Methodological analysis for decision-making regarding solid waste management in megacities

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Optimal solid waste management requires to design mathematical models that enable the analysis of every variable associated with this management, taking into consideration local waste management particularities and needs

This proposal is based on real variables and data in accordance with the particularities of cities, to minimize possible decision-making errors which are analyzed through **artificial neural networks, decision trees and vector support machines**.

Life-cycle assessment is proposed as a future line of research for inclusion in the model for determining environmental impacts.

Solid waste management in megacities
Case study: Bogotá, Colombia

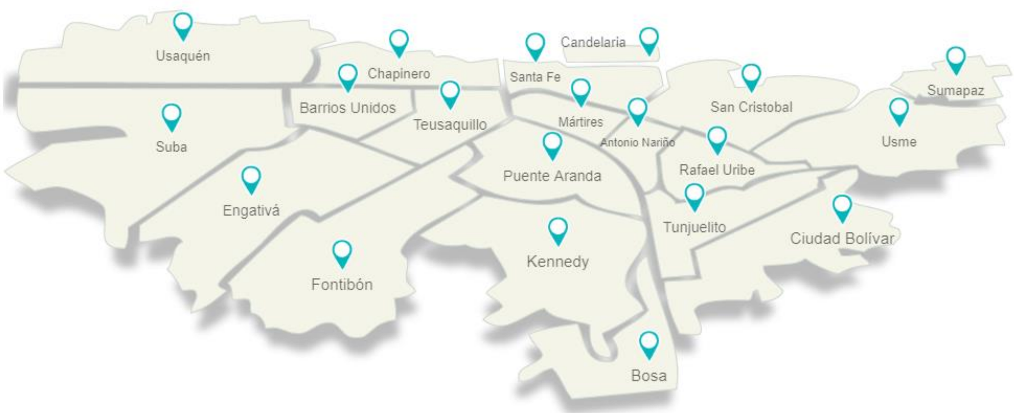

Figure 1. Location of the different Bogotá districts [1].

The city of Bogotá is divided into 20 administrative districts, each of which has its own mayor and a local administrative council. The city currently has a home waste collection scheme divided into 5 collection areas (exclusive service areas - ASE) for 2020.

Solid waste management in megacities
Case study: Bogotá, Colombia

According to the information provided by the study "Projections of population by localities for Bogotá 2016-2020" the population of Bogotá in 2020 is **8.380.801 inhabitants**, who disposed of approximately **1.860.536,30 tons** of solid waste/year at the sanitary landfill

The City of Bogotá, capital city of Colombia, is a city whose complexity and dynamism requires the implementation of technologies, policies and guidelines to properly manage urban solid waste. This is due to the characteristics of its growing population, which have diverse socio-economic levels that behave differently.

