Environmental Degradation and Loss Biodiversity with Use of the Magnetic Radiation

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Abstract. Environmental impacts caused reductions in the maintenance of biodiversity, pollute water bodies, air, and soil. The objective of this research was to associate the use of georeferencing with analysis of environmental classes, areas of permanent protection, land use and occupation, biodiversity conservation, and water quality despite multiple applications. The data obtained and analyzed in the 60 selected literature indicated that the use of magnetic radiation via geoprocessing is already applied efficiently and effectively in mapping APP's (n = 20%); biodiversity (n = 18.3%) fires, burn and hot spots (n = 21.6%); degradation (n = 31.6%), and hydro resources (n = 15%), in regions subject to drought or not. It realized that the use of this system is essential for environmental management in whatever class one wishes to monitor or analyze, including the conservation of biodiversity.

Key words: quality of life, global conservation, geographic information system

Introduction

Environmental degradation and biodiversity loss can be informers through magnetic radiation. A question, today, has anthropic actions provided changes in the atmosphere? And water? The soil? Biodiversity? A quality of human life will measure by the amount of forest and water quality, the health of the community (Cambraia Filho, 2019).

The use of geoprocessing in environmental evaluation is an association between the design geospatial and scale used and the environmental conditions. After, the results have analyzed with statistical study and visual (Barcellos and Bastos, 1996).

On a degradation has a character-specific: in APP. These are habitat-specific and born for the species of the birds, butterfly, bees, snakes, crabs, fishes, plants, and other aspects, However, degradation of the hem caused by the loss of biodiversity of those animals. The studies (Campos et al., 2016; Leal et al., 2013) show the extensions of this.

Another observation is about the actions for the delimitations of those areas because those are not delimited. In the Pará State, Mãe do Rio District in the urban zone occurred in 2014 (Silva et al., 2014). In the other states of Brazil too: Pontão – RS (Lima, 2015), Cruz das Almas – BA (Magri and Baião, 2016), and Porto Velho -RO (Silva et al., 2017).

The Brazil Energetic Matrix is not limited because this country localized on the Equator line. The index sunlight is the best source for development energy and conservation of the forest and conservancy of the soil, shallow water, atmosphere, wildlife in the Brazilian biomes, biodiversity, and guaranteed quality energy because her not produce the waste solid to environmental pollution (Casar, 2018).

The maintenance of the forest is necessary because she promotes the absorption of the carbon dioxide (CO_2) and liberation of the oxygen gas, and this is a purification of the atmospheric air. The condition necessary for life on the planet and after the vegetation diversity increment for the factors of the dissemination of the seeds across the birds, butterfly, wind, human, and water, and today this is our humanity problem (Pons and Pejon, 2008).

The environmental resources (water, air, and soil) are explored for the human to urbanization because the population has grown, need to increase the pasture, agricultural

production, and this cause impacts (e.g., climate change), but this is not all, the deforestation is cause loss in the diversity (e.g., animals and plants) because occurred the lost the habitat, and the most important, the quality of life degraded day by day (Ferreira and Ferreira Neto, 2018). Other aspects directed to the hydrographic basin, the hydric bodies need of the ciliary forest, to the protection of the water quality, irrigation, supply of the city, basic human needs (e.g., to take a bath; foods). The rivers cross more states, nations, and the pollution can disseminate, and degraded plants, animals, air and soil, lost permanent preservation areas (Silva et al., 2017).

The biodiversity studied by geoprocessing images that in extinction (e.g., lion monkey of the blackface), the reason for this, is the loss of habitat, considered an ecological region for the reproduction, nutrients, climate change caused for deforestation. The use of geoprocessing images takes a vision of the problem more clearly, and contribution to the elaboration of the laws more efficiently (Lorini; Persson and Silva, 1996).

Other species are under extinction (e.g., beans, rabbits). There is an insect that is more important on the earth because he is the best dispersion of the seeds in the world. Nevertheless, the loss of the flowers and pollen affects the distribution of the species, and this will cause their mass extinction, as well as a decrease in food production if the environmental humidity and temperature do not be more elevate (Gostinski, 2018).

The temporal parameters of biodiversity will affect relations with the time of the landscape modification and loss of species diversity. The results in ecological deficit on sensitive species because of the change or fragmentation is recent, but any stay in the area to proximal future is dependent on the stability of the population. For this, the study of the historical process modification in the landscape can help prevention to future loss (Uezu and Cullen Junior, 2012).

For to study all degradation, the use of the georeferencing is necessary because the images show a significant effect on the degraded area, show Hydrical bodies, the size of the deforestation, soil exposition, and all alterations after this action. In the Amazon, this s a fact because a technical manual elaborates for the Brazilian Institute of Geography and Statistics (IBGE, 2013).

All these problems justify this study and increase its relevance because it will generate data that will allow the development of environmental actions to mitigate the impacts identified with the use of georeferencing. So, the objective of this study answers a question: the use of georeferencing is a real contribution to the analysis, comprehension, and visualization of environmental degradation and biodiversity conservation?

Literature Survey

Environmental Degradation

Today, the degradation of natural resources accelerate because of the consumption of technology is more significant. Metals, wood, water for energy hydric, soil for food production, are some examples. However, this exploration caused more impacts on the environment. All this is a linkage between the use of the natural resources and loss of the biodiversity (Pereira Júnior and Pereira, 2017).

Problems of desertification cause the deforestation. The transformation of timber extraction in coal is frequently. For example, in the Cerrado biome, the removal of wood to turn it into charcoal is a frequent activity, and this has caused problems of desertification and loss of native species of that locality (Correa, 2010).

Another highly exploited natural resource is ores. The excavations necessary to obtain such support causes the emission of particles with low density, and that take to the atmosphere, with that the air becomes contaminated by microorganisms until then in a state of latency, and

when inhaled by the human being, can cause problems for his health (Mechi and Sanchez, 2010).

Another environment most frequently explored is the soil to pasture degradation (global problem) and other economics activists. The real reasons for such action are numerous, for example, construction of roads and buildings, increasing the area of agricultural production (e.g., sugar, potato, watermelon), pasture, recreation, infrastructure in urbanized areas, among many other purposes, but all this occurs in an unplanned way (Almeida; Simões and Ferraz, 2019).

The growth of arable areas has caused an increase in the use and occupation of land without any management, and this has resulted, among other impacts, in erosion and loss of cultivable soils, and this can hinder food production, and make it impossible to replenish them because the disabling of the composition, and this does not allow anthropic recomposition (Vanzela et al., 2010).

Nevertheless, these impacts analyzed in association with, for example, vegetation, water, and soil. When deforestation occurs, whether marginal or not, rain falls on the earth already without the proper vegetation cover, and this causes the increase of surface runoff, sediment drag, and consequent transport to the water body that compromises the flow, due to loss of depth (Silva, 2013).

