

## COLLECTION AND DISPOSAL OF WASTE IN SMALL TOWNS

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### ABSTRACT

Producing waste is an output of the consumer society. It generates high volumes of waste that need to be managed in order to avoid an inappropriate destination. This work seeks to analyze the profile, volume produced and disposal of solid waste in small towns in the west of Santa Catarina. To operationalize the study data was collected in the municipalities of west region of Santa Catarina. Scripts were applied questionnaires for public managers, presidents of associations of pickers, waste collection points and individual collectors. For analysis of the results was considered in those with less than 25,000 inhabitants. The results show that: I) The population density explains more than 80% of the budget destined for household solid waste collection and recycling; II) Spent with collection and disposal services is R\$ 44.22 per capita; III) Recycling provides a monthly gross income of R\$ 2,286.98 for dung; IV) That 61% of municipalities have waste management plan, but the data did not demonstrate the effectiveness thereof; V) The main difficulty pointed out by prefectures refers awareness of the population. This leads to the conclusion that the integrated solid waste management requires more than public policy. This study contributes to the understanding of the area by reinforcing that the solid waste management should (and can) be treated in an integrated manner, considering all aspects of sustainability.

**Keywords:** sustainability; solid waste management; integrated management.

### COLETA E DESTINAÇÃO DE RESÍDUOS EM MUNICÍPIOS DE PEQUENO PORTE

#### RESUMO

Produzir resíduos é um *output* da sociedade de consumo. Gera elevados volumes de resíduos que necessitam ser gerenciados para que, desse modo, se evite uma destinação inadequada. Este trabalho busca analisar o perfil, volume produzido e destinação de resíduos sólidos em municípios de pequeno porte no oeste catarinense. Para operacionalizar o estudo foram coletados dados em municípios da Mesorregião Oeste de Santa Catarina. Foram aplicados roteiros de questionários para gestores públicos, presidentes das Associações de Catadores, pontos de coleta de resíduos e catadores individuais. Para análise dos resultados foi considerado pequeno município aquele com menos de 25.000 habitantes. Os resultados mostram que: i) a densidade populacional explica mais de 80% do orçamento destinado à coleta de Resíduos Sólidos Domiciliares e coleta Seletiva; ii) o gasto médio com serviços de coleta e destinação é de R\$ 44,22 per capita; iii) a reciclagem propicia uma renda bruta mensal de R\$ 2.286,98 por catador; iv) que 61% dos municípios possuem Plano de Gestão de Resíduos, mas os dados não demonstram a efetividade dos mesmos; v) a principal dificuldade apontada pelas prefeituras refere-se à conscientização da população. Isto permite concluir que a gestão integrada dos resíduos sólidos requer mais que políticas públicas. Este estudo contribui para o entendimento da área ao reforçar que a Gestão de Resíduos Sólidos deve (e pode) ser tratada de forma integrada, considerando todos aspectos da sustentabilidade.

**Palavras-chave:** sustentabilidade; gestão de resíduos sólidos; gestão integrada.

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## INTRODUCTION

Waste is a problem in the cities, when they are not properly managed (BARBOSA *et al.*, 2016). Become elements that cause disease, clog drainage systems of rainwater, produce bad smells, proliferation of insects and pests and give a connotation of carelessness and management of public spaces (DOMINGOS; BOEIRA, 2015). Although don't be so notorious, similar characteristics are perceived in rural areas that do not manage the waste (ROCHA *et al.*, 2012).

Considering the national indicators, where a person generates on average 1 kg of waste per day (BRASIL, 2013), it becomes a challenge for municipalities to manage the volume of materials that are "thrown in the trash" every day (SILVA; BIERNASKI, 2018). A selective collection contributes to optimizing the use of materials, the generation of segregation for shipment for recycling and reuse of materials, and especially the possibility of marketing for waste pickers engaged in these processes (SILVA; DONAIRE, 2007).

