POST-IMPLEMENTATION ANALYSIS OF NATURAL WETLANDS SYSTEMS IN PAJEÚ PARK, SOBRAL-CE

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Highlights:

· Increase in efficiency and addressing challenges in the implementation of natural wetland systems

· The implementation of the natural wetland system in Pajeú Park has significantly improved the socio-spatial quality of the area, demonstrating the success of this approach.

· The results suggest that further improvements in the system's infrastructure are essential to optimize the removal of various parameters.

Keywords: green-blue infrastructures; sustainability urban management; water quality.

INTRODUCTION

The struggle for territory and space occupation in urban centers has been expanding with the urban development of cities. This movement is accompanied by a lack of adequate planning, especially in developing countries, which promotes impermeabilization, environmental degradation, and disorderly occupation. Along with climate change, this scenario is increasingly worrisome, as many urban areas are exposed to environmental risks. In this sense, Nature-Based Solutions (NBS) have been employed globally to promote the adaptation and resilience of urban and rural areas.

Within the various NBS, green-blue infrastructures (GBIs) contrast conventional planning approaches. Green-blue infrastructures pertain to interventions in natural or semi-natural spaces and water resources, such as flood control, water purification, climate regulation, wildlife habitat, and recreation. Additionally, they involve the conservation, restoration, and sustainable management of these environments to provide benefits, including storm protection, aquatic habitat, water recreation, and potable water supply. Rain gardens, parks, green roofs, wetlands, and bioswales are examples of GBIs designed and managed to provide ecosystem services (Midão et al., 2023).

This study aims to analyze the post-implementation efficiency of a natural wetlands system in an urban stream in Sobral, Ceará.

METHODOLOGY

This study was conducted on the Pajeú stream in Sobral, Ceará, located in the semi-arid north-central region of the state. The area experiences high temperatures of around 40°C in the latter half of the year, with significant rainfall during the rainy season. Additionally, low humidity results in notable daily temperature variations. Sobral is part of the Acaraú River basin and includes several conservation areas.

The wetland system, designed in 2018, is the responsibility of the Sobral government and is named Pajeú Park. The project involved the introduction of macrophyte species along the Pajeú River bank. The system comprises natural wetlands (NWS) and constructed wetlands (CWS). *Juncus* sp, *Thalia geniculata, Canna indica, Colocasia esculenta*, and *Heliconia psittacorum* were planted along the stream and at strategic points. Thirteen species of macrophytes were inserted, with 58,323 units in CWS, with 5,847 m² and 81,989 units on NWS which has 8,215.56 m² (FIGURE 01).

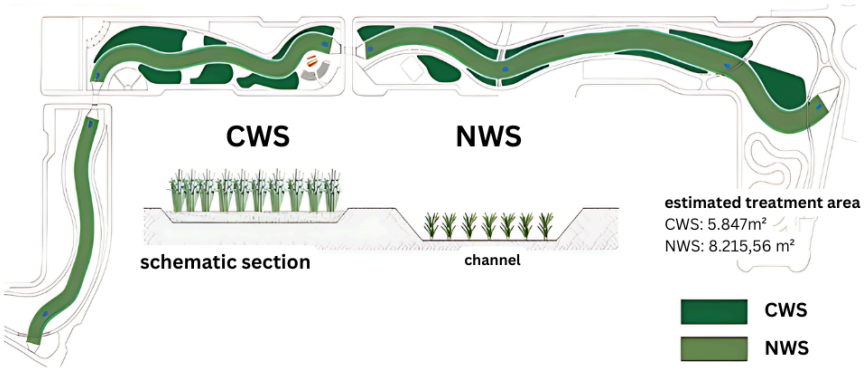

Figure 01: Pajeú Park showing CWS and NWS

This species selection was based on multiple criteria, including resistance to climatic and environmental conditions and rapid growth. Furthermore, the diversity of species chosen promotes the removal of pollutants and aesthetically enriches the landscape with varied flowering and size.

Following the establishment and fixation, a rigorous monitoring process was initiated. The monitoring involved monthly data collection from two key points: upstream and downstream of the natural wetland system (NWS). The data collected included physicochemical and microbiological analyses, such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), total phosphorus, total nitrogen, dissolved oxygen, pH and coliforms, all conducted following the methods described in APHA (2012). This process was repeated for a period of 13 months, ensuring a comprehensive understanding of the system's performance over time.

RESULTS AND CONCLUSIONS

The water quality analysis at the two collected points indicated significant variations in the evaluated parameters, as shown in Table 1.

	BOD (mg/L)	COD (mg/L)	TOTAL PHOSPHORUS (mg/L)	NITROGEN (mg/L)	OXYGEN (mg/L O_2)	PH	COLIFORMS (UFC/ 100 mL)
Upstream	123±116	427,5±303	13,7±8	14,3±10,2	2,6±2,5	7,3±0,6	1936±1154
Downstream	91±111	363,5±333	12,2±8	11±7,7	3,3±4,4	7,2±0,6	902±866

Table 1. Analytical characterization of natural wetland implemented on Pajeú river.

Regarding organic matter measured in BOD and COD, parameter variations were observed between dry and rainy seasons, with minimum values of 3.34 mg/L and 18.5 mg/L, respectively. The removal efficiency of BOD was 25±33%, while for COD, an average removal of 25±30% was observed. Considering the classification of water bodies established by CONAMA 357/2005, the water body was outside the compliance for these parameters in most of the analyzed periods.

Regarding total nitrogen, in the 13 collection campaigns conducted, average values for inlet into the system were 14.3±10 mg/L, while for outlet, values of 11±7.2 mg/L were observed, resulting in an average removal of 25±32%. Although the system showed removal for this parameter, the value exceeds what is permitted by regulations, suggesting occasional nitrogen inputs through clandestine sewage connections and urban drainage runoff.

Regarding total coliforms, the values showed wide variability, with a maximum value of 5117 MPN/100mL and a minimum value of 567 MPN/100mL. The average removal, considering all campaigns conducted, was 47.4±31.4%. In all collections, percentage removals for this parameter were observed, even at low levels. It is noted that the systems are not designed for coliform removal; however, physical-chemical and climatic phenomena may lead to a reduction in this parameter.

The dissolved oxygen analyzed at the two collection points revealed a slight increase in concentrations of this parameter, with a value of 2.6±2.5 mg/L at the upstream point and 3.3±4.4 mg/L at the downstream point. Even though, the final value is lower than what applicable legislation requires, which should be a minimum of 5 mg of O_2/L.

In conclusion, it can be inferred that the natural wetland system provided better socio-spatial quality to Pajeú Park regarding landscape contemplation. Water quality has improved since the system's installation, although there is variability in the results found. Despite not presenting high values, reductions were observed in most of the analyzed parameters. Additionally, there was an increase in dissolved oxygen levels and a decrease in turbidity.

Nevertheless, there are some challenges regarding the management and maintenance of the Parks, mainly concerning safety and proper use by users, which can be addressed with greater community involvement.

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