Possible sustainable measures to be applied in the community of Lago do Catalão in Iranduba, Brazil

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ABSTRACT

This research approached the environment where the residents of the Lago do Catalão Community live, in the municipality of Iranduba, in the state of Amazonas, from the perspective of sustainability. The justification is given by the fact that it is in a floodplain, being subject to the seasonality of the Solimões River since it is a totally floating community. In this sense, this work presents possible sustainable measures to be applied in this community. The observation method was used to analyze the sustainable activities in the community and their implications in the implementation of ecological activities, investigating the reason for the failures in the realization of ecological activities in the community so that it could suggest options for sustainable practices for the residents, considering that the community is a passage of tourist routes. The steps of the method were a) collecting data about the community, b) conducting dialogues with the community representative, c) identifying the main difficulties in the implementation of sustainable projects, d) analyzing these difficulties and e) designing solutions capable of overcoming these difficulties. The results showed that a) an experimental structure for dry toilet was created and approved in the community, b) a river water treatment system for domestic consumption was proposed, c) another proposition was the implementation of Handy Pod systems to filter wastewater and c) the implementation of aquatic macrophytes for phytoremediation of the area was suggested. The conclusion shows that the waters are the main source of life for everyone in the community because they get their food from it, through it they move, around them their lives are revolving and constantly adapting to their reality. Therefore, there is a need to care for and preserve rivers and lakes. And each resident of the Lago do Catalão community is aware of their responsibility for their environment.

Keywords: Sustainability, Lago do Catalão, Sustainable activity, Floodplain, Sustainable measures.

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INTRODUCTION

Implementing eco-friendly activities can be a challenge in many communities in the Amazon region. However, on the waters, these challenges become even greater. It is important to understand the reasons behind the failures in carrying out these activities so that effective solutions can be proposed. In addition, it is essential to consider the implications of these activities on the implementation of sustainable practices (Chaves *et al*, 2020). An in-depth analysis of the waste discarded in the Catalan Lake can reveal the main obstacles faced by residents and provide *insights* on how to overcome them. Based on these analyses, it was possible to suggest options for sustainable practices that are feasible and appropriate for the community. It is important to emphasize that the implementation of sustainable practices not only benefits the environment, but can also bring economic and social benefits to the community (Moreira; Manzatto, 2023).

By adopting sustainable practices, residents can reduce their environmental impact and contribute to the preservation of the region, since the Amazon region is home to the most extensive river system and the largest liquid mass on earth, being covered by the largest tropical rain forest (Ferreira; Saraiva, 2009; Lameira, 2023; Mesquita, 2023; Ramirez *et al.*, 2023). In recent years, there has been a growing concern with the environment and environmental sustainability (Sartori et al., 2014). This theme in Brazil still needs to be explored more closely. Due to its rich biodiversity and environmental challenges, the country has sought policies and initiatives to promote sustainability in the Amazon (Avelar *et al.*, 2023; Costa et al., 2023; Guimarães *et al.*, 2023). With this, we see the need to seek means and technologies to keep the environment conserved.

The community of Lago do Catalão, in addition to being a passage of tourist routes, is a community 100% with floating houses (Souza, 2020). Therefore, it is important to analyze the sustainable activities in the region, in relation to the disposal of toilet waste generated by the community itself. The general objective of this article is to present some possible sustainable measures that can be applied in the community of Lago do Catalão in Iranduba, state of Amazonas, in the Brazilian Amazon. It is a social technology, a type of technology which, according to Silva and Nascimento-e-Silva (2020), is notable for being focused on its users, characterized by care for the environment. It is hoped that this scientific article will provide an understanding of this sustainable activity, essential in the Catalão community, the disposal of toilet waste, investigating the reasons behind the failures in carrying out ecological activities and suggesting options for sustainable practices for residents. This can help promote more effective sustainable development in the region and improve the quality of life for residents (Pedro, 2022).

LITERATURE REVIEW: LIVING IN RIVERS AND THEIR CHALLENGES

The hitherto well-known types of Amazonian rivers are: whitewater rivers (muddy water), clearwater rivers, and blackwater rivers. (Sioli 1985). The Solimões/Amazon River is the main water collection channel of the largest and most voluminous river basin in the world. By modelling the fluvial relief along its longitudinal profile, it influences the life of the Amazonians (Pacheco; Brandão; Carvalho, 2012). In this sense, it is important to point out, according to the quote that stands out below:

> It is the object of concern of today's Geography to know more and more about the natural environment of man's survival, as well as to understand the behavior of human societies, their relationships with nature, and their socioeconomic and social relations (Queiroz, Soares and Tomaz Neto, 2018, p 109).

We constantly see the need to be careful and to look more delicately at the environment in which we live. According to Sorre (1967), who studied the relationship between man and the environment, through its spatial organization and the techniques employed. For him, space would be the result of the cohabitation of man and nature, surrounded by intentionality (Braga, 2007). In view of this, Santos (1988) states that the reorganization of space and the various forms of relationship with the environment require a relationship of learning and experience (Louzada; Brandão; Santos, 2018).

> [...]. there was already a dependence on the water environment of the native peoples; the waters were extremely important for transportation, production, hunting, among other determining factors for social interactions (Queiroz, Soares and Tomaz Neto, 2018, p.110).

