Uses and Misuses of the Paciência River and its Modifications as a Consequence of the Urbanization

Usos e Desusos do Rio Paciência e suas Alterações como Consequências da Urbanização

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RESUMO
O objetivo deste estudo foi avaliar as mudanças em um trecho do rio Paciência, através da percepção dos moradores da comunidade Dom Ricardo. A hipótese trabalhada no presente estudo foi de que as ações antrópicas contribuíram para os impactos ambientais que acabaram na degradação do rio. Para realizar a pesquisa, foi utilizada a técnica de bola de neve. Os Moradores da comunidade relataram que o lixo produzido em suas casas é colocado em um contêiner que foi instalado dentro do campus da Universidade Estadual do Maranhão e também em lixões localizados perto de suas casas. Todos os entrevistados acreditam que o rio está poluído por efluentes domésticos associados aos resíduos sólidos como o principal tipo de poluição observado. As modificações observadas no rio ao longo dos anos foram principalmente a largura e profundidade e aspectos relacionados à cor de sua água. Observou-se que, em geral, os moradores são indiferentes ou não se importam com o rio, pois não possuem nenhum tipo de relação com o mesmo. Assim, preservação desse corpo hídrico depende de ações integradas realizadas na Ilha do Maranhão, como de conscientização, preservação e recuperação.

Palavras-Chave: Educação Ambiental; Recursos Aquáticos; Resíduos Sólidos; Rio Paciência.

ABSTRACT
The aim of this study was to evaluate the changes in a section of the Paciência River, through the perception of the residents of the Dom Ricardo community. The hypothesis worked on the present study was that anthropic actions contributed to the environmental impacts that ended up in the degradadion of the River. To carry out the research, the snowball technique was used. Residents of the community reported that the garbage produced in their homes is placed into a container that was installed inside the State University of Maranhão Campus and also in dumps located near their homes. All respondents believe that the river is polluted and mentioned domestic effluents associated with solid waste as the main type of pollution observed. The modifications observed over the years were mainly the width and depth of the river and aspects related to the color of its water. It was observed that, in general, the residents are indifferent or do not care about the River because they do not have any type of relation with it. The preservation of this river depends on actions performed in the Island of Maranhão, such as actions of awareness, preservation and recovery of the river.

Key Words: Environmental education; Paciência River; Solid Waste Water; Resources.

1 INTRODUÇÃO

Water is one of the most important physical elements in the composition of the terrestrial landscape. It is important to the plants, animal and human life through the interaction with the other elements of its drainage environment (NETTO, 1996). It is a finite natural resource that has shown a depreciation of its quality, due to the progress of human societies, disorderly growth of cities and the lack of public policies that guarantee the preservation of these aquatic bodies (MERTEN; MINELLA, 2002).

Water bodies are affected by the release of substances from several sources such as domestic and industrial effluents (MERTEN; MINELLA, 2002; KANU; ACHI, 2011). In addition to the activities resulting from urban occupations (SILVA DAMASCENO et al., 2015), agriculture and other activities inadequately performed in the countryside such as the use of fertilizers, herbicides and insecticides (CETESB, 2009) are also responsible for the degradation of aquatic courses, concentrating nutrients and affecting the water quality (MENEZES et al., 2016).

The state of Maranhão has a rich hydrographic network, however it is being impacted due to the human activities. An example of that is the urban agglomeration of the city of São Luís, which due to the characteristics of the elements of nature and the pressure of human activities, the environment has been impacted in almost all of its basins (MACÊDO; FEITOSA, 2011).

The Paciência River is one of the main water sources of the island of São Luís, once it supplies a great part of the city. However, it is impacted due to the release of domestic effluents along its course, making it unfeasible for other uses (CASTRO, 2001). Knowing the impacts of this important water body, it is possible to study the environmental perception, which is proving to be of great importance for the understanding of man and the environment (FERRARA, 1999). Thus, the perception of each individual about the surrounding environment is seen as an efficient tool in environmental studies, where each individual perceives it in a particular way (COSTA; COLESANTI, 2011).

