

Drinking Water Distribution in the Urban Area of Paraná: Implementation of Flow Sensors

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Academic Year: 2025

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Introduction: Contextualization



Paraná, Entre Ríos

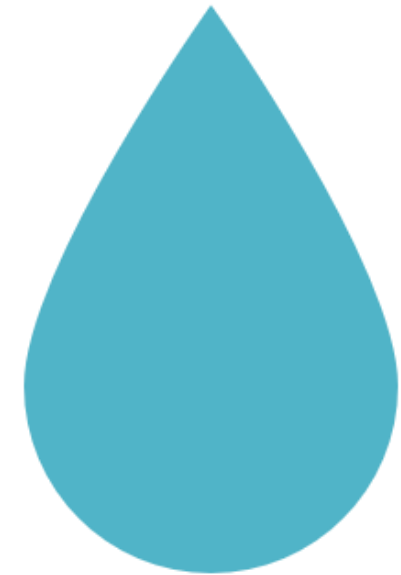
Introduction

Contextualization

- **4,974 square kilometers**
- **391,962 people in the year 2022**
- **141,269 homes**
- **134,525 homes with access to running water**
- **500 liters of daily consumption per person.**

Our purpose

- Improve the management of water pipes systems
- Reduce water outages in the city of Paraná
- Focus on obtaining maximum efficiency in water distribution



Map of the presentation

- Introduction
- Problem Description
 - ❑ Water Outages in the Urban Areas of Paraná
 - ❑ Identification and Analysis of the Causes or Factors that Give Rise to the Problem of Water Outages
 - ❑ Identification and Description of the Consequences of Water Outages
- Implementation of Water Flow Sensors to Detect Leaks and Failures
 - ❑ Strengths and Weaknesses of the Implementation of Water Flow Sensors