The problem situation that motivates this study is associated with the concern associated with the volume of solid waste produced and its adopted management system (ABRELPE, 2017). It is understood that the region west of Santa Catarina has the potential to create a structure together that allows them to add value to the materials collected, provided that there is an initial diagnosis of the volume of materials collected, and the evaluation of the profile of these solid wastes and potential aggregation of the value available (MINGORI, 2019). And thus generate sustainable solutions for Solid Waste Management (SANTOS; SILVA, 2016).

Leaving from this context, the next objective appears: to analyse the profile, produced volume and destination of solid residues in local authorities of small transport in the western inhabitant of Santa Catarina. The social relevance (ALMEIDA; NEUMANN; SANCHES, 2018) of a study of this nature is associated the public health (FERREIRA; ANJOS, 2001), efficient management of public resources (SILVEIRA; PHILIPPI, 2008), well valuable aggregation is of the persons (POLAZ; TEIXEIRA, 2009), projection (ALMEIDA; GOMES, 2018), to the collected materials (MAIELLO; BRITO; VALLE, 2018), empreendedorismo (CAMPOS *et al.*, 2009), generation of opportunity of job and income (SILVA; PESSALI, 2018) and local and territorial development of the local authorities ((PANTOJA; PEREIRA, 2018) of the west extreme habitant of Santa Catarina (MINGORI, 2019).

The article is structured in sections. In the sequence, the section 2 presents a conceptual outline on management of solid residues. In the sequence the item methodology describes the distance been passed to execute the inquiry. The section 4 presents and analyses the results of the inquiry. The section 5 discusses the results and presents the final considerations, and is followed by the references of the works quoted in the text.

## MANAGEMENT OF SOLID RESIDUES

Solid residues consist of all the materials, substances, objects or resultant discarded goods of the human activity in society (BRASIL, 2010). They are made available in the environment in solid state or semisolid, as well as gases and liquids contained in containers which peculiarities make his launch impracticable in the public net of sewer pipe or in bodies d'água (RAVINDRA; KAUR; MOR, 2015). The generation of solid residues is a problem for the local authori-

ties that they aspire to the sustainability in the municipal management (CHAMIZO-GONZÁLES; CANO-MONTERO; MUÑOZ-COLOMINA, 2018).

The management of solid residues consists of a set of methodologies that try to reduce and to remove the generation of residues, as well as the attendance of the productive cycles taking as a finality the reduction of the generation of the residue in his origin, to reduce the produced environmental impact and to look after the correct destination of the residues originating from the productive processes (FERREIRA, 2018). It is becoming more and more popular in the world, in the intention of accommodating the growing quantities of residues that the population produces (HAVUKAINEN *et al.*, 2017).

The subject management of solid residues has been an analysis object in several Brazilian studies, for example, under the optics of the management of urbane solid residues (SILVA; BIER-NASKI, 2018; FERREIRA, 2018), management of solid residues in enterprises metal mechanics of small transport (STUMPF; THEIS; SCHREIBER, 2018), the logistics re-is like tool of management of residues of the retail trade supermarket (MARTÍNEZ *et al.*, 2017), analysis of environmental costs made a list of the residues of the chemical industry (MORAES *et al.*, 2017), residues management in the Central office of Training of Industrial Solid Residues of Chapecó (Cetric) (MELLO; SEHNEM, 2016), management of residues of services of health in hospital organizations of the public administration (MARANHÃO; PEREIRA; TEIXEIRA, 2016), management of solid residues in the civil construction (SOUZA *et al.*, 2015), management of residues of service of health in military organization (MARANHÃO; SOUZA; TEIXEIRA, 2015), management of solid residues in ways of lodging (LAMAS, 2015), management of solid residues and tourism (SPERB; TELLES, 2014), management of solid residues in environments of supportive economy (LOPES; LIMA, 2014), relation between public power and society in the management of solid residues (RIBEIRO; PEREIRA, 2014), management of solid residues of the industry of biodiesel (ALTOÉ; VOESE, 2014), environmental adaptation of manufacturers of tackle of household appliances for exempt production of dangerous products and management of solid residues (SILVEIRA *et al.*, 2013), between others.

