GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Environment, health and the challenges of urban drainage in the municipality of Presidente Epitácio, Western São Paulo, Brazil

Ricardo dos Santos
Professor PhD, Unesp, Brasil
ricasantos2000@gmail.com
ORCID iD: https://orcid.org/0000-0001-9650-8615

Edson Luís Piroli
Professor PhD, Unesp, Brasil
edson.piroli@unesp.br
ORCID iD: https://orcid.org/0000-0002-3350-2651

Submissão: 09/09/2025
Aceite 12/11/2025
SANTOS, Ricardo dos; PIROLI, Edson Luís. Ambiente, saúde e desafios da drenagem urbana no município de Presidente Epitácio, Oeste Paulista, Brasil. **Revista Nacional de Gerenciamento de Cidades**, *[S. l.]*, v. 14, n. 91, p. e2532, 2026. DOI: 10.17271/23188472149120266226. Disponível em: https://publicacoes.amigosdanatureza.org.br/index.php/gerenciamento_de_cidades/article/view/6226.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Ambiente, saúde e desafios da drenagem urbana no município de Presidente Epitácio, Oeste Paulista, Brasil

RESUMO

Objetivo - Identificar as possíveis relações entre o ambiente, a saúde e os problemas decorrentes da drenagem urbana inadequada no município de Presidente Epitácio, estado de São Paulo, contribuindo para a reflexão sobre o tema.

Metodologia – Para a realização da pesquisa, foram empregados levantamentos bibliográficos, elaboração de mapas temáticos e análise de dados secundários sobre morbidade hospitalar e mortalidade de 1998 a 2019, além de informações sobre Dengue e Leishmanioses, por local de residência, de 2007 a 2019, complementadas por trabalho de campo.

Originalidade/relevância – As inundações estão entre os principais desastres no Brasil, em razão do elevado número de vítimas, pessoas afetadas e prejuízos socioeconômicos, sendo agravadas pela expansão de áreas impermeabilizadas. A gestão inadequada das águas pluviais urbanas intensifica esses impactos e amplia os riscos à saúde, especialmente no que se refere às doenças de veiculação hídrica. Nesse contexto, ao integrar a análise ambiental e indicadores de saúde em um recorte local, a pesquisa preenche uma lacuna ainda presente na literatura, marcada pela escassez de estudos que articulem essas dimensões.

Resultados – Os resultados da morbidade hospitalar revelaram que as doenças mais prevalentes são as do aparelho respiratório, que ocupam o segundo lugar em número de óbitos. Esse padrão indica a influência das condições ambientais e urbanas sobre a saúde da população. Além disso, os dados sobre Dengue têm se mostrado bastante expressivos nos últimos anos, especialmente na área urbana, com um aumento preocupante de casos de Leishmaniose Tegumentar Americana e Leishmaniose Visceral, reforçando a relação entre drenagem urbana inadequada, acúmulo de água e proliferação de vetores, indicando a necessidade de melhorias no monitoramento de indicadores de saúde, especialmente em doenças relacionadas à água.

Contribuições teóricas/metodológicas – A pesquisa contribui ao fortalecer a abordagem integrada entre drenagem urbana, ambiente e saúde e, metodologicamente, ao articular análise espacial, dados epidemiológicos e trabalho de campo, incentivando a adoção de sistemas de drenagem urbana mais sustentáveis e resilientes frente às limitações técnicas e aos elevados custos dos modelos tradicionais.

Contribuições sociais e ambientais – Os sistemas de drenagem devem ser integrados ao planejamento ambiental, considerando a dinâmica das bacias hidrográficas para soluções mais eficazes, aliadas a alternativas baseadas na natureza e educação ambiental, que implica mudanças nos hábitos e atitudes em relação ao ambiente.

PALAVRAS-CHAVE: Ambiente. Saúde. Drenagem urbana.

Environment, health and the challenges of urban drainage in the municipality of Presidente Epitácio, Western São Paulo, Brazil

ABSTRACT

Objective - Identify possible relationships between the environment, health, and problems arising from inadequate urban drainage in the municipality of Presidente Epitácio, state of São Paulo, contributing to reflection on the theme.

Methodology - To conduct the research, bibliographic surveys, thematic maps, and analysis of secondary data on hospital morbidity and mortality from 1998 to 2019 were used, in addition to information on dengue and leishmaniasis, by place of residence, from 2007 to 2019, complemented by fieldwork.

Originality/relevance – Floods are among the most serious disasters in Brazil, due to the high number of victims, people affected, and socioeconomic losses, aggravated by the expansion of impervious areas. Inadequate urban stormwater management intensifies these impacts and increases health risks, especially with regard to waterborne diseases. In this context, by integrating environmental analysis and health indicators at the local level, the research fills a gap still present in the literature, marked by a scarcity of studies that articulate these dimensions.

Results – The results of hospital morbidity revealed that the most prevalent diseases are those of the respiratory system, which rank second in number of deaths. This pattern indicates the influence of environmental and urban conditions on the health of the population. In addition, data on dengue fever have been quite significant in recent years, especially in urban areas, with a worrying increase in cases of American tegumentary leishmaniasis and visceral

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

leishmaniasis, reinforcing the relationship between inadequate urban drainage, water accumulation, and vector proliferation, indicating the need for improvements in the monitoring of health indicators, especially for water-related diseases.

Theoretical/methodological contributions – The research contributes to strengthening the integrated approach between urban drainage, environment, and health and, methodologically, to articulating spatial analysis, epidemiological data, and fieldwork, encouraging the adoption of more sustainable and resilient urban drainage systems in the face of technical limitations and the high costs of traditional models.

Social and environmental contributions – Drainage systems must be integrated into environmental planning, considering the dynamics of watersheds for more effective solutions, combined with nature-based alternatives and environmental education, which implies changes in habits and attitudes towards the environment.

KEYWORDS: Environment. Health. Urban drainage.

Ambiente, salud y los desafíos del drenaje urbano en el municipio de Presidente Epitácio, Oeste de São Paulo, Brasil

RESUMEN

Objetivo - Identificar las posibles relaciones entre el medio ambiente, la salud y los problemas derivados del drenaje urbano inadecuado en el municipio de Presidente Epitácio, estado de São Paulo, contribuyendo a la reflexión sobre el tema.

Metodología - Para llevar a cabo la investigación, se utilizaron estudios bibliográficos, la elaboración de mapas temáticos y el análisis de datos secundarios sobre morbilidad hospitalaria y mortalidad de 1998 a 2019, además de información sobre dengue y leishmaniasis, por lugar de residencia, de 2007 a 2019, complementada con trabajo de campo.

Originalidad/relevancia - Las inundaciones se encuentran entre los principales desastres en Brasil, debido al elevado número de víctimas, personas afectadas y pérdidas socioeconómicas, agravadas por la expansión de las áreas impermeabilizadas. La gestión inadecuada de las aguas pluviales urbanas intensifica estos impactos y aumenta los riesgos para la salud, especialmente en lo que se refiere a las enfermedades transmitidas por el agua. En este contexto, al integrar el análisis ambiental y los indicadores de salud en un enfoque local, la investigación llena un vacío aún presente en la literatura, marcada por la escasez de estudios que articulen estas dimensiones.

Resultados - Los resultados de la morbilidad hospitalaria revelaron que las enfermedades más prevalentes son las del aparato respiratorio, que ocupan el segundo lugar en número de muertes. Este patrón indica la influencia de las condiciones ambientales y urbanas en la salud de la población. Además, los datos sobre el dengue han sido muy significativos en los últimos años, especialmente en las zonas urbanas, con un preocupante aumento de los casos de leishmaniasis tegumentaria americana y leishmaniasis visceral, lo que refuerza la relación entre el drenaje urbano inadecuado, la acumulación de agua y la proliferación de vectores, lo que indica la necesidad de mejorar el seguimiento de los indicadores de salud, especialmente en las enfermedades relacionadas con el agua.

Contribuciones teóricas/metodológicas - La investigación contribuye a fortalecer el enfoque integrado entre el drenaje urbano, el medio ambiente y la salud y, metodológicamente, a articular el análisis espacial, los datos epidemiológicos y el trabajo de campo, fomentando la adopción de sistemas de drenaje urbano más sostenibles y resilientes frente a las limitaciones técnicas y los elevados costes de los modelos tradicionales.