Therefore, the aim of this study was to evaluate the changes in a section of the Paciência River, through the perception of the inhabitants of the Dom Ricardo community, in order to find out how much the anthropic actions contributed to the environmental impacts that ended up in the degradation of the Paciência River.

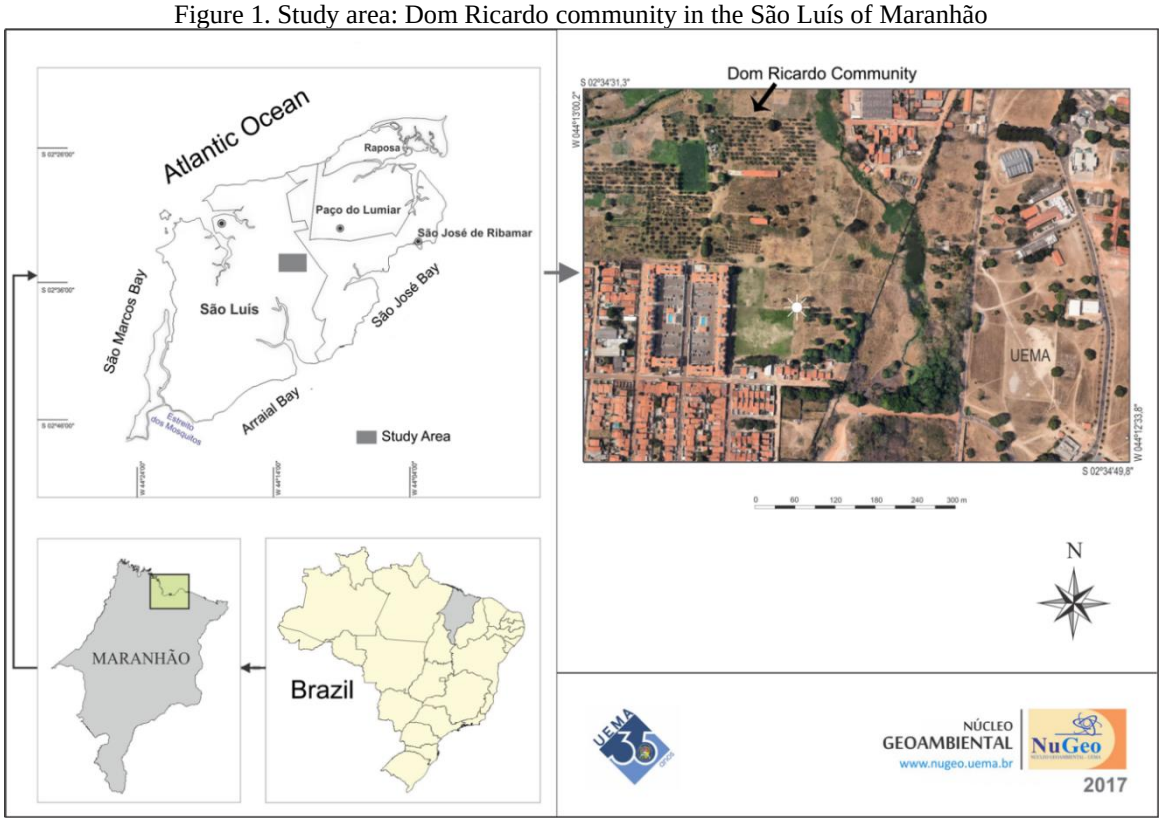
2 MATERIAL AND METHODS

2.1 STUDY AREA

The Paciência River is located in the east portion of the island of Maranhão. It is the main watercourse of the eastern central region of the island and it drains part of the area of the cities of São Luís, São José de Ribamar and Paço do Lumiar. The river has been used since the beginning of the occupation of the interior of the island. This watercourse plays an important role in the local economy through the irrigation of the areas of olericulture and floriculture.