Biodiversity

The forest and water are the habitats of more studies. All environmental degradation at any level directly affects biological diversity, especially when there is a loss of 'habitat.' The most significant loss of biological diversity of concern is related to bees. In this case, georeferencing is useful because it identifies the loss of plant cover, especially those whose flowering is seasonal, and the dispersal of pollen is entomophily. It can help in the creation of Conservation Units for those species in extinction and thus contribute to the maintenance of biodiversity (Gostinski, 2018).

A method more efficient to study diversity biological is getting to know the habitat. The georeferencing is good because of the images of the area where be the animal or vegetable. Knowledge of topography, relief, rivers, the forest is necessary to study them and best to know behaviorism, reproduction, density, nutritional necessity (Carvalho and Carvalho, 2012).

Other studies can conduct with used images the distribution of the tree species in an area. The acquisition of aerial photographs makes it possible to identify and characterize the delivery, the situation of the endemic species and differences to exotic ones, the degree of fragmentation, and the original forest. It allows the characterization of the distribution, the domain, or not of a species (Santos; Oliveira and Espíndola, 2015).

Georeferencing

This process involves three colors components of the spectrum: red, green, and blue. The reflectance-based on the combination of these colors with special filters, and when the reflectance sees the object, is absorbed, the images formed, obtained in sizes different spectrum (Figure 1).

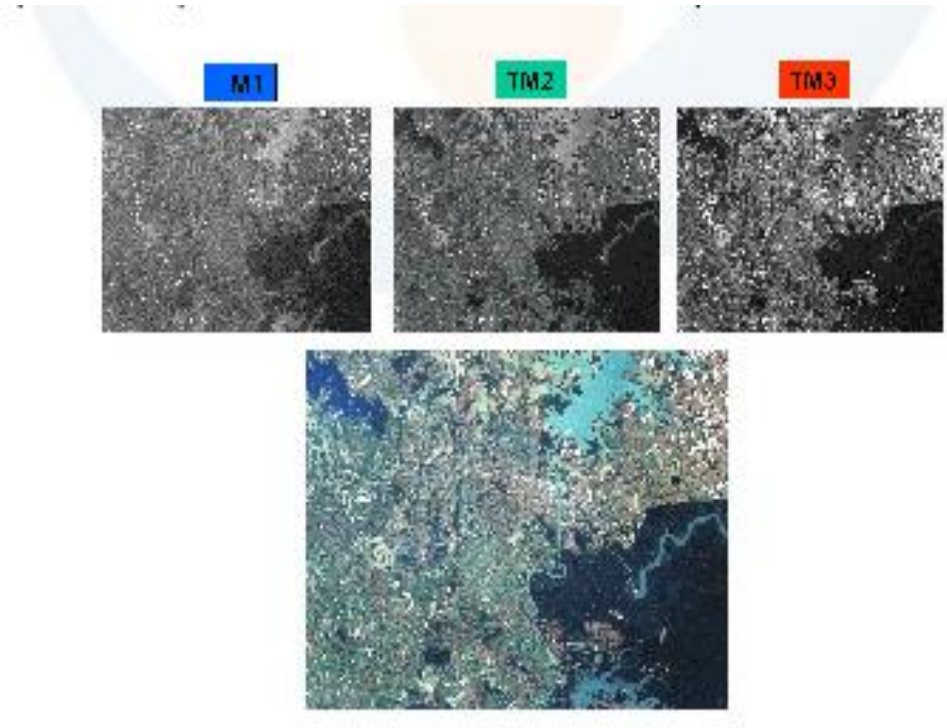

Figure 1. Three colors and final image after the filter. Image available at http://www3.inpe.br/unidades/cep/atividadescep/educasere/apostila.htm

Remote sensing, which appeared in 1960, is currently used in association with orbital components for a vision of aquatic and terrestrial ecosystems. The sensors capture the energy of the emitted object, are converted into a passive signal. In Brazil, the application of this system is essential for the management of environmental resources, their exploitation, and loss of biodiversity (Braúna and Cruz, 2009).

The function of sensing is the electromagnetic radiation captured from materials (rocks, soils, vegetation, water, buildings. The emission or reflection of the object detected in two ways: quantitative and qualitative interaction between all materials. The interpretations occurred to form the image of the area (imaging systems), graphics, or digits, called "non-imaging" (Guedes and Silva, 2018).

This system has the possibility for the maps actualization in the different scales about aspects spectrum, and temporal favored for environmental studies for the Biology, Geography, hydrographic basin, deforestation, soil degradation), used and soil occupation, urban expansion, risk area (Borges; Pacheco and Santos, 2015).

Guedes and Silva (2019) affirmed that the linkage between terrestrial surface objects is electromagnetic radiation (ER). The sensor analysis of the coverage vegetal has a principle the incidence and emission on the surface of the leaf (Figure 2a) because the sunlight in the colors RGB arrives at the superficial side and the reflation captured for imaging systems and divergence in and the different values that the reflection acquires (Figure 2b), denominates spectral signatures (Guedes and Silva, 2019; INPE, s/d).

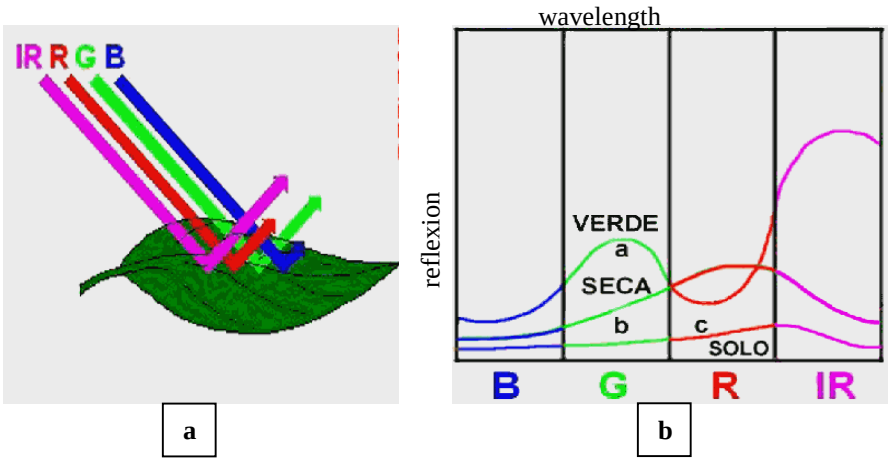

Figure 2. The reflation of leaf surface and wavelength, and de different values of the reflection Adapted from the original image available at http://www3.inpe.br/unidades/cep/atividadescep/educasere/apostila.htm

All-natural recourses and the earth are ever-changing. The method best for this identification is the sensor use because of can data collected in the extensive territory in the dimension's continentals' countries, for example, Brazil. Individual study of the resource is necessary to select the color band in association with the color (INPE, n/d) 1 - blue = 0.45 a 0.52 mm, water coast; the difference between soil and vegetation (coniferous and deciduous); 2 - green = 0.52 to 0,69 mm, vegetation mapping, water quality, and 3 - red = 0.63 to 0.69 mm, absorption of chlorophyll, urban areas, soil use, agricultural areas, water quality, and plant differences (Figure 3).