In the international context, the variety of directions for the studies about the thematic residues management solid also exists, and contemplate scientific investigations that are about identification of the constituent elements of the management of municipal solid residues (FUSS; BARROS; POGANIETZ, 2018), it structures logistics and geographical of the informal collection, marketing, national and international recycling of recovered valuable solid residues (BOTELLO-ALVAREZ *et al.*, 2018), evaluation of the cycle of life for comparison of the effects of different types of services of sweep of street and environmental impacts (BARTOLOZZI *et al.*, 2018), types of responsibilities for the producer of residues (CHAMIZO-GONZÁLES; CANO-MONTERO; MUÑOZ-COLOMINA, 2018), management of solid residues in small cities (RODRIGUES *et al.*, 2018), evaluation of the environmental impacts of the system of management of urbane solid residues (LIIKANEN *et al.*, 2018), use energy, energetic demand and management of urbane solid residues (BEHROOZANIA *et al.*, 2018), strategies of management of electronic garbage (YONG; LIM; ILANKOON, 2019), between others.

Besides, the National Politics of Solid Residues (BRASIL, 2010) is a set of national directives that legislates on beginnings, objectives and instruments, directives relative to integrated management of solid residues, inclusive the dangerous ones, the responsibility of the creators and of the public power and the applicable economical instruments. It is a global reference of

premises that contribute to the realization of an efficient management of residues. From his promulgation, the National Politics of Solid Residues (PNRS – Política Nacional de Resíduos Sólidos) has been an analysis object in different Brazilian organizational contexts, in the intention of understanding how you implement it in his plenitude. for example, the study carried out by Batista (2018) who looked to analyze and to describe the current state of the economical instruments in the activities developed by the different supply chains you re-are in the context of the PNRS. Spínola (2014) analyzed the action of the State (Conder, State Public prosecution service and Municipal Town hall of Ilhéus), of the Private enterprise (Ilhéus Faculty and Solar Ambiental), of the Civil Society (Residents' association of the District Hernani Sá, Cooperative of the Collectors of Solid Residues You were Recycling Clean Conscience and Institute Our Ilhéus), of the civil society (Brazilian Institute of Municipal Administration) and of the Infraero in the process of implementation of the National Politics of Solid Residues in Ilhéus – BA.

Silva (2016) investigated the reasons since which, last five years of validity of the PNRS, the collectors were still in so precarious social, economical and legal situation and the development of his work to remain made difficult. Almeida (2016) effectuated the analysis of the process of formulation of the National Politics of Solid Residues where it looked to understand like the structural aspects (resources had by the actors) and the agency aspects (in the defense of his interests) make a list of articulation capacity dynamically and in what measured they help in the explanation of the politics that was formulated. Leitzke (2015) analysed the importance of the Environmental Education for the implementation of the National Politics of Solid Residues – PNRS, checking how if it gave the consolidation of the Environmental Education in the Decade of the Education for the Sustainable Development, fixed by the United Nations between 2005/2014. Dinnebier (2015) had as checking purpose like the Environmental Right it can be applied to face the ecological crisis and so that there are reduced the environmental impacts caused by the packings. The study of Camargo (2014) proposed a set of indicators of sustainability for the management of the urban solid residues in the local authority of Bragança Paulista – SP, for a bit the consultation of his Municipal Council of Defense of the Environment – Condema, having like context the PNRS. Straioto (2012) prepared a conceptual proposal of incorporation of the National Politics of Solid Residues in the Management of Design, in his three levels – operationally, functionally and strategically. From a theoretical inquiry on the subjects and of the identification of parameters of the Law 12.305/2010, the integration of the subjects was carried out with the parameters. Since result obtained the proposal of strategic management of design for sustainability, functional management of participative design and operational management of design of the cycle of life of the system-product. Celeri (2012) valued the contribution of the devices that integrate the PNRS and his ramifications, while setting out, to interpret and to value a case study at the Intermunicipal Partnership of the Valley of the Paranapanema in the state of Sao Paulo, listing adaptation premises to the joined models.