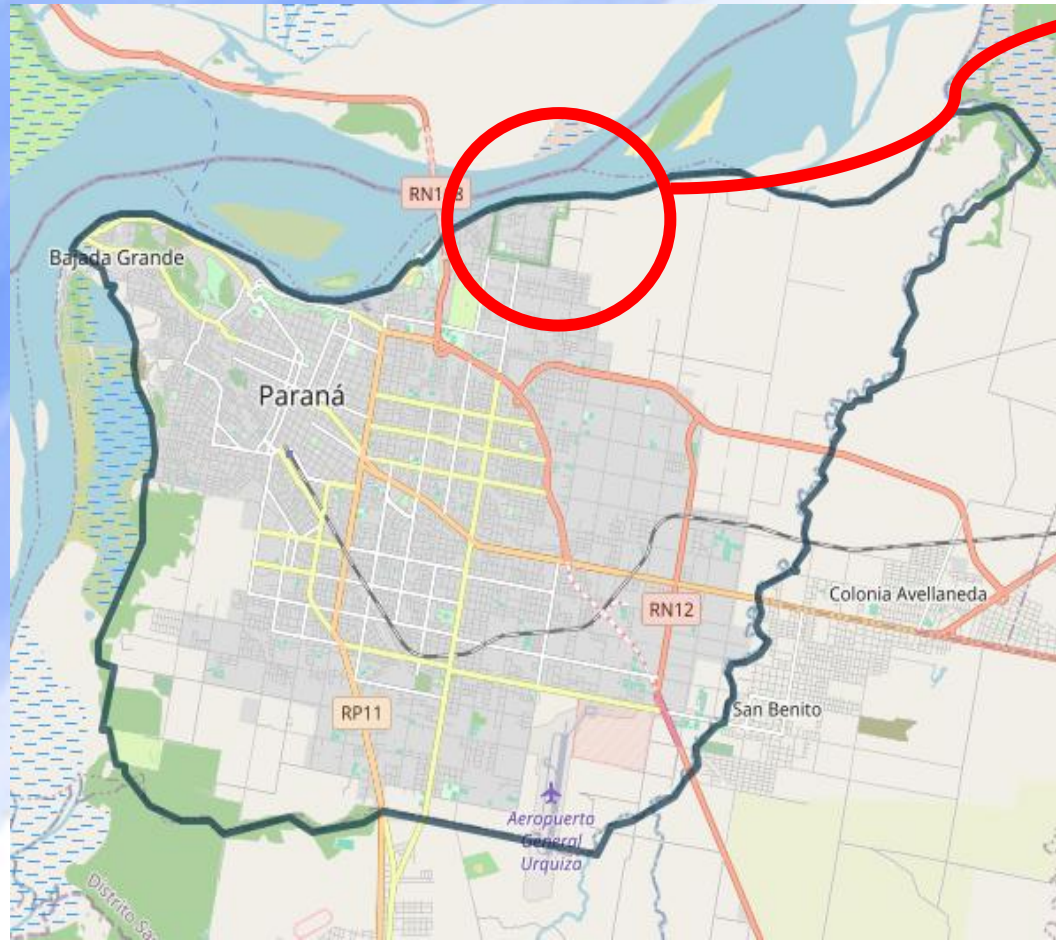


Expected Impact



Problem Definition and Analysis: Problem Description

