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Data Article

Analytical framework and data for a municipal solid waste environmental performance assessment

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ABSTRACT

This article contains (i) a set of spreadsheets with data compiled from municipal sanitation or solid waste plans, and (ii) data of the individual and aggregate performance indicators. These indicators have been published in the Journal of Cleaner Production in the article entitled "A municipal solid waste indicator for environmental impact: assessment and identification of best management practices." The data contained in the spreadsheets are divided as follows: worksheet 1 includes the municipal solid waste generation data from the Brazilian municipalities studied; worksheet 2 presents the individual indicators that form the aggregate indicator; worksheet 3 presents the aggregate indicator and the classification of the municipalities; worksheet 4 provides data correlation; worksheets 5 to 10 depict boxplot graphs of the data; and worksheets 11 to 14 present graphs of individual indicators on a per capita basis and the ranking of municipalities.

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Specifications Table

Subject	Waste Management and Disposal
Specific subject area	Municipal solid waste performance indicators
Type of data	Spreadsheet
How data were acquired	Data were acquired through content analysis of municipal solid waste or sanitary plans of 150 municipalities. After processing of raw data, the indicators for CO_2 equivalent (CO_2e) and energy consumption were acquired by modelling using the Waste Reduction Model.
Data format	Raw and analyzed data, and concise numerical data.
Parameters for data collection	A content analysis of 150 municipalities was conducted based on their waste management practices, as presented in municipal waste or sanitation plans, to calculate the greenhouse gases emissions and energy consumption of these municipalities. Based on the content analysis, the total amount of each type of waste destined for recycling, composting, and incineration (if applicable), and the total distance travelled by the waste to the landfill, composting, and recycling units were identified. These are secondary data that are available at governmental departments such as the Environmental Company of São Paulo State (CETESB), the Environment Department of São Paulo State, MSW or Basic Sanitation Plans, and the National System Information on Solid Waste Management.
Description of data collection	The data were extracted based on a review of municipal solid waste or sanitary plans of municipalities. The data were then used to develop an aggregate indicator through a life cycle assessment approach.
Data source location	The content of the solid waste and sanitary plans for the following small municipalities in São Paulo State, Brazil, were reviewed:

Águas da Prata	Icem	Pontalinda
Alambari	Iepê	Pontes Gestal
Alfredo Marcondes	Igarata	Populina
Alvinlândia	Ilha Comprida	Porangaba
Anhembi	Indiaporã	Presidente Alves
Anhumas	Iporanga	Quadra
Aparecida D'oeste	Irapuru	Quintana
Arandu	Itaoca	Ribeira
Arapeí	Itapirapuã Paulista	Ribeirão Corrente
Arco-Íris	Itapura	Ribeirão do Sul
Arealva	Jambeiro	Ribeirão Grande
Areias	Jeriquara	Rifaina
Ariranha	João Ramalho	Sagres
Aspásia	Jumirim	Salto Grande
Avaí	Lagoinha	Santa Albertina
Barão de Antonina	Lavrinhas	Santa Clara D'oeste
Barra do Chapéu	Lucianópolis	Santa Cruz da Conceição
Barra do Turvo	Luziânia	Santa Ernestina
Bom Sucesso de Itararé	Lutécia	Santa Salete
Borá	Macedônia	Santana da Ponte Pensa
Boracéia	Magda	Santo Antônio da Alegria
Borebi	Manduri	Santo Antônio do Aranguá
Braúna	Mariápolis	Santo Antônio do Jardim
Brejo Alegre	Meridiano	Santo Antônio do Pinhal
Buritizal	Mesópolis	Santo Expedito
Cabrália Paulista	Mira Estrela	Santópolis do Aguapeí
Caiuá	Monções	São Joao do Pau D'alho
Campina do Monte Alegre	Monte Alegre do Sul	São Jose da Bela Vista
Canas	Monte Castelo	São Jose do Barreiro
Canitar	Monteiro Lobato	São Pedro do Turvo
Catiguá	Motuca	Sarapuí
Clementina	Nantes	Sebastianópolis do Sul
Colômbia	Narandiba	Silveiras
Coronel Macedo	Natividade da Serra	Taciba
Corumbataí	Nova Aliança	Tapiraí
Cruzália	Nova Campina	Taquaral
Dirce Reis	Nova Castilho	Taquarivaí
Dourado	Nova Guataporanga	Tarabai
Dumont	Nova Luzitania	

	Echaporã	Ocauçu	Tejupá
	Embaúba	Óleo	Terra Roxa
	Espírito Santo do Turvo	Onda Verde	Torre de Pedra
	Estrela do Norte	Oscar Bressane	Torrinha
	Estrela D'oeste	Palmeira D'oeste	Turiúba
	Euclides da Cunha Paulista	Paraiso	Ubirajara
	Flora Rica	Pardinho	Uchoa
	Gabriel Monteiro	Parisi	Vitória Brasil
	Gália	Paulistânia	
	Guatapará	Paulo de Faria	
	Herculândia	Pedrinhas Paulista	
	Ibirarema	Pereiras	
		Platina	
		Pongai	
Data accessibility	The data are presented with this article.		
Related research article	The data are associated with the paper published online at the Elsevier journal "Journal of Cleaner Production": Deus, R. M. et al. A municipal solid waste indicator for environmental impact: assessment and identification of best management practices [1].		