While the PNRS became an object of analysis of several studies in Brazil, several management models for integrated management of the solid residues also were appearing. It is the case of the work of Silva (2000) it undertakes an analysis of the model of management of solid residues of the Bureau of Urbane Cleaning of Belo Horizonte – MG, focusing the partnership constituted with the Association of the Collectors of Paper, Cardboard and Materials You were Recycling. Melo (2009) that proposed a methodology for the management of solid residues from the integration of the methodologies of the system of environmental management, of the most clean production

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and of the suggestions, already published, of projects of management of residues of construction extolled by the Resolution n. 307 of the Conama and to apply this methodology in an industry of products and breeze blocks of concrete. Silva (2015) leas (i) an evaluation of the current model of management of the urbane solid residues of the city of Reef / foot through the lifting of eight thematic axles, what are valued according to the technique of analysis of the content. In sequence, (ii) it studied the relation of four indicators (population, income, generation and composition gravimetric) in 31 sectors of collection of urbane solid residues, using, for such, multivariad techniques, like the analysis of the component principal and of the hierarchical grouping.

Koetz (2016) demonstrated, through the realization of a diagnosis, the operational situation found in the enterprise relative to the separation of his solid residues and reways, his treatment and final destination. Bianco (2018) proposed a model of management of differentiated RSU, in the stages of collection, transport, treatment and use of residues, able to attend the legal prerogatives in economical, social and environmental extent, and, what makes possible the introduction of a model economical creator of wealth, job and income in a sustainable environment in the local authorities of the Western Mesoregion of the Paraná. So, evidences of the inquiry signal that the subject management of solid residues keeps on being stimulating and when investigators' glances were attracted to understand his meanders, specificities, performance and contribution for a sustainable society.

## METHODOLOGY

This study was developed in the western extreme inhabitant of Santa Catarina. It contemplated 59 local authorities distributed in 2 microregions (Chapecó and São Miguel of the West), when 4 municipal associations Ameosc are understanding – Association of the Local authorities of the Western Extreme of Saint Catherine, with 19 local authorities, Amerios – Association of the local authorities of Between Rivers, with 17 local authorities, Amosc – Association of the Local authorities of the West of Saint Catherine, with 21 local authorities and Amnoroste – Association of the Local authorities of the Northwest of Saint Catherine, with 06 local authorities. The local authorities of Grove, pertaining to Amosc, Coronel Martins, Galvão and Jupιά pertaining to Amnoroste, in spite of the associations belonged target, were considered an aim of the present project, because of being out of the microregions created by the Plan of State Development, which draws a strategy for the development of the state (PLANO SC 2030, 2018).

In a first moment questionnaire was applied to the public agents, for map the profile and volume of residues collected in his city, urban and rural data were collected on the same instrument, but because they are usually collected at different times, it was possible to obtain the quantities individually. The itinerary of the questionnaire contemplated investigations on annual budget destined to the solid residues; quantity of residues collected annual and destination (landfill, recycling or other one); associations, cooperatives and enterprises that collect materials were recycled by you; campaigns of collection of residues carried out in the local authorities; geographical location of the landfills of the local authority; current useful life of the used landfills; and main difficulties.

I join the cooperatives and private enterprises of collectors of residues the questions were done, mainly, to the managers of the entity. Also, in the sequence, inquiry was effectuated near the autonomous / individual collectors, what were mapped he was seeing indication

snowball and what they were not in the sample of the formal collector of the local authority. For both, there was used itinerary that was contemplating the next investigations about: Classification / type, quantities, destiny and sale price of the collected residues, quantity of collaborators wrapped in the processes, main trouble faced in the collection and recycling of residues.