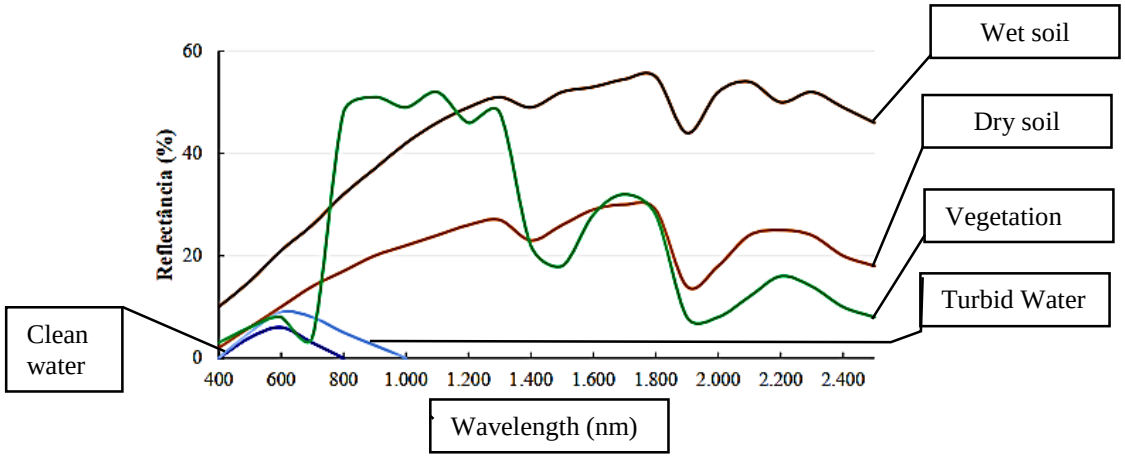

Figure 3. Spectral performance clear water, turbid water, dry and wet soil, and vegetation

Source: Adaptade the original in Cambraia Filho (2019).

The plants or vegetation of an area is identification under three aspects: (1) Leaf green index (GLI); (2) Normalization of Green, Red, Difference Index (NGRDI); (3) Vegetation index with atmospheric resistance to visible (VARI). After, with the images, is possible the formation of mosaics, and to determine the conditions of the landscapes, and conservation state (Cambraia Filho, 2019).

The use of geoprocessing for the soil is essential because the maintenance or conservation of this natural resource is necessary. The support of soil quality and fertility is crucial, for this o geoprocessing is an excellent tool. It is possible to see images degraded areas, erosion,

deforestation, maps for the environmental recuperation, new areas for plantations, pasture. For this and other facts, those images are vital for management sustainability. Besides, it is possible to model via thematic maps, the digital elevation models (DME) that allow a better understanding of the landscape — soil relationship (Souza and Silva, 2016).

For the hydrographic basin, the application of georeferencing can indicate the conditions in which the vegetation protects the springs, the margins of the water bodies and, with this, identify the degree of impacts degradation that can occur in those areas, and allow restorative, recuperative, mitigating actions in them (Silva; Linhares and Bastos, 2010).

Methodology

A systematic review survey because, according to what was synthesized by Igarashi et al. (2015), The site revisions allow the obtaining of an answer to a specific question related to the objective of the research. One must add evidence about the problem for which the solution. The scope is quantitative because of analytical and statistical data. Qualitative because it generated the answer to the critical question.

The selection of the secondary dates was effect in the links, magazines, universities, specialized this theme. The space of publications selected was 2008 to 2020, with two primordial articles (1993 and 1996). It was affected to choose the best information about the use of georeferencing, degradation is biodiversity, and a relationship between them. After obtaining the data collection, they treated with the use of spreadsheets contained in software Excel, version 2013 (Microsoft Corporation, 2013).

The Descriptive Statistical was applied to calculate medium, standard deviation, and absolute and relative frequencies. Graphic tables prepared by the recommendations of the Brazilian Institute of Geography and Statistics (IBGE, 1993).

Results and Discussion

Literature Selected

The date analysis obtained indicated the use of georeferencing in the areas more diverse of the environmental aspects in the 63 chosen studies, published between 2008 and 2020 (Table 1).

Table 1. Literature selected for the composition of this study

Environmental aspect	***fi***	***fr (%)***	$\overline{x}$	±	σ
APP's	12	20,0	1.5	±	0.7
Biodiversity (animal and vegetation)	11	18,3	2.4	±	2.8
fires, burn and hot spots	13	21,6	4.3	±	2.1
Degradation	19	31,6	4.8	±	2.8
Hydric resources	05	15,0	1.3	±	0.7
Totals	**60**	**100,0**	**12**	±	**9.1**

Note: APP's – Permanent Protection area. Source authors (2020).

The time scale is necessary because Barcellos and Brito (1996) affirmed: cultural factors, economics, and demographics have at all levels and visualized in the collection, treatments, exposition, and spatial information. The geographic space is not homogenous complex, may be discontinuous, and different from the physical space.

The dates analyzed indicate two essential aspects of environmental worry: APP's, biodiversity (n=12 = 20%) and fires or burns (n = 13; 21,6% each). In the Amazon Forest, this act is common because the agricultural uses this action to prepare the soil to plant the seeds. Agricultural activity in the region.

Another aspect is the linkage between soil (n = 3; 4,8%) use and hydric resources (*n* = 13; 20,6%). True because in the soil are pores that allow the infiltration and percolation water, especially in the rhizosphere. The statistical this relation is not similar, but the reality show this. About soil the three surveys using georeferencing (Kalish, 2010; Silva, 2015; Souza and Silva, 2016). In the Rondônia state, Trevisan and Alves (2010) concluded region northwest the deforestation is growth. 960 ha area occurs vegetation in 10% (secondary forest and capoeira).

Research on biodiversity (n =12 19%), degradation (n =11; 17.5%) and water resources (n =13; 20.7%) shows a concern with the link between them. For the former, the loss of habitat is significant in the variation of the reproduction space, and this causes a genetic alteration, and consequent body dimorphism or total extinction of the species. Satellite monitoring of land use and land cover can, therefore, better identify the state of conservation and contribute to the maintenance of biological diversity.

Permanent Protection Area (APP)

Among selected studies about APPs (*n* = 12; 20%), indicating a division in eight themes (Table 2).

Table 2. Identification of the eight themes

Nº	Identification Theme	*fi*	*fr* (%)	Description
1	Characterization	1		Moraes et al. (2018)
1	Degradation	1	8.33	Trevisan and Alves (2010)
2	Delimitation	4	33.3	Silva et al. (2014); Lima (2015); Santana Júnior (2016); Matiello et al. (2017).
3	Determination	1	8.33	Brito et al. (2018).
4	Spaces	1	8.33	Silva et al. (2017).
5	Mapping	2	16.6	França (2011); Oliveira (2014).
6	Monitoring	1	8.33	Leal (2013).
7	Restauration	1	8.33	Magri and Baião (2016).
8	Soil use and occupation	1	8.33	Campos et al. (2016).
	Totals	**12**	**100**	----------

Source: Authors (2020).