The study was carried out in a local community called Dom Ricardo, located in the neighborhood of Jardim São Cristóvão II, which is part of the metropolitan region of the city of São Luís, Maranhão (Figure 1). It is about 15 km from downtown (2º34'45.52"S 44º12'49.13"W), and it is limited to the north with Lourenço Vieira da Silva avenue; to the South with the Independence Park, place where the Agricultural Exhibition of Maranhão (EXPOEMA) takes place; to the East with the Universidade Estadual do Maranhão (Campus Paulo VI – UEMA); to the West with the São Cristóvão neighborhood.

Figure 1. Study area: Dom Ricardo community in the São Luís of Maranhão



The Association of Residents of the community consists of approximately 100 residences, with a population of around 250 people, as well as an area of 35,780 m^2 and perimeter, 889,104 m (2014) in personal communication.

2.2 DATA ANALYSIS

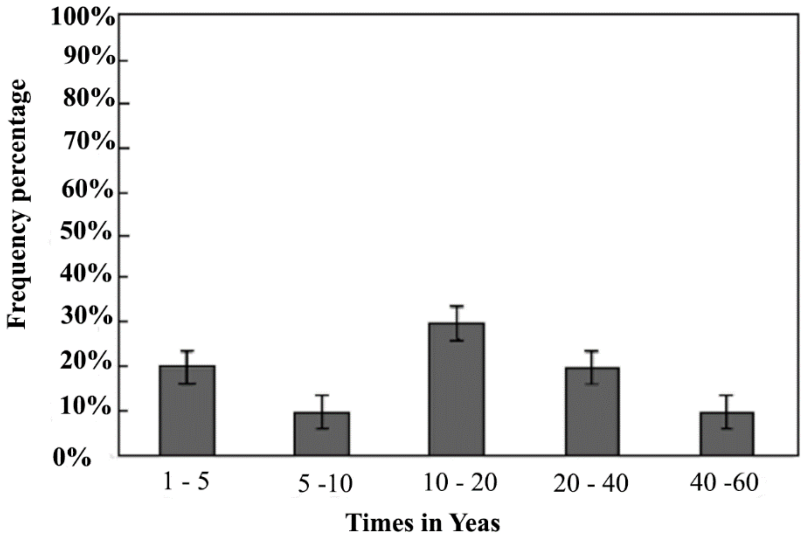
Initial visits were undertaken to recognize the area. Then the questionnaires were applied randomly. The questionnaires were composed of open-ended questions and semi-structured interviews with questions defined prior to the application of questions of interest to the interviewer.

The interviews were conducted with local representatives, with a total of fifteen questions, related to characterization, where the respondent spontaneously and freely talks whether changes caused impact along the Paciência River. In order to carry out the research, the method known as snowball sampling was used, which according to Biernacki and WALDORF (1981) is a non-probabilistic method used in social research where the initial participants of a study indicate new participants, which in turn indicate new participants and so on. The results of this study are summarized in Table 1.

3 RESULTS AND DISCUSSION

Regarding gender, of the people interviewed 77.7% were male and 22.2% female. Most of the respondents have only completed elementary education (44.4%). Only 22.2% finished high school and 11.1% are illiterate. The same percentage was obtained for people with incomplete elementary education and also for those who pursues a bachelor degree. More than half of the respondents are from the city of São Luís (55.5%), 30% of them have been living in the area for a period between 10 and 20 years, as shown in (figure 2).

Figure 2. This graph show how long people have lived in the study area



Regarding the fate of the garbage produced in their homes, residents reported that the city hall garbage truck collects the disposal twice in the week. However, due to the poor pavement condition of the streets, it is impossible for the garbage truck to enter many streets of the neighborhood. Therefore, they also use a container that was placed inside the State University of Maranhão, as well as in dumps located nearby.

About 55.5% of the respondents related the transmission of diseases in the vicinity due to garbage residues, which attracts insects and organisms that transmit diseases, such as: leptospirosis, zica virus, dengue and chikungunya. The most observed types of animals in the vicinity of their homes that they believe to be related to disease transmission are rats, buzzards, cockroaches, and mosquitoes.