Value of the Data

- The data can be used locally to assess the environmental impacts of municipal solid waste management in small municipalities in the state of São Paulo, Brazil. They may be used more broadly by those aiming at implementing efficient and effective aggregate indicators at other small municipalities.
- The data benefit researchers who want to establish comparisons with their own data or use the data presented in this paper to develop and test new aggregate indicators. The data may also help public managers to elaborate better waste management policies aimed at improving the quality of public services provided to the population.
- With minor adjustments or increments, such as the addition of new social and economic indicators, the data structure can be used to assess all dimensions of urban solid waste management sustainability, as well as to outline strategies for sustainable development.

1. Data

The datasheets contain data collected from municipal solid waste or sanitation plans. The datasheets also include data for the calculation of individual and aggregate indicators, which were collected from government and non-governmental organizations datasets. Timespan for the data is 1 year.

Fig. 1 shows the municipalities that were considered in this study.

The article contains a spreadsheet data file (.xlsx format) with the following data tabs:

- Worksheet 1 (entitled "WASTE DATA"): Data about municipal solid waste generation and the average distance to the landfill and/or recycling/composting plant of 150 small municipalities (<10,000 inhabitants) in the state of São Paulo, Brazil;
- Worksheet 2 (entitled "INDICATORS"): Socioeconomic and individual indicators data resulting from the survey and modeling in the Waste Reduction Model (WARM);
- Worksheet 3 (entitled "MULTIPLE INDICATOR"): normalized individual indicators, aggregate environmental performance indicator and the classification of municipalities. This worksheet also contains two graphs, one referring to the general classification of municipalities, and the other referring to the composition of the normalized indicators of each municipality;
- Worksheet 4 (entitled "SPEARMAN CORRELATION"): Spearman correlation matrix between indicators. This worksheet also contains a graph of the correlations between variables;
- Worksheet 5 (entitled "ENERGY GRAPH"): descriptive summary of energy consumption (kWh) data and their outliers. This worksheet also contains a boxplot graph of the data;
- Worksheet 6 (entitled "CO2E GRAPH"): descriptive summary of carbon dioxide equivalent (CO_2e) data and their outliers. This worksheet also contains a boxplot graph of the data;
- Worksheet 7 (entitled "POPULATION GRAPH"): descriptive summary of population data. This worksheet also contains a boxplot graph of the data;

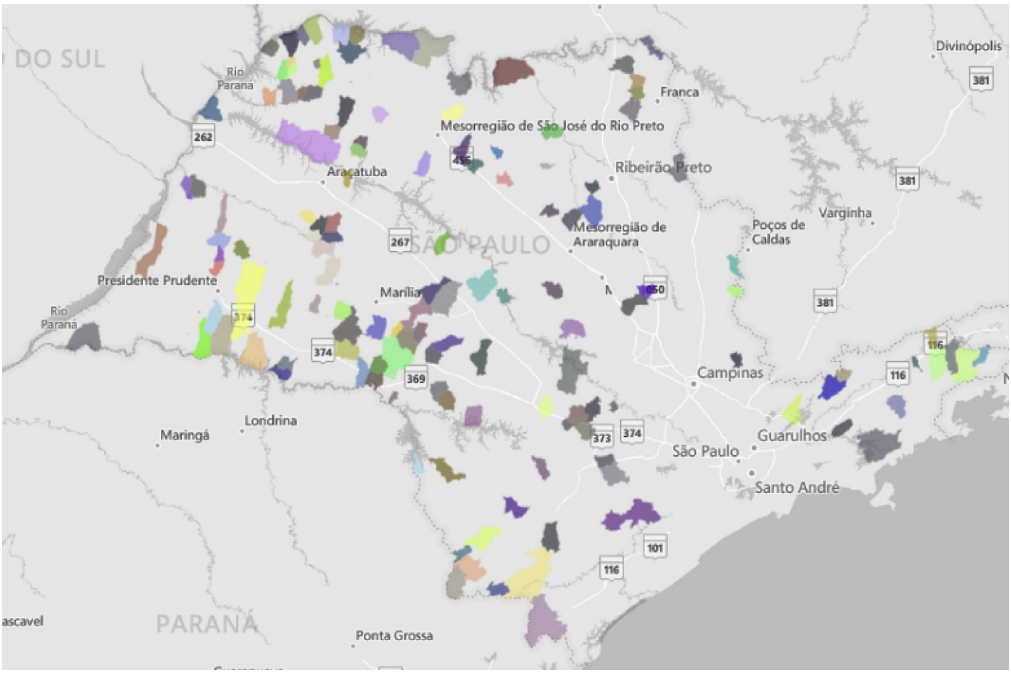

Fig. 1. Small municipalities in the State of São Paulo included in this study.