According to Serrão, Almeida and Carestiato (2020), in order to be able to study nature and its natural processes and thus apply this knowledge in the conservation and preservation of natural environments, it was necessary to create a term that, according to him, specifically for ecology, makes it easier for us to know which environments are more fragile, which support fewer changes in the environment. In this way, we can create nature reserves and parks to conserve them for the future, preventing them from being destroyed.

For Vasconcellos (2019), sustainability can be defined as a capacity to support the environment based on a logic that satisfies present human needs without compromising the ability of future generations to meet their own needs. This will require a balance between three pillars, which are: the social, economic and ecological dimensions simultaneously (Elkington, 1994; Doliveira *et al*., 2021; Sartori; Latronic; Campos, 2014), as well as having as fundamental characteristics the equity in the distribution of economic and ecological goods (natural resources).

Environmental problems represent one of the most debated topics in contemporary times. Encouraging change and habits, sensitizing the population and encouraging the adoption of pro-

sustainability behaviors are some of the main challenges faced (Oliveira; Brazil, 2020). Through an environmental perception, the main representations of water that appeared were: being essential for the present and for the future; maintenance of survival (Kuhnen; Becker, 2010).

According to Kuhnen and Becker (2010), water quality is a measure capable of diagnosing the state of conservation of the environment as a whole, since through its analysis the degree of soil erosion, organic discharges, sewage pollution and even atmospheric pollution are verified. For no other reason, river basins have been used as planning units for environmental management (Graff, 2000; Freitas, 2000).

BASIC SANITATION AND WATER QUALITY CATALÃO LAKE

According to Neu, Santos and Meyer (2016), the contamination of water bodies advances with economic and population growth (Barros; Amin, 2007). The lack of adequate sanitation, both in rural and urban areas, is another important source of water contamination. Basic sanitation directly interferes with the balance of ecosystems and is essential for the control and reduction of diseases, directly affecting the quality of life of populations (IBGE, 2010).

According to Ribeiro and Rooke (2010), most of the health problems that affect the world's population are intrinsically related to the environment. More than one billion people on Earth do not have access to safe housing and basic services, even though every human being has the right to a healthy and productive life in harmony with nature. In Brazil, diseases resulting from the lack or inadequate sanitation system, especially in poor areas, have aggravated the epidemiological situation (Brasil, 2006).

The proper disposal of human waste aims, fundamentally, to avoid the pollution of the soil and water sources and the contact of flies and cockroaches (vectors) with the feces, controlling and preventing the diseases related to them. Basic sanitation is a service that, like health and education, influences the lives of individuals in a direct and visible way. This is because, linked to sanitation practices are issues of housing, food, health and working conditions, or in a more summarized way, they touch all the fundamental spheres of the human being's life. (Ferreira; Garcia, 2017).

Among the situations experienced by community members is the absence of basic sanitation for floating buildings, and also of a water reservoir for the dry season (Jesus *et al*., 2022). There is a lack of initiatives by the government to apply technologies that meet these needs, such as, for example, the lack of regularity in the collection of solid waste, which happens once a month, or even once every two months by the City Hall. The dynamics established in the experiences of this population point to the challenges of thinking about the urban and peri-urban in the Amazon, and how the government has been recognizing local experiences for proper regional planning (Quaresma, 2022).

In the dry season, the water in the lake becomes unfit for use. Another situation to be highlighted is that of sanitary sewage, which is improperly executed, and also the continuous supply of water that does not exist. Considering that basic sanitation services are not offered in this community as required by Law 11,455 (Brasil, 2007) and that the lack of them causes problems to the health of the population, it is necessary to create alternative proposals and equipment that can be implemented in Lago do Catalão (Brandão, 2023).

DISPOSAL OF TOILET WASTE AND SUSTAINABILITY

According to Neumann (2023), without sanitation options, human waste is directly released into the water on which the community lives. It is the same water where people bathe, wash clothes and dishes, recreation, and sometimes get food and water for consumption. As such, people living in these floating communities regularly suffer from diarrhoeal diseases caused by sewage-related pathogens (Andrews, 2018; Pandey *et al*., 2014). Located in Peru, there is a community that has a similar scenario to our study area, called the Claverito community, which lacks access to clean water, sanitation, and waste management, among other infrastructure, and improved conditions (Bachman, 2020). Drinking water supply and sewage management are persistent problems for floating communities due to the technical challenges associated with living in the water (Neumann, 2023).

According to Neumann (2023), a non-profit organization called *Wetlands Work*, leveraged an idea to develop a successful sanitation system for floating communities in Cambodia, called *HandyPod*, which captures sewage inside a floating container populated with water hyacinth (murumuru) *Eichhornia crassipes* (Wetlands Work, 2013). The water around Claverito has a high load of fecal contamination, which has negative impacts on the health of the community. Water hyacinth was able to maintain concentration at safe levels in shallow water.

Wetlands, known as wetlands, little explored in Brazil, contribute significantly to a healthy environment as (Cohen et al., 2016; Richardson et al., 2016). Wetlands retain water to a large extent during periods of drought, thus keeping the water table high and moderately stable. Orimoloye 2020. They can contribute to the landscape, such as generating flows, retaining nutrients and sediments, and supporting biodiversity, according to Cohen et al. 2016. Wetlands play an irreplaceable role in regulating the global climate, maintaining the global hydrological cycle, protecting ecosystem diversity, and safeguarding human well-being, Xu (2019). Wetland ecosystems are an efficient and low-cost solution, especially in rural areas.