The criterion of selection of the investigated region is associated to the fact of being the most distant region of the capital of the state. Because of bringing together a great number of small local authorities, with characteristics of having urban and rural productive systems, which segregates the residues profile and enlarges the range for the collection, specially for the spacious wrapped territorial areas and operational costs for the efficient management of the system of collection, according to Figure 1.

Figure 1 – Region/municipalities object of study



Source: The authors.

The justification for the limitation of this area like aim of the study, is associated to the type of colonization, which in this region is originating from Rio Grande do Sul and formed mainly by Italians and Germans. Besides, it is a physically detached region of the remainder of the state, because of being practically situated in the same tableland, having so, practically homogeneous conditions, which possibly will make easy the study and the suggestion of solutions, accepted the problems when to be similar was shared also (MINGORI, 2019).

We present the data of the inquiry of descriptive form, using the middle one as main measure and charts crossed like main strategy of presentation of the finds. When relevant and opportune, we use the sum, frequency or other statistical measures and statistical tests, to demonstrate similarities or differences wanted in the analysis.

## PRESENTATION AND ANALYSIS OF THE DATA

The description of the results is that it presents in two complementary sections. In the first one (4.1) he presents to himself the characteristics and profile of the local authorities of the region of study. In this section (4.1) there are analysed the informations supplied by the Public Agents who collaborated with the inquiry. In the section 4.2 are presented the data captured near the collectors of residues for recycling. In this work obtained data of interviewed collectors are presented in 34 cities of the region.

### Presentation and analysis Data of the studied Region

The collected data, there are originating 59 local authorities of the Western Mesoregião of Santa Catarina. Composed by Microrregion of Chapecó (38 local authorities) and Microrregião of São Miguel do Oeste (21 local authorities), the region is a cradle of the Brazilian agro industries of birds and it is a dynamic development pole in the State of Santa Catarina. For analysis effects, those were considered local authorities of small population transport with even 25.000 habitants (CALVO *et al.*, 2016). On basis of this criterion, hackle the cities of the regions they were subtracted of the sample, when there are remaining 57 local authorities which middle general characteristics are shown in the chart 1.

Table 1 – General characteristics of the studied region

Micro-Region	Municipalities of the sample		Average population		Annual volume of waste generated (tons/year)		Budget (medium R\$/ano)
	N	%	Total	Rural	Urban	Rural	
Chapecó	37	64,9%	6216,78	3747,11	1022,10	64,24	261.241,66
São Miguel do Oeste	20	35,1%	6979,70	3514,25	998,29	69,80	262.155,13
TOTAL	57	100%	6484,47	3665,40	1013,74	66,18	261.562,18

Source: The authors.

Since there are not significant statistical differences, between the regions, we treat, initially, the sample as the only. Annual total budget destined to the collection of Home Solid Residues and selective collection of the local authorities of this region, add R\$ 14,909,044.02 up, with a minimum for R\$ 38,000.00 and a maximum for R\$ 1,200,000.00, with Average = R\$ 261,562.18 and Detour-standard = R\$ 233,680.69. More than the half (56,1 %) has budget inferior to R\$ 200.000.00. The middle expense per capita is of R\$ 44.22, being that the obvious narrow relation between total population and “Budget”. The population explains more than 80 % of orçamento<sup>2</sup>

The majority (34) of the investigated local authorities has Plan of Management of Residues (PGR) (59,6 %) and another 15,8 % they are in preparation phase of plane<sup>3</sup>. Though there is no differentiation budgetary between what they have (or not) PGR, which have plans also has bigger number of selective campaigns, according to Table 2, which shows also other characteristics of the region segregated in strata of traineeship of development of the PGR.