The water that they consume comes from wells made in their own home (55.5%), community well (33.3%) or from the supply of the Environmental Sanitation Company of Maranhão - CAEMA (11.1%), which takes water from the Paciência River. All the respondents affirmed to use septic tanks to release domestic sewages produced in their homes. None of the residents claimed to have a direct relationship with the river, due to the low quality of the water, however they unconscious use the water by other means.

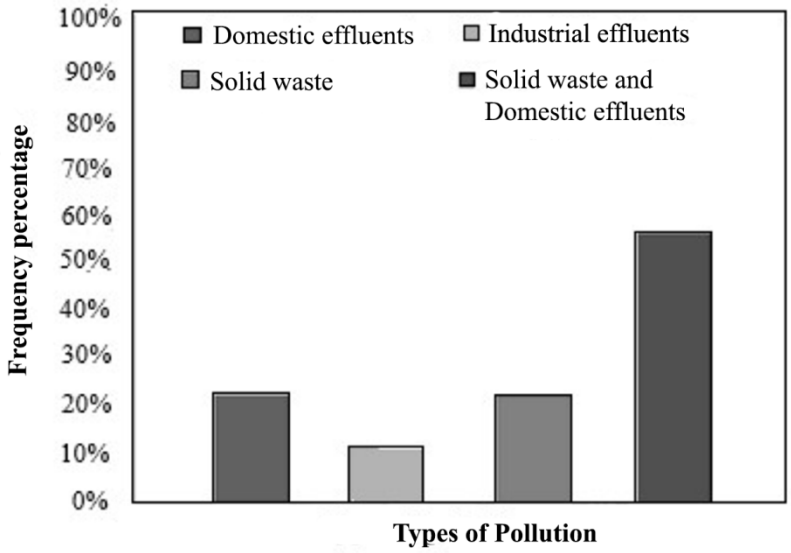
The use of artesian wells is due to the belief of the in habitants that the ground water is devoid of contaminants by the natural process of filtration by the layers of soil and rocks present in the environment, however it is known that pollutants coming from the anthropic action in urban agglomerates may reach the ground water causing contamination (COLVARA et al., 2012). In addition, it is important to note that in the present study, there are no significant differences in the number of pathogens. Analysis of ground water for drinking purposes are made through physical chemical and microbiological analyzes established through the legislation in force in Brazil, specifically, the Decree 2914, of December 12, 2011, of the Ministry (BRAZIL, 2011) and Resolution 396 of April 3, 2008 by the National Environment Council (CONAMA) (BRAZIL, 2008).

The drilling of artesian wells is a specialized activity of engineering, and for that there is a proper legislation and a detailed study of the area to be drilled must be done. Therefore, it is necessary to have a constructive project, granting and environmental licensing (CAPUCCI, 2001), but the existence of these factors was not mentioned by the community. When artesian wells drilling is not done properly, it can lead to problems, often through the clandestine construction of wells, contributing to the poor quality of groundwater. At the same time, government policy does not provide conditions for the construction of wells for riverine communities.

The watershed of the Paciência River as well as the rivers that are part of it are used for the irrigation of horticulture and floriculture and also for leisure activities. However, it is undergoing to a severe process of silting in its bed, due to the removal of ciliary forest, besides the pollution caused by domestic sewage. Therefore, actions are needed in the community with the objective of raising awareness of the population and stimulating a

