

Analysis of Flood Causal Factors and their Possible Solution: The Case of Almafuerter Avenue

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Summary— The city of Paraná, with its valuable architectural and cultural heritage, faces the recurring challenge of pluvial flooding, especially in the Almafuerter Avenue area, caused by moderate rainfall. Inadequate topography, unplanned urban growth and changes in land use contribute to this problem.

To address this issue, this work proposes the creation of absorptive green spaces to allow rainwater to infiltrate the ground, preventing its accumulation in the streets. This is not only functional but also improves the quality of life of the community. In addition, an awareness campaign will promote the importance of keeping public spaces clean to avoid blockages in drains. Despite some drawbacks, these solutions promise to reduce flood risk, prevent property damage, and improve community safety in the affected area.

Keywords: Pluvial flood mitigation, absorptive green spaces, sustainable urban development, Drainage system

Resumen— La ciudad de Paraná, con su valioso patrimonio arquitectónico y cultural, enfrenta el desafío recurrente de inundaciones pluviales, especialmente en la zona de la Avenida Almafuerter, causadas por lluvias moderadas. La topografía inadecuada, el crecimiento urbano no planificado y los cambios en el uso del suelo contribuyen a este problema.

Para abordar este problema, este trabajo propone la creación de espacios verdes absorbentes para permitir que el agua de lluvia se infiltre en el suelo, evitando su acumulación en las calles. Esto no solo es funcional, sino que también mejora la calidad de vida de la comunidad. Además, una campaña de concienciación promoverá la importancia de mantener limpios los espacios públicos para evitar obstrucciones en los desagües. A pesar de algunos inconvenientes, estas soluciones prometen reducir el riesgo de inundaciones, prevenir daños a la propiedad y mejorar la seguridad de la comunidad en la zona afectada

Palabras clave: Mitigación de inundaciones pluviales, espacios verdes absorbentes, desarrollo urbano sostenible, sistema de drenaje

I. INTRODUCTION

This presentation is about an issue in Paraná, which is a coastal city located in the province of Entre Ríos, which belongs to Argentina. It is a city with a population of almost 340,000 inhabitants so it is neither a very small nor a very big city.

This work is about pluvial flood problem in the city of Paraná, which I will address from the Civil Engineering area, analysing one of its possible solutions. To achieve this, I divided it into the following sections. Firstly, I am going to study the problem in the northwest area of the city located on

Almafuerter street, indicating the causes that originate this problem. Secondly, I am going to talk about the impact that this problem has and how it affects people. Finally, I am going to present how to approach this problem and propose a solution.

II. PROBLEM DEFINITION AND ANALYSIS

A. Description of the Context

The city of Paraná has a rich architectural and cultural heritage. In its historic center you can find numerous colonial and neoclassical buildings, such as the Cathedral of Nuestra Señora del Rosario, the Municipal Palace and the Government House of the province of Entre Ríos. These buildings reflect the European influence in the architecture of the city.

The Paraná River is one of the main attractions of Paraná. Its coasts offer beautiful landscapes and spaces for outdoor recreation, such as parks and beaches. The city also has a port that is used for navigation and fluvial transport. Fig. 1 shows the location of the city of Paraná in the province of Entre Ríos. The city borders a watercourse. This is the Paraná River, which is one of the most important rivers in the region.



Fig. 1. Location of Paraná [1]

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However, a city with so much to offer people also presents some problems. The city of Paraná has challenges, among which the problem of pluvial floods stands out. The city is located in a flood-prone area and it is crossed by numerous streams and watercourses, which expose it to a major risk of flooding due to intense and prolonged weather events. This situation has become recurrent and worrying for the community, affecting urban areas and nearby rural areas.

One specific area where a pluvial flood problem has been identified is the Almafuerite Av. area, delimited by Juan del Campillo and Division de los Andes streets. This area is important for commercial and residential activities.

B. Problem Statement

In the previously mentioned area of Almafuerite Av., floods are generated due to medium magnitude rains. This causes numerous problems for residents and businesses.

This area is recurrently affected by pluvial floods. The presence and persistence of this problem generates serious inconveniences and frustrations in the area in question. These rainwater floods result in the accumulation of rainwater in the study area, reaching levels that exceed the drainage capacity of the local sewage system and overflowing on public roads.

A. Description of Scenes that Help Picture the Problematic Situation

The photos in this section will help understand the issue of floods in an area on Almafuerite Av.

Fig. 2 indicates the location of the affected area which this work is about. It is located next to a large green space. This is the racetrack.



Fig. 2. Location of the affected place [2]

Fig. 3 shows a photo on a day when Almafuerite avenue is flooded. It is evident what the problem is and what its consequences are. The photo shows the level that the water can reach and the seriousness of the problem.



Fig. 3. Affected area on Almafuerite Av. [3]

C. Identification and analysis of causes or factors that give rise to the problem:

There are many factors that give rise to the problem. The first cause is related to inadequate topography and drainage. The topography of the city of Paraná, with low areas and an insufficient drainage network, makes it difficult for a rapid evacuation of rainwater. The lack of an adequate drainage system in these areas favors the accumulation of water and increases the risk of flooding.

