BRASIL. **Lei n. 12608, de 10 de abril de 2012**. Instituiu a Política Nacional de Proteção e Defesa Civil. Brasília, Disponível em: <http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12608.htm> Acesso em: 20 set. 2019.

CHRISTOFOLETTI, A. **Modelagem de sistemas ambientais**. Editora Blucher, 1999.

SERVIÇO GEOLÓGICO DO BRASIL – CPRM. **Programa Levantamentos Geológicos Básicos do Brasil:** FOLHA ITABERABA. 2006. Disponível em: <https://rigeo.cprm.gov.br/bitstream/doc/21309/1/relatorio_litogeoquimica_itaberaba_2006.pdf>. Acesso em: 15 jul. 2021.

SERVIÇO GEOLÓGICO DO BRASIL – CPRM. **Programa Levantamentos Geológicos Básicos do Brasil:** Projeto Itaberaba – Feira de Santana. 2021. Disponível em: <http://www.cprm.gov.br/publique/Geologia/Geologia-Basica/Projeto-Itaberaba---Feira-de-Santana-328.html>. Acesso em: 12 jul. 2021.

CUNHA, S. B. da. Canais fluviais e a questão ambiental. In:CUNHA, S. B. da; GUERRA, J. T. **A questão ambiental: diferentes abordagens**. Rio de Janeiro:Bertrand Brasil.2003.250 p.

EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA – EMBRAPA. **Bioma Caatinga – Vertissolos**. 2021. Disponível em: <https://www.agencia.cnptia.embrapa.br/gestor/bioma_caatinga>. Acesso em: 15 jul. 2021.

GAMA, D. C.; JESUS, J. B. de. Principais solos da região Semiárida do Brasil favoráveis ao cultivo do Eucalyptus L'Heritier. **BIOFIX Scientific Journal**, v. 5, n. 2, p. 214-221, 2020. Disponível em: <https://revistas.ufpr.br/biofix/article/view/70968>. Acesso em: 15 jul. 2021.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE. **Cidades: Itaberaba**. 2020. Disponível em: <https://www.ibge.gov.br/cidades-e-estados/ba/itaberaba.html>. Acesso em: 15 jul. 2021.

_____. **Produção Agrícola Municipal.** 2019. Disponível em: https://sidra.ibge.gov.br/pesquisa/pam/tabelas Acesso em: 23 jul. 2021.

_____. **Manual técnico de Uso da Terra**. 2013. 3ª Ed. Rio de Janeiro.

INSTITUTO NACIONAL DE METEOROLOGIA – INMET. **Gráficos Climatológicos:** Itaberaba. 2021. Disponível em: <https://clima.inmet.gov.br/GraficosClimatologicos/DF/83377>. Acesso em: 15 julho 2021.

LIMA, A. P. de A.; SANTOS, H. S. B. dos; OLIVEIRA, J. L. de; SANTOS, R. L. A influência do relevo no uso e ocupação do solo: uma breve análise das regiões de Itaberaba e Lençóis – BA. In: SIMPÓSIO NACIONAL DE GEOMORFOLOGIA, 7., 2008, Belo Horizonte. **Anais Eletrônicos** [...]. Belo Horizonte: União de Geomorfologia Brasileira, 2008. Disponível em: http://lsie.unb.br/ugb/sinageo/7/1003.pdf. Acesso em: 20 jul. 2021.

LIMA, K. C. **O Holoceno superior na bacia do rio Itapicuru (Bahia/Brasil):** proposição de cenário para o baixo curso e planície costeira. 2017. 1 recurso online (127 p.). Tese (doutorado) - Universidade Estadual de Campinas, Instituto de Geociências, Campinas, SP. Disponível em: <http://www.repositorio.unicamp.br/handle/REPOSIP/325411>. Acesso em: 2 set. 2018.

MEIRELLES, M. S. P.; JONATHAN, M.; FERRAZ, R. D.; ARVOR, D. Subsídios da Geomática para a Avaliação da Influência da Dinâmica do Uso do Solo nos Serviços Ecossistêmicos, 2007. In: BRANQUINHO, F.; FELZENSZWAL, I. **Meio Ambiente:** Experiências em pesquisa multidisciplinar e formação de pesquisadores. Ed. Mauad Ltda, Rio de Janeiro, p. 113-130, 2007

OLIVEIRA, I. R. **Indústria de calçados e implicações socioespaciais: a grande fábrica de calçados no município de Santo Estevão-BA**. 2012. 150 f. Dissertação (Mestrado em Geografia). Instituto de Geociências, Universidade Federal da Bahia, Salvador. 2012. Disponível em: <https://repositorio.ufba.br/ri/bitstream/ri/19793/1/Ildo%20Rodrigues%20Oliveira.pdf> . Acesso em: 25 jul. 2021

ROSS, J. L.S. **Ecogeografia do Brasil**: Subsídios para planejamento ambiental. 1ª ed. Editora Oficina de Textos, São Paulo, 2006.

SANTOS, M. T. A. dos. **Fronteiras do sertão baiano: 1640-1750**. 2010. 433 f. Tese (Doutorado em História). Faculdade de Filosofia, Letras e Ciências Humanas, Universidade de São Paulo, São Paulo. 2010. Disponível em: https://www.teses.usp.br/teses/disponiveis/8/8138/tde-09072010-133900/publico/2010_MarcioRobertoAlvesdosSantos.pdf. Acesso em: 10 jul. 2021.

SILVA, D. V. S.; CRUZ, C. B. M. Tipologias de Caatinga: Uma Revisão em Apoio a Mapeamentos Através de Sensoriamento Remoto Orbital e GEOBIA. **Revista do Departamento de Geografia**, v. 35, p. 113-120, 2018.

SODRÉ, A. S. R. A Forja do Vaqueiro no Sertão de Itaberaba-BA. **Revista Historiador**, *[S. l.]*, n. 10, 2018. Disponível em: https://www.revistahistoriador.com.br/index.php/principal/article/view/190. Acesso em: 29 jul. 2021.

SOUZA JÚNIOR, T. B. de. **“Pedra que Brilha” em uma região sertaneja:** institucionalização, poder e sociedade (1850-1888). 2015. 142f. Dissertação (Mestrado em História). Universidade Estadual de Feira de Santana, Feira de Santana. 2015.

SOUZA, S. O. Geotecnologias Aplicadas a análise espaço temporal do Uso e da Ocupação da Terra na Planície Costeira de Caravelas (BA). **Boletim Goiano de Geografia**, v. 35, n. 1, p. 71-89, 2015.

SOUZA, S. O.; REIS, Fe. S. Evolução Espaço-Temporal do Uso e Ocupação do Município de Senhor do Bonfim, Bahia. **Geoambiente On-line**, n. 38, p. 106-128, 2020.

VITOUSEK, P. M.; MOONEY, H.A.; LUBCHENCO, J.; MELILLO, J. M. (1997) Human domination of Earth's ecosystems. **Science**, v. 277, n. 5325, p. 494-499.