The theme "delimitation," number five (*n* = 31%), are the more resourced. The application of the Law (nº4.771, nº 12651/12) and one resolution CONAMA n° 303 (Brasil, 2002). In Mãe do Rio, the measured the urban area APP's which vegetation and application of the date's resolution 303: springs (50 m around) limited range (30 m, river width). In this study, Silva et al. (2014), in Mãe do Rio (PA), concluded: The APP's areas urbanized; loss vegetation. The Law is not applied, is not conservation them.

In the Pontão (RS) southern region of Brazil, the conclusion is similar because, in the study effected by Lima (2015), concluded about APP's areas in not the extension in accord of the Law. In the Northeast region, in the municipality of Cruz das Almas (BA), the APP's are occupied in 97,4% which pasture, and 37,3% municipal area.

Biodiversity

For this theme, the analysis of the data indicates (*n* = 11; 18, 33%) articles selected in five aspects (Table 3).

Table 3. Five themes about biodiversity selected

Nº	Identification Theme	*fi*	*fr (%)*	Description
1	Bees	1	9,09	Gostinski, 2018.
2	Biodiversity conservation	2	18.18	Santos; Carvalho and Carvalho, 2013; Pinheiro, 2019.
3	Habitat description	1	9.09	Carvalho and Carvalho, 2012
4	Mapping	2	18.18	Santos; Silva, 2011; Ferraz and Duarte, 2011.
5	Maintenance plants	5	45.45	Cambraia Filho, 2019; Cesari, 2018; Guedes and Silva, 2018; Mascarenhas et al., 2019; Santos, Oliveira and Espíndola, 2015.
	Totals	**11**	**100**	

Source: Authors (2020).

After analysis of the data, it in aspect four, Gostinski (2018) observed a bee, and your environmental services (e.g., pollen. dispersion). The fly occurs between 06 am, with atmosphere temperature is 25ºC. More activities make to 10 am (*M. fasciculate*); 11 am – 02 pm. However, if action deforestation, the flower is lost, and the bees no make the pollen dispersion. Santos et al. (2015), in your work, demonstrated a degradation in APP's areas. A solution is to create the Conservation Units, Law n° 9985 (Brasil, 2000), and biodiversity protection. The urban tree conservation is vital to bee and birds, bat, and other pollinators, and this is a conclusion read by Mascarenhas et al. (2019), in the research effected in Olivia flowers Avenue, Vitória da Conquista (BA). Maintenance of the trees in urban areas, UC's, place, is essential to maintain biodiversity.

Carvalho and Carvalho (2012) applied georeferencing to study habitat with morpho climates aspects and species association. Know domain morpho climate is essential to verify the dispersion of species, and images generated by georeferencing are ideal for the study of habitat and species.

Fire, Burn and Hotspots

The articles (*n* = 13; 21,6%) selected aborded three environmental aspects (Table 4).

Table 4. Themes selected to fire, burn, and hotspots analyzed, which geoprocessing

Number	Identification Theme	*fi*	fr (%)	Description
1	Burning	6	50.0	Gontijo et al., 2011; Lazzarini et al., 2016; Pereira et al., 2018; Resende, 2017; Silva, 2015; Sacramento and Michel, 2019
2	Forest fires	3	15,38	Bacani, 2016; Durigan and Ratter, 2016; Paulino; Martins, 2016
3	Hot spots	4	30.78	Costa et al., 2017; Fernandes et al., 2018; Nascimento et al., 2017; Souza et al., 2016
	Totals	**13**	**100**	----------

Source: Authors (2020).

Burns are a hazard to all species vertebrates and invertebrates and plants. Nevertheless, in Brazil, the Cerrado region, the burn is fire spontaneous due to the colorful shape of the sand grains. Durigan and Ratter (2016) call attention is necessary a policy about the fire in Cerrado to maintenance the structure and species conservation and biodiversity, the suppression of this, loss hem. The images of fire focus or burns are necessary for conservation.

Silva (2015) affirmed about Cerrado: forest fire is significant in billions of years, and the temporal images are more important for analysis and quantification of the burn area. Souza et al. (2016) affirmed that burn-in Cerrado is a common practice for pasture formation and now a preoccupation which biodiversity loss. However, not are citation about loss biodiversity.

Burns in Brazil is critical of the international community. Lazzarini et al. (2016), Pereira et al. (2018), and Resende (2017) identified GIS burned areas in the Tocantins, Mato Grosso and eastern portion of the Cerrado Biome, burning air between 2012 and 2015, associated the scarcity of rainfall in the same period. The burns have resulted in pasture and agricultural expansion; this exposes the soil to solar radiation and causes more frequent burning in this biome.

The Degradation, and Desertification, and Canopy, Soil Use, and Occupation

After selections, it has obtained 19 (n = 19; 31.6%) articles. The data analysis indicated that degradation and desertification are studies more frequently with the use of georeferencing (Table 5).

Table 5. Four themes selected in 19 articles to four environmental analysis

Nº	Identification Theme	*fi*	*fr* (%)	Description
1	Degradation	8	42.10	Aguiar et al. (2010); Mech; Sanchez (2010); Sá et al. (2011); Gonçalves et al. (2013); Silva (2013); Figueiredo (2015); Santos (2016): Ferreira and Ferreira Neto (2018).
2	Desertification	5	26.31	Soares et al. (2011); Almeida et al. (2013); Almeida et al. (2014); Francisco et al. (2013); Pereira et al. (2018).
3	Degradation and Desertification	2	10.52	Braúna; Cruz (2008); CGEE (2016).
4	Canopy, soil use, and occupation	4	21.05	Andrade et al. (2019); Aquino et al. (2012); Vaeza (2010); Vanzela et al. (2010);
	Totals	**19**	**100**	----------

Source: Authors (2020).

Analysis effected in images, temporal series, and multispectral dates semiarid in the northwest region. Aguiar (2010) affirmed that index rides are associated which climate conditions. Mechi and Sanchez (2010) analyzed a degradation caused by send extraction in river Paraiba do Sul (SP), in floodplain area caused deterioration in soil, water, plants, and biodiversity.

Sá et al. (2011) have specific dates that environmental resource extractivist (pasture, wood, agriculture) cause desertification in the semiarid region. Silva et al. (2013) analyzed a vegetal canopy in the River Parari (PB). The images georeferencing localized areas impacts on vegetation, rivers, irregular soil occupation life of quality degraded, the georeferencing of a vegetal canopy in Coco Island, Xavantina New (MT).

Another river, Piranhas, São João das Piranhas (PB), Figueiredo (2015), identified the bioindicators' environmental degradation. The activists (mine, irrigate agriculture, solid waste deposition) cause impacts in water, loss biodiversity. Ferreira et al. (2018) identify the pasture degradation in different five class canopy vegetal (no degraded; gently degreased; moderate degreased; severely degrade; extreme degrade).