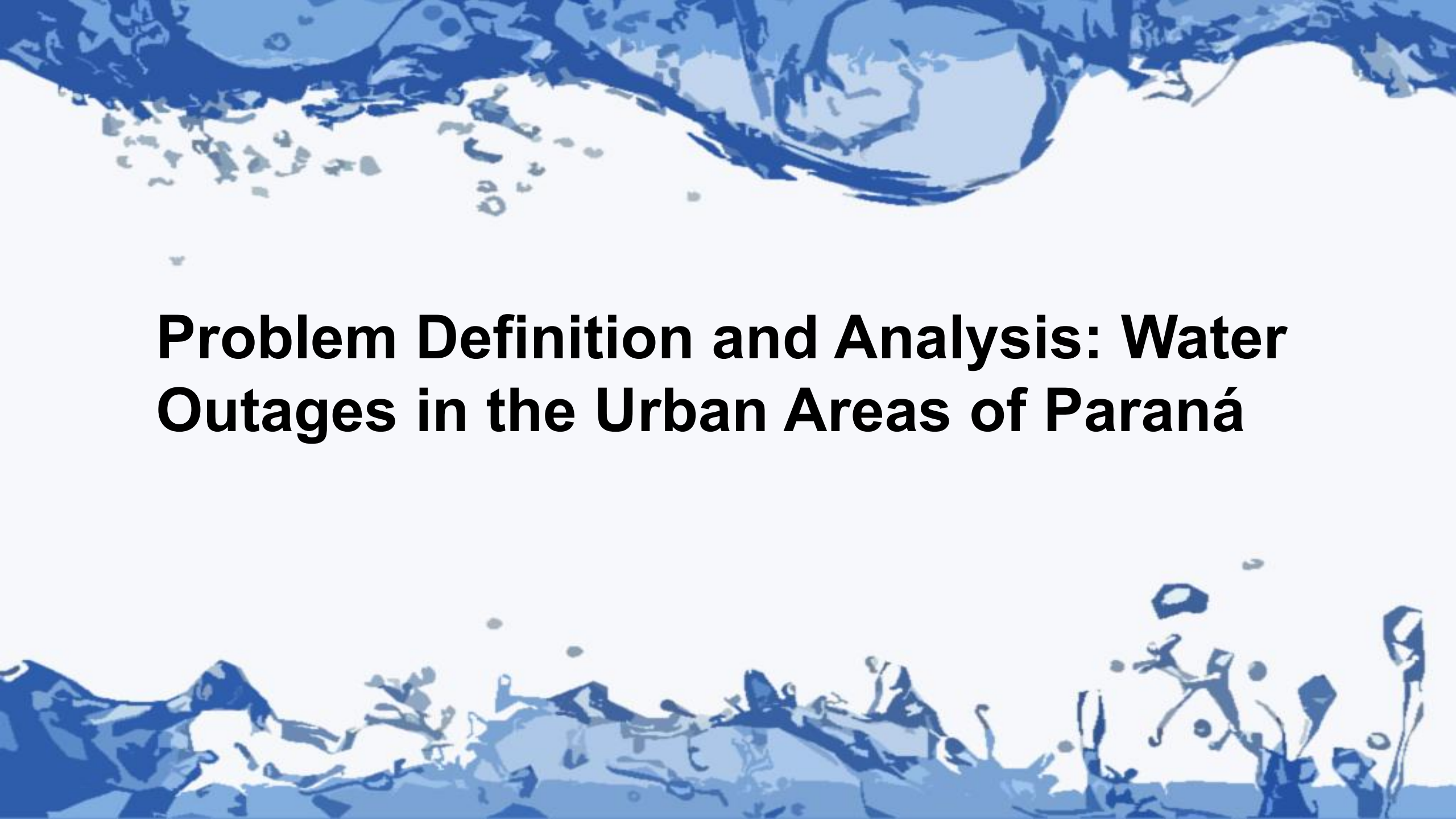
Problem Definition and Analysis: Problem Description



