



ISSN: 2230-9926

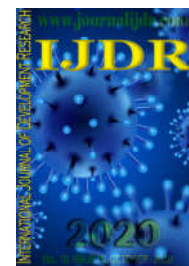
Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research

Vol. 10, Issue, 10, pp. 41581-41587, October, 2020

<https://doi.org/10.37118/ijdr.19856.10.2020>



RESEARCH ARTICLE

OPEN ACCESS

MUDANÇAS NO NÍVEL DA ÁGUA DO RIO CRIXÁS E IMPACTOS AMBIENTAIS NO MUNICÍPIO DE SANTA TEREZINHA DE GOIÁS

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ARTICLE INFO

Article History:

Received 18th July, 2020

Received in revised form

27th August, 2020

Accepted 09th September, 2020

Published online 30th October, 2020

Key Words:

Ação Antrópica, Impactos Ambientais, Rio Crixás.

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ABSTRACT

Os recursos hídricos sofrem impactos significativos da ação antrópica, cujo uso indiscriminado pode levar ao seu exaurimento. Objetivou-se analisar as condições ambientais decorrentes da ação antrópica e os impactos ambientais, no nível de água ocasionada no período compreendido entre os anos 2000 e 2017 no Rio Crixás, tendo em vista as exigências da sustentabilidade ambiental e os ODS – Objetivos do Desenvolvimento Sustentável. Utilizou-se Sistema Estadual de Geoinformação de Goiás (SIEG), imagens de satélite pelo Google Earth, coordenadas latitude $S14^{\circ}25'11,884''$ e longitude $W49^{\circ}43'50,295''$. Escolheram-se dados de medição a cada cinco anos, em 2000, 2005 e 2010, bem como um comparativo dos anos 2015, 2016 e 2017, com as médias das variações do nível de água constatado na Estação Fluviométrica Uirapuru. Os resultados demonstraram oscilações de nível de água, em escala decrescente no tempo, até os dias atuais.

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Citation: Ubirajara de Lima Ferreira. "Fitoterápicos e Plantas Medicinais no Tratamento de Sintomas do Climatério: uma análise da produção científica", *International Journal of Development Research*, 10, (10), 41581-41587.

INTRODUCTION

Natural climate change, like that rainfall rate, as well as the anthropic action influence the water level of the groundwater, the sources, streams and rivers. To Marengo et al. (2015) there are other factors responsible for the problem of lack of water, such as inadequate management policies for water resources and citizens' attitudes, which translates into pollution and waste of water. It also stands out deforestation, erosion, silting, destruction of sources, desertification, fires, agriculture, livestock, mining, anthropic actions that contribute to reducing water levels on streams and rivers, water pollution and extinction of species of fauna and flora. Federal law 9433 of 1997 establishes national water resources policy, discriminating management and planning actions, so that human needs can be met, without, however, we forget about future generations. That said, the principle of precaution and rational use of this resource are conditions *sine qua non* for the precepts of sustainable development. In this context, the interest has arisen in researching environmental conditions and impacts in sub-bacia Hidrográfica of the Crixás River caused by

the anthropic action on "Crixá-Açu" River, popularly known as Crixás River, in the municipality of Santa Terezinha de Goiás, considering the practices of agriculture and livestock and gold and emerald mining activity in the municipality and surrounding areas. The need to achieve environmental sustainability and the 17 SDGs - Sustainable Development Goals, of the ONU's 2030 (ONUBR, 2015), specifically the goals of 2 – Zero hunger and sustainable agriculture; 6 – Drinking water and sanitation; 14 – Life in water and 15 – Terrestrial life were the north of the investigation, aiming the harmony between the human being and the environment. Therefore, the objective of this study was to analyze the conditions of water availability resulting from anthropic action and environmental impacts on the Crixás River between 2000 and 2017.

ENVIRONMENT AND ITS CHARACTERISTICS

BRAZIL (1988) conceptualizes that environmental resources are defined as the atmosphere, interior, surface and underground waters, estuaries, territorial sea, soil, basement, biosphere elements, fauna and flora.

Water is among the main affected by anthropic action in the environment. The water is a renewable natural resource, but it may run out if its use is indiscriminate. The problem of the environment in urban areas should be studied in a political, social and scientific context, because it should not only be of the municipal or state authorities' responsibility. For this reason, proper use of this resource should be made aiming at its availability to the region. Water availability is a determining aspect for population fixation and growth of anthropic activities, whether in urban or rural areas. The indiscriminate use of water and the pollution produced favors its scarcity, consequently, there is the increasing need for follow-up (REBOUÇAS, 2006). The city of Santa Terezinha de Goiás – GO, for example is taken as an example when the subject refers to urban development, due to environmental problems, related to the level and quality of water of the Crixás River due to the social, economic, cultural importance and mainly environmental for the region.