Due to the need to provide a better destination for the waste produced in floating households, thinking in a sustainable way, in 2016 a project was proposed as a test for the implementation of an ecological toilet in the community of Catalão, which was carried out at the Lago do Catalão Municipal School, which is floating. The Community of Lago do Catalão has approximately 370

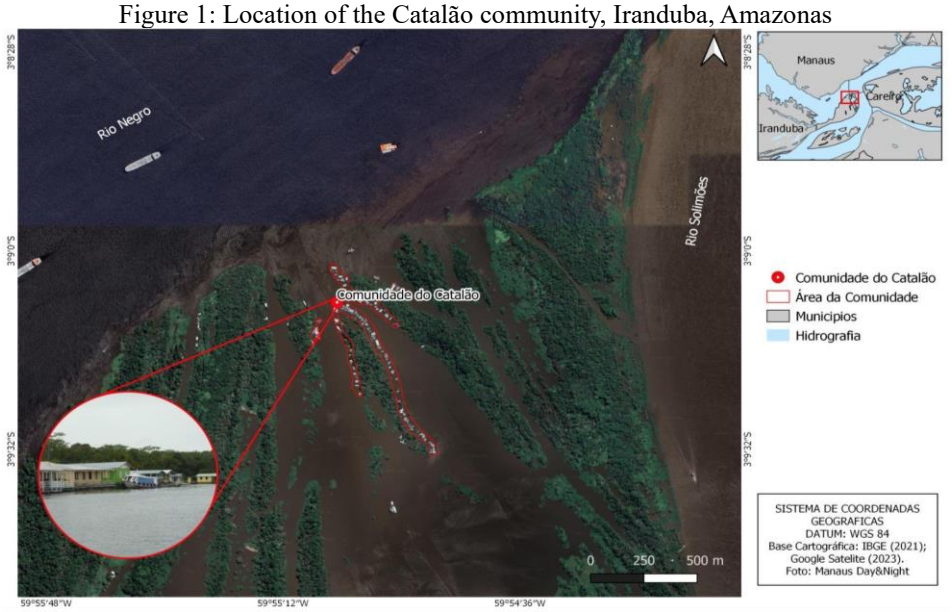
people, 115 houses, the installation of this ecological toilet was carried out in the school of the community in which it receives, in addition to the children of the community, students from a part of Xiborena and another part of students from Manaus specifically from the neighborhood of Mauazinho, who attend the school, in the morning the elementary school 1 works, in the afternoon, elementary school 2 and in the evening, technological education.

An attempt to generate a sustainable practice with the dry toilet, which instead of mixing the waste with water, the system installed in the school would use lime and sawdust and even everything that was deposited in the toilet would not go to water as the toilets do in the other floating houses in the community, the mixture is accumulated and removed every certain period. An experimental structure was set up in the school and a bathroom with fiber walls was built, adapted to the local reality. The residents of the community liked and embraced the idea of the dry toilet, considering that they live on the water and there is a pressing need to take care of their livelihood in a rational and sustainable way, so as not to pollute their waters (Mesquita *et al.*, 2023).

METHODOLOGY

The floating community of Lago do Catalão, as shown in figure 1, is located in the floodplain of the Rio Negro at the confluence with the Solimões River, being part of the municipality of Iranduba, in the state of Amazonas, in the Central Amazon (Ramos et al., 2014). This area includes a lake connected to the aforementioned rivers, approximately 3 km from the port of Ceasa in the city of Manaus (Leite et al., 2006).

Figure 1: Location of the Catalão community, Iranduba, Amazonas



Source: IBGE Cartographic Base (2021).

In the lake, there is a floating community that houses 115 families, the topography of the area is uniform and flat, due to the fluvial accumulation, being formed by the domains of the province of Cenozoic deposits, constituted by Quaternary sediments represented by alluvium of Holocene origin, presenting altitudes that rarely exceed 100 meters. The main characteristic of the region is lowlands containing a chain of lakes close to or connected to each other, which, according to the seasonal variation of the water level, can flood completely or dry up completely (Brito, 2006).

The research had an exploratory character, since a survey of information about the community and sustainable practices was carried out. It can be defined as a previous study whose objectives are to gather and expand information about the object analyzed by the researcher (Noll, 2020). The investigative practice was carried out in two moments, the first part being a bibliographic survey, in articles, magazines, dissertations, reports referring to the area of interest, following the recommendations of Nascimento-e-Silva (2023), and the second was the field visit in the study area that was the floating community. Gil (2019) says that bibliographic studies are carried out on material already published, which deals with the themes that are part of a given textual production under construction. On the other hand, Vergara (2013) states that field research represents the moment in which the researcher has greater contact with his object of study, which allows him to make more assertive inferences in his investigative course. The field research carried out aimed to understand the problem with the residents of the community and the school with which the ecological toilet test project was started and the sustainable practices carried out by them to better take care of their environment.