Contribuciones sociales y ambientales - Los sistemas de drenaje deben integrarse en la planificación ambiental, teniendo en cuenta la dinámica de las cuencas hidrográficas para obtener soluciones más eficaces, junto con alternativas basadas en la naturaleza y la educación ambiental, lo que implica cambios en los hábitos y actitudes hacia el medio ambiente.

PALABRAS CLAVE: Ambiente. Salud. Drenaje urbano.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

1 INTRODUCTION

Floods are among the main disasters in Brazil, considering the total number of deaths, people affected and damage generated. In the last 70 years, it is estimated that almost 8,000 lives have been lost, around 20 million people have been impacted and more than US$ 9 billion in accumulated damage has been caused by floods (Miguez; Di Gregório; Veról, 2018). Brazil ranks 11th, with 270,000 people affected by floods (Christofidis; Assumpção; Kligerman, 2019). A similar scenario is observed on a global scale, with floods being the most recurrent type of disaster, with numerous consequences, including the contamination of domestic water, which exposes the population to risks of microbiological contamination (Dzodzomenyo *et al.*, 2022).

This situation highlights concerns about urban drainage, both in the country and around the world, particularly due to urban growth and the disorderly occupation of river basins. This situation is triggered by the significant increase in waterproofed areas, favoring the accumulation of water, which, if not properly drained through an adequate drainage system, causes flooding, torrents and, in more serious cases, floods (Lapietra *et al.*, 2023; Rana *et al.*, 2024). Climate change, environmental pollution, and inefficient sanitation have contributed to the worsening of this situation (Huynh *et al.*, 2023; Ziliotto; Chies; Ellwanger, 2024).

The analysis of the likelihood of flooding must take into account both natural and man-made factors. Natural factors include the topography of the region, the characteristics of the drainage network of the watershed, as well as the intensity, quantity, distribution and frequency of rainfall. Other relevant aspects include the type of soil, its moisture content and the presence or absence of vegetation cover. Water dynamics and the characteristics of the terrain are essential parameters for this assessment (Amaral; Ribeiro, 2009; Santos *et al.*, 2025).

Areas prone to flooding need to be identified and included in municipal plans, especially in the Master Plan, so that their occupation occurs according to criteria or is properly restricted, avoiding future problems. Detailed mapping and studies can be an important aid to risk management and appropriate land use planning in the municipality (Frutuoso; Grigio; Neta Barros, 2020). In this context, inadequate control of these events and poor-quality drainage systems also need to be considered (Ali *et al.*, 2022).

Recently, Federal Law 14.026, of July 15, 2020, reaffirmed that it is the responsibility of public authorities to act on issues related to basic sanitation, such as drinking water supply, sewage disposal, urban cleaning and solid waste management, and drainage and management of urban rainwater (Brasil, 2020). However, in the country, this service is basically considered to cover water supply, solid waste collection and disposal and sewage collection, varying in its scope according to each region. On the other hand, sewage treatment and final disposal, urban drainage and vector control services are not carried out adequately and are less than desired (Oliveira *et al.*, 2015).

Urban stormwater drainage, together with micro and macro drainage systems, requires a multidisciplinary approach that encompasses environmental sanitation and various aspects related to public health (Fátima, 2013). There is a clear relationship between proper urban stormwater management and the prevention of waterborne diseases (Tucci, 2012; Fátima, 2013; Pessanha, 2019; Brito *et al.*, 2020; Cordeiro *et al.*, 2020; Dzodzomenyo *et al.*, 2022; Shaikh *et al.*,

ISSN 2318-8472, v. 14, n. 91, 2026

2023). However, there is little research linking stormwater management and health (Faria *et al.*, 2023; Huynh *et al.*, 2023).

Some studies have pointed to a relationship between records of flooding and leptospirosis due to problems in urban drainage services (Fátima, 2013, Pessanha, 2019; Brito *et al*, 2020; Cordeiro *et al.*, 2020). Others have also indicated this relationship with evidence of arbovirus cases, the best known being dengue, chikungunya, mayaro, yellow fever, and Zika, transmitted mainly by the bite of infected female mosquitoes of the genus Aedes (Tucci, 2012; Cordeiro *et al.*, 2020; Faria *et al.*, 2023). There is ample evidence of the relationship between the incidence of extreme hydrological events and the compromise of infrastructure, public health, and social well-being (Angelakis *et al.*, 2023; Shaikh *et al.*, 2023; Reimann *et al.*, 2024).

Recent studies have analyzed the drainage and management of rainwater in Municipal Basic Sanitation Plans (PMSB) and discussed their relationship with arboviruses. 16 PMSB from municipalities with a population of less than 50,000 inhabitants in the state of Minas Gerais were evaluated. The results demonstrate the precariousness of the management of drainage and rainwater management services in the municipalities under study. Although arboviruses and other diseases related to inadequate environmental sanitation are mentioned in the PMSBs, in practice, the actions proposed to combat these diseases consist mainly of education and awareness-raising processes for the population. In addition, the search for intersectorality and comprehensiveness in the provision of sanitation services is limited, although it is recognized as important (Faria *et al.*, 2023).

Arboviruses represent one of the main public health problems in the world. Although some are geographically restricted, they can quickly become endemic (Pabbaraju *et al.*, 2016). This issue has received increasing attention from the World Health Organization (WHO) in recent years, especially due to its association with climate change.

The identification of this scenario alerts municipal authorities to the urgent need to improve stormwater management, as this situation poses a risk to the health of the population, who often come into contact with contaminated water (Brito *et al.*, 2020). Having a Municipal Basic Sanitation Policy (PMSB) and its resulting documents does not, in itself, guarantee a reduction in the incidence of sanitation-related diseases (Bayer; Uranga; Fochezatto, 2021). It is therefore essential to invest in consistent urban planning capable of addressing the weaknesses of urban development policies that repeatedly expose the most vulnerable social groups to risky situations (Aboui; Akamba, 2023).

Urban rainwater management needs to be carried out in the context of the watershed, seeking to bring the drainage network closer to natural runoff processes, in conjunction with structural and non-structural measures, also considering the need for population expansion. Traditional urban drainage practices generally focus on projects designed to prevent flooding through localized solutions that promote the dispersion or rapid removal of water to locations far from the runoff generation centers. However, this approach solves the problem in one area, but transfers it downstream, resulting in higher costs for the sizing of new structures. In addition, reservoir structures do not solve the problems related to the increase in runoff volume (Tassi; Poleto, 2010; Piroli, 2022).

One of the known solutions that integrates ecological and environmental aspects is the Low Impact Development proposal, which prioritizes the recovery and maintenance of

ISSN 2318-8472, v. 14, n. 91, 2026

natural drainage systems. This approach aims to restore infiltration conditions and reduce sources of diffuse pollution, seeking to retain runoff close to its place of origin. Among the techniques used in this perspective, known as green technologies, are bioretention, swales, ditches, infiltration trenches, infiltration basins and rainwater landscaping, as well as green roofs. These solutions have multiple purposes, such as beautifying the environment, increasing pedestrian safety and providing conditions for both passive and active recreation (Tassi; Poleto, 2010).

Thus, the transition to sustainable and resilient urban drainage systems is becoming increasingly relevant, with the abandonment of traditional urban drainage systems, which are proving progressively inefficient and costly. In this context, nature-based solutions, due to their ability to reduce surface runoff and increase evapotranspiration and infiltration rates, are valuable options for stormwater management and the restoration of the hydrological cycle in urban areas (Ncube; Arthur, 2021; Palermo *et al.*, 2023).

Considering the context presented, this work seeks to contribute to discussions regarding the possible relationships between the environment, health and problems arising from inadequate urban drainage in the municipality of Presidente Epitácio, state of São Paulo. As this is a relevant and little-researched topic, the aim is to make a contribution.

2 OBJECTIVES

The objective of this research was to identify possible relationships between the environment, health, and problems arising from inadequate urban drainage in the municipality of Presidente Epitácio, state of São Paulo, contributing to reflection on the theme.