City of Paraná

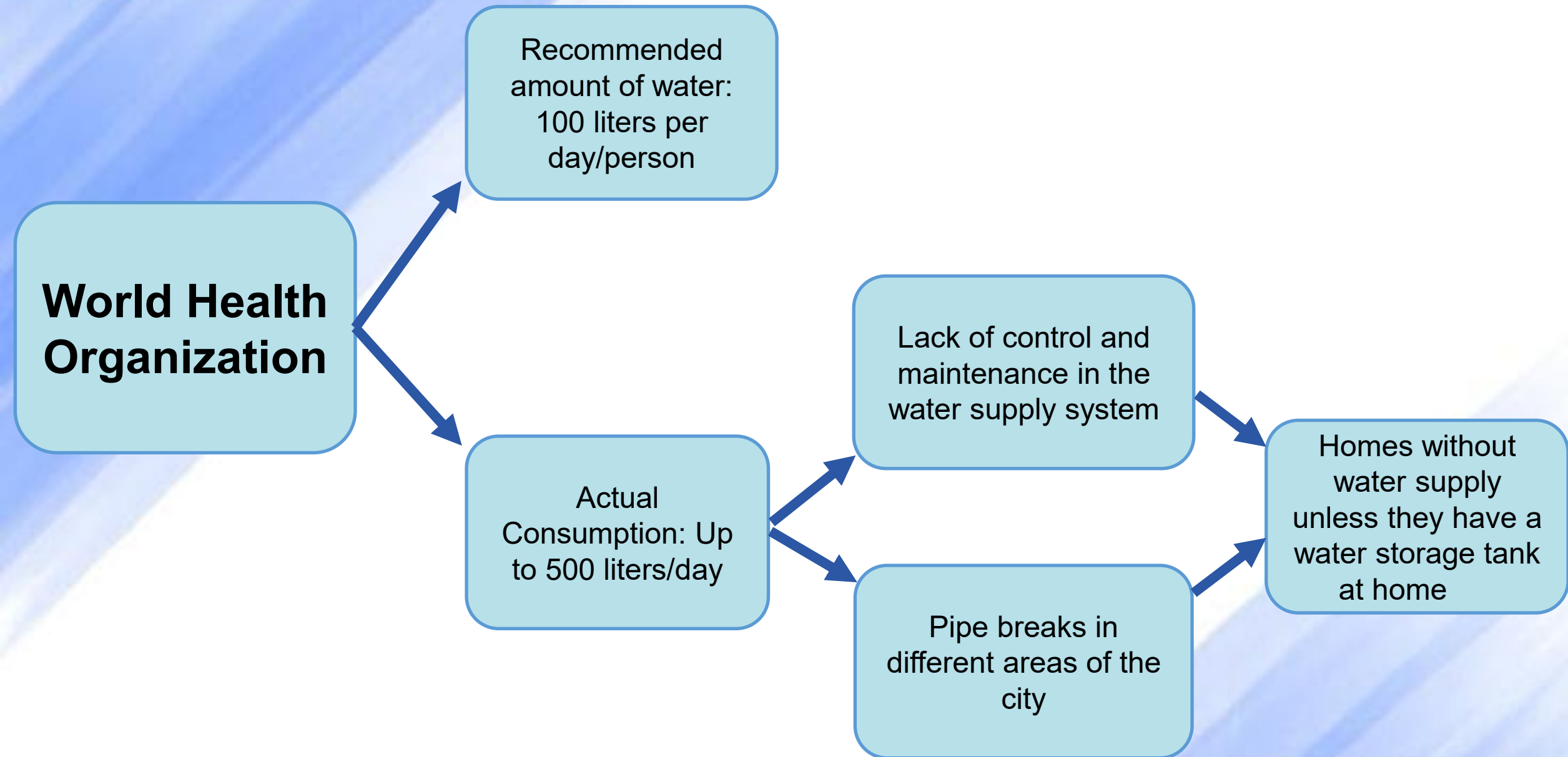


Water extraction pump

A blue-tinted background image showing a large splash of water at the top and bottom, with a white central area where the text is located. The water splash is dynamic, with many droplets and bubbles visible.

Problem Definition and Analysis: Water Outages in the Urban Areas of Paraná

Problem Definition and Analysis: Water Outages in the Urban Areas of Paraná



A blue-tinted background image showing a large splash of water at the top and a smaller splash at the bottom, with many water droplets in the air.

**Problem Definition and Analysis:
Identification and Analysis of Causes
or Factors that Give Rise to the
Problem of Water Outages**

Problem Definition and Analysis: Identification and analysis of causes or factors that give rise to the problem of water outages

Causes

- Infrastructure failure
- Increase in water demand
- Technical failures in water treatment plants
- Extreme weather conditions
- Lack of investments to improve the water system

A blue-tinted background image showing a large splash of water at the top and a smaller splash at the bottom, with many water droplets in the air.

Problem Definition and Analysis: Identification and Description of the Consequences of Water Outages

Consequences

- Negative effects on public health
- Economic impact
- Lack of classes in schools and universities
- Increase social inequalities
- Degradation of the environment
- Damage to old pipes, causing leaks and wasting of more water
- Discomfort among people
- Protests and loss of confidence in the politicians

A blue-tinted background image showing a large splash of water at the top and bottom, with a white central area where the text is located. The water splash is dynamic, with many droplets and ripples.

Problem Approach: Implementation of Water Flow Sensors to Detect Leaks and Failures



Clamp-on Ultrasonic Flowmeter

Selection and Installation of Flow Sensors

- **Description:** Device that works by measuring the velocity of the liquid in the pipe with external transducers.
- **Selection Criteria:** Precision, durability, and cost.
- **Installation:** Strategic locations identified during the analysis.

System Monitoring and Maintenance

- Continuous Monitoring System
- Automatic Alerts
- Regular Maintenance

A blue-tinted background image showing a large splash of water at the top and a smaller splash at the bottom, with many water droplets in the air.

Strengths and Weaknesses of the Implementation of Water Flow Sensors

Strengths

- ✓ Improved water distribution efficiency through real-time monitoring
- ✓ Equitable distribution of water
- ✓ Rapid leak and pressure detection

Weaknesses

- Significant initial investment to buy and install the sensors
- Dependence on technology
- Training required for personnel responsible for monitoring and maintenance

Conclusion

What is the problem?

- Lack of control and maintenance
- Frequent pipes breaks
- Homes without water supply.

What is proposed?

- Flow sensors detect leaks and pressure in real time

What is expected with this implementation?