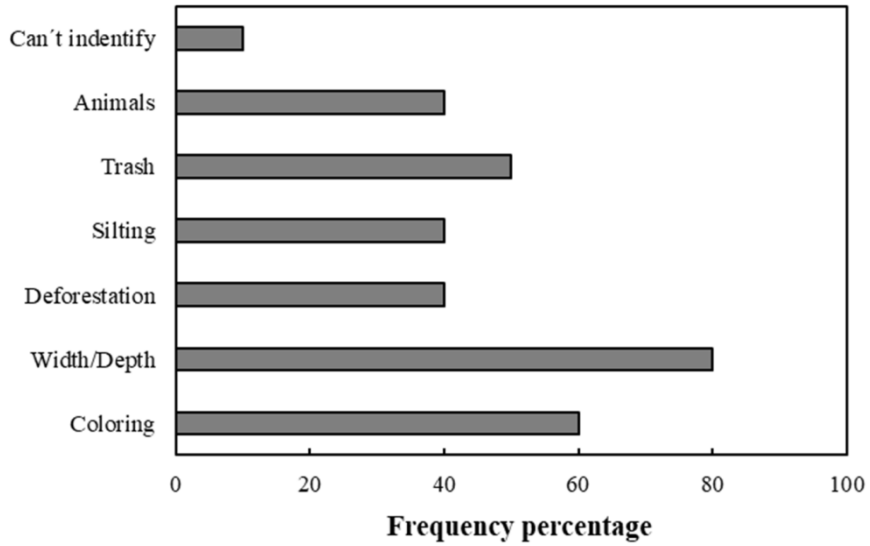
clear vision of the impacts related to the inadequate disposal of solid waste in the environment (SANTOS, 2011). All respondents believe that the river is polluted mainly by domestic effluents associated with solid waste (55.5%) and only by domestic effluents (22.2%) (Figure 3).

Figure 3. The most common types of waste observed Community Dom Ricardo, Maranhão, Brazil



Thus, the urbanization process is the main cause of degradation and consequently pollution of the Paciência River, since it receives a great amount of sewage discharge produced by the surrounding communities. It is worth emphasizing that these factors are correlated with the absence of management and the lack of sanitary planning that could be taken as a foundation to inhibit the exhaustion and consequently the contamination of the water body (PEREIRA, 2004) Changes in color, width and depth, deforestation, siltation, large amounts of garbage and animals were mentioned (Figure 4).

Figure 4. Modifications of Paciência river observed by the residents over the years in Dom Ricardo Community, Maranhão, Brazil



During the interviews, it was asked what could be done to improve the environmental conditions of the Paciência River. All respondents answered that the government should clean up the river and prohibit solid waste disposal and sewage by companies and also by the population. Most of the substances that contribute to water pollution come from industries, agriculture and human activities. Discharges, landfills, chemical dumps, chicken coops, underground injected toxicants, use of fertilizers and pesticides, septic tanks, urban drainage, and air and surface water pollution are examples of sources of ground water pollution. For the community the use of septic tanks and the polluted river waters do not affect the ground water, so that they can keep on using the artesian wells. However, most of the solid waste produced by Dom Ricardo community is dumped into the river bed nearby the State University of Maranhão. Therefore, it was observed that there is lack of knowledge of this problem by the local community, once most people are not aware of the risks of the pollution of the river basin.

When asked what benefits the unpolluted river would bring to the population, all respondents answered that an unpolluted river would contribute to leisure activities, besides being a source of food. Some residents reported that between the years 2005 and 2006 they used to consume many fish caught from Paciência River. Moreover, some respondents mentioned that if the river were unpolluted, air quality could be improved and the microclimate would be stable. They also mentioned the impossibility of using the river for some essential activities, however they use artesian wells for agriculture and supply of their residences. Although it is an immediate solution to the water shortage, it could be a future

problem, since the river basin is heavily impacted by pollution and the community lacks adequate sanitation. The absence of adequate sanitation may compromise the river water quality, consequently, the water from wells would also be impacted.

Through the interviews, it was observed that despite the degraded state of the river, it still plays an important role in the local economy through the irrigation of horticulture in some stretches where river sources are still used for the supply system of the Island of São Luís. This importance is evidenced in the large number of artesian wells found in the area. These wells are used for irrigation of the community garden created through the Association of Residents of Jardim São Cristóvão II. In addition, the wells are also for the daily consumption of the residents.