3 METHODOLOGY

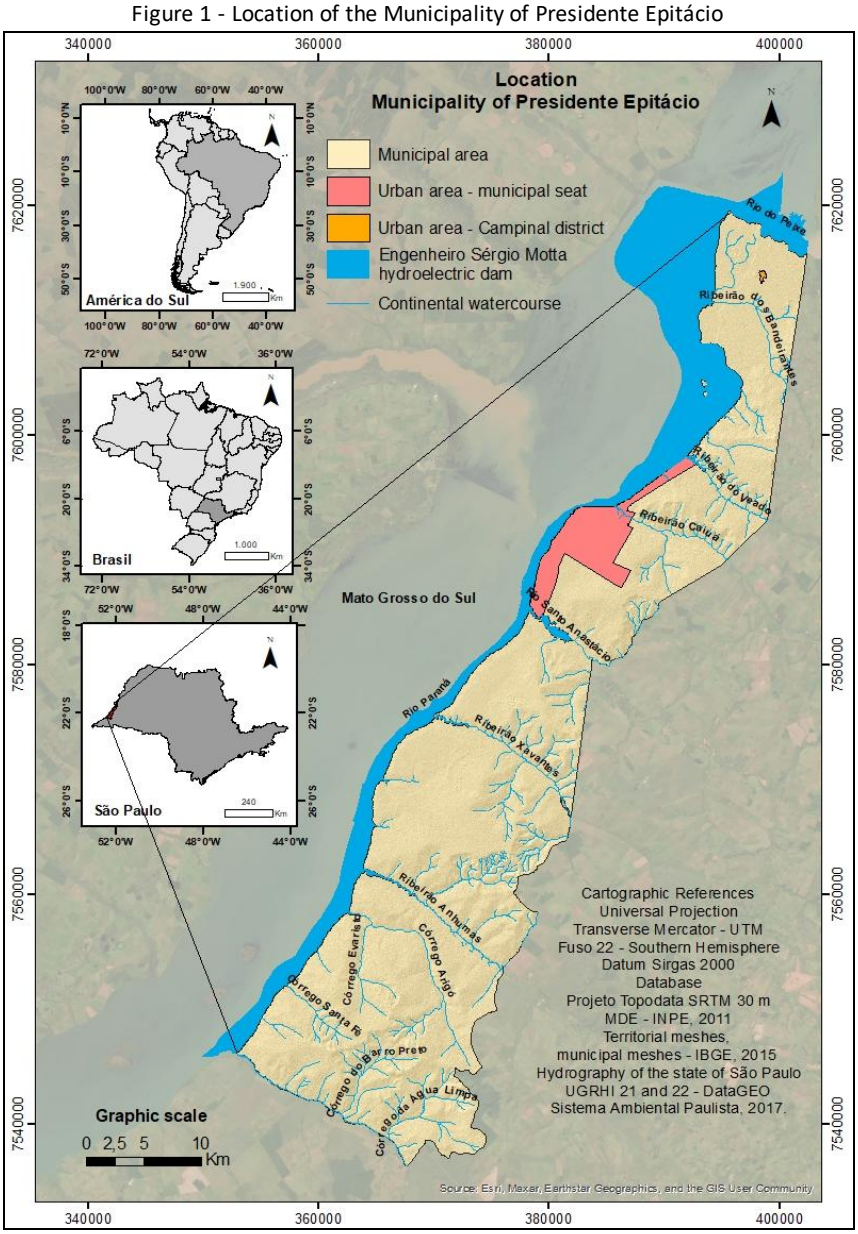
3.1 Location of the study area

The municipality of Presidente Epitácio is located in the hydrographic basin of the Paraná River, in the west of the state of São Paulo, bordering the state of Mato Grosso do Sul (Figure 1), a region known as Pontal do Paranapanema.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 1 - Location of the Municipality of Presidente Epitácio



Elaborated by Santos, 2020.

In the municipality, the urban area is made up of the town - the municipal seat - and the district of Campinal. The rural area includes the Agrovilas, as well as several rural properties. According to the Brazilian Institute of Geography and Statistics (IBGE), the municipality has a total area of around 1,260.28 km², considered one of the largest in the region, with a resident population of 39,505 in 2022.

The characteristics of the study area reflect the region's history of occupation, marked by intense deforestation and the inappropriate appropriation of large areas. This process has caused various environmental problems such as erosion and silting up of watercourses, as well as socio-economic problems such as land conflicts and significant social inequalities, creating a complex picture that requires an integrated analysis between society and nature (Santos; Coca, 2017).

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

3.2 Acquisition, data processing and systematization

In order to carry out the research, bibliographic surveys were carried out on the subject to provide a basis for discussions on the environment, health and urban drainage, with a focus on the municipality of Presidente Epitácio. The maps were drawn up using geoprocessing techniques using ArcGIS software, available from the São Paulo State University (Unesp), at the Faculty of Science and Technology in Presidente Prudente.

The slope map of the municipality of Presidente Epitácio was drawn up from the Digital Elevation Model (DEM) extracted using the Shuttle Radar Topography Mission (SRTM), with a resolution of 30 meters, using the SRTM raster image 1S22W052V3 (.tif), published in 2011 (http://www.dsr.inpe.br/topodata/). The data came from the National Institute for Space Research (INPE) and is part of the Brazilian Geomorphometric Database - TOPODATA.

Secondary open-access data was collected from the Ministry of Health, through the Unified Health System (SUS) - Department of Informatics of the SUS - DATASUS. The data obtained refers to hospital morbidity (causes of hospitalizations) and mortality (causes of deaths) from 1998 to 2019. In addition, information was obtained on dengue, visceral leishmaniasis and American tegumentary leishmaniasis, by place of residence, from 2007 to 2019. This data was then organized into figures and graphs to facilitate visualization and analysis.

The municipal boundary, as well as the others, was extracted from the cartographic bases of the Brazilian Institute of Geography and Statistics (IBGE) - Municipal meshes, territorial meshes of 2020, while the drainage networks (dam and continental body of water), come from the hydrography of the State of São Paulo, the Water Resources Management Units - UGRHI 21 and 22 and DataGEO - Environmental spatial data infrastructure of the state of São Paulo (IDEA - SP). Fieldwork was carried out to identify the problems arising from urban drainage, which were recorded using photos.