The water availability from a watershed is directly related to the use and occupation of soils throughout the drainage area, mainly the water of its tributaries (MENDONÇA et al. 2015). Lima and Zakia (2004) state that riparian forest is important for the maintenance of aquatic ecosystems because it contributes to water infiltration into the soil, providing the supply of the water table, conserving water quality and hindering the surface flow of particles and sediments that would cause pollution and silting up of water resources. Freitas et al. (2013) also claim that forests provide shade while maintaining the thermal stability of water, protect against the direct impact of rain on the soil, reduce erosive processes and serve as shelter and food to the fauna. The degradation of environmental quality is the adverse change in the characteristics of the environment of resulting actions that harm the health, safety and well-being of the population; adverse conditions for social and economic activities; biota and aesthetic or sanitary conditions of the environment; material or energy against established environmental standards (BRASIL, 1981). There are several environmental impacts that can occur if the care and conservation of the place are not taken, for example: erosions, losses of riparian forests and nutrients, whistling of water resources, soil compaction and leaching. The soil may have a splash effect causing the crusting, increasing the surface runoff that removes the most fertile layer (GUERRA, 2007, p. 69).

WATER RESOURCES AND ANTHROPIC ACTION

All area degraded by natural or anthropic action results in the modification of original characteristics (SUHUGUSOFF et al., 2007). It was no different in the region of Santa Terezinha de Goiás, where there was political emancipation of the municipalities of Guarinos, Amaralina, Uirapuru and Campos Verdes, and the migration of people, especially from Teófilo Otoni, in Minas Gerais (SILVA, 2006), whose migrants were intended for the municipality of Santa Terezinha de Goiás, and later to Campos Verdes. For the researcher, despite the low variation in demographics in the 13 municipalities that integrate the sub-basin of the Crixás River, in the 1980s, the municipalities of Pilar, Crixás, Guarinos, Santa Terezinha and Campos Verdes were the ones that suffered the most from territoriality, de-territoriality and re-territoriality, high levels of violence and homicides and environmental degradation. Moreover, the important role of water in maintaining ecosystems and survival of fauna and flora cannot be

disregarded. Therefore, the degradation of water resources by the influx of organic or inorganic matter not captured and without attention to renewable cycles generates impacts that exceed its biotic and abiotic components (MORAES; LORANDI, 2016). Also, according to Vieira (2013), just as eyelashes protect the eyes of living beings against sweat and dust that could hurt them, riparian forests have the function of protecting rivers, streams and surrounding lakes and lagoons against the weather caused by nature itself, as well as human action. Therefore, it is essential to understand the environment and its characteristics, resources, aspects and environmental impacts resulting from anthropic action, as well as to know environmental legislation.

ENVIRONMENTAL LEGISLATION

Among the environmental laws, in addition to the federal constitution, it stands out laws: no. 6,938 of 08.31.1981, no. 12,651 of 05.25.2012, no. 9,433, of 01.08.1997, no. 9,605, of 02.12.1998, as well as the Rule of the National Council on the Environment (CONAMA) no. 01/1986, among others. Law no. 6,938 of 08.31.1981 has on the National Environment Policy, presenting principles to achieve the preservation, improvement and recovery of environmental quality conducive to life, with the aim of ensuring conditions for sustainable development, based on monitoring the analysis of the quality of the environment, protection of ecosystems and environmental resources and also on environmental education (BRASIL, 1981). Federal law no. 12,651, of 05.25.2012, "Brazilian Forest Code" establishes general standards on the protection of native vegetation, permanent preservation areas, among others. In the single paragraph states that it aims at sustainable development and brings with it several principles, namely:

V - Fostering scientific and technological research in the search for innovation for the sustainable use of soil and water, the recovery and preservation of forests and other forms of native vegetation; IV - common responsibility of the Union, States, Federal District and Municipalities, incollaboration with civil society, in the creation of policies for the preservation and restoration of native vegetation and its ecological and social functions in urban and rural areas (BRAZIL, 2012, p. 1-2).

Also, in Article 4, said law deals with the protection of native vegetation, alters laws no. 6,938/1981, 9,393/1996 and 11,428/2003 among others, by clearly defining the "APPs – Permanent Preservation Areas" in order to discipline the relationship of people and companies in relation to the doubts that hung over the required protection range, depending on the width of the river, a true ecological corridor to protect the life and regular transit of the fauna, which the riparian forests provide.