Table 2 – Waste management plan x campaigns, frequency and distribution

Has a plan? (PGR)	Average number of City campaigns	Urban collection frequency (average month)	Collection frequency Neighborhoods (average month)	Rural collection frequency (average month)*	Destined for recycling (Total ton)	Destined for Landfill (Total ton)	% Recycled	Population (total people)
No reply	1,50 <sup>a</sup>	20,00	12,00	6,50	726,00	3.834,00	16%	25.690
No	2,14	13,00	9,33	0,24	3.722,40	9.219,80	29%	66.995
In preparation	3,00	15,56	13,78	1,15	902,40 <sup>a</sup>	4455,40 <sup>a</sup>	17%	44.589
Yes	2,57	15,88	10,82	0,45	10.161,90	32.112,66	24%	489.085
<b>TOTAL</b>	<b>2,44</b>	<b>15,37</b>	<b>11,02</b>	<b>0,73</b>	<b>15512,70</b>	<b>49621,86</b>	<b>23,8%</b>	<b>626.359</b>

Note: <sup>a</sup> The fitted numbers they correspond to the significantly different averages for category (test t) of the set of the sample (to the risk of 95 %).

\* Rural estimates were made based on the amount of waste collected and reported by the researched associations.

Source: The authors.

Though the PNRS (LAW N. 12.305, of the 2nd of August of 2010), was stipulating term for implementation of municipal PGR in even 4 (four) years after the date of publication, we check that there is still no service to this public politics for significant part of the local authorities (21,9 %) <sup>4</sup>. In any way, possible to infer of the Table 2, that the PGR seem not to have the wanted effectiveness, in the studied region. I.e. the frequencies of collection and destination are similar in all strata, and, though more than 65 % of the volume destined to the recycling results from local authorities that have Plans, that is due, apparently, to the elevated population contingent. There are distinguished, for fewer, those local authorities that are preparing the plans (see note <sup>a</sup> of the Table 2).

On June 24, 2020, bill 4162/2019 was approved, which gave rise to Law N<sup>o</sup> 14,026 of 15/07/2020, which extended the deadlines for the preparation of waste management plans, varying the dates from August 2021 to August 2024, with shorter deadlines for Capitals and metropolitan municipalities and more extended deadlines for municipalities with smaller amounts of inhabitants (BRASIL, 2020).

On the other hand, it was found that all municipalities surveyed are for their waste to landfill and/or recycling answer to what determines the law (that is, there is no “dumps”). The total waste destined for landfills (49,621 ton) are forwarded to the five existing landfills in the region, as shown in Table 3. Although landfills do not have their own recycling units, they have agreements with collector associations, which receive the waste that can be recycled for processing.

Table 3 – Location of landfills, cities networks and volume

Microrregion	Location of landfill (amount of cities networks)					Total
	Anchieta	Bom Jesus do Oeste	Iporã do Oeste	Saudades	Xanxerê	
Chapecó	6	2	0	21	8	37
São Miguel do Oeste	10	0	5	5	0	20
Total cities networks	16	2	5	26	8	57
Amount received/ per month (ton)	13.723,60	348,00	4.126,00	26.083,26	5.341,00	49,621,86

Source: The authors.



The company Tos Ambiental serves 42 cities and delivers the waste in landfills of Anchieta to Miss, being responsible for 39,806.86 tons of waste collection, or more than 80% of the volume generated in the region. The company Continental delivers in Xanxerê material from seven municipalities. The Serni company delivery in Iporã do Oeste material from five municipalities and waste in Xanxerê the from Tunápolis. The company CW delivery in Bom Jesus material from two municipalities.

Together the regions collect for recycle 15,512 ton of waste, and 9,866.80 ton from 37 municipalities of Chapecí in 5,825 tons of 20 municipalities in the region of São Miguel do Oeste. The average per capita daily uptake of both regions is 0.96 g of waste each day, with a standard deviation of 0.65.

