Evaluation of rainwater detention basins in the urban area of a middle sized city in Brazil

Evaluation des bassins de retenue des eaux pluviales dans la zone urbaine d'une ville de taille moyenne au Brésil

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RÉSUMÉ

Compte tenu du manque d'études sur la post-implantation des bassins de retenue et l'incitation à utiliser cette technique dans les municipalités de taille moyenne, cet article vise à évaluer les unités insérées dans l'environnement urbain d'Araraquara, sous leurs aspects physiques, environnementaux et socio-économiques. La méthodologie utilisée a été divisée en cartographies des unités de détention, application de critères d'évaluation, connaissance de l'implantation, du fonctionnement et de la maintenance et de leurs coûts, et évaluation de la perception et de l'acceptation de la population. Vingt-quatre unités de détention, caractérisées comme ouvertes et herbeuses, ont été identifiées et leur implantation a généralement lieu loin de la convivialité de la population et des ménages. Toutes les unités ont été déployées uniquement pour la fonction hydrologique. À l'exception de deux cas, l'entretien était inexistant ou inefficace, entraînant une végétation excessive, une élimination inadéquate des déchets solides et des dépôts de sédiments dans les unités. Les coûts de mise en œuvre allaient de 8 à 12 dollars par mètre carré, tandis que les coûts d'entretien étaient de 85 dollars par mois. Enfin, la population était en faveur de ces unités, car la maintenance existe ou est plus fréquente, soulignant également l'importance de la multifonctionnalité de ces espaces pour améliorer leur acceptation et leur intégration dans l'espace urbain.

ABSTRACT

Given the lack of studies on the post-implantation of the basins and the incentive to use this technique in medium-sized municipalities, this article aims to evaluate the units inserted in the urban environment of Araraquara, under physical, environmental and socioeconomic aspects. The methodology used was divided into mappings of the detention units, application of evaluation criteria, knowledge about the implantation, operation and maintenance and their costs, and evaluation of the perception and acceptance of the population. Twenty-four detention units, characterized as open and grassy, have been identified, whose implantation usually occurs far from the conviviality of the population and the households. All units were deployed solely for the hydrological function. With the exception of two cases, maintenance was non-existent or inefficient, resulting in excessive vegetation, inadequate disposal of solid waste and sediment deposition within the units. Implementation costs ranged from $ 8 / m² to $ 12 / m², while the maintenance cost was $ 85 per month. Finally, the population was in favor of these units, since maintenance exists or occurs more frequently, also reporting the importance of the multifunctionality of these spaces to improve their acceptance and integration in the urban space.

MOTS CLÉS / KEYWORDS

(Coût, environnement urbain, maintenance, perception de la population et techniques de compensation) / (Compensatory techniques, cost, maintenance, population perception and urban environment)

1 INTRODUCTION

In Brazil, the use of compensatory techniques in urban drainage was characterized, for the most part, by the implantation of rainwater detention basins for flood dampening and, consequently, the minimization of the occurrence of urban floods. Its beginnings occurred in the 1990s and in the metropolitan areas of São Paulo, Belo Horizonte, Curitiba and Porto Alegre (BAPTISTA, NASCIMENTO and BARRAUD, 2015).

Currently, the adoption of detention basins in medium-sized cities, such as the municipality of Araraquara, SP, Brazil, has become a trend to minimize the impacts of urban occupation on the surface runoff of rainwater. The implantation of the detention basins is an obligation, foreseen in the Urban Drainage Director Plan, for new subdivisions in the urban area, for more than 10 years.

During this period, Araraquara underwent an intense process of approval of allotments and with that, the implantation of the detention basins also intensified, surpassing until the moment 24 units of detention, resulting from this process of urban expansion (PERONI, 2018).

In view of the significant use and quantity of detention basins in the urban area of the city of Araraquara, and absence of studies on these post-implantation units, the mapping and characterization of these units under the physical, environmental and socioeconomic aspects of as well as the knowledge of maintenance practices and the perception of the surrounding population about these units that, in some cases, are located in front of the residences. From now on, it is expected to know the urban insertion of these post-implantation units in urban areas.