Article 4th A Permanent Preservation Area in rural or urban areas is:

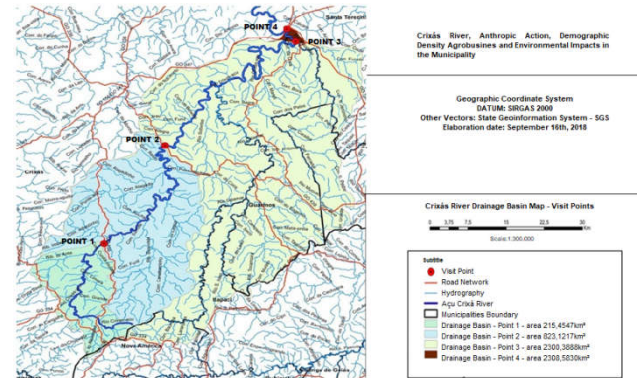
I - the marginal ranges of any perennial and intermittent natural water course, excluded from the edge of the regular bed trough, in minimum width of: (Included by Law No. 12,727 of 2012). **a)** 30 (thirty) meters, for watercourses of less than 10 (ten) meters wide; **b)** 50 (fifty) meters, for watercourses that are 10 (ten) to 50 (fifty) meters wide (Brazil, 2012, p.5).

In turn, the management of water resources in Brazil has been based on the application of the instruments of the National Water Resources Policy (PNRH). Law No. 9,433, of 01.01.1997 places the watershed as a territorial unit of planning and management. The goals of environmental policy are: to ensure the current and future generations the necessary availability of water, in quality standards appropriate to their uses; prevention and defense against critical hydrological events of natural origin or resulting from the inadequate use of natural resources (BRASIL, 1997). Law no. 9,605, of 02.12.1998 provides crimes against the environment, specifically in Chapter V, dividing into five sections: Fauna; Flora; Pollution and other Environmental Crimes; crimes against Urban Planning and Cultural Heritage, finally Crimes against the Environmental Administration. In turn, Rule 01/1986 defines environmental impact as any change in the physical, chemical and biological properties of the environment, caused by any form of matter or energy resulting from human activities that, directly or indirectly, affect the health, safety and well-being of the population; social and economic activities, but also the aesthetic and sanitary conditions of the environment; the biota and the quality of environmental resources (CONAMA, 1986).

METHODOLOGY

The subject matter of the study was the Goiano River, plain, winding, holder of small falls and rapids, called "Crixá-Açu", known as the Crixás River, tributary of the Araguaia River. It is born in the watershed between the municipalities of Nova América and Crixás, borders the municipalities of Guarinos, Santa Terezinha de Goiás, Uirapuru, Mara Rosa, Novo Mundo, Amaralina, Bonópolis, São Miguel do Araguaia and Nova Crixás, which the mouth of the river runs near the village of Luiz Alves, district of the municipality of São Miguel do Araguaia, Goiás on the edge of the municipalities of Bonópolis and Mara Rosa, according to the research carried out by Góis (2018). An area of 2,401.2438 km² was separated from the sub-basin, at the junction of the municipalities of Crixás, Guarinos and Santa Terezinha de Goiás. The extension of the head of the Crixás River to the starting point of study is 160km downstream, represented by the blue line. For the records, the scale 1:300,000 was used. Data and images were collected at the Image Processing and Geoprocessing Laboratory, Federal University of Goiás (LAPIG, UFG). The State Geoinformation System of Goiás (SIEG) and satellite images were used by Landsat 7 and 8, Google Earth, Remote Sensing and Geoprocessing with Arcgis 10.5, Qgis and Envi 4.7 and latitude coordinates S 14°25'11,884" e longitude 49°43'50,295" W. It is evidenced the four points of visit on site which occurred on August 30 and 31, 2018 which areas of the drainage sub-basin from point 1 to 4, cumulatively aggregated represent 2.308 km² (Figure 1).

Data from the historical series were collected in the National Water Resources Information System (SNIRH) of the National Water Agency (ANA) and CPRM, recorded at the fluvimetric station installed in the Crixás River, in the Municipality Uirapuru, Goiás, at the geographic limit and downstream of the municipality of Santa Terezinha de Goiás, under the coordinates latitude S 13°53'54.96" and longitude 49°57'5.04"W. The variables analyzed were: rainfall index, demographic density, drainage sub-basin area in the four selected points, average water level of the Crixás River in the reserved stretch, vegetation and silting.