RESULTS AND DISCUSSION

Many technologies have been developed around the world to reduce the contamination of the population and the consumption of water in the conventional basic sanitation system, which use hydraulic models. One of these alternatives is the dry toilet, it is a bioconstruction that does not require water. According to Castro and Castro (2019), the US *Green Building Council* (USGBC) establishes that the dry toilet is one of the technologies with the greatest potential today. Its mechanism consists of the use of sanitary waste for the composting process and transformation of waste into humus, through the synthesis of microorganisms and consequent cleaning of the compost.

The idea of implementing dry toilets as a sustainable solution was of great relevance and in addition to collaborating with the environment, and the excessive consumption of water produces inputs that can be used for plant fertilization, and thinking about a community about the water was one of the solutions designed to help these residents preserve their environment, considering that they do not have basic sanitation and are in direct contact with the water and all their waste is deposited in the river, as discussed by Neumann (2023).

The big problem presented in the dry toilet taken to the Catalan Community, was its large structure that according to the residents of the community was the main barrier, and the representative of the community tried to insert it in several different environments, first in a restaurant, then they tried to install it in the school, and to put an end to the representative tried to put it on her floater, But due to its large structure it made it heavy, so it happened that in all the places that were thought of installing the ecological toilet would make the floating in a way sink and also took away a good necessary part of the space, even the school that has a large structure could not maintain it for a long time, as shown in Figure 2, the structure of the access to the bathroom can be observed.

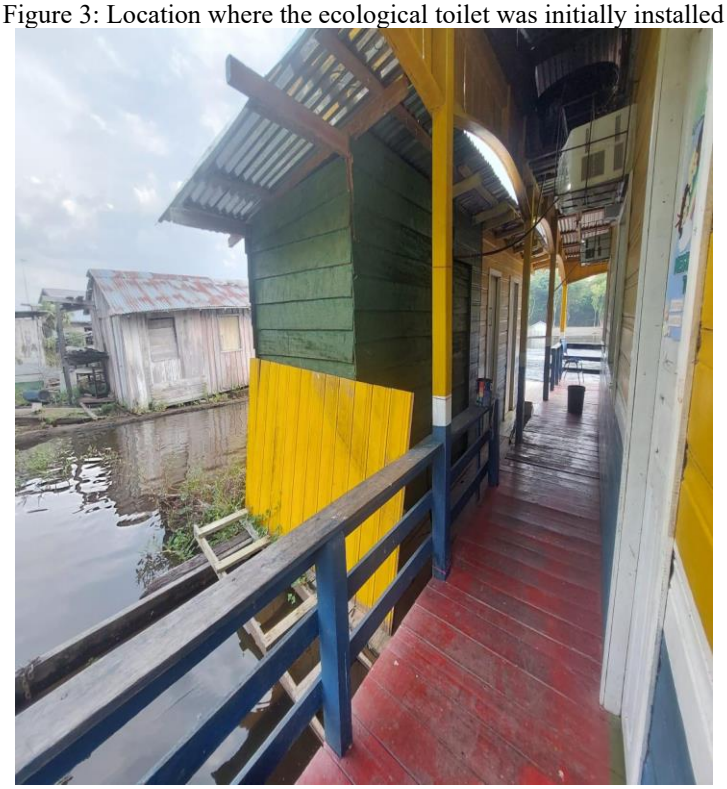
Figure 2: Ladder that was used to access the dry toilet

Source: Photograph captured by the authors.

Due to these difficulties, the toilet was never used. When taken to school, there was great admiration on the part of the students and curiosity, but it was not handled, because they already had in view the great obstacle that would come later, because the bathroom would need to be handled correctly within the time stipulated according to its use, and due to the fact that there had not been an instruction for its use. The school administrators thought it best not to use it. However, it is important to emphasize that there was no prejudice against the possibility of using the bathroom, neither by children nor by adults.

During the *on-site visit* to the school, the structure of the bathroom was observed. Although the float was large, it was still not possible to support the weight of the toilet installed there, as its large structure affected the float itself. It was then removed and given another destination outside the community, leaving only the place where it was installed (Figure 3).

Figure 3: Location where the ecological toilet was initially installed

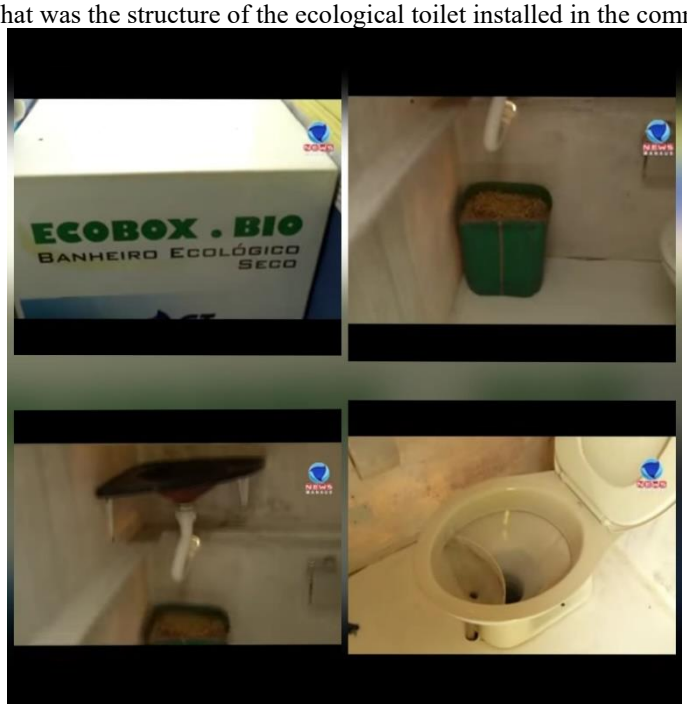


Source: Photograph captured by the authors.