Dates analyzed are indicated to use witch synonymous: degradation and desertification); in environmental terms, this is not true. Soares et al. (2011) in Review literature write: desertification occurs inland dry, soil use inadequate (pasture, irrigated agriculture). Almeida et al. (2013) affirmed: desertification is an essential problem associated which loss humid atmosphere and soil degradation result of anthropic pressure in natural resources.

In Piaui State, Francisco et al. (2013), the Seridó region has utilized the Lends Deteriored Semarid Index (LDSI – SC, Soil capony*Soil declivity*Soil erosion), the protection is low because de canopy vegetation canopy, erosion risk is low because this area mapped desertification. To Almeida (et al. (2014) desertification has originated in zones degrades (arid, semiarid, and sub-humid) caused to anthropic press and climate change; (**c)** In Vitoria da Conquista (BA), Pereira et al. (2018) analyzed imagens georeferencing identified vulnerability areas in dry periods and anthropic actions.

In Ceará State, do area more vulnerable is municipally Tauá. The elevate caption of the reflectance characterized exposed soil and, consequently, desertification. The Centre for Management and Strategic Studies (CGEE, 2016) affirmed: the degradation of the natural resources makes environmental a loss, arid, and semiarid climates. Moreover, this finishes in desertification confirmed which images georeferencing.

Hydric resources published five (*n* = 5; 15%) articles in three aspects (Table 6).

Table 6. Four themes selected in five articles

Nº	**Identification Theme**	***fi***	***fr* (%)**	**Description**
1	Hydrographic basin	2	40.0	Flauzino et al. (2010); Santos et l. (2015)
2	Microbasin hydrographic	1	20.0	Nadalin (2010)
3	Water reservoirs	1	20.0	Sobral et al. (2017)
4	Rivers	1	20.0	Pereira and Moraes (2014)
	Totals	**5**	**100**	----------

Source: Authors (2020).

Flauzino et al. (2010) analyzed images georeferenced the Paranaíba river (MG), showed deforestation (82,44%), pollution, and anthropic occupation (43,675 km^2). Santos et al. (2015) studied the Uriboca river, Belém (PA), concluded: seven springs are in the anthropic area; two, in the mining area. The APP's urbanized, secondary Vegetation, functions environmental services is not executed. A study conducted by Nadalin (2010), in Viradouro (SP), images analyzed showed 32 springs analyzed, 24 (*n* = 75%) one localized in the urban area received pluvial water is vulnerable. The other (*n*=15; 62,5%) partly degraded which anthropic actions (sugar cane crop and pasture).

The rivers analyzed by Pereira and Moraes (2014) call Íaco, in Sena Madureira (AC), the dates concluded rural zone, today, are expanded (pasture, agriculture, and illegal timber trade); water pollution occurs because of the community is not sensible to conservation. The limits of the river compromised in the urban area. Vegetal canopy, soil use, and occupation have a relation which water quality and biodiversity conservation. Vaeza et al. (2010), make the analysis of the images the Irati (PR), Arroio dos Pereira's basin can occur floods because the

basin area occupied: lakes = 9, 68%; forest = 0,22%; streets = 4,84%; permeable areas = 5,73%; roofs = 10,53% and low vegetation = 46,45%.

Another study, Vanzela et al. (2010), the survey carried out in-stream Três Barras, Marinópolis (SP), the images georeferencing analyzed indicated activities anthropic (house, agriculture, forest degraded). Aquino (2012) writes: the vegetal canopy is necessary for the maintenance of the water quality. The confirmation has effected in Piaui State because 45,5% of the territory is vulnerable to desertification after analysis of the images georeferencing. In-Stream Rose Water (SP), Pollo et al. (2019) analyzed dates and images of the soil occupation in the basin and concluded: pasture (37,10%; coffee (35,74%), sugar crop (34,17%), the quality water, biodiversity, and life quality are not right.

Conclusion

The application of georeferencing via electromagnetic radiation has proven effective in understanding current environmental problems such as deforestation of APP's, soil exposure, and consequent leaching, especially in areas where the precipitation rate is high. In the driest areas, desertification identified with images generated in sensors that show the soil without vegetation cover, which causes the loss of arboreal animals, invertebrates that feed on suppressed vegetation.

Regardless of the environmental landscape to be analyzed, the use of electromagnetic radiation and the formation of images of different locations in different classes such as soil, water, vegetation cover, river basins, can be managed with the help of this electromagnetic system.

It is the recommendation that the use of this technology is more frequent in all the agencies of environment management, with the training of the body of environmental inspection and that the updating of software wakes up with the advancement of global technology.

References

Aguiar, A. E. X., Oliveira, I. P., & Cruz, M. L. B. (2010). Degradação/desertificação na região de Canindé - CE: análise e mapeamento espectro-temporal a partir de imagens Landsat. *6.* Anais do Seminário Latino Americano de Geografia Física, Universidade de Coimbra.

Almeida, J. B., Moreira, A. A., Fernandes, F. H. S., Almeida, R. P., & Nery, C. V. M. (2014). O Sensoriamento Remoto aplicado ao Estudo da Desertificação na Região Semiárida do Norte de Minas Gerais. *Revista Brasileira de Geomorfologia, 2*(02), 41-49.

Almeida, M. B. F., Simões, M., & FerraZ, R. P. D. (2019). Aplicação do sensoriamento remoto no estudo dos níveis de degradação de pastagens. In: Túlio, L. (Ed.), *Aplicações e princípios do sensoriamento remoto* (V. 3, pp. 11-21). Ponta Grossa: Atena.

Almeida, R. P., Nery, C. V. M., & Lima, F. A. (2013). Uso do sensoriamento remoto para estudo da susceptibilidade ao processo de desertificação na região semiárida do norte de Minas Gerais. *Revista Caminhos da Geografia, 14*(47),162-168.

Andrade, B. S., Melo, M. R. S., & Silva, M. H. S. (2019). Geoprocessamento aplicado a análise da cobertura e uso da terra na área de proteção ambiental dos mananciais do córrego Lajeado, Campo Grande – MS. *Sociedade e Território, 31*(01), 200-221.

Aquino, C. M. S., Almeida, J. A. P., & Oliveira, J. G. B. (2012). Estudo da cobertura vegetal/uso da terra nos anos de 1987 e 2007no núcleo de degradação/desertificação de São Raimundo Nonato – Piauí. *RAEGA, 25*, 252-278.

Bacani, V. T. (2016). Geoprocessing applied to risk assessment of forest fires in the municipality of Bodoquena, Mato Grosso do Sul. *Revista Árvore, 40*(06), 1003-1011.

Barcellos, C., & Bastos, F. I. (1996). Geoprocessamento, ambiente e saúde: uma união possível? *Cadernos Saúde Pública, 12*(03), 389-397.

Borges, G. M., Pacheco, A. P., & Santos, F. K. S. (2015). Sensoriamento remoto: avanços e perspectivas. *Revista de Geografia, 32*(02), 267-292.

Brasil (2000). Law nº 9.985. Retrieved from: http://www.planalto.gov.br/ccivil_03/leis/l9985.htm.