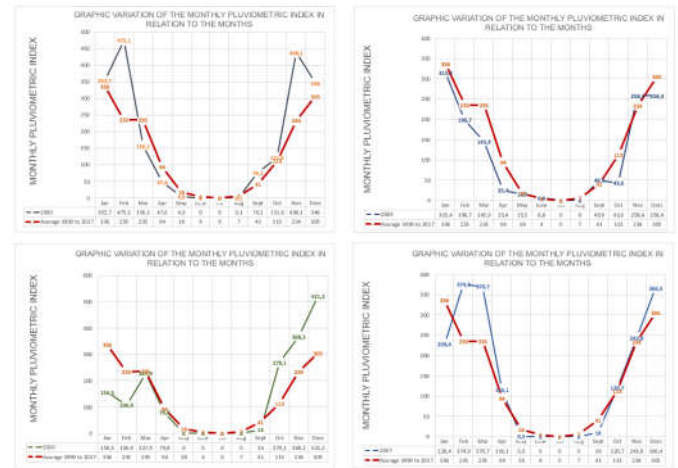
Source: Elaborated by Goisand others (2018).

Figure 1. Study area of the Hydrographic Sub-basin of the Crixás River and visitation points 1, 2, 3 and 4, from the left to the right (160km below the source, upstream of Santa Terezinha de Goiás).

Water level in the fluvimetric station was measured from 2000 to 2017. Measurement data were collected every five years in 2000, 2005 and 2010, as well as comparison of the years 2015, 2016 and 2017 in order to analyze the variations. The data were organized in maps, photographic records, figures, tables and confronted with literature and legislation.

RESULTS AND DISCUSSION

Figure 2 demonstrates the Rainfall Index that occurred at Nova América Station, located in the municipality of Nova América, GO, upstream of the source of the Crixás River and about 160km from the Drainage Sub-basin reserved for study, in the years 2000, 2005, 2010 and 2017.



Source: Nova América Pluviometric Station, elaborated by Gois and the author (2018)

Figure 2. Pluviometric index, New America Station, 2000, 2005, 2010 e 2017.

The three highest indexes of 521.2, 475.1 and 438.1mm/month were recorded in December/2010, February/2000 and November/2000, respectively. The three lowest precipitation indexes, in a 0 (zero) precipitation scale, took place between June and August in almost every year of 2000, 2005, 2010 and 2017. The average of the period 2000/2017, except for the years 2000 and 2005, always fluctuated below the Rainfall Index of the years analyzed, demonstrating low incidence of rainfall upstream of the source of the River and downstream of the Drainage Sub-basin, with the decreasing level of water of the Crixás River between the years 2000 to 2017.

Table 1: Census Population in the Santa Terezinha region of Goiás from 1980 to 2018

NR.	Municipality	CENSUS POPULATION - "IMB - INST. MAURO BORGES" PROJECTION				
		1980	1991	2000	2010	2018
1	Nova América	2.204	2.022	2.185	2.259	2.388
2	Itapaci	14.225	12.652	13.931	18.458	22.013
3	Hidrolina		4.378		4.157	3.846
4	Pilar de Goiás	9.246	4.845	339	2.779	2.515
5	Guarinos		3.711	2.844	2.299	2.035
6	Santa Terezinha de Goiás	10.964	16.522	12.015	10.302	9.588
7	Campos Verdes		16.648	8.057	5.020	3.270
8	Crixás	30.219	22.213	14.673	15.760	17.028
9	São Miguel do Araguaia	22.793	19.169	22.793	22.283	22.771
10	Nova Crixás			10.323	12.603	12.914
11	Mara Rosa	21.524	21.291	11.939	10.649	10.216
12	Uirapuru			3.043	2.933	2.970
13	Amaralina			3.074	3.434	3.789
TT	Crixás River Municipalities	111.175	123.451	105.216	112.936	115.343

NOTE 1: GUARINOS was emancipated from Pilar de Goiás

NOTE 2: CAMPOS VERDES was emancipated from Santa Terezinha de Goiás (35 Thousand inhabitants)

NOTE 3: NOVA CRIXÁS was emancipated from Crixás

NOTE 4: UIRAPURU was emancipated from Crixás

NOTE 5: AMARALINA was emancipated from Mara Rosa

Source: Elaborated by the author, based on data from the IMB-Mauro Borges Institute (2018).