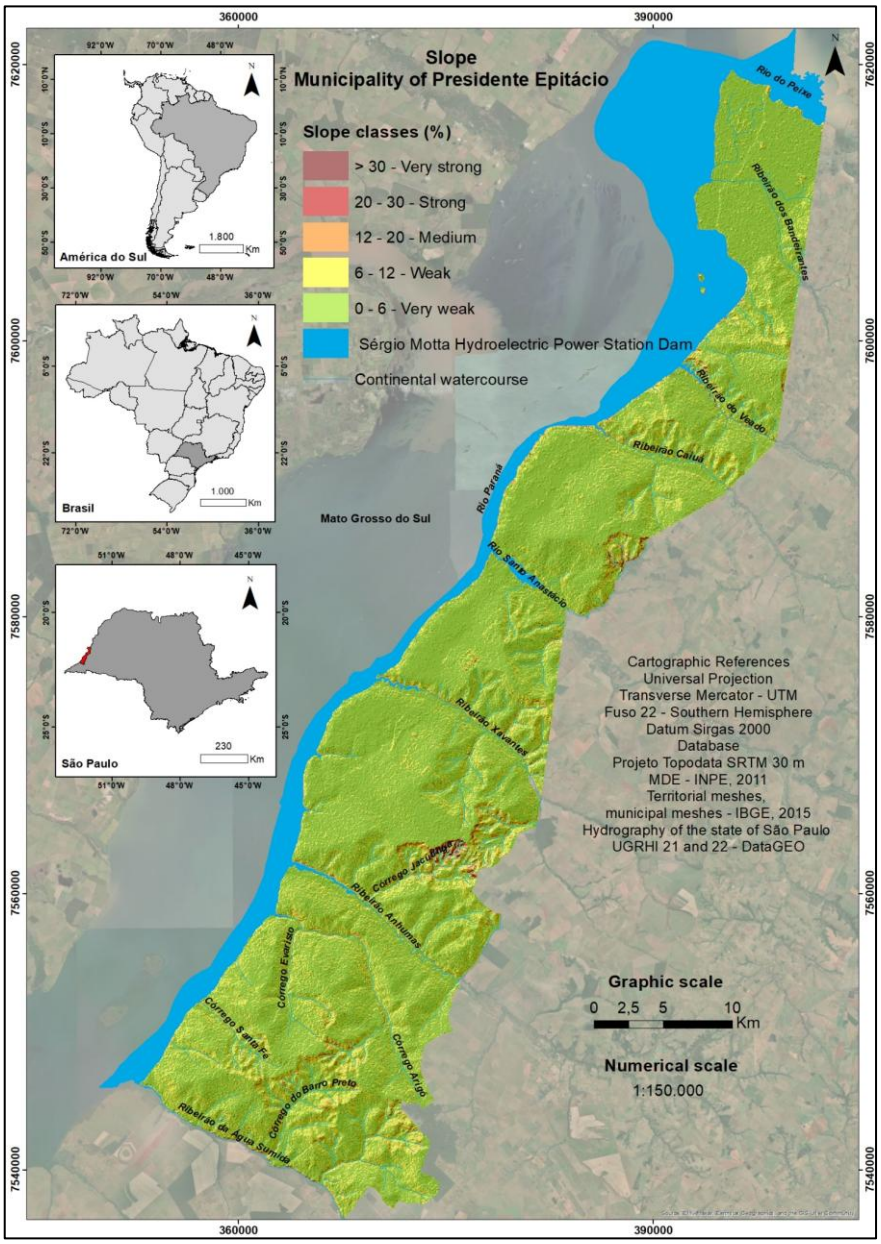
4 RESULTS

Due to the relatively flat terrain present in most of the municipality of Presidente Epitácio, episodes of flooding and flash floods are common in both rural and urban areas. In the urban area, the problem is more pronounced, as this space is located on the river terraces of the Paraná River, which are characterized as ancient depositional environments and therefore have a dynamic intrinsic to the river. In Presidente Epitácio, some of the flood plains have a tenuous boundary with the terraces, showing a contiguous and simultaneous dynamic between the two environments, due to the low slope amplitudes in the area (Figure 2).

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 2- Slope in the municipality of Presidente Epitácio



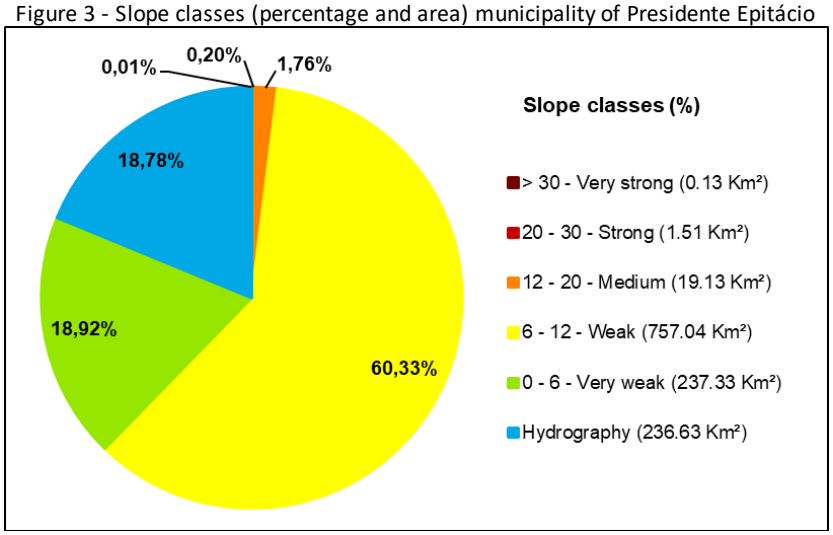
Elaborated by Santos, 2020.

In the municipality, there is a predominance of very weak slopes (0 to 6%) and weak slopes (6 to 12%). The other slopes are not very significant. Thus, weak slopes prevail with 60.33% and very weak slopes with 18.92%. Medium slopes were identified at 1.76%, strong slopes at 0.20% and very strong slopes at 0.01% (Figure 3).

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 3 - Slope classes (percentage and area) municipality of Presidente Epitácio



Elaborated by Santos, 2020.

Despite the fact that the municipality has a Municipal Urban Macro-Drainage Plan with several works implemented, the expansion of rainwater galleries, among other water drainage mechanisms (Figures 2 and 3), the problems involving flooding and flash floods persist. These continue to affect the population in various areas, causing damage and exposing people to risks such as the possibility of spreading waterborne diseases (Figures 4 and 5). Even with various urban drainage interventions, every year the city demonstrates that it is not prepared for intense rainfall.

Figure 2 - Urban stormwater drainage area

Figure 3 - Urban stormwater drainage intervention project

Source: Santos, 2020.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 4 – Flooding after rains in Presidente Epitácio

Figura 5 - Flooding almost invading a residence

Source: Santos, 2020.

Among the various damages that flooding can cause are health-related problems. The analysis of health data is fundamental to understanding the environment and is a relevant indicator of environmental quality and quality of life. In this study, we sought to verify their possible relationship with issues relating to urban drainage.

In this research, we sought to verify, as health parameters, the causes of hospital morbidity (hospitalizations) and the causes of mortality (deaths) by place of residence, from 1998 to 2019. The data was extracted and organized according to ICD 10 (International Statistical Classification of Diseases and Related Health Problems), which uses the International Classification of Diseases, established by the World Health Organization (WHO).

Cases of Dengue (Aedes Aegypti) by area of residence, municipality of infection, from 2007 to 2019, cases of American Tegumentary Leishmaniasis and Visceral Leishmaniasis by area of residence, municipality of infection, from 2007 to 2019 were also surveyed. These were selected due to their notoriety in recent years at the municipal level. All the health data obtained came from the SUS Information Technology Department (DATASUS), linked to the Unified Health System (SUS) of the Ministry of Health.

Table 1 shows the total causes of hospital morbidity (hospitalizations) by place of residence, from 1998 to 2019 in Presidente Epitácio, reflecting the health problems that most affected the population in the selected period, followed by Figure 6 with the percentage. The data showed that diseases of the respiratory system (ICD chapter X) stood out with 17.52% of cases (15,242); diseases of the circulatory system (ICD chapter IX), with 13.72% of cases (11. 939); problems related to pregnancy, childbirth and the puerperium (ICD chapter XV), with 12.39% of cases (10,777); diseases of the digestive system (ICD chapter XI), with 12.31% (10,708); diseases of the genitourinary system (ICD chapter XIV), with 8.35% (7. 264); injuries, poisonings and certain other consequences of external causes (chapter XIX of the ICD) with 8.29% of cases (7,212); neoplasms (chapter II of the ICD) with 5.43% (4,725) and certain infectious and parasitic diseases (chapter I of the ICD), with 5.24% (4. 556); endocrine, nutritional and metabolic diseases (chapter IV of the ICD), with 3.67% of cases (3,190) and mental and behavioral disorders (chapter V of the ICD), with 3.29% of occurrences (2,864). The other illnesses were identified with a lower incidence. The results can be better visualized and compared in Figure 6.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

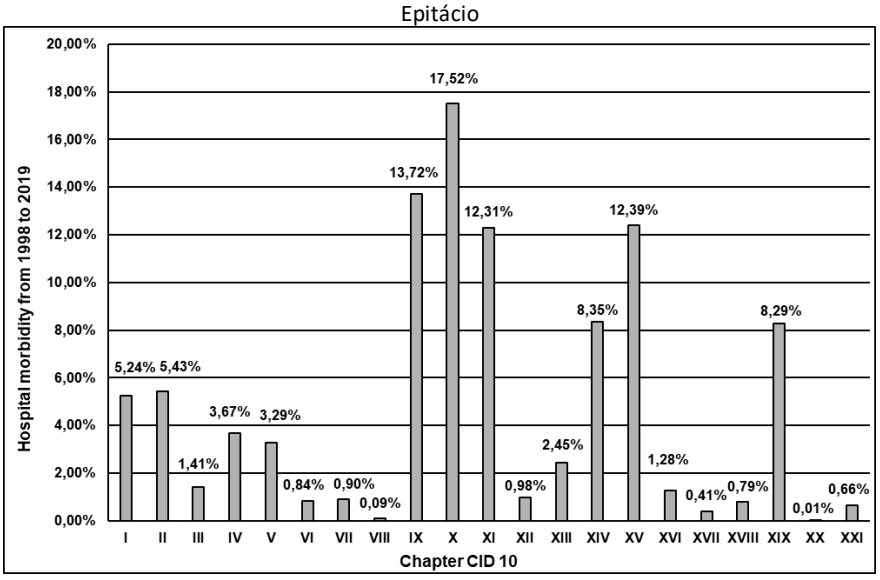
ISSN 2318-8472, v. 14, n. 91, 2026

Table 1 - Causes of hospital morbidity (hospitalizations) by place of residence, from 1998 to 2019 - Presidente Epitácio