Another big reason is the unplanned urban growth of the city that has led to the construction of buildings, streets and paved areas without considering the absorption capacity of the soil. This increases surface runoff and reduces infiltration, increasing the risk of flooding.

Also, changes in land use have made things worse. Urbanization and expansion of impervious surfaces, such as concrete and asphalt, replace natural water absorption areas, such as green spaces and forests. This leads to increased surface runoff and increased load on drainage systems.

D. Identification and Description of the Consequences

Various consequences of the flood problem in a sector of Almafuerite Av. can be mentioned. Floods cause damage to homes, infrastructure and vehicles, generating significant economic losses. Repairs and restoration of affected areas represent considerable costs for the municipality and residents.

Stagnant water can be a breeding ground for mosquito-borne diseases like dengue and Zika, posing a public health risk. In addition, water contamination can affect the quality of the drinking water supply and increase the risk of gastrointestinal illnesses.

In addition to this, pluvial floods can cause soil erosion, degradation of green areas and loss of natural habitats. In addition, debris carried by floods can contaminate rivers and bodies of water, eliminate aquatic life and biodiversity.

III. THE WAY FORWARD

A. *Problem approach*

One of the key solutions proposed in this project is the creation of green absorptive spaces. These spaces consist in landscaped areas specially designed to absorb and retain rainwater. By providing a place where water can be absorbed into the ground rather than pooling on the streets, the risk of pluvial flooding can be significantly reduced. These spaces are not only functional, but also aesthetically pleasing, improving the quality of life in our community.

Fig. 4 shows the absorptive green spaces, which are also known as rain gardens. The image shows how a visually pleasing space is generated.



Fig. 4. Rain gardens [4]

In addition to creating green spaces, this project also proposes raising people's awareness about the importance of keeping public spaces clean. Garbage and debris accumulated in streets and gutters can clog storm drains, making the flooding problem even worse. By educating the city residents about the importance of properly disposing of waste and avoiding littering in the streets, storm drains can be kept free of blockages, and it is possible to ensure they work efficiently during rain events.

In addition to these measures, the implementation of early warning systems can also be considered so that residents are better prepared for possible flooding and can take preventive measures. With these measures the quality of life in the affected area will greatly improve.

B. *Strengths and Weaknesses of the Proposal*

The proposed solution has several significant strengths. First, it focuses on a sustainable solution to the problem. The creation of absorptive green spaces not only addresses pluvial flooding, but also contributes to improving the environmental quality of the community and provides aesthetically pleasing green areas for recreation of residents. This dual functionality is an important advantage.

Furthermore, the implementation of these green spaces has the potential to significantly reduce the risk of pluvial flooding by allowing rainwater to be naturally absorbed into the soil. This can help prevent property damage and improve community safety during heavy rains.

The awareness campaign on the importance of keeping public spaces clean is also a crucial strength. By educating residents about proper waste management and avoiding littering on streets, you can keep storm drains free of blockages and ensure they function efficiently during rain

events. This encourages citizen responsibility and active community participation in solving the problem.

However, there are some weaknesses that must be considered. First, creating absorptive green spaces may require considerable investments in design and construction, which could be a financial challenge for the community. Additionally, these spaces will require ongoing maintenance to ensure they are functioning properly, which means additional costs in the long run.

Community education and behavior change can also take time and effort, and not all residents may be willing to actively participate. Furthermore, although absorptive green spaces can reduce the risk of flooding, they cannot prevent flooding in cases of exceptionally heavy rainfall or extreme weather events.

Finally, the successful implementation of this solution will require effective coordination between local authorities and the community, which could be a logistical challenge. In short, the effectiveness of the solution will largely depend on the community's willingness and ability to address these challenges in a collaborative and sustainable manner.

IV. CONCLUSION

The city of Paraná, with its rich architectural heritage and natural beauty along the Paraná River, grapples with a persistent challenge: pluvial floods in the Almaguer Avenue area. These floods, caused by moderate rainfall, have led to significant inconveniences, affecting both residents and businesses. The project proposes two pivotal solutions—creating absorptive green spaces and launching a community awareness campaign. While these measures offer a sustainable path to mitigate flooding, they also come across some financial and logistical challenges. However, by fostering community engagement and addressing these issues collaboratively, the project has the potential to significantly improve the quality of life in the affected region, safeguarding the city's cultural heritage and community well-being.

This project underscores the importance of sustainable urban development in the face of environmental challenges, showcasing how well-planned green infrastructure and community education can not only mitigate flood risks but also enhance the overall living conditions. While challenges persist, the commitment to addressing them with a sustainable, collaborative approach offers a beacon of hope for the Almaguer Avenue area and, indeed, for the broader city of Paraná. With these proposed solutions, the community can look forward to a future where the recurring threat of pluvial floods becomes more manageable, ensuring a safer and more resilient environment for residents and businesses alike.

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The present project is a skills integration activity in Inglés I at Universidad Tecnológica Nacional, Facultad Regional Paraná, carried out by EFL engineering students. The yearlong project requires students to delve into a problem in the city where they live and to address it by means of a simple project in English. Should the reader have any questions regarding this work, please contact Graciela Yugdar Tófaló, Senior Lecturer, at gyugdar@frp.utn.edu.ar.