2 METHODS

The methods used consisted of five steps, as follows:

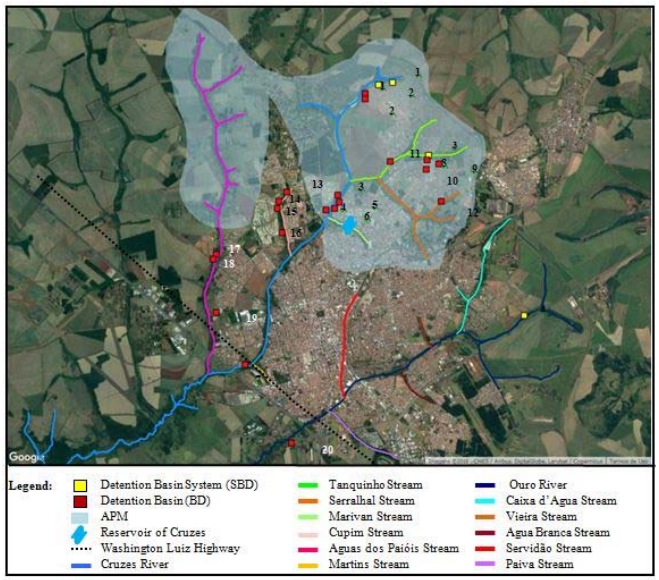
- Step 1 – Mapping of the Detention Basins: consisted in the identification and location of the units inserted in the urban area of Araraquara, SP, through the analysis of images of Google Earth, followed by confirmation of the positioning of each detention basin through on-site visits
- Step 2 – Application of evaluation criteria: evaluation criteria were applied in the units, based on the visual observation and the photographic record of each basin of detention. The defined criteria were relative position of the units regarding the condominium, the subdivision, the green area and the institutional area; visibility, isolation, conservation, observed use and concentration of detention basins.
- Step 3 – Knowledge about the implementation, operation and maintenance: consisted in obtaining data on recommendations and/or practices of execution pertinent to the operation and maintenance of the units, as well as about those responsible for these activities. For this purpose, visits were made to municipal public organ and construction companies responsible for these units.
- Step 4 – Survey of the costs of implementation, operation and maintenance: construction companies of some units were consulted, as well as those responsible for the operation and post-implementation maintenance, in order to obtain the costs involved with the implantation, operation and maintenance of these units during the work of construction and post-execution.
- Step 5 – Perception and acceptance of the Population: in order to evaluate the knowledge, acceptance, perception and sensitivity of the population regarding environmental and sanitary aspects (presence of water, solid wastes, vegetation, animals and vectors of diseases), social (insecurity), economic (real estate valuation) and cultural (integration of residents with the units) of the detention basins. A questionnaire composed of 11 questions, mostly closed type, was elaborated and applied to the population in front of or close to the detention units implanted and in operation.

2.1 The Municipality of Araraquara, SP

Araraquara is a Brazilian municipality located in the geographic center of the State of São Paulo, distant 277 km from the São Paulo, capital. According to estimates by the Brazilian Institute of Geosciences and Statistics (IBGE), in 2018, the city had a population of 233,744 and a population density equal to 207.90 person/km².

3 RESULTS AND DISCUSSION

The present article identified and evaluated 24 rainwater holding units, inserted in the urban area of Araraquara. Of this total, 4 were classified as Detention Basin Systems (SBD) and 20 as Detention Basins (BD). SBDs represent a system composed of more than one holding basin operating in series, while BD indicates a single detention basin.



Spatial Distribution of SBD and BD in Araraquara
Source: ARARAQUARA (2015) e Authors (2018)

Most of these units are located in the Hydrographic Sub-basin of Ribeirão das Cruzes, especially upstream of the Cruzes Dam, a point of water abstraction of the municipality. In addition, they are mostly located on the banks of the water courses and in the Area of Protection of Springs - APM, according to the figure on the side.