ICD Chapter 10		Total
I	Infectious and parasitic diseases (A00 - B99)	4.556
II	Neoplasias (tumors) (C00 - D48)	4.725
III	Diseases of the blood and hematopoietic organs and some immune disorders (D50 - D89)	1.226
IV	Endocrine, nutritional and metabolic disorders (E00 - E90)	3.190
V	Mental and behavioral disorders (F00 - F99)	2.864
VI	Diseases of the nervous system (G00 - G99)	731
VII	Diseases of the eye and appendages (H00 - H59)	784
VIII	Diseases of the ear and mastoid apophysis (H60 - H95)	76
IX	Diseases of the circulatory system (I00 - I99)	11.939
X	Diseases of the respiratory system (J00-J99)	15.242
XI	Diseases of the digestive system (K00-K93)	10.708
XII	Diseases of the skin and subcutaneous tissue (L00-L99)	854
XIII	Diseases of the musculoskeletal system and connective tissue (M00-M99)	2.130
XIV	Diseases of the genitourinary system (N00-N99)	7.264
XV	Pregnancy, childbirth and puerperium (O00-O99)	10.777
XVI	Some conditions originating in the perinatal period (P00-P96)	1.117
XVII	Congenital malformations, deformities and chromosomal anomalies (Q00-Q99)	354
XVIII	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	687
XIX	Injuries, poisoning and certain other consequences of external causes (S00-T98)	7.212
XX	External causes of morbidity and mortality (V01-Y98)	6
XXI	Factors influencing health status and contact with health services (Z00-Z99)	572

Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

Figure 6 - Causes of hospital morbidity (hospitalizations) by place of residence, from 1998 to 2019 - Presidente Epitácio



Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

With regard to the occurrences of causes of mortality (deaths) by place of residence, from 1998 to 2019 in Presidente Epitácio, Table 2 shows the total, highlighting the most frequent causes that affected the population in the period analyzed. Figure 7 shows the percentage.

The data showed that diseases of the circulatory system (Chapter IX of the ICD) stand out significantly with 28.62% of cases (1,438). This was followed by diseases of the respiratory system (ICD chapter X), with 16.30% of cases (819); neoplasms (ICD chapter II) with 10.55% of cases (530); symptoms, signs and abnormal findings on clinical and laboratory examination, not elsewhere classified (ICD chapter XVIII) with 8.28% of cases (416); endocrine, nutritional and metabolic diseases (ICD chapter IV), with 8. 26% of cases (415); diseases of the digestive system (chapter XI of the ICD), with 6.83% of cases (343); external causes of morbidity and mortality, understood as accidents and intentional or unintentional violence (chapter XX of the ICD), with 5.81% of cases (292) and some infectious and parasitic diseases (chapter I of the ICD), with 5.23% of occurrences (263). The other causes were identified with lower incidence. The results can be better verified and correlated in Figure 7.

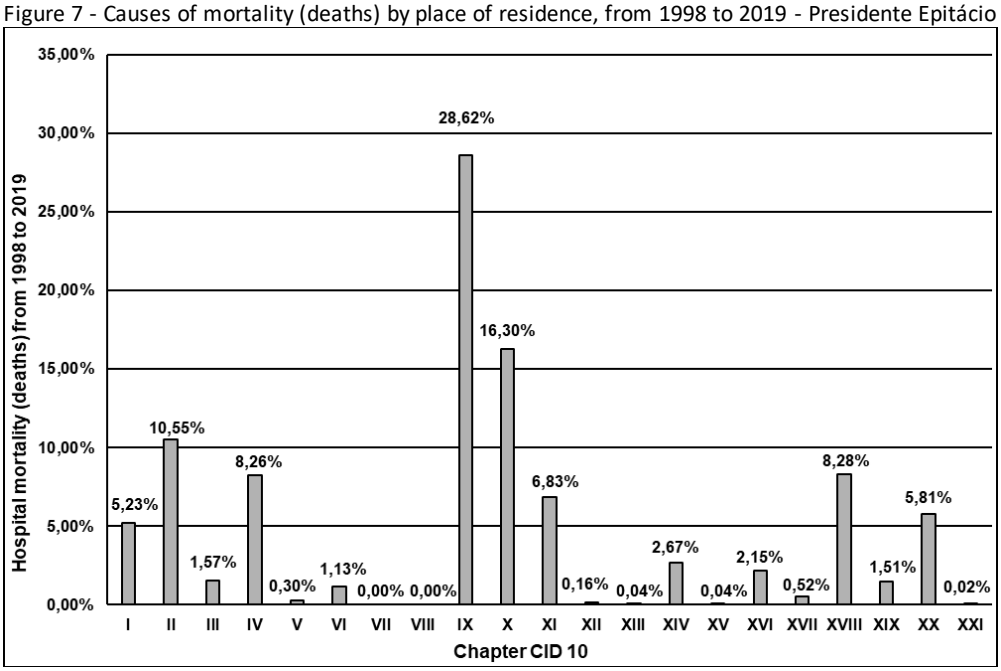
Table 2 - Causes of mortality (deaths) by place of residence, from 1998 to 2019 - Presidente Epitácio

ICD Chapter 10		Total
I	Infectious and parasitic diseases (A00 - B99)	263
II	Neoplasias (tumors) (C00 - D48)	530
III	Diseases of the blood and hematopoietic organs and some immune disorders (D50 - D89)	79
IV	Endocrine, nutritional and metabolic disorders (E00 - E90)	415
V	Mental and behavioral disorders (F00 - F99)	15
VI	Diseases of the nervous system (G00 - G99)	57
VII	Diseases of the eye and appendages (H00 - H59)	0
VIII	Diseases of the ear and mastoid apophysis (H60 - H95)	0
IX	Diseases of the circulatory system (I00 - I99)	1.438
X	Diseases of the respiratory system (J00-J99)	819
XI	Diseases of the digestive system (K00-K93)	343
XII	Diseases of the skin and subcutaneous tissue (L00-L99)	8
XIII	Diseases of the musculoskeletal system and connective tissue (M00-M99)	2
XIV	Diseases of the genitourinary system (N00-N99)	134
XV	Pregnancy, childbirth and puerperium (O00-O99)	2
XVI	Some conditions originating in the perinatal period (P00-P96)	108
XVII	Congenital malformations, deformities and chromosomal anomalies (Q00-Q99)	26
XVIII	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	416
XIX	Injuries, poisoning and certain other consequences of external causes (S00-T98)	76
XX	External causes of morbidity and mortality (V01-Y98)	292
XXI	Factors influencing health status and contact with health services (Z00-Z99)	1

Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 7 - Causes of mortality (deaths) by place of residence, from 1998 to 2019 - Presidente Epitácio



Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

With regard to Dengue (Aedes Aegypti), studies show that it is one of the main public health problems in the world, considered to be on the increase by the World Health Organization (WHO) and not always properly diagnosed. Transmitted by the Aedes mosquito, the main species, Aedes Aegypti, also transmits the Yellow Fever virus, Chikungunya and the Zika virus, which can result in significant social and economic losses. This scenario is exacerbated by the influence of temperature, relative humidity and rainfall, among other factors. Thus, rainfall is a relevant condition for the emergence of potential breeding sites, as well as for the survival and reproduction of the mosquito (Gabriel *et al.*, 2018).

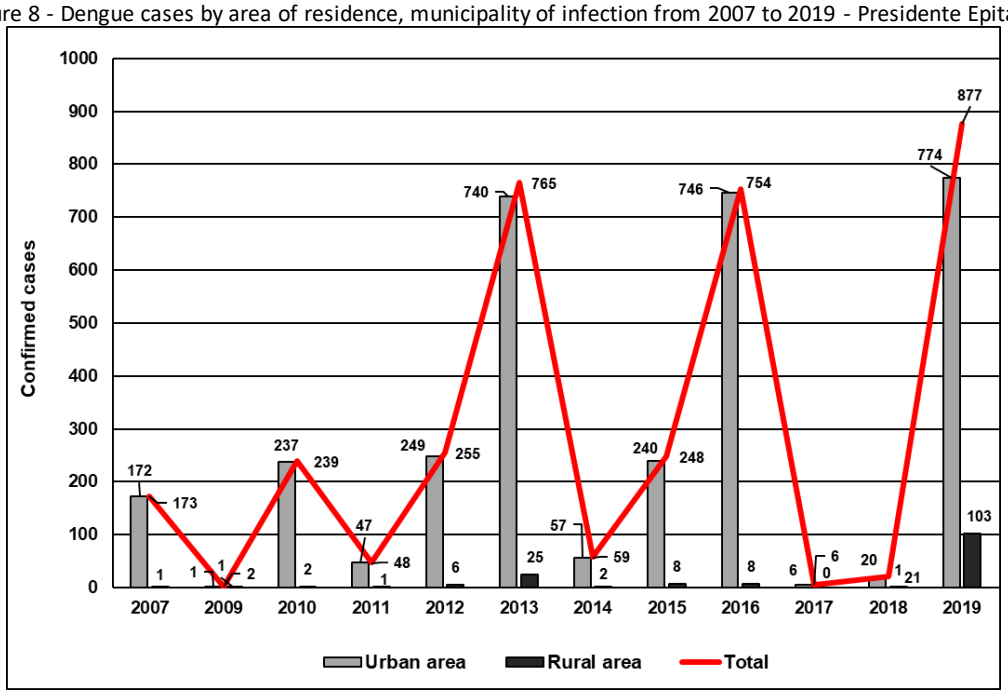
Due to its extensive flat areas with low slopes, the municipality of Presidente Epitácio has a natural potential for the proliferation of Aedes Aegypti, particularly during rainy periods when rainwater can easily accumulate. This factor, combined with the carelessness of the population, can expose local society to this and other viruses, especially in the urban area.