In fact, when the possibility of installing a dry toilet came to the community, this was widely accepted, taking into account that they live in houseboats, so their dynamics and reality are different, as well as Serrão et al. (2020) raise the approach of applying knowledge on conservation and preservation of natural environments. Its resource is water and it is known that it is a finite resource, in addition to being extremely necessary for survival (Silva et al., 2023). So, they start from the principle that everything that is for the care and better preservation of rivers and lakes, the residents of this community, they are inserting in their practices, trying to be more sustainable and contributing in some way to preserve the environment (Pedro, 2022).

Because the structure of the ecological toilet taken in the community was not successful, a specific project could be worked with the community in mind and thus meet its needs in terms of size and material to be built, so that it could be possible for residents to use this idea of the dry toilet in their homes, have the necessary training to handle the inputs generated and thus apply a sustainable practice beneficial to the residents and the environment. Figure 4 shows the structure of the ecological toilet installed in the community.

Figure 4: What was the structure of the ecological toilet installed in the community like?



Source: Photos captured from the Record News video (2016).

With this practice, the people who live in the community would be passing on ethnoknowledge, a term that refers to the knowledge, traditions (culture) passed down from generation to generation in traditional communities, learned from daily life and direct interaction with the environment that surrounds them and their natural phenomena (Nascimento, 2013). The case of the unsuccessfully installed toilet prompts a rethinking of a lighter and smaller design. With extensive training for handling and maintenance. Future generations living in the community would grow up and become familiar with this sustainable habit, thus valuing the environment more and more (Pedro 2022).

In the Catalão community, the population does not have easy access to drinking water, as their waste is discharged *in natura*, under their floating residences, as discussed (Neumann, 2023). The great intention of the residents of the community is to carry out a project that would implement a system of treatment of the river water, because for them to have water for consumption it is necessary to cross on the other side of the river. In addition to the difficulty of transportation, there is the cost of gasoline. But, during the rainy season, they collect the water that falls on the roofs for consumption.

Corroborating with Quaresma (2022), residents have great challenges, especially with the government, to better think about regional planning, with the specificities of a 100% floating community. The community representative reports that even living in the middle of the waters, it is painful to know that the main problem is the contamination of the water with waste and lack of adequate treatment for potability, and in some periods the waters become even more unhealthy and it is not even possible to wash clothes, dishes and other purposes (Gonçalves; Sundays, 2019). Due to the lack of basic sanitation and its waste being deposited directly in the river, there are times when

everything is evident in the waters, in addition to polluting the landscape of the rivers, causing diseases to the residents themselves due to improper consumption (Meschede, 2018).

Another possible solution for the disposal of bathroom waste are techniques that can be implemented such as Handy Pod. It is a water treatment system designed to filter wastewater in floating communities using natural vegetation. It is inserted under the toilet of a houseboat, capturing raw sewage in an expandable bag, called a digester, a successful project for Cambodia's floating communities, in which they have characteristics similar to those of the Catalan Lake.

The implantation of aquatic macrophytes is also suggested, which may contribute to the absorption of a large amount of nutrients responsible for the eutrophication process, thus contributing to the phytoremediation of the area. Aquatic macrophytes, which according to Diniz (2021) regions with aquatic macrophytes, play a significant role in processing nutrients, adsorbing and absorbing toxic substances, and regulating hydraulic flow.

In Brazil, several studies have been carried out to examine the role of macrophytes in improving water quality; the first studies were developed by Manfrinato (1989**),** who verified the efficiency of *Eichhornia crassipes in the* decontamination of the waters of the Piracicaba River, SP, thus making it possible to apply the reality of the residents of the Catalão community, as this species is found in the place.

CONCLUSION

As presented in this research, it is remarkable how the lack of basic sanitation in areas that have a water-dependent dynamic is of great concern to its inhabitants, the lack of drinking water and its constant search for a sustainable solution requires a look at the specificities of the place. Address techniques that can be adapted to the reality of the residents of Lago do Catalão not only with their waste, but also a way for them to have a "cleaner" water.

Through this research it was possible to identify these difficulties for a sustainable practice in their environment, but it was also possible to observe the interest of the residents in wanting to solve such problems in their community, thus willing to eventually participate in some project that presents them with a sustainable practice in relation to their waste and also to adopt the ecological bathroom with a design that does not harm their floats because as discussed their main problem was the structure presented. It is of great relevance to have a look at these floating communities and thus raise hypotheses and solutions through sustainable practices to also preserve the environment.

The techniques presented are feasible, however, a joint action is necessary between the infrastructure presented, the management, provided by the public power in relation to basic sanitation and academia with training, information, and implementation in the community of the culture of sustainability. It is also noteworthy that the initial project presented to the community, here called

ecological toilet, can be implemented as a sustainable practice, but resizing the design, measurements, and adaptation to the reality of floating houses. For future studies, a survey on water preservation projects is suggested, focusing on the reality of Amazonian communities.