Table 2. Water level (cm), at the Uirapuru Fluviometric Station, 1999 to 2010

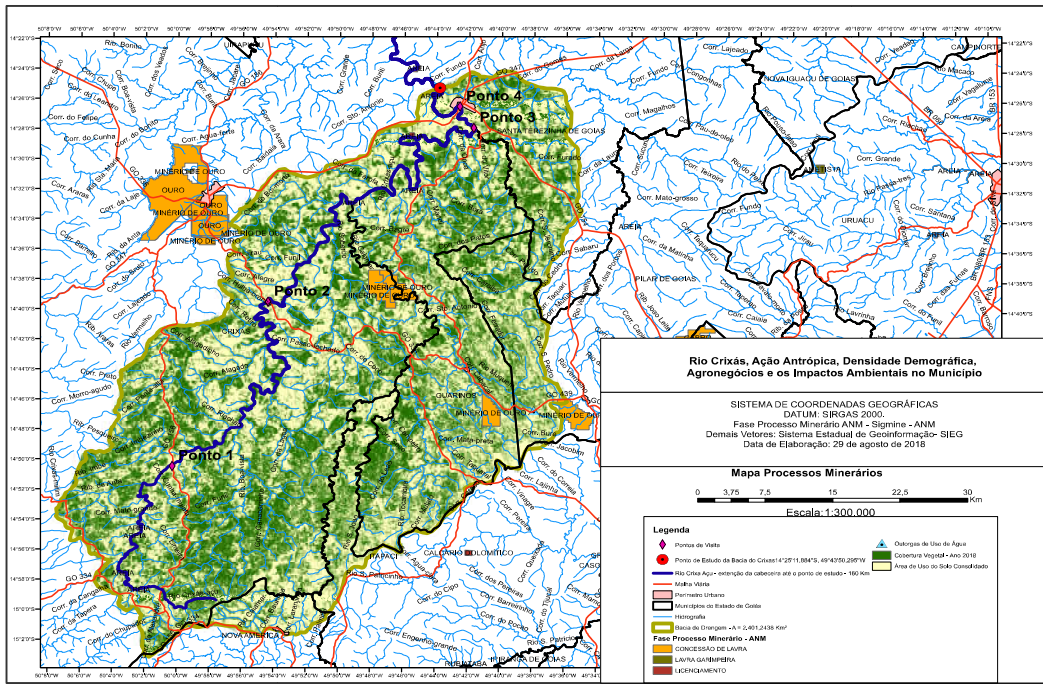
Months	YEARS											
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Jan		457	369	552	420	518	363	268	352	269	350	388
Feb		459	277	457	394	701	304	319	679	502	325	278
Mar		521	341	352	402	480	373	456	376	537	314	309
Apr		335	273	274	362	393	296	350	279	412	340	264
May		240		205	226	289	210	230	213	261	259	172
Jun		190		172	180	219	170	178	167	194	194	142
Jul		164		151	153	175	144	152	143	161	156	122
Aug		141	123	125	129	148	120	127	122	136	129	106
Sep		139	124	121	116	124	108	115	107	116	130	
Oct		122	163	126	113	133	121	178	105	108	145	
Nov			263	217	184	166	176	160	260	167	140	206
Dec	323	473	328	223	181	243	360	324	251	376	350	306

Source: Elaborated by Gois and the author (2018).

Table 3. Water level (cm), at the Uirapuru Fluviometric Station, 2011 to 2017.