Figure 8 shows confirmed cases of Dengue in Presidente Epitácio, by area of residence, municipality of infection, from 2007 to 2019. The data shows considerable numbers of occurrences, predominantly in the urban area. There is an oscillation in cases, showing a growth, reaching a higher number of records in 2019, both in the urban and rural areas, configuring a worrying scenario.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 8 - Dengue cases by area of residence, municipality of infection from 2007 to 2019 - Presidente Epitácio



Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

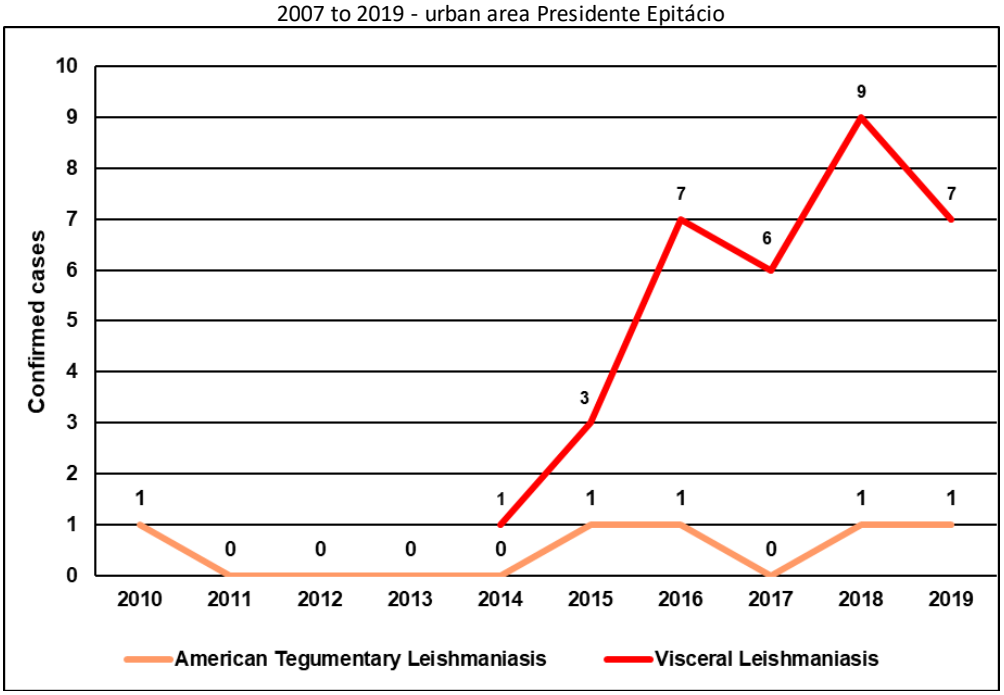
Leishmaniasis, in all its forms, is currently classified not only as a neglected tropical disease, but also as one of the most important infectious diseases, with numerous gaps that need to be studied. The Leishmania genus is made up of approximately 30 different species, manifesting itself in humans as American Tegumentary Leishmaniasis, responsible for the mucosal, cutaneous and mucocutaneous forms of the disease (the dermatotropic leishmaniases), and Visceral Leishmaniasis, also known as kala-azar (non-dermatotropic), transmitted by the well-known straw mosquito (Lutzomia longipalpis). In Brazil, the spread of the disease continues in new areas, as well as the reactivation of outbreaks that were apparently already under control. This situation is largely due to failures to control the disease, associated with difficulties in identifying it, with canids acting as one of its main hosts. The re-emergence of the disease, which is becoming predominantly urban, requires veterinarians to be more accurate in their diagnoses (Azevedo; Marcilli, 2020).

The spread of the disease caused by the Leishmania genus is related to environmental hygiene, with regular cleaning of backyards, domestic animal shelters and the proper disposal of organic waste, rubble and other materials that can attract the transmitting mosquito being essential. Thus, the irregular disposal of organic and inorganic materials in any environment can encourage the proliferation of the disease, as well as creating breeding grounds for vectors of other diseases. Therefore, the population needs to be made aware of the importance of these practices.

In Presidente Epitácio, there have been some cases of American Tegumentary Leishmaniasis in the urban area, with fluctuations over the period analyzed. As for Visceral Leishmaniasis, there has been a significant increase since 2015, with a slight decrease in 2019 (Figure 9). However, both must be properly monitored in order to prevent their spread.

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 9 - Cases of American Tegumentary Leishmaniasis and Visceral Leishmaniasis, municipality of infection from 2007 to 2019 - urban area Presidente Epitácio



Source: Ministry of Health - SUS Information Technology Department - DATASUS.
Organized by Santos, 2020.

In previous surveys carried out in the municipality, a statistical sample was used to administer 691 questionnaires to residents, distributed among various census sectors in the urban area. The results showed that the irregular disposal of garbage in inappropriate places, such as vacant lots, and the burning of garbage, branches and leaves, is a significant problem, often caused by the population itself, mentioned by 45.6% of those interviewed (Santos; Leal, 2011). At present, this situation is still common, even contributing to the obstruction of rainwater drainage galleries at some points.

It is clear that, in order to solve the problem, it is necessary to invest in environmental education among the population, preventing situations like this from continuing to occur. In addition, it is essential to implement actions that promote proper urban environmental planning, since the works carried out so far have not been enough to resolve the issue.

5 FINAL CONSIDERATIONS

Urban drainage problems currently represent a significant challenge and can lead to flooding and flash floods which, in more serious cases, result in flooding that is difficult to deal with. In Presidente Epitácio, flooding becomes frequent after torrential rains, showing that the municipality is not adequately prepared to deal with these events. This scenario is favored by the relatively flat terrain present in most of the municipality's territory.

The municipality has an Urban Macro-Drainage Plan and regularly carries out various interventions to mitigate or solve the problem. However, the challenge persists. From time to time, rainfall events cause damage, harming the population. Among these are the associated health problems, which expose the environment and residents, making them vulnerable to

ISSN 2318-8472, v. 14, n. 91, 2026

various diseases.

An analysis of the health problems identified in the municipality's population, referring to hospital morbidity (hospitalizations) by place of residence, between 1998 and 2019, with data from DATASUS, revealed that the most prevalent diseases are those of the respiratory system, which may indicate a relationship with the presence of excessive humidity. In addition, some infectious and parasitic diseases, which are usually associated with contact with water, appear in eighth place (Table 1 and Figure 6).

When analyzing the causes of mortality (deaths) by place of residence in the same period, it can be observed that diseases of the circulatory system cause the most deaths, followed by diseases of the respiratory system, which occupy second place. In addition, some infectious and parasitic diseases appear in seventh place (Table 2 and Figure 7).

With regard to the data on cases of Dengue (Aedes Aegypti) and American Tegumentary and Visceral Leishmaniasis, by area of residence and municipality of infection, between 2007 and 2019, there has been an increase in both cases, especially Dengue, which occurs predominantly in urban areas. These cases are directly related to inadequate water drainage and irregular waste disposal, as well as poor environmental hygiene in backyards.

The scenario identified, although inconclusive, points to the need for improvements in the monitoring of health indicators, especially those diseases associated with waterborne diseases. On the other hand, there is a pressing need to improve health diagnoses, which can be signaled by ill-defined causes of symptoms, signs and abnormal findings in clinical and laboratory tests, not classified elsewhere, which show a significant percentage in the graphical representations shown. As pointed out by Santo (2008), data quality is compromised when causes are poorly defined.