- Worksheet 8 (entitled "GDP GRAPH"): descriptive summary of Gross Domestic Product (GDP) data and their outliers. This worksheet also contains a boxplot graph of the data;
- Worksheet 9 (entitled "WQI GRAPH"): descriptive summary of Waste Quality Index (WQI) data and their outliers. This worksheet also contains a boxplot graph of the data;
- Worksheet 10 (entitled "WASTE GENERATION GRAPH"): descriptive summary of waste generation data and their outliers. This worksheet also contains a boxplot graph of the data;
- Worksheet 11 (entitled "ENERGY RANK"): annual per capita indicator data and the ranking of municipalities for energy consumption. This worksheet also contains a graph of the ranking;
- Worksheet 12 (entitled "CO2E RANK"): annual per capita indicator data and the ranking of municipalities for CO_2e. This worksheet also contains a graph of the ranking;
- Worksheet 13 (entitled "WQI RANK"): annual per capita indicator data and the ranking of municipalities for WQI. This worksheet also contains a graph of the ranking;
- Worksheet 14 (entitled "WASTE GENERATION RANK"): annual per capita indicator data and the ranking of municipalities for waste generation. This worksheet also contains a graph of the ranking;

2. Experimental design, materials, and methods

2.1. Selection of municipalities

This study adopted a secondary data extraction method to obtain data from small municipalities (up to 10,000 inhabitants) in the State of São Paulo. The inclusion criteria consisted of all necessary data for the performance of life cycle assessment, such as waste generation, composition, recycling and composting rate, being available for the municipality. Of a total of 645 municipalities in São Paulo State, 273 are small municipalities, and of these, a total of 123 municipalities were excluded from the sample due to unviable, corrupted, vitiated, unrealistic, or partially available data, resulting in 150 municipalities being analyzed (Fig. 1).

2.2. Data collection

Each municipality considered was analyzed based on the waste management practices included in its municipal plans of basic sanitation or solid waste plans. Data was gathered in structured spreadsheets and they present the total amount of each type of waste and their destination, the amount of waste that is recycled and composted, and the distance traveled by the waste to the landfill, composting, and/or recycling units. The general gravimetric composition of municipal solid waste was collected from solid waste plans for small municipalities in São Paulo State.

2.3. Waste Reduction Model

For assessment of individual indicators data, the Waste Reduction Model (WARM), Version 14, from the United States Environmental Protection Agency, a widely applied model in many different cities around the world [2–6], was used to process the data.

2.4. Indicators data (outputs)

At the final stage, the environmental impacts data of municipalities are presented in the spreadsheets as CO_2 equivalent, which comprises the set of gases that contribute to global warming, and the energy consumption [7].

2.5. Aggregate indicator

An aggregate data performance indicator is presented in the spreadsheet. The components of the aggregate indicator are the per capita waste generation, which is widely used [6], the per capita emission of CO_2e, the per capita energy consumption, and the Waste Quality Index (WQI), developed by CETESB [8]. The WQI evaluates final disposal sites for solid waste from a technical and environmental point of view. Its value may range from 0.0 to 10.0 points, with values below 7.0 points indicating poor landfill conditions, while points ranging from 7.1 to 10.0 indicate sufficient landfill conditions.

2.6. Calculating the aggregate indicator

Each indicator (I) was normalized using the relative maximum and minimum values (Equation (1)) from the data collected and presented in the spreadsheet. The normalization generated indicators with values ranging from 0 to 1 [1].

$$I = \frac{x_i - x_{i,min}}{x_{i,max} - x_{i,min}} \tag{1}$$

where $x_{i,max}$ and $x_{i,min}$ are the maximum and minimum values based on the data, for each indicator (i), respectively.

After normalization, the aggregation was performed by computing the geometric mean of the normalized indicators, according to Equation (2). All indicators were given equal weight (1/4). The aggregate indicator (AI) varies between 0 and 1.

$$AI = \sqrt[4]{WG_I \times GHG_I \times EC_I \times WQI_I} \tag{2}$$

where WG_I is the normalized indicator of solid waste generation (kg inhabitant^{-1} year^{-1}), GHG_I is the normalized indicator of CO_2e emission, EC_I is the normalized indicator of energy consumption and WQI_I is the normalized indicator of Waste Quality Index (WQI).

All collected and processed data are presented in the spreadsheet.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.105085.

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