Brasil (2002). Resolution n° 303, Retrieved from http://www2.mma.gov.br/port/conama/legiabre.cfm?codlegi=379.

Braúna, A. L., & Cruz, M. L. M. B. (2008). Geoprocessamento aplicado a análise da degradação e desertificação no município de Tauá – CE. 13. 2008. Anais do Simpósio Brasileiro de Geografia, Viçosa, Universidade Federal de Viçosa.

Brito, A. P. M., Santos, I. M. M., & Nogueira, R. S. (2018). Uso do geoprocessamento na determinação de APP's úmidas no município de Redenção – CE. 2. Anais do Segundo Encontro de Docentes da Universidade de Integração Internacional da Lusofonia Afro-Brasileira. Redenção: *Campus* Ceará.

Cambraia Filho, D. S. (2019). Utilização de índices de Vegetação baseados na porção visível do espectro eletromagnético para monitoramento de fitofisionomias do Cerrado. Dissertação (Mestrado em Geociências Aplicadas e Geodinâmica), Universidade de Brasília, Distrito Federal.

Campos, S., Cardoso, L. G., Campos, M., Nardini, R., Rodrigues, B.T., Rodrigues, M. T., Taglirini, F. S. N., & Traficante, D. P. (2016). Geoprocessamento aplicado no diagnóstico dos conflitos de uso e ocupação do solo em áreas de preservação permanente no ribeirão das agulhas – Botucatu (SP). *Revista InterEspaço, 2*(6), 163-175.

Carvalho, T. M., & Carvalho, C. M. (2012). Sistemas de informações geográficas aplicadas à descrição de habitats. *Acta Scientiarum, 34*(01), 79-90.

Cesari, G. H. C. N. (2018). Estimativa da biomassa por sensoriamento remoto: um potencial para avaliação da produção de energia. Trabalho de Conclusão de Curso (Bacharelado em Engenharia de Energia), Universidade de Brasília, Distrito Federal.

CGEE (2016). Centro de Gestão e Estudos Estratégicos. Desertificação, degradação de terras secas no Brasil. Brasília: CGEE.

Correa, C. (2010). Desmatamento na Caatinga já destruiu metade da vegetação original. Disponivel em: https://www.mma.gov.br/informma/item/6122-desmatamento-na-caatinga-ja-destruiu-metade-da-vegetacao-original. Acesso em: 15 fev. 2020.

Costa, G. A., Firmino, C. T., & Pirovani, D. B. (2017). Análise da aplicação do sensoriamento remoto na detecção de focos de calor. Anais do Encontro Latino Americano de Iniciação Científica. São José dos Campos: UNIVAP. Disponível em: http://www.inicepg.univap.br/cd/INIC_2017/anais/indice_geral.html. Acesso em: 17 fev. 2020.

Durigan, G., & Ratter, J. A. (2016). The need for a consistent fire policy for Cerrado Conservation. *Journal of Applied Ecology*. 53, 11-15.

Fernandes, T., Hacon, S. S., Novais, J, W. Z., Sousa, I. P., & Fernandes, T. (2018). Detecção e análise de focos de calor no município de Parauapebas – PA, Brasil por meio da aplicação geotecnologia. *Enciclopédia Biosfera*, *15*(28), 398-412.

Ferraz, A. S., & Duarte, V. D. (2010). Uso do sensoriamento remoto na detecção de alterações da cobertura vegetal em Cataguases entre 1985 e 2008. *Revista Virtu – ICH [versão eletrônica]*. Disponível em: http://www.ufjf.br/virtu/atual/. Acesso em: 18 fev. 2020.

Ferreira, G. C. V., & Ferreira neto, J. A. F. (2018). Usos de geoprocessamento na avaliação de degradação de pastagens no Assentamento Ilha do Coco, Nova Xavantina – Mato Grosso, Brasil. *Revista de Engenharia na Agricultura*, 26(2), 140-148.

Figueiredo, L. A. (2015). Analise geoambiental dos bioindicadores de degradação e as técnicas de geoprocessamento: um estudo de caso. Trabalho de Conclusão de Curso (Licenciado em Geografia), Universidade Federal de Campina Grande, Paraíba.

Flauzino, F. S., Silva, M. K A., & Nishiyama, L. (2010). Geotecnologias aplicadas à gestão dos recursos naturais na bacia hidrográfica do rio Paranaíba no Cerrado Mineiro. *Sociedade & Natureza*, *22*(1), 75-91.

França, C. N. (2011). Mapeamento de APP – Área de Preservação Permanente e Reserva Legal de parte da bacia hidrográfica do ribeirão cafezal: comparativo entre o código florestal de 1965 e o projeto de lei n. 1.876/99. Trabalho de Conclusão de Curso (Bacharel em Geografia), Universidade Estadual de Londrina, Paraná.

Francisco, P. R. M., Pereira, F. C., Silveira, T. A., Lima, A. K. V. O., Dantas, M. R., & Santos, J. J. A. (2013). Análise da degradação de áreas do núcleo de desertificação Seridó utilizando modelagem em SIG.8. Anais do Congresso Norte Nordeste de Pesquisa e Inovação. Salvador: IFBA, Campus Senhor do Bonfim. Disponível em: http://www.ifac.edu.br/index.php?option=com_content&view=article&id=2931%3Aanais-dos-trabalhos-do-viii-connepi-2013-estao-disponiveis-para-consulta-e-downloads-&catid=335%3Anoticias&Itemid=182. Acesso em: 24 fev. 2020.

Gonçalves, J. L. G., Francisco, P. R. M., & Vieira, E. N. L. (2013). Identificação de áreas degradadas através de técnicas de detecção de mudanças. 8. Anais do Congresso Norte Nordeste de Pesquisa e Inovação. Salvador: IFBA, Campus Senhor do Bonfim. Disponível em: http://www.ifac.edu.br/index.php?option=com_content&view=article&id=2931%3Aanais-dos-trabalhos-do-viii-connepi-2013-estao-disponiveis-para-consulta-e-downloads-&catid=335%3Anoticias&Itemid=182. Acesso em: 24 fev. 2020.

Gontijo, G. A. B., Pereira, A. A., Oliveira, E. D. S., & Acerbi júnior, F. W. (2011). Detecção de queimadas e validação de focos de calor utilizando produtos de sensoriamento remoto. *15*. Anais do Simpósio Brasileiro de Sensoriamento Remoto. Curitiba: Estação Convention Center. Disponível em: http://www.clickgeo.com.br/anais-xv-simposio-brasileiro-sensoriamento-remoto/. Acesso em: 20 fev. 2020.

Gostinski, L. F. (2018). *Recursos alimentares e forrageamento de duas espécies de abelhas sem ferrão, Melipona (Melikerria) fascilulata Smith, 1854 e Melipona (Michmelia) fflavolineata Friese 1900 (Apidae, Meliponini), na região da baixada maranhense, Brasil.* Tese (Doctorate in Conservations and Biodiversity), Federal Universisty of Maranhão.