Finally, it can be concluded that drainage systems must be integrated with other aspects of environmental planning and management, since problems do not arise in isolation. It is essential to consider the dynamics of the watershed as a whole in order to achieve more effective solutions, in a multidisciplinary approach.

Urban rainwater management must be integrated into the watershed context, seeking to align the drainage network with natural runoff processes, taking into account population expansion. Traditional approaches, which aim to prevent flooding by quickly dispersing the water, end up transferring the problem to downstream areas, generating additional costs for new structures. In contrast, Low Impact Development proposes solutions that respect natural drainage systems, promoting infiltration and reducing pollution. Techniques such as bioretention, ditches and green roofs not only control runoff, but also beautify the environment and provide recreational spaces.

Urban vegetation can be an important ally in this process, provided it is planned and implemented with well-defined criteria, in contrast to the culture of widespread waterproofing. However, all this effort depends on environmental education, which implies changes in habits and attitudes towards the environment.

ISSN 2318-8472, v. 14, n. 91, 2026

6 REFERENCES

ABOUI, E. M. S. M.; AKAMBA, G. Y. Précarité de Logement et Problèmes Sanitaires en Contexte d'Inondabilité au Quartier Étam-Bafia, Yaoundé. **European Scientific Institute,** v. 19, n. 5, 2023. DOI: https://doi.org/10.19044/esj.2023.v19n5p73. Disponível em: https://eujournal.org/index.php/esj/article/view/16470. Acesso em: 07 jan. 2026.

ALI, A; NISAR, S.; KHAN, M. A. MOHSAN, S. A. H.; NOOR, F.; MOSTAFA, H.; MAREY, M. A Privacy-Preserved Internet-of-Medical-Things Scheme for Eradication and Control of Dengue Using UAV. **Micromachines**, v. 13, 10, 2022. DOI: https://doi.org/10.3390/mi13101702. Disponível em: https://www.mdpi.com/2072-666X/13/10/1702. Acesso em: 10 dez. 2026.

AMARAL, R.; RIBEIRO, R. R. Inundações e enchentes. *In:* TOMINAGA, L. K.; SANTORO, J.; AMARAL, R. (Org.). **Desastres naturais:** conhecer para prevenir. São Paulo: Instituto Geológico, 2009, p. 39 - 52.

ANGELAKIS, A. N.; CAPODAGLIO, A. G.; VALIPOUR, M.; KRASILNIKOFF, J.; AHMED, A. T.; MANDI, L.; TZANAKAKIS, V. A.; BABA, A.; KUMAR, R.; ZHENG, X.; MIN, Z.; HAN, M.; TURAY, B.; BILGIÇ, E.; DERCAS, N. Evolution of Floods: From Ancient Times to the Present Times (ca 7600 BC to the Present) and the Future. **Land.** v. 12, n. 1211, 2023. DOI: https://doi.org/10.3390/land12061211. Acesso em: 04 dez. 2026.

AZEVEDO, R. C. de F.; MARCILI, A. Skin disturbs caused by leishmania sp. Infection: review. **Brazilian Journal of Development**, Curitiba, v. 6, n. 4, p. 19328-19346, abr., 2020. Disponível em: https://www.brazilianjournals.com/index.php/BRJD/article/view/8757/7505. Acesso em: 08 out. 2024.

BAYER, N. M.; URANGA, P. R. R.; FOCHEZATTO, A. Política Municipal de Saneamento Básico e a ocorrência de doenças nos municípios brasileiros. **URBE. Revista Brasileira de Gestão Urbana**, Curitiba, v. 13, 2021, p. 1-17. Disponível em: https://www.scielo.br/j/urbe/a/tNPJ5QhVVvqCyQmcn7by9Mt/?format=pdf&lang=pt. Acesso em: 20 set. 2024.

BRITO, F. S. L.; ROSÁRIO, K. K. L.; MORAIS, M. S.; CRUZ, R. H. R. Drenagem urbana e sua influência na epidemiologia de leptospirose na cidade de Belém - região Amazônica do Estado do Pará. **Revista de Geografia (Recife)**, v. 37, n. 3, 2020. Disponível em: https://periodicos.ufpe.br/revistas/index.php/revistageografia/article/view/245991. Acesso em: 28 ago. 2024.

BRASIL. **Lei Federal Nº 14.025, de 15 de julho de 2020.** Atualiza o marco legal do saneamento básico. Disponível em: https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/lei/l14026.htm. Acesso em: 20 set. 2024.

CORDEIRO, J.; SILVA, F. H.; CAMPERA, F. A. N.; COSTA, F. Sistemas de drenagem urbana e o saneamento: uma análise cienciométrica. **Research, Society and Development**, v. 9, n. 11, 2020, p. 1-29. Disponível em: https://rsdjournal.org/index.php/rsd/article/view/9616. Acesso em: 10 out. 2024.

CHRISTOFIDIS, D.; ASSUMPÇÃO, R. S. F. V.; KLIGERMAN, D. C. A evolução histórica da drenagem urbana: da drenagem tradicional à sintonia com a natureza. **Saúde Debate**, Rio de Janeiro, v. 43, Número Especial 3, p. 94-108, dez, 2019. Disponível em: https://www.scielo.br/j/sdeb/a/jpNVWVZSdNRRyQS3qtWmz9g/. Acesso em: 03 set. 2024.

DZODZOMENYO, M. ; ASAMOAH, M. ; Li, C.; KICHANA, E.; WRIGHT, J. Impact of flooding on microbiological contamination of domestic water sources: a longitudinal study in northern Ghana. **Appl Water Science**, v. 12, n. 235, 2022. DOI: https://doi.org/10.1007/s13201-022-01757-6. Disponível em: https://link.springer.com/article/10.1007/s13201-022-01757-6. Acesso em: 05 jan. 2026.

FARIA, M. T. S; RIBEIRO, N. R. S.; DIAS, A. P., GOMES, U. A. F.; MOURA, P. Relações entre drenagem e o manejo das águas pluviais e arboviroses em 16 Planos Municipais de Saneamento Básico de Minas Gerais – Brasil. **Revista DAE**, São Paulo, v. 71, n. 242, p. 51-66, out a dez, 2023. Disponível em: https://revistadae.com.br/artigos/artigo_edicao_242_n_2164.pdf. Acesso em: 03 set. 2024.

FÁTIMA, Maria de. **Impactos da drenagem urbana na saúde pública em municípios de pequeno porte no estado do Rio Grande do Norte, Nordeste do Brasil**. 2013. 250 f. Tese (doutorado) - UFPE, Centro de Tecnologia e Geociências, Programa de Pós-graduação em Engenharia Civil, Recife. Disponível em: https://repositorio.ufpe.br/handle/123456789/12911. Acesso em: 04 out. 2024.

ISSN 2318-8472, v. 14, n. 91, 2026

FRUTUOSO, G. K. da C.; GRIGIO, A. M.; NETA BARROS, T. C. de A. Inundações urbanas: um olhar para o planejamento urbano na revisão do plano diretor de Assú – RN, Brasil. **Revista Nacional de Gerenciamento de Cidades**, *[S. l.]*, v. 8, n. 61, 2020. DOI: 10.17271/2318847286120202431. Disponível em: https://publicacoes.amigosdanatureza.org.br/index.php/gerenciamento_de_cidades/article/view/2431. Acesso em: 4 jan. 2026.

GABRIEL, A. F. B.; ABE, K. C.; GUIMARÃES, M. de P.; MIRAGLIA, S. G. El K. Avaliação de impacto à saúde da incidência de dengue associada à pluviosidade no município de Ribeirão Preto, São Paulo. **Cadernos Saúde Coletiva**, Rio de Janeiro, 2018, 26 (4), p. 446-452. Disponível em: http://www.scielo.br/pdf/cadsc/v26n4/1414-462X-cadsc-1414-462X201800040119.pdf. Acesso em: 09 set. 2024.

HUYNH, T. T. N.; HOFSTRA, N.; NGUYEN, H. Q.; BAKER, S.; PATHIRANA, A.; PEREZ, G. A. C.; ZEVENBERGEN, C. Estimating disease burden of rotavirus in floodwater through traffic in the urban areas: A case study of Can Tho city, Vietnam. **Journal of Flood Risk Management**, v. 17, 1, 2023. DOI: https://doi.org/10.1111/jfr3.12955. Disponível em: https://onlinelibrary.wiley.com/doi/10.1111/jfr3.12955. Acesso em: 10 jan. 2026.