REFERENCES

1. ANDREWS, L. (2018). Integrating human health, ecology and built environment design: A TDAR Gardens intervention case study within an informal slum community in the Peruvian Amazon. Thesis (Doctor of Philosophy). University of Washington, Seattle.

2. AVELAR, M. C., et al. (2023). O potencial pedagógico das unidades de conservação na Amazônia paraense: educação ambiental e função socioambiental. Peer Review, 5(1), 259–276. https://doi.org/10.53660/prw.123.uni128.

3. BACHMAN, R. A. (2020). Reimagining the amphibious city: From health data to ecological design in an Amazonian informal community. Dissertation (Master's in Landscape of Architecture). University of Washington, Washington.

4. BARROS, F., & AMIN, M. (2008). Água: um bem econômico de valor para o Brasil e o mundo. Revista Brasileira de Gestão e Desenvolvimento Regional, 4(1), 75–108. https://doi.org/10.54399/rbgdr.v4i1.116.

5. BRAGA, R. M. (2007). O espaço geográfico: um esforço de definição. GEOUSP − Espaço e Tempo, (22), 65–72. http://www.geografia.fflch.usp.br/publicacoes/Geousp/Geousp22/Artigo_Rhalf.pdf.

6. BRANDÃO, R. G. S. (2023). Proposal for water treatment with sustainable alternatives for the floating community of Lago do Catalão in Iranduba-AM. In: XI ENCONTRO DE SUSTENTABILIDADE – ENSUS. Proceedings, Universidade de Santa Catarina, Florianópolis.

7. BRASIL. (2007). Lei 11.445, de 5 de janeiro de 2007. Estabelece as diretrizes nacionais para o saneamento básico. Brasília: Senado.

8. BRASIL. (2006). Manual de saneamento (3rd ed.). Brasília: Funasa.

9. BRITO, J. G. (2006). Influência do pulso de inundação sobre variáveis limnológicas de um lago de várzea da Amazônia Central, lago Catalão. Dissertation (Master's in Tropical Biology and Natural Resources). Universidade Federal do Amazonas; Instituto Nacional de Pesquisas da Amazônia, Manaus.

10. CASTRO, A. B. C., & CASTRO, S. R. S. (2019). Banheiro ecológico uma alternativa sustentável para comunidades no interior da Amazônia. Nature and Conservation, 12(2), 1–10. http://doi.org/10.6008/CBPC2318-2881.2019.002.0001

11. CHAVES, M. P. S. R., et al. (2020). Sustentabilidade & Qualidade de vida: práticas sustentáveis de saúde em comunidades ribeirinhas no Amazonas. Revista de Políticas Públicas, 24(1), 265–285. https://dx.doi.org/10.18764/2178-2865.v24n1p265-285

12. COHEN, M. J., et al. (2016). Do geographically isolated wetlands influence landscape functions? Proceedings of the National Academy of Sciences, 113(8), 1978–1986.

13. COSTA, M. M. K., AMARAL, L. S., & LOPES, M. L. B. (2023). O papel do Banco da Amazônia no desenvolvimento regional. Revista Paranaense de Desenvolvimento, 44(144), 41–54. https://ipardes.emnuvens.com.br/revistaparanaense/article/view/1279

14. DINIZ, C. R., et al. (2021). Uso de macrófitas aquáticas como solução ecológica para melhoria da qualidade de água. Revista Brasileira de Engenharia Agrícola e Ambiental, 9, 226–230. https://doi.org/10.1590/1807-1929/agriambi.v9nsupp226-230

15. DOLIVEIRA, S. L. D., et al. (2021). A sustentabilidade na reutilização de resíduos de pallets de madeira no setor supermercadista. Mix Sustentável, 7(2), 93–104. https://doi.org/10.29183/2447-3073.MIX2021.v7.n2.93-104

16. ELKINGTON, J. (1994). Towards the sustainable corporation: Win-win-win business strategies for sustainable development. California Management Review, 36(2), 90–100. https://doi.org/10.2307/41165746

17. FERREIRA, A. L., & SARAIVA, W. J. S. (2009). Estudo da evolução dinâmica fluvial dos rios do Amazonas com base em imagens de RADAR e satélite nos últimos 30 anos, balanço entre área e deposição de possíveis consequências para a ocupação humana. In: XIV SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO. Proceedings, Natal.

18. FERREIRA, M. P. F., & GARCIA, M. S. (2017). Saneamento básico: meio ambiente e dignidade humana. Dignidade Re-Vista, 2(3), 12.

19. FREITAS, W. P. (2000). Águas: considerações gerais. In: FREITAS, W. P. (Org.). Águas: aspectos jurídicos e ambientais. Curitiba: Juruá, p. 17-28.

20. GIL, A. C. (2019). Como elaborar projetos de pesquisa. 7. ed. São Paulo: Atlas.

21. GONÇALVES, R. M., & DOMINGOS, I. M. (2019). População ribeirinha no Amazonas e a desigualdade no acesso à saúde. Revista de Estudos Constitucionais, Hermenêutica e Teoria do Direito, 11(1), 99–108. https://doi.org/10.4013/rechtd.2019.111.06

22. GRAF, A. C. B. (2000). A tutela dos estados sobre as águas. In: FREITAS, W. P. (Org.). Águas: aspectos jurídicos e ambientais. Curitiba: Juruá, p. 51-75.