Guedes, J. C. F., & Silva, S. M. P. (2018). Sensoriamento remoto no estudo da vegetação: princípios físicos, sensores e métodos. *Acta Geográfica*, *12*(29), 127-144.

Guedes, J. C. F., & Silva, S. M. P. (2018). Sensoriamento remoto no estudo da vegetação: princípios físicos, sensores e métodos. *Acta Geográfica, 12*(29), 127-144.

IBGE (1993). Instituto Brasileiro de Geografia e Estatistica. Normas para apresentação tabular. Rio de Janeiro: IBGE.

IBGE (2013). Instituto Brasileiro de Geografia e Estatistica. Manual de uso da terra. Rio de Janeiro: IBGE.

Igarashi, W., Igarashi, D. C. C., & Borges, B. J. (2015). Revisão sistemática e sua potencial contribuição em "negócios, gerenciamento e contabilidade". *Gestão & Regionalidade, 31*(91), 138-151.

INPE (n.d.). Instituto Nacional de Pesquisas espaciais. Introdução ao sensoriamento remoto, produtos de sensoriamento remoto, sensoriamento remoto e suas aplicações para recursos naturais. Disponivel em: http://www3.inpe.br/unidades/cep/atividadescep/educasere/apostila.htm. Acesso em: 20 fev. 2020.

Kalish, A. D., Ferrer, T. R., & Lahm, R. A. (2010). Análise temporal do uso do solo através de ferramentas de geoprocessamento - estudo de caso: município de Butiá/RS. Trabalho de Conclusão de Curso (Bacharel em Geografia), Pontífice Universidade Católica do Rio Grade do Sul, Rio Grande do Sul.

Lazzarini, G. M. J., Ferreira, L. C. C., Felíssimo, M. F. G., Oliveira, L. N., & Alves, M. V. G. (2016). Análise da detecção e ocorrência de queimadas em áreas urbanizadas. *Ciência e Natura, 38*(3), 1265-1275.

Leal, J. V., Todt, V., & Thum, A. B. (2013). O uso do SIG para monitoramento de áreas degradadas - estudo de caso: APP do Arroio Gil, Triunfo – RS. *Revista Brasileira de Cartografia, 65*(5), 976-983.

Lima, G. (2015). Utilização de ferramentas de geoprocessamento para a delimitação das áreas de preservação permanente (APP's) no município de Pontão/RS, segundo o novo Código Florestal (lei 12.651/2012). 6. Anais do Congresso Brasileiro de Gestão Ambiental. Porto Alegre, Instituto Porto Alegre (IPA).

Lorini, M. C., Persson, V. G., & Silva, J. X. (1996). Geoprocessamento aplicado à conservação de espécies ameaçadas de extinção: o projeto mico-leão-da-cara-preta. Disponível em: http://www.carto.eng.uerj.br/fgeorj/segeo1996/114/index.htm. Acesso em: 15 fev. 2020.

Magri, R. A. F., & Baião, T. C. (2016). Restauração de APPs degradadas e a viabilização do sequestro de carbono: estudo de uma bacia hidrográfica urbana no município de Passos – MG. *Revista Ambiência*, *12*(1), 921-930.

Mascarenhas, P. S. M., Mascarenhas, A. D. C. N., Pereira, D. S., Sousa, C. J. P., & Mascarenhas, P. H. C. (2019). Mapeamento com geoprocessamento da biodiversidade arbórea da Avenida Olivia Flores em Vitória da Conquista – BA. 10. Anais do Congresso Brasileiro de Gestão Ambiental. Fortaleza: Universidade de Fortaleza.

Matiello, S., Cerri, F., Pagani, C. P., & Lima, J. S. (2017). O uso do geoprocessamento para delimitação e análise de áreas de preservação permanente de um córrego em Nova Mutum, Paraná – RO. *Revista Presença Geográfica*, *6*(1), 40-50.

Mechi, A., & Sanchez, D. J. (2010). Impactos ambientais da mineração no estado de São Paulo. *Estudos Avançados, 24*(68), 209-220.

Microsoft corporation. Excel 2013. Disponível em: https://products.office.com/pt-br/previous-versions/microsoft-excel-2013. Acesso em: 10 jan. 2020.

Moraes, E. T. I., Freire, A. A. AP., Torres, L. M., Azevedo, S. D., & Araújo, S. R. (2018). Geoprocessamento na caracterização de Áreas de Preservação Permanente em Paragominas, Amazonia Oriental. 3. Anais do Congresso Internacional De Ciências Agrárias. IFPA: Campus Castanhal.

Nadalin, I. (2010). Georreferenciamento da microbacia hidrográfica do municipio de Viradouro inserida na UGRHI 12 – Baixo Pardo/Grande. Trabalho de Conclusão de Curso (Bacharelado em Ciências Biológicas), Faculdades Integradas Fafibe, São Paulo.

Nascimento, O. S., Souza, I. R. M., Nascimento, W. P. S., & Nascimento, J. S. (2017). Análise espaço-temporal dos focos de calor no municipio de Parnaguá, Piauí, entre 2008 a 2015. *Revista Brasileira de Gestão Ambiental*, *11*(1), 193-199.

Oliveira, T. G. (2014). Mapeamento das Áreas de Preservação Permanente (APP) na região Serrana do Rio de Janeiro: um estudo de caso na bacia do rio Boa Esperança, Nova Friburgo. Trabalho de Conclusão de Curso (Bacharel em Ciências Ambientais), Universidade Federal Fluminense, Rio de Janeiro.

Paulino, B. G., & Martins, P. T. A. (2016). Análise temporal da ocorrência de incêndios florestais no Parque Estadual Serra de Caldas Novas (PESCaN), Goiás. *Revista Brasileira de Geografia*, *09*(05), 1465-1485.

Pereira júnior, A., & Pereira, E. R. (2017). Degradação ambiental e a diversidade biológica/biodiversidade: uma revisão integrativa. *Enciclopédia Biosfera, 14*(26), 922-937.

Pereira, K. K., & Morais, J. F. (2014). Técnicas de geoprocessamento aplicada aos problemas ambientais que afetam o rio Íaco dentro do limite do município de Sena Madureira AC. *Revista Brasileira de Gestão Ambiental*, *8*(3), 01-06.

Pereira, M. C. M., Souza, A. M. B., Oliveira, P. C. M., Lima, M. J. M., & Oliveira, F. J. (2018). Uso do sensoriamento remoto na detecção de focos de queimadas no parque nacional do Xingu. 3. Anais do Congresso Internacional de Ciencias Agrárias. Recife: Mar Hotel Convention.

Pereira, R. N., Silva, M. T., Vianna, L. M., & Lemos, O. L. (2018). Uso de sensoriamento remoto na identificação de áreas susceptíveis a desertificação na microrregião de Vitória Da Conquista – BA. Semana de Engenharia Florestal na Bahia. Vitória da Conquista: Teatro Glauber Rocha. Disponivel em: http://www2.uesb.br/eventos/seeflor/?page_id=605. Acesso em: 20 fev. 2020.