- Improve the efficiency of the water distribution system

References

- Argentine Republic, “2022 Census Results.” gob.ar. https://censo.gob.ar/index.php/datos_definitivos_entre_rios/ (Accessed: June. 26, 2025).
- United Nations, “The Sustainable Goals Report 2022.” un.org. <https://unstats.un.org/sdgs/report/2024/Goal-06/> (Accessed: June. 26, 2025).
- “GIS,” parana.gob.ar. <https://gis.parana.gob.ar/> (Accessed: Sep. 9, 2025).
- Parana Municipality, “Echeverría Water Treatment Plant.” parana.gob.ar. <https://parana.gob.ar/areastematicas/gobierno/planta-potabilizadora-echeverria> (Accessed: June. 26, 2025).
- J.A. Morales-Novelo, C. M. Medina-Rivas, L. Rodríguez-Tapia and D. A. Revollo-Fernández, “Spatial inequality of domestic water consumption in Mexico City,” *Water Res. and Econ*, vol. 40, art. 100210, Nov. 2022. Accessed: August. 26, 2025. doi:10.1016/j.wre.2022.100210. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S2212428422000172?via%3Dihub>
- United Nations, “Water.” un.org. <https://www.un.org/en/global-issues/water> (Accessed: August. 26, 2025).
- M. Kutylowska and M. O.-Szostak, “Comparative analysis of water-pipe network deterioration-case study,” *Water Pract. & Tech.*, vol. 11, no. 1, pp. 148-157, Mar. 2016. Accessed: Sep. 9, 2025. doi:10.2166/wpt.2016.018. [Online]. Available: <https://iwaponline.com/wpt/article-abstract/11/1/148/20722/Comparative-analysis-of-water-pipe-network?redirectedFrom=fulltext>
- S. I. Zhou, T. A. McMahon, A. Walton and J. Lewis, “Forecasting operational demand for an urban water supply zone,” *Journal of Hydrology*, vol. 259, no. 1-4, pp.189-202, Mar 2002. Accessed: Sep. 9, 2025. doi:10.1016/S0022-1694(01)00582-0 [Online]. Available: <https://www.sciencedirect.com/science/article/abs/pii/S0022169401005820?via%3Dihub>
- C. Arrighi, F. Tarani, E. Vicario and F. Castelli, “Flood impacts on a water distribution network,” *Nat. Hazards and Earth System Sci.*, vol. 17, no. 12, pp. 2109-2123, Dec. 2017. Accessed: Sep. 9, 2025. doi:10.5194/nhess-17-2109-2017 [Online]. Available: <https://nhess.copernicus.org/articles/17/2109/2017/>
- L.-Y. Huang, Y.-C. Wang, C.-M. Liu, T.-N. Wu, C.-H. Chou, F.-C. Sung and C.-C. Wu, “Water outage increases the risk of gastroenteritis and eyes and skin diseases,” *BMC Public Health*, vol. 11, art. 726, Sep. 2011. Accessed: Sep. 9, 2025. doi:10.1186/1471-2458-11-726 [Online]. Available: <https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-11-726>
- A. Raihan, J. J. Pereira, R. A. Begum and R. Rasiah, “The economic impact of water supply disruption from the Selangor River, Malaysia,” *Blue-Green Systems*, vol. 5, no. 2, pp. 102-120, Dec. 2023. Accessed: Sep. 9, 2025. doi:10.2166/bgs.2023.031 [Online]. Available: <https://iwaponline.com/bgs/article/5/2/102/97013/The-economic-impact-of-water-supply-disruption>
- P. Thomson, A. L. Pearson, E. Kumpel, D. B. Guzmán, C. L. Workman, D. Fuente, A. Wutich, J. Stoler and Household Water Insecurity Experiences Research Coordination Network (HWISE-RCN), “Water Supply Interruptions Are Associated with More Frequent Stressful Behaviors and Emotions but Mitigated by Predictability: A Multisite Study,” *Environ. Sci. & Tech.*, vol. 58, no. 16, pp.7010-7019, Apr. 2024. Accessed: Sep. 9, 2025. doi:10.1021/acs.est.3c08443 [Online]. Available: <https://pubs.acs.org/doi/10.1021/acs.est.3c08443>
- Badger Meter, “Dynasonics TFX-5000 Ultrasonic Clamp-On Flow Meter.” badgermeter.com. <https://www.badgermeter.com/es-es/productos/medidores/medidores-de-flujo-ultrasonicos/medidor-de-flujo-ultrasonico-de-pinza-dynasonics-tfx-5000/> (Accessed: Sep. 17, 2025).

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