The community garden has as main characteristic the subsistence family farming and crops for commercialization. It occupies a great extension of the river that flows through the local community. The study area also presents important characteristics for the planting, such as sandy soils, which are rich in humic acids, ideal for plantations of potatoes, cassava, manioc and also for the cultivation of coconut. In fact, there is a cooperative of family farmers in the community that develops agriculture. The farmers cultivate mostly cassava, okra, corn, pepper, and others.

It can also be mentioned that the dumping of garbage observed near the river may be a serious problem since the decomposition of the waste produces a highly contaminated liquid called leachate, and due to the poor condition of the disposal of the garbage, the leachate can reach both the underground and the surface waters (PEREIRA, 2004). That becomes even more serious and alarming when taking into account the use of wells for the community garden maintenance. Probably the water from these wells comes from the same sources that supply the river. Some studies point out the risks of diffuse contamination through the abstraction of water from wells for irrigation of crops such as fruit and vegetable plantations, which may contain contaminant forms of protozoan cysts, worms and helminth eggs. In other words, fruits and vegetables irrigated with contaminated waters may be as a carrier for various enteric diseases (TIYO et al., 2015).

Environmental balance is a challenge for mankind. Natural resources begin to show signs of scarcity either by irrational exploitation or activities that modify the natural characteristics of the environment (COELHO, 2012), which was observed in the Dom Ricardo community. There is a need for transformative and sensitizing actions in order to recover the natural course of water, so that the next generations will be able to use it. (COELHO, 2012) emphasizes also the importance of Environmental Education between

man and nature through articulations of values, attitudes and behaviors which will promote a transformation of the society.

4 CONCLUSIONS

Anthropogenic action has been causing several types of environmental degradation and pollution along the Paciência river watercourse, especially in the area near the State University of Maranhão.

This problem has been accentuated lately, especially due to the accelerated process of urbanization along the river, which causes several negative consequences. It is even worse when some residents seem to be indifferent regarding the current conditions of the river.

The study was addressed to the Dom Ricardo community in order to understand how the community sees the problem of pollution of the river basin. In order to mitigate this problem, there is a need for governmental actions and for pollution control in the river basin, as well as awareness and preservation programs that aim to protect that water body, in partnership with the State University of Maranhão and the riverside communities.

REFERENCES

BIERNACKI, P.; WALDORF, D. ¨Snowball sampling: Problems and techiniques of chain referral sampling¨, **Sociological methods & research**, v.10, n.2, p. 141–163, 1981.

BRASIL, RESOLUÇÃO CONAMA no 396, de 3 de abril de 2008. Dispõe sobre a classificação e diretrizes ambientais para o enquadramento das águas subterrâneas e dá outras providências. Disponível em < http://pnqa.ana.gov.br/Publicacao/RESOLU%C3%87%C3%83O%20CONAMA%20n%C2%BA%20396.pdf> Acessado em 05/09/2019

BRASIL, PORTARIA Nº 2,914, DECEMBER 12, 2011 Provides on the procedures for controlling and monitoring the quality of water for human consumption and its standard of potability. 2011. Available at http://bvsms.saude.gov.br/bvs/saudelegis/gm/2011/prt2914_12_12_2011.html access in November 2018.

CAPUCCI, E. et al. **Poços Tubulares e Outras Captações de Águas Subterrâneas - Orientação aos Usuários. Rio de Janeiro**: SEMADS, 2001, 70p. Disponível em <file: /// C: /Users/CCB-TB188321/Downloads/Pocos_tubulares.pdf>. Accessado em 22 de Novembro de 2017.

CASTRO, A. C. L. Diversidade da Assembleia de peixes em Igarapés do estuário do Rio Paciência (MA-Brasil). **Atlântica**. Rio Grande, v.23, p.39-46, 2001

CETESB, COMPANHIA AMBIENTAL DO ESTADO DE SÃO PAULO. Variáveis de qualidade de água**. CETESB**, São Paulo, 2009. Disponível em: <http://www.cetesb.sp.gov.br/ Agua/rios/variaveis.asp#transparencia>. Acessado em 26 de novembro de 2017

COELHO, M.A. Percepção Ambiental dos Moradores Ribeirinhos do Médio Itapecuru em Rosário-MA como subsídio a uma Proposta de Educação Ambiental. **Revista Brasileira de Educação Ambiental,** v. 7, n, 2, p. 29-36, 2012.