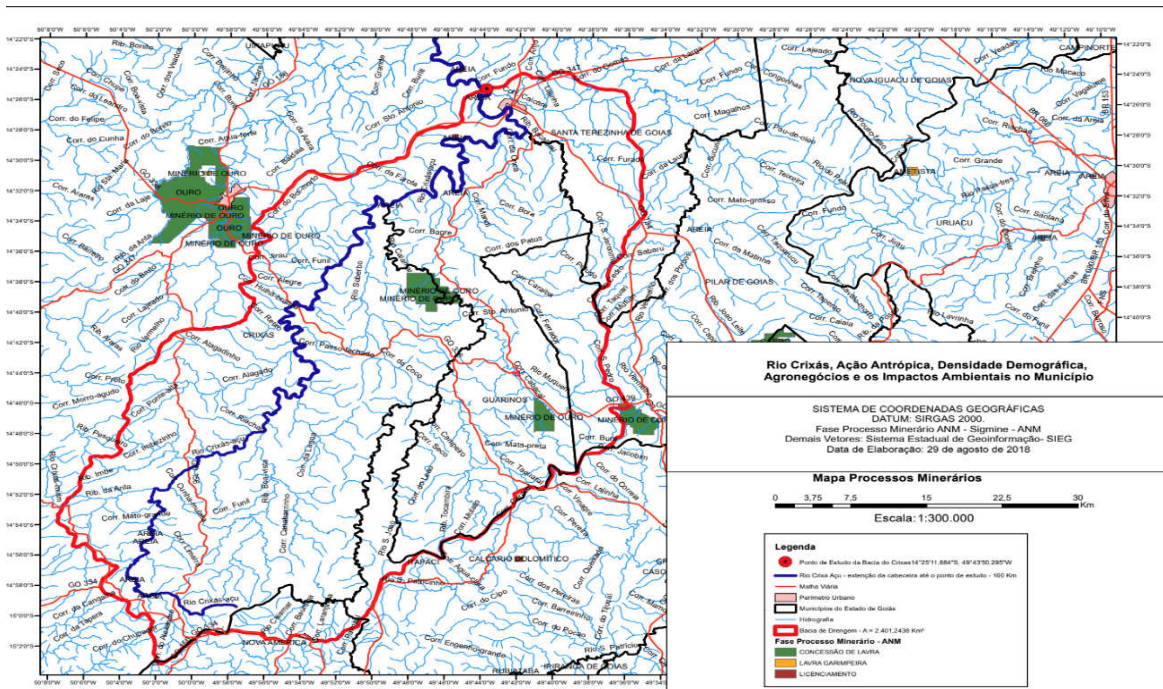
Months	YEARS							Average 1999 to 2017
	2011	2012	2013	2014	2015	2016	2017	
Jan	535	477	396	330	249	462	243	389
Feb	352	379	449	331	319	381	330	402
Mar	474	334	378	356	401	294	293	388
Apr	346	256	344	325	365	198	265	315
May	224	186	220	214	290	155	180	222
Jun	178	156	196	168	197	130	141	175
Jul	148	135	152	139	162	115	118	146
Aug	125	116	128	118	131	99	105	124
Sep	107	113	114	109	113	89	85	114
Oct	156		121	102	108	80	84	123
Nov	192	224	151	202	117	234	166	192
Dec	379	260	392	374	126	246	307	306

Source: Uirapuru Fluviometric Station, adapted by Gois and the author (2018).



Source: Elaborated by Goisand the author (2018).

Figure 4. Land use and occupation in the study area of the Rio Crixás Sub-basin.



Source: Elaborated by Goisand the author (2018).

Figure 5. Mining activity under intensive use of water. Crixás River



Source: Authors (2018).

Figure 6. Photographic records in the course of the Crixás River. Points 1, 2, 3 e 4.

The demographic density occurred in the period 1980 to 2018 was also analyzed, in order to identify the processes of migration, territoriality and de-territoriality, which occurred in the municipalities that make up the Crixás River sub-basin, based on municipal data and statistics of the Mauro Borges Institute (table 1). Table 1 shows the emancipation and formation of new municipalities, under an increase of approximately 5,000 (5,000) people in the Crixás sub-basin region, contrary to the migratory exodus that characterized the 1980s of the populations of the interior to the capital. In the municipality of Santa Terezinha de Goiás there were approximately 35 thousand inhabitants, in the late 1980s until the emancipation of Campos Verdes, which had 16,648 inhabitants, higher than the cedant municipality, which had 16,522 inhabitants in 1991, according to the IMB - Instituto Mauro Borges (2018). It is worth mentioning the drastic reduction in the number of inhabitants in both municipalities, mainly due to the decline in gold mining activity, projecting at 8,931 and 2,459 residents for 2018, in Santa Terezinha de Goiás and Campos Verdes, respectively.

There was a reduction in the area of riparian forests in the sub-basin, verified "in loco" originated by the anthropic action exerted on the Crixás River, due to the population increase, the practice of agriculture and mainly of livestock. Another environmental problem was the silting up and the reduction of the river's water level, in order to compromise its perpetuity in the medium and long term. The silting up of the river channel where the riparian forest was extracted to the river bank, originates in deforestation, in the compaction generated by the trampling of cattle in the pastures, in the absence of contour lines. With the removal of native vegetation cover, for planting crops and pastures, the permeability of the land is reduced, which leads the rainwater to flow directly into the water courses, compromising infiltration, supply of groundwater and maintenance of regularity of flow of water courses at different times of the year. Brazil (2012) points out that in order to achieve environmental sustainability, one of the principles reported in item V must be complied with, namely the recovery and preservation of forests and other forms of native vegetation.