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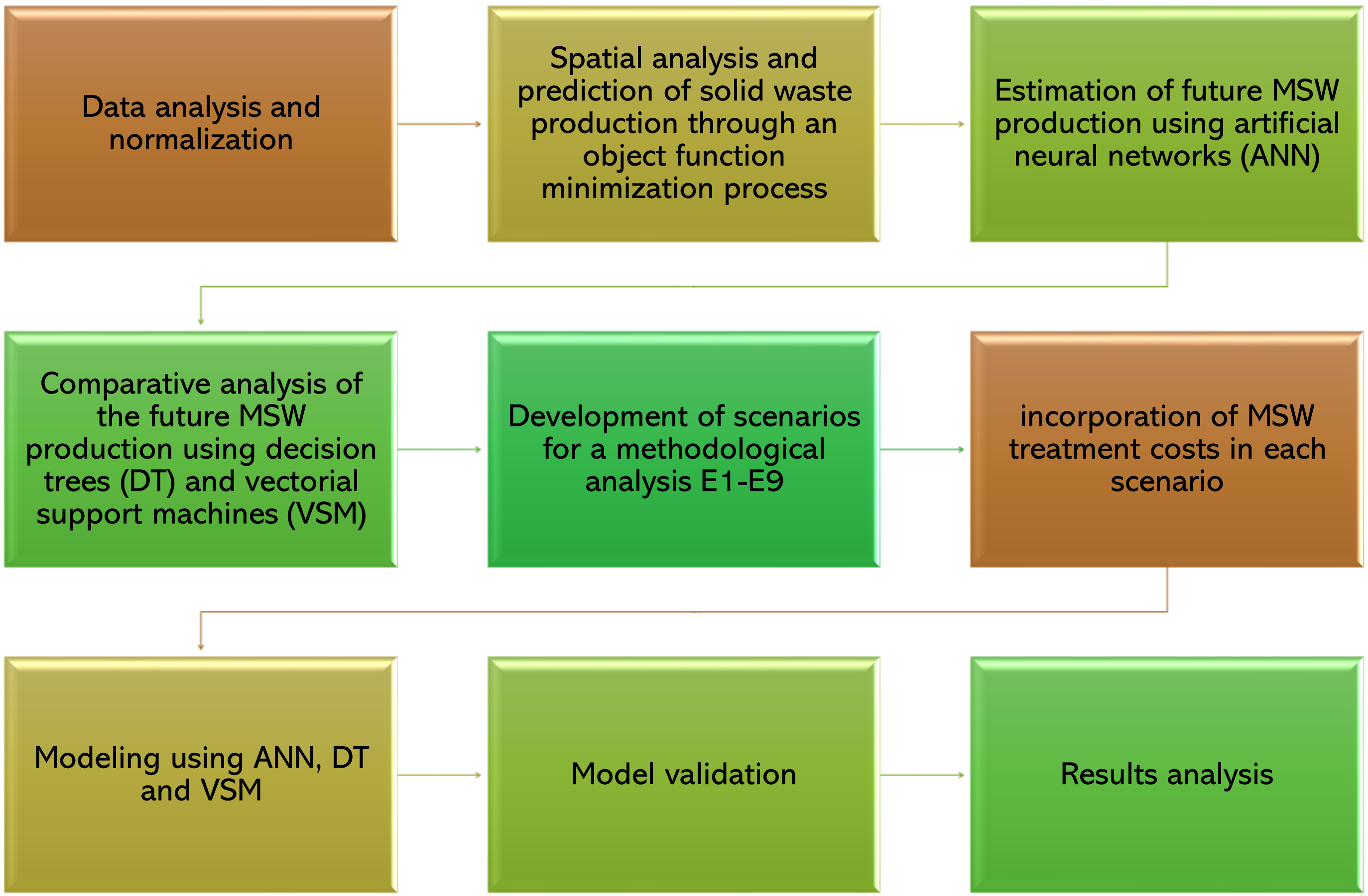
Solid waste management in megacities

Methodological analysis for decision-making process



Model variables

- Municipal solid waste produced an every ASE and every collection zone (t/month)
- Population (hab)
- Socio-economic stratification (Strata 1 to 6)
- Spatial distribution of the solid waste generation in the city
- Economic cost of soild easte treatment on every scenario (Colombian $/t)
- Selling of reusable waste incomes (Colombian $/t)

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The development of this research began gathering data of MSW generation in Bogotá in 2016.

2020 projection values were computed to analyze the behavior of MSW production

The model will be validated with known real values to predict MSW production in 2016-2020.

The first tool used to analyze data was the decision trees using non-parametric machine learning

Support vector machines were the second method implemented as a forecasting model.

Lastly, recurrent neural network models to forecast data were implemented

An analytical methodology (combination of GIS systems and statistical methods) has been used

MSW production in every ASE was evaluated.

ArcGIS software was used to analyze the available data

The model includes the economical costs of MSW treatment associated with every scenario ($/t).

These scenarios were considered accounting for the different treatment alternatives available at the city of Bogotá.

Scenario	
E1	E 1.1 Incineration
	E 1.2 Sanitary landfill
E2	E2.1 Gasification
	Sanitary landfill
E3	E.3.1 Mechanical + Anaerobic digestion with energy generation
	Sanitary landfill
E4	E.4.1 Mechanical + Open air composting
	Sanitary landfill
E5	E5.1 Mechanical + Closed composting
	Sanitary landfill
E6	E6.1On source Classified Waste Waste composting
	Sanitary landfill
E7	Sanitary landfill + gas capture + burning
E8	Sanitary landfill + gas capture + energy generation
E9	Sanitary landfill + gas capture + gas selling

The model structure includes the average MSW treatment costs ($/t) and incomes for the reusable materials selling ($/t)

Once all the model variables has been set, interrelations between them are determined for every scenario using Artificial Neural Networks

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Similarly, Vectorial Support Machines and Decision Trees are implemented as comparative analysis strategies

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Once results are obtained, the methodology validation is performed, using actual MSW production data (2017-2019)

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