In the application of the evaluation criteria, there were trends in the insertion and urban integration of the detention units. Regarding the relative position of the units, the great majority of them is located outside the boundaries of the condominium or the open allotment, predominating its implantation in green areas of the respective enterprises. Only two units are within the confines of the subdivision and four units are located in institutional areas.

At this point, it is worth noting that each holding unit is responsible for the temporary storage of rainwater coming from the boundaries of a particular real estate development. Of the total units, 15 belong to open lots, characterized, for the most part, by housing subsidized by housing programs of the Federal Government. While the rest is characterized by closed condominiums of high standard.

The detention units evaluated are characterized by open and grassy structures with large area and depth, composed of inflow and outflow structures, and extravasor. They are connected to the conventional urban drainage system of enterprise (construction company project), and have a pipe that interconnects their outflow structure with the closest water course. In addition, they are fenced in all around and have a gate for people and machines.

Overview of a DB

Source : Authors (2017)

One type of water inflow structure

Source : Authors (2017)

One type of water outflow structure

Source : Authors (2017)

Regarding the criterion of visibility, the majority of the units had high visibility at the ground level, being easy visualization structures. As for the insulation and protection elements, half of the detention units are fully closed, which indicates inhibition to access them. Regarding the state of conservation, most of them showed absence or inefficiency of maintenance practices, resulting in inadequate conservation conditions, highlighting the presence of solid residues, especially of civil construction, erosion points and excess of vegetation inside and around the units.

In the observed use criterion, the detention units are designed and implemented solely for the hydrological function, although in some units the nearby residents appropriated themselves by these spaces, although it is not recommended, for the practice of fishing, cultivation of fruits and vegetables besides grazing of animals. Finally, with regard to the concentration, it was observed that most real

estate developments have a single unit of detention, that is, the detention of rainwater is carried out in a concentrated manner.

Solid waste inside the BD
Source : Authors (2017)

Erosion inside the BD
Source : Authors (2017)

Excess vegetation inside the SBD
Source : Authors (2017)

Regarding the execution practices in the phases of implantation, operation and maintenance of the detention units, it was observed that these are the first stage to be executed when the works of implantation of the condominium or allotment begins. These units, at this stage, help not only the storage of rainwater, but also the containment of sediments from upstream soil movement. In turn, the operation and maintenance practices focus on the control of grass vegetation and sediment removal and solid waste within the units.

As for the costs of implementing these practices, the implementation of the units ranged from US$ 8/m² to US$ 12/m². For the operation and maintenance of these, only vegetation control was considered, with one cleaning per month, with four employees working for one day, resulting in an approximate amount of US$ 85 per cleaning / month.

Finally, the evaluation of the perception of the population about SBD and BD showed that almost all of the interviewed inhabitants know about the existence of these units, although without clearly understanding its functionality. They reported as sequentially associated problems with the frequent occurrence of insects, high vegetation, inadequate disposal of solid wastes, insecurity and the presence of noxious and domestic animals, and standing water for more than 24 hours inside the units. detention. Many favored the multifunctionality of these spaces, justified by the absence of urban recreational structures, sports and leisure practices in their neighborhood. In addition, residents reported on the need for awareness of the functioning and importance of these techniques, as well as frequent and efficient maintenance practices to assist in the acceptance of the population of units.

4 CONCLUSION

With the evaluation of the 24 units of detention, it was possible to observe the tendency to implant these units outside the limits of the real estate projects, far from the residents' living. However, its visibility has been shown to be high at ground level.

The units mostly have insulation structures (fence and gate), although several are depredated. The precarious state of preservation associated with absence or inefficiency of maintenance was a relevant observation to evaluate the difficulties of post-implantation of these units, including the acceptance of the population that reinforced the need for frequent maintenance practices.

There was also a lack of incentives in the design and execution of detention units for these units to associate the hydrological function with recreational, sporting, landscape or social life. Even in poor neighborhoods of these urban facilities, the urban land destined to the implantation of these units is not optimized and valued, wasting an opportunity of appropriation of these spaces by the population, as well as to promote the quality of life of the residents.

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