COLVARA, J. G.; LIMA, A. S.; SILVA, W. P. Avaliação da contaminação de água subterrânea em poços artesianos no sul do Rio Grande do Sul. **Brazilian Journal of Food Technology**, Campinas, v.2, p.11-14, 2009.

Avaliação da contaminação de água subterrânea em poços artesianos no sul do Rio Grande do Sul. Brazilian Journal of Food Technology,

Campinas, v.2, p.11-14, jan. 2009.

COSTA, R.G.S.; COLESANTI, M.M. **The contribution of environmental perception to studies of green areas, RA'E GA - Geographic Space in Analysis,** 2011. p. 238-251.

FERRARA, L. D. As Cidades Ilegíveis: percepção ambiental e cidadania. In: RIO, V. D.; OLIVEIRA, L. (Orgs.). **Percepção Ambiental: a experiência brasileira**. 2 ed. São Paulo: Studio Nobel. p. 1999.

CAVALCANTI-JUNIOR, F. A. C. **Zoneamento do escoamento superficial da bacia hidrográfica do Rio Paciência, Ilha do Maranhão-MA.** 2016. 240 f. Dissertação (Mestrado em Geografia). Universidade Estadual Paulista, Presidente Prudente, 2016. Available at: <http://hdl.handle.net/11449/134353>. Accessed on November of 2018.

KANU, I.; ACHI, O. K. Industrial Effluents and Their Impact on Water Quality of Receiving Rivers in Nigeria. J**ournal of Applied Technology in Environmental Sanitation**, v. 1, n.1, p.75-86, 2011.

MACÊDO, J.R. dos S .; FEITOSA, A.C. ¨ Human intervention in the landscape of the Igarapé Basin of the guide, Municipality of São Luís-MA¨, São Luís, **Cadernos de pesquisa**, São Luís, v. 18, n. 2, p. 27-37, 2011.

MENEZES, J. P. C.; BITTENCOURT, R. P.; FARIAS, M. S.; BELLO, I. P.; FIA, R.; OLIVEIRA, L. F. C. Relação entre padrões de uso e ocupação do solo e qualidade da água em uma bacia hidrográfica urbana. **Engenharia Sanitária e Ambiental**, v. 21, n.3, p. 519-534, 2016.

MERTEN, G.H .; MINELLA, J.P. Qualidade da água em bacias hidrográficas rurais: um desafio atual para a sobrevivência futura. **Agroecologia e Desenvolvimento Rural Sustentável**,v.3, n. 4, p. 33-38, 2002.

NETTO, A.L.C. Hydrology of Slope in Interface with Geomorphia. In: WEGENER, A. **The Origin of Continents and Oceans**. New York: Wiley, 1996. p.103-137.

PEREIRA, R.S. Identificação e caracterização das fontes de poluição em sistemas hídricos. **Revista Eletrônica de recursos hídricos**, v. 1,n. 1, p. 20-36, 2004.

SANTOS, G.G.D. **Análise e perspectivas de alternativas de destinação dos resíduos sólidos urbanos: o Caso da Incineração e da Disposição em Aterro**, 2011. 208p.

SILVA DAMASCENO, M. da C. et al. Seasonal evaluation of the surface water quality of the Amazon River on the edge of the city of Macapá, Amapá, Brazil. **Environmental and Water Journal**, v.10, n.3, p. 2015.

TIYO, R. et al. Water on *Cryptosporidium* spp., *giardia* spp., and coliforms in Parana, Brazil. **Revista do Instituto de Medicina Tropical de São Paulo**, v. 57, n.4, p. 333-336, 2015.