Data on the systematic reduction in the water level of the river are shown in table 2 (1999-2010) and table 3 (2011-2017), showing the average obtained at the Uirapuru Fluviometric Station, in the homonymous municipality, immediately downstream of the Drainage Sub-basin analyzed in the municipalities Guarinos / Santa Terezinha de Goiás. When carrying out the measurements, it was found that the distance from the source of the Crixás river to the reserved area of the sub-basin comprises approximately 160km and the distance from the fluviometric station to its source totalize 296 km. The oscillation in the water level reductions of the months, without considering the rainy season in the region, obeys the natural cycle and suffers human action related to the environment, in order to cause the loss of riparian forests, consequently reducing the water quality in the river Crixás. It was observed that in the year 2017, the water level was lower than the average of the years 2015 and 2016, occurring elevation only in the rainy periods. The evaluation carried out every five years (2000, 2005 and 2010); the comparison of the last three years (2015, 2016 and 2017) and the average water level in the Crixás River, verified at the Uirapuru Fluviometric Station, shows a gradual decline, requiring immediate measures that lead to the reversal of the trend, under penalty of further

worsening the installed water crisis. Brazil (1981) shows rules on monitoring. This control is provided as oscillations in water levels, respecting the cycle, directing actions to achieve conservation, improvement and recovery of environmental quality. According to Rosa et al. (2014) the maintenance of forest vegetation contributes to water retention in hydrographic basins, reducing the erosive action on the soil and supplying groundwater. According to Freitas et al. (2013) deforestation, preparation of land for formation of pastures, planting crops and the use of pesticides expose the soil to the erosive action of rain and wind, thereby preventing natural regeneration and the formation of native forest. The use and occupation of the soil, especially for the formation of pastures for cattle breeding, to the extreme of the river banks, shown in figure 4, shows the non-compliance with the pertinent legislation with regard to PPAs - Permanent Preservation Areas, which varies from 30m to 500m, depending on the width of the river (Law no. 12.651, of 05.25.2012, "Brazilian Forest Code"). Added to this is the practice of deforestation, which causes silting up on the Crixás River and degrades the Drainage Sub-basin, mainly between Points 1 and 2 and part of Point 3. In the region, gold mining activities are also practiced, under intensive use of water for shale extraction and washing, aimed at removing gold and precious stones, mainly emeralds, located in figure 5.

Multinational companies in the mining sector, with financial resources and large machinery, explore in the municipalities of Pilar, Guarinos, Crixás and Campos Verdes, within and around the Drainage Sub-basin reserved for study, in the municipalities of Guarinos, Crixás and Santa Terezinha de Goiás. At points 2 and 3, where water is directed to the Crixás river, mainly from the Caiamar river and the São Gerônimo stream, its main tributaries, which in the municipality of Guarinos, in the region bordering Santa Terezinha, flow there, increasing their level of water, even in the dry season, which is more pronounced in the months of July to November of each year. In this way, this Drainage Sub-basin, including the Caiamar River and the São Pedro and São Gerônimo streams, contribute decisively to the flow into the Crixás River, for its continuity, otherwise, its course would have stopped from Santa Terezinha de Goiás in the dry season. It was found that the riverbed is dry in several sections of points 1 and 2, remaining small isolated wells, which are upstream of the bridge over the Crixás River (Figure 6). There is an irregular damming of the river on the new bridge under construction on the P1 at the height of the Auriverde village, district of the municipality of Crixás, which limits runoff and compromises the aquatic life downstream. In P2 it is possible to see under the concrete bridge the existence of small wells, where the water flowed with difficulty, which in situations of greater water scarcity compromises the regularity of the flow and the natural course of the river will be interrupted. There is the presence of garbage on the margin in P3, left by fishermen or visitors and silting up hinders the natural flow of the river in P4. On P3 and P4, despite being very shallow and silted up for most of the course, the Crixás River improves the water level through its contribution, especially from the Caiamar River and the São Pedro and São Gerônimo streams in the Drainage Sub-basin, approximately 12km from the city of Santa Terezinha de Goiás.

Conclusion

In the drainage area of the Crixás River sub-basin, reserved for study, there was a relevant environmental impact with regard

to deforestation, reduction and extinction of riparian forests, caused silting up, in order to cause a gradual reduction in the water level in the period 2000/2017.

Anthropic action, due to the rudimentary practice of agriculture and livestock, mining, non-observance with the relevant legislation, low inspection led to the worrying picture of environmental degradation, compromising the longevity of the Crixás River in the medium and long terms. Actions are needed to contain silting, to restore riparian forests, by replanting native flora species, supervised by a technical staff from the State Secretariat for the Environment and Sustainable Development - SSED and/or the municipality of Santa Terezinha de Goiás, associated with environmental education courses and training. These actions can help to guarantee water in quantity and quality for future and auxiliary in the fulfillment of SDGs 2 (zero economy and sustainable agriculture), 6 (drinking water and sanitation), 14 (life in water) and 15 (terrestrial life) of the Agenda 2030 of the UN.