LAPIETRA, I.; RIZZO, A.; COLACICCO, R.; DELLINO, P.; CAPOLONGO, D. Evaluation of Social Vulnerability to Flood Hazard in Basilicata Region (Southern Italy). **Water**, Basel, Switzerland 15, 2023, DOI. https://doi.org/10.3390/w15061175. Acesso em: 05 jan. 2026.

MIGUEZ, M. G.; DI GREGÓRIO, L. T.; VERÓL, A. P. **Gestão de riscos e desastres hidrológicos.** Rio de Janeiro: Elsevier, 2018.

NCUBE, S.; ARTHUR, S. Influence of Blue-Green and Grey Infrastructure Combinations on Natural and Human-Derived Capital in Urban Drainage Planning. **Sustainability**, 13 (5), 2571, 2021. DOI: https://doi.org/10.3390/su13052571. Disponível em: https://www.mdpi.com/2071-1050/13/5/2571. Acesso em: 05 jan. 2026.

OLIVEIRA, J. P. M.; OLIVEIRA, J. M. O.; BARRETO, E. S.; SILVA, S. S. da; SILVA, S. S. da; MARACAJÁ, P. B. **Saúde/Doença:** As consequências da falta de saneamento básico - INTESA - Informativo Técnico Do Semiárido (Pombal-PB), v. 9, n. 2, p. 23-29, Jun - Dez, 2015.

PABBARAJU, K.; WONG, S.; GILL, K.; FONSECA, K.; TIPPLES, G.A.; TELLIER, R. Simultaneous detection of Zika, Chikungunya and dengue viruses by amultiplex real-time RT-PCR assay. **Journal of Clinical Virology**, v. 83, p. 66-71, 2016. Disponível em: https://pubmed.ncbi.nlm.nih.gov/27614319/. Acesso em: 16 ago. 2024.

PALERMO, S. A.; TURCO, M.; PIROUZ, B.; PRESTA, L.; FALCO, S.; DE STEFANO, A.; FREGA, F.; PIRO, P. Nature-based solutions for urban stormwater management: an overview. **IOP Conference Series: Earth and Environmental Science,** 1196 012027, 2023. DOI: 10.1088/1755-1315/1196/1/012027. Disponível em: https://iopscience.iop.org/article/10.1088/1755-1315/1196/1/012027. Acesso em: 10 jan. 2026.

PESSANHA, L. A. C. **Espacialidade das ocorrências de doenças de veiculação hídrica em Niterói/RJ.** 2019. 147 f. Dissertação (Mestrado em Geografia) - Universidade Federal Fluminense, Niterói.

PIROLI, E. L. **Água e bacias hidrográficas:** planejamento, gestão e manejo para o enfrentamento das crises hídricas. 1. ed. São Paulo: Editora UNESP, 2022.

RANA, S. M. S.; HABIB, S. M. A.; SHARIFEE, M. N. H.; SULTANA, N.; RAHMAN, S. H. Flood risk mapping of the flood-prone Rangpur division of Bangladesh using remote sensing and multi-criteria analysis. **Natural Hazards Research**, 4, march 2024, p. 20-31. DOI: https://doi.org/10.1016/j.nhres.2023.09.012. Disponível em: https://www.sciencedirect.com/science/article/pii/S266659212300094X?via%3Dihub. Acesso em: 08 abr. 2024.

REIMANN, L.; KOKS, E.; MOEL, H.; TON, M. J.; AERTS, J. C. J. H.. An Empirical Social Vulnerability map for flood risk assessment at global scale ("GlobE-SoVI"). **Earth's Future**, 12, 2024. DOI: https://doi.org/10.1029/2023EF003895. Disponível em: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023EF003895. Acesso em: 05 jan. 2026.

SHAIKH, O. A.; BAIG, M. T.; TAHIR, S.; PAREKH, A. E.; NASHWAN, A. J. Dengue outbreak following unprecedented flooding in Pakistan. **Hygiene and Environmental Health Advances**, v. 7, 100076, setembro de 2023. DOI:

ISSN 2318-8472, v. 14, n. 91, 2026

https://doi.org/10.1016/j.heha.2023.100076. Disponível em: https://www.sciencedirect.com/science/article/pii/S2773049223000326?via%3Dihub. Acesso em: 07 jan. 2026.

SANTO, A. H. Causas mal definidas de morte e óbitos sem assistência. **Revista da Associação de Medicina Brasileira**, São Paulo, 54 (1) p. 23 – 28, 2008. Disponível em: https://www.scielo.br/j/ramb/a/PBKPCmzm5K9cZVx6HrFHtGP/?lang=pt. Acesso em: 10 set. 2024.

SANTOS, J. O. dos; SILVA, J. K. S da; ROCHA, E. de A.; VALADARES, P. H. C.; SOARES, W. de A. Ação degradante das inundações: Análise de danos em edifícios históricos do Bairro do Recife (PE). **Revista Nacional de Gerenciamento de Cidades**, *[S. l.]*, v. 13, n. 89, 2025. DOI: 10.17271/23188472138920256163. Disponível em: https://publicacoes.amigosdanatureza.org.br/index.php/gerenciamento_de_cidades/article/view/6163. Acesso em: 05 jan. 2026.

SANTOS, R. dos; LEAL, A. C. Análise da Qualidade de Vida na Estância Turística de Presidente Epitácio - São Paulo. **Formação (Online)**, Presidente Prudente, v. 2 n. 18, p. 3-28, jul./dez., 2011. Disponível em: https://revista.fct.unesp.br/index.php/formacao/article/view/872. Acesso em: 02 jul. 2024.

SANTOS, R. dos; COCA, E. L. F. Sociedade e natureza no Pontal do Paranapanema - SP: a unidade da geografia e o desenvolvimento regional. **Geografia (Londrina),** Londrina, v. 26, n. 1, 2017, p. 62-75. Disponível em: https://ojs.uel.br/revistas/uel/index.php/geografia/article/view/30055. Acesso em: 06 set. 2024.

SANTOS, R dos. **Planejamento ambiental e ordenamento territorial:** subsídios à gestão ambiental do município de Presidente Epitácio, estado de São Paulo, Brasil. 2020. 372 f. Tese (Doutorado em Geografia) - Faculdade de Ciências e Tecnologia, Universidade Estadual Paulista, Presidente Prudente.

TASSI, R.; POLETO, C. Gerenciamento integrado de bacias urbanas. *In:* POLETO, C. **Introdução ao gerenciamento ambiental**. Rio de Janeiro: Interciência, 2010.

TUCC, C. E. M. **Gestão da drenagem urbana**. Brasília: CEPAL/IPEA, 2012. (Textos para Discussão CEPAL-IPEA, 48).

ZILIOTTO, M.; CHIES, J. A. B.; ELLWANGER, J. H. Extreme Weather Events and Pathogen Pollution Fuel Infectious Diseases: The 2024 Flood-Related Leptospirosis Outbreak in Southern Brazil and Other Red Lights. **Pollutants**, 4 (3), p. 424-433, 2024. DOI: https://doi.org/10.3390/pollutants4030028. Disponível em: https://www.mdpi.com/2673-4672/4/3/28. Acesso em: 07 jan. 2026.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 14, n. 91, 2026

STATEMENTS

CONTRIBUTION OF EACH AUTHOR

- **Study Concept and Design**: Ricardo dos Santos e Edson Luís Piroli.
- **Data curation:** Ricardo dos Santos e Edson Luís Piroli.
- **Formal analysis:** Ricardo dos Santos.
- **Acquisition of Financing:** Ricardo dos Santos e Edson Luís Piroli.
- **Research:** Ricardo dos Santos.
- **Methodology:** Ricardo dos Santos e Edson Luís Piroli.
- **Writing - Initial Draft:** Ricardo dos Santos.
- **Writing - Critical Review:** Ricardo dos Santos e Edson Luís Piroli.
- **Review and Final Editing:** Ricardo dos Santos.
- **Supervision:** Edson Luís Piroli.

CONFLICTS OF INTEREST STATEMENT

We, **Ricardo dos Santos and Edson Luís Piroli**, declare that the manuscript **entitled Environment, health, and challenges of urban drainage in the municipality of Presidente Epitácio, western São Paulo, Brazil**:

1. **Financial ties:** There are no financial ties that could influence the results or interpretation of the work.
2. **Professional Relationships:** Has no professional relationships that could impact the analysis, interpretation, or presentation of results.
3. **Personal Conflicts:** I have no personal conflicts of interest related to the content of the manuscript.