Pinheiro, P. F. V. (2019). Fragmentação florestal em Áreas Protegidas na Amazônia Maranhense e Conservação da Biodiversidade. Tese (Doutorado em Biodiversidade e Conservação), Universidade Federal do Pará, PARÁ.

Pollo, R. A., Campos, S., Cardoso, L. G., & Rodrigues, B. T. (2019). Uso e ocupação do solo parta planejamento de bacias hidrográfica. In: Campos, S. et al. (Eds.), *Geoprocessamento aplicado no planejamento de bacias hidrográficas* (pp. 1-5). Ponta Grossa: Atena.

Pons, N. A. D., & Pejon, O. J. (2008). Aplicação do SIG em estudo de degradação ambiental: o caso de São Carlos (SP). *Revista Brasileira de Geociências, 38*(2), 295-302.

Resende, F. C. (2017). Análise da distribuição espacial das áreas queimadas na porção nordeste do Bioma Cerrado. Dissertação (Mestrado em Geografia), Universidade Federal de São João del-Rei, Minas Gerais.

Sá, I. I. S., Galvincio, J. D., Moura, M. S. B., & Sá, I. B. (2011). Avaliação da degradação ambiental na Região do Araripe- Pernambucano utilizando técnicas de sensoriamento remoto. *Revista Brasileira de Geografia Física*, *6*, 1292-1314.

Sacramento, J. F., & Michel, R. F. M. (2019). Análise multitemporal de áreas queimadas na Mata Atlântica do sul da Bahia a partir de classificação orientada a objeto e índices espectrais. 12. Anais do Simpósio Brasileiro de Sensoriamento Remoto. Santos: Mendes Convention Center.

Santana júnior, J. J. (2016). Delimitação e diagnóstico das áreas de preservação permanente e da cobertura florestal no município de Cruz das Almas – BA. Trabalho de Conclusão de Curso (Bacharelado em Engenharia Florestal), Universidade Federal do Recôncavo da Bahia, Bahia.

Santos, A. L. C., Carvalho, C. M., & Carvalho, T. Q. (2013). Importância de remanescentes florestais para a conservação da Biodiversidade: estudo de caso na Mata Atlântica em Sergipe através de sensoriamento remoto. *Revista Geográfica Acadêmica, 7*(2), 58-84.

Santos, J. M. A. (2016). Detecção de áreas degradadas no municipio de Mata Grande – AL, como uso de geotecnologias. Dissertação (Mestrado em Meteorologia), Universidade Federal de Alagoas, Alagoas.

Santos, L. S., Gutierrez, C. B. B., Dias, N. M., & Pontes, A. N. (2015). Análise espacial na gestão de recursos hídricos: bacia hidrográfica do rio Uriboca, Belém, Pará. *Enciclopédia Biosfera*, *11*(22), 161-172.

Santos, R., Oliveira, R. M., & Espíndola, C. R. (2015). O uso do geoprocessamento como subsídio para analisar a ocorrência e distribuição potencial da espécie *Arapatiella*

psilophylla na região sudeste da Bahia. 17. Anais do Simpósio Brasileiro de Sensoriamento Remoto. João Pessoa: Centro de Convenções de Joao Pessoa.

Santos, S., & Silva, L. C. (2011). Mapeamento por imagens de sensoriamento remoto evidencia o bioma Pampa brasileiro sob ameaça. *Boletim de Geografia, 29(*2), 49-57.

Silva, G. J. G. (2013). Degradação ambiental no município de Parari - PB: uma análise por meio do sensoriamento remoto. Monografia (Especialista em Geoambiência e Recursos Hídricos no Semiárido), Universidade Estadual da Paraíba, Paraíba.

Silva, H. R. O., Guimarães, S. C. P., & Oliveira, L. B. (2017). O uso do geoprocessamento na espacialização e avaliação das Áreas de Preservação Permanente: Cidade de Porto Velho-RO. *Revista Franco-Brasileira de Geografia,* 30. Disponível em: https://journals.openedition.org/confins/11764

Silva, J. M., Linhares, D. P., & Bastos, W. R. (2010). Geoprocessamento Aplicado a Análise Integrada do uso da Terra e Qualidade de Água na microbacia do Rio Preto - Rondônia. *Caminhos da Geografia, 11*(34), 1-21.

Silva, M. S., Lemos, S. S., & Moraes, A. (2014). *Uso de geotecnologias para delimitação de Áreas de Preservação Permanente e análise das áreas de conflito de uso e ocupação do solo na zona urbana do município de Mãe do Rio - PA.* Retrievede from: http://anpur.org.br/app-urbana-2014/anais/ARQUIVOS/GT3-72-33-20140518141544.pdf.

Silva, P. H. S. (2015). *Detecção e análise de áreas queimadas por meio de normalização de séries temporais MODIS na região do Jalapão.* 2015. Dissertation, MA in Geography, Universidade de Brasília, Distrito Federal.

Soares, D. B., Mota filho, F. O., & Nóbrega, R, S. (2011). Sobre o processo de desertificação. *Revista Brasileira de Geografia Física, 1*, 174–188.

Sobral, M. C. S., Lopes, H., Candeias, A. L., Melo, G., & Gunkel, G. (2017). Geotecnologias na gestão de reservatórios: uma revisão e uma proposta de integração. *Engenharia Sanitária e Ambiental, 22*(05), 841-852.

Sousa, A. C. C., & Silva, M. (2016). Geoprocessamento aplicado ao Levantamento de solos no município de Inconfidentes – MG. *Revista Brasileira de Geografia Física*, *9*(01), 200-214.

Souza, I. R. M., Iwata, B. F., Albuquerque, B. C. D., Leite, A. C. S., & Morais, R. C. S. (2016). Análise espaço temporal dos focos de calor no município de Formosa do Rio Preto – BA. 7. Retrievede from: http://www.ibeas.org.br/congresso7/conteudo.php?id=12.

Trevisan, G. V., & Alves, D. S. (2010). Avaliação das áreas de preservação permanente em municípios de Rondônia através de videografia aérea. *Revista de Geografia, 27*(2), 168-178.

Uezu, A., & Cullen júnior, L. (2012). Da fragmentação florestal à restauração da paisagem: aliando conhecimento científico e oportunidades legais para a conservação. In: Paese, A., Uesu, A., Lorini, M. L., & Cunha, A. (Eds.), *Conservação da biodiversidade com SIG* (cap. 1, 13-22). São Paulo: Oficina de textos.

Vaeza, R. F., Oliveira filho, P. C., Maia, A. G., & Disperti, A. A. (2010). Uso e ocupação do solo em bacia hidrográfica a partir de orbitais de alta resolução. *Floresta e Ambiente, 17*(1), 23-29.

Vanzela, L. S., Hernandez, F. B. T., & Franco, R. A. A. M. (2010). Influência do uso e ocupação do solo nos recursos hídricos do Córrego Três Barras, Marinópolis. *Revista Brasileira de Engenharia Ambiental, 14*(1), 55-64.