23. GUIMARÃES, D. F. S., et al. (2023). Os povos da floresta na produção do espaço e da sustentabilidade na Amazônia: o caso do território do Médio Juruá – Caraurari/AM. Antíteses, 16(31), 59–86. https://doi.org/10.5433/1984-3356.2023v16n31p059-086

24. IBGE. (2010). Censo Demográfico 2010. Disponível em: http://www.sidra.ibge.gov.br/bda/tabela/listabl.asp?c=1378&z=cd&o=7

25. IBGE. (2021). Base cartográfica. Disponível em: https://www.ibge.gov.br/geociencias/cartas-e-mapas/bases-cartograficas-continuas.html

26. JESUS, G. L., et al. (2022). Características hidrogeomorfométricas da microbacia do Rio Lagartixa, Amazônia Ocidental, Brasil. Recima 21 – Revista Científica Interdisciplinar, 3(6), 1–21.

27. KUHNEN, A., & BECKER, S. M. S. (2010). Psicologia e meio ambiente: como jovens e adultos representam água de abastecimento. Psico, 41(2), 6.

28. LAMEIRA, M.K.S. (2023). Análise da estrutura horizontal e composição de uma floresta tropical como subsídio à ampliação do seu potencial produtivo para o manejo florestal. Dissertação (Mestrado em Ciências Florestais). Universidade Federal do Amazonas, Manaus.

29. LEITE, R. G., SILVA, J. V. V., & FREITAS, C. E. (2006). Abundância e distribuição das larvas de peixes no Lago Catalão e no encontro dos rios Solimões e Negro, Amazonas, Brasil. Acta Amazônica, 36(4), 557–562. https://doi.org/10.1590/S0044-59672006000400018

30. LOUZADA, C. O., BRANDÃO, J. P., & SANTOS, E. C. (2018). O modo de vida ribeirinho na Ilha do Januário no Rio Amazonas. Boletim Goiano de Geografia, 38(1), 178–199. https://doi.org/10.5216/bgg.v38i1.52820

31. MANFRINATO, E. S. (1989). Avaliação do Método Edafo-Fitodepuração para tratamento preliminar de águas. Dissertação (Mestrado em Agronomia). Universidade de São Paulo, Piracicaba.

32. MESCHEDE, M.S.C. (2018). Implicações para a saúde de escolares a partir consumo de água e material particulado atmosférico inalado em escolas de Santarém e Mojuí dos Campos, Pará, Amazônia. Tese (Doutorado em Ciências). Universidade Federal do Oeste do Pará, Santarém.

33. MESQUITA, F. R., et al. (2023). Microbiological analysis of water distributed in the urban area on the Municipality of Guajará, upstate of Amazonas, Brasil. Concillium, 23(4), 116–125. https://doi.org/10.53660/CLM-994-23C24

34. MESQUITA, J. J. F. (2023). Urbanização amazônica via bioindústrias: o caso da Metrópole Manaus e de cidades da calha do Solimões – Amazonas (Coari/AM e Parintins/AM). Dissertação (Mestrado em Geografia). Universidade Federal do Amazonas, Manaus.

35. MOREIRA, D. N., & MANZATTO, A. G. (2023). As potencialidades que favorecem o desenvolvimento sustentável na Amazônia. Revista Brasileira de Planejamento e Desenvolvimento, 12(3), 751–777. https://doi.org/10.3895/rbpd.v12n3.15547

36. NASCIMENTO, G. C. (2013). Mestre dos mares: o saber do território, o território do saber na pesca artesanal. In: CANANÉA, F. A. (Org.). Sentidos de leitura: sociedade e educação. João Pessoa: Imprell, p. 57–68.

37. NASCIMENTO-E-SILVA, D. (2023). O método científico-tecnológico: coleta de dados. Manaus: DNS Editor.

38. NEU, V., SANTOS, M. A. S., & MEYER, L. F. F. (2016). Banheiro ecológico ribeirinho: saneamento descentralizado para comunidades de várzea na Amazônia. Revista Em Extensão, 15(1), 28–44. https://doi.org/10.14393/REE-v15n12016_art02

39. NEUMANN, R. B., et al. (2023). Influence of Water Hyacinth (Eichhornia crassipes) on Concentration and Distribution of Escherichia coli in Water Surrounding an Informal Floating Community in Iquitos, Peru. Geohealth, 21(7). https:/doi.org/10.1029/2022GH000768

40. NOLL, G. C. (2020). Materializações digitais da cultura: os transatores vocais e a comunicação contemporânea. Tese (Doutorado em Comunicação Social). Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre.

41. OLIVEIRA, I. P., & BRASIL, D. S. (2020). Psicologia ambiental e problemas ambientais: uma revisão de literatura. DOXA: Revista Brasileira de Psicologia e Educação, 22(1), 108–122. https://doi.org/10.30715/doxa.v22i1.13735.

42. ORIMOLOYE, I. R., et al. (2020). Análise geoespacial da dinâmica das zonas húmidas: esgotamento das zonas húmidas e conservação da biodiversidade da zona húmida de Isimangaliso, África do Sul. Jornal da King Saud University-Science, 1, 90–96.