Thanks:

CAPES / FAPEG support.

REFERENCES

- BRASIL. IBGE - Brazilian Institute of Geography and Statistics. Population estimates. Available at <https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?edicao=25272&t=resultados>. Accessed on September 17th, 2019.
- Conama, National Environment Council. Resolution No. 1, of January 23, 1986. "Provides for basic criteria and general guidelines for assessing environmental impact". Published in the Official Gazette on 02/17/1986, Brasília, DF, 1986.
- Freitas, E.P., Moraes, J.F.L., Filho Afonso, P., Storino, M. Environmental indicators for permanent preservation areas. Brazilian Magazine Agricultural and Environmental Engineering, v.17, n.4, p.443-449, 2013.
- Guerra, A. J. T., Silva, A. S., Botelho, R. G. M. (Ed.). Erosion and Soil Conservation: Concepts, Themes and Applications. Rio de Janeiro: Bertrand Brasil. 2007
- Gois, L. Mapping and Remote Sensing, LAPIG / SIEG. Arcgis software 10.5, Qgis and Envi 4.7, coordinates latitude S 14°25' 11,884'' and longitude 49°43'50,295''W (2018).
- GOIÁS. IMB - Instituto Mauro Borges. Census Population of Goiás Municipalities. Available at http://www.imb.go.gov.br/index.php?option=com_content&view= Accessed on 10/02/2018.
- Marengo, Nobre, C.A., Seluchi, ME., Cuartas, A., Alves, L.M., Mediondo, E.M., Obregón, G., Sampaio, G. Drought and the Water Crisis 2014-2015 in São Paulo. University of São Paulo Magazine (USP), São Paulo, n. 106, p.31-44, 2015. DOI: <https://doi.org/10.11606/issn.2316-9036.v0i106p31-44>.
- MENDONÇA, D.S., MAGALHÃES, S.C.M., TRINDADE, W.M. Water and health: an analysis of the stream between rivers in Pirapora-Mg. Brazilian Journal of Medical Geography and Health, Hygeia, v.11, n.20, p. 189 - 200, Jun., 2015.
- MORAES, M.E.B., LORANDI, R. Research methods and techniques in watersheds. Ilhéus, BA: Editus, 2016, 283p.
- ONUBR. United Nations in Brazil. Sustainable Development Goals, Agenda 2030. Available at: <https://nacoesunidas.org/pos2015/>. Accessed on 10/03/2018.
- REBOUÇAS, A. C. (Ed.). Sweet Waters in Brazil: Ecological Capital, Use and Conservation. São Paulo: Escrituras Editora. 2006
- SOUZA, G.L.R. History of Agribusiness in Brazil. CESP Academic Sheet, São Gotardo, MG, nº 13, p.13-15, 2017.
- SUHUGUSOFF, V.G., PILIACKAS, J.M. Brief history of anthropic action on coastal ecosystems in Brazil, with an emphasis on mangroves in the state of São Paulo. Integration, Butantã, n. 51, p. 343-351, oct. 2007.
- SILVA, S. A. de F. Campos Verdes: Memory, History and Knowledge. Dissertation to obtain the title of Master, Catholic University of Goiás - UCG, p. 37, 57, 60 and 82. Goiânia, 2006. Retrieved from the internet on 17/09/2019. Available: <http://tede2.pucgoias.edu.br:8080/bitstream/tede/2308/1/SONILDA%20APARECIDA%20DE%20FATIMA%20SILVA.pdf>. Accessed September 17th, 2019.
- VIEIRA, R.M.A. The usefulness of riparian forests as a permanent preservation area. Jus Navigandi, Teresina, year 18, n. 3725, sep., 2013. Available at: <http://jus.com.br/artigos/25273>. Accessed on 02/10/2018.
- BRASIL. Brazilian Law no. 6,938 of 8/31/1981. Provides for the protection of native vegetation. Official Gazette, Executive Branch, Brasília, DF, 08/31/1981.
- BRASIL. Brazilian Federal Law No. 9,433, of January 8, 1997, Institutes the National Water Resources Policy, Official Gazette, Executive Branch, Brasília, DF, July 17th, 2001.
- BRASIL. Brazilian Law no. 12,651, of May 25, 2012. Provides for the protection of native vegetation. Official Gazette, Executive Branch, Brasília, DF, 05/28/2012.