43. PACHECO, J. B., BRANDÃO, J. C. M., & CARVALHO, J. A. (2012). Geomorfologia fluvial do Rio Solimões/Amazonas: estratégias do povo varzeano do sudoeste do Careiro da Várzea. Revista Geonorte, 2(4), 542–554.

44. PANDEY, P. K., et al. (2014). Contaminação de recursos hídricos por bactérias patogênicas. AMBExpress, 4(1), 51.

45. PEDRO, J. P. B. (2022). Solução semicoletiva de tratamento de águas fecais e seu processo de apropriação em comunidade de área alagável da Amazônia. Tese (Doutorado em Saneamento, Meio Ambiente e Recursos Hídricos). Universidade Federal de Minas Gerais, Belo Horizonte.

46. QUARESMA, E. M. (2022). Notas sobre o planejamento urbano e regional em Iranduba/AM: percepções, conflitos, avanços e limites para implementação da REURB. Trabalho de Conclusão de Curso (Especialização Lato Sensu em Tecnologias Aplicadas à regularização fundiária e prevenção de conflitos socioambientais, habitacionais e sanitários: Rede Amazônia). Universidade Federal do Pará, Belém.

47. QUEIROZ, M. S., SOARES, A. P. A., & TOMAZ NETO, A. G. (2018). Comunidades rurais ribeirinhas e as águas do rio Solimões no município de Iranduba-Amazonas. Revista Brasileira de Meio Ambiente, 4(1).

48. RAMÍREZ, Y.S., et al. (2023). A pressão ecológica na cidade de Manaus – Amazonas. Revista FOCO, 16(6), 1-18. https://doi.org/10.54751/revistafoco.v16n6-189.

49. RAMOS, M. F. L., WACHHOLZ, F., & SILVA NETO, J. C. A. (2020). Qualidade dos recursos hídricos na comunidade flutuante Lago do Catalão, Iranduba-AM. Caminhos Geogr., 21(73), 98–115. https://doi.org/10.14393/RCG217347290.

50. RECORD NEWS. (2016). Amazônia: conheça a cidade que flutua sobre as águas do Rio Negro. Retrieved from https://www.youtube.com/watch?v=IYMIaoCsjzA.

51. RIBEIRO, J. W., & ROOKE, J. M. S. (2010). Saneamento básico e sua relação com o meio ambiente e a saúde pública. Trabalho de Conclusão de Curso (Especialização em Análise Ambiental). Universidade Federal de Juiz de Fora, Juiz de Fora.

52. RICHARDSON, Curtis J., et al. (2016). Soil restoration: the foundation of successful wetland reestablishment. Wetl. Soil. Gene. Hydrol. Landscap. Classificat, 469.

53. SANTOS, M. (1988). Metamorfose do espaço habitado. São Paulo: Hucitec.

54. SARTORI, S., LATRÔNICO, F., & CAMPOS, L. M. S. (2014). Sustentabilidade e desenvolvimento sustentável: uma taxonomia no campo da literatura. Ambiente & Sociedade, 17(1), 1–22.

55. SERRÃO, M., ALMEIDA, A., & CARESTIATO, A. (2020). Sustentabilidade: uma questão de todos nós. São Paulo: Senac.

56. SILVA, R. O., & EL ROBRINI, M. (2023). Influência do índice de chuvas e de rejeitos de efluentes na qualidade das águas do igarapé Santos (Tucuruí – Sudeste Paraense/Amazônia Oriental). Boletim Paulista de Geografia, 108, 188–212. https://doi.org/10.54446/bpg.v109i1.2953.

57. SILVA, R. O., & NASCIMEMTO-E-SILVA, D. (2020). Conceituação e magnitude das tecnologias sociais para a consolidação do ensino tecnológico no contexto da pandemia de Covid-19. In: III CONGRESSO AMAZONENSE DE EDUCAÇÃO À DISTÂNCIA – JAMAIS COMO ANTES – A ERA DA EDUCAÇÃO 5.0. Anais... Porto Velho, Instituto Federal de Rondônia.

58. SIOLI, H. (1985). Amazônia - Fundamentos da Ecologia da maior região de florestas tropicais. Petrópolis: Vozes.

59. SORRE, M. (1967). El hombre en la tierra. Barcelona: Labor.

60. SOUZA, D. N. F. (2020). O devir das águas os modos de vida dos moradores do Lago do Catalão em Iranduba, AM. Dissertação (Mestrado em Ciências Humanas). Universidade do Estado do Amazonas, Manaus.

61. VASCONCELLOS, N. J. S. (2019). Educação ambiental: um caminho para a sustentabilidade. Revista Franciscana de Educação, 2(2), 76–77.

62. VERGARA, S. C. (2013). Projetos e relatórios de pesquisa em Administração. São Paulo: Atlas.

63. WETLANDS WORK. (2013). Floating villages and the HandyPod: Floating Villages and the HandyPod. Retrieved from https://wetlandswork.com/products-and-services/sanitation-in-challenging-environments/handy-pods.

64. XU, Ting, et al. (2019). Wetlands of international importance: Status, threats, and future protection. International Journal of Environmental Research and Public Health, 16(10), 1–23. https://doi.org/10.3390/ijerph16101818.