When asked about the difficulties of garbage separation, the main difficulties pointed out by public officers were mentioned in two orders, which are aggregated in Table 4.

Table 4 – Difficulties mentioned by public informants

Difficulty	Number of quotes
Population awareness / waste separation	18
Disposal of waste	12
High cost of implementing selective collection	5
Financial Resources	4
Bureaucracy for inert disposal (furniture and building materials))	2
Disposal of hospital and veterinary waste	1
Rubbish dumps that accumulate water	1
Planning and organization	1
Irregular deposits	1
Lack of dumps	1

Note: seventeen prefectures did not report difficulties

Source: The authors.

The following section provides information provided by the collectors.

### Collector information

70 interviews were conducted in 35 cities in the study area, with individual collectors, companies and associations that spontaneously collect waste in cities. There are a total of 180 collectors in these cities, which collect a total of more than 10,000 tons per year of recyclable plastic waste, paper and cardboard, and metals, as detailed in Table 5.

Table 5 – Quantity and price of waste collected

Category	Type	Average quantity per city (ton / year)	Total Quantity (ton / year)	Average price (R\$)
Plastic	PET Crystal	12,35	432,16	1,45
	PET Green	6,30	220,47	1,29
	PEBD Crystal	21,23	748,23	0,92
	PEBD Colored	19,80	692,84	0,76
	PP (bucket Basin)	9,7	174,56	0,59
	PS+ABC (little bottle)	3,08	46,20	0,37
	PVC	2,00	30,00	0,36

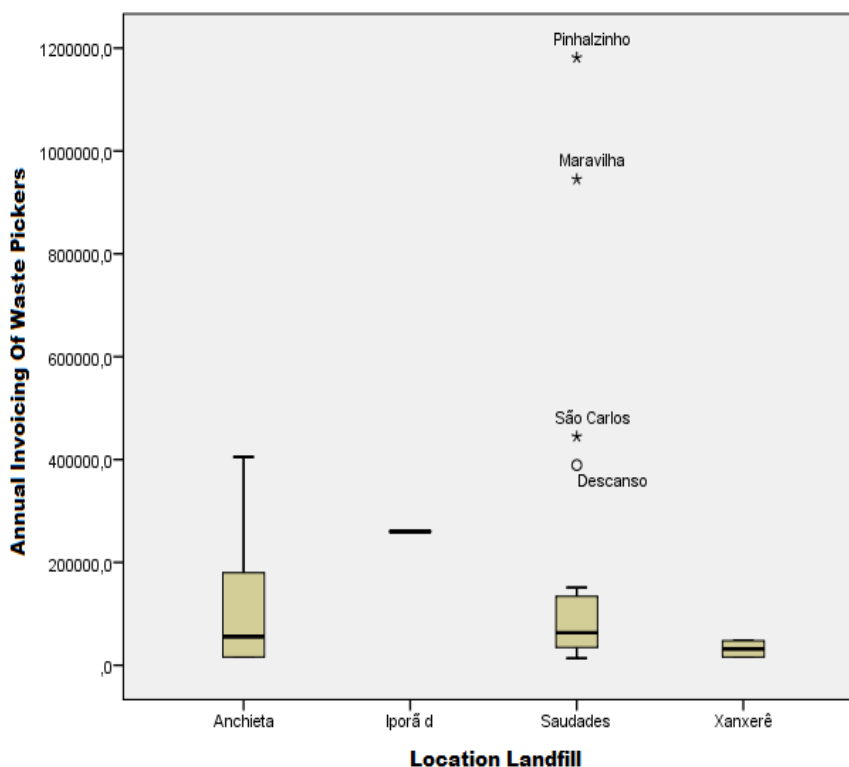
Paper / Cardboard	Cardboard	48,09	1.586,85	0,42
	Mixed Cardboard	76,39	2.673,76	0,13
	White Paper	11,25	146,25	0,30
	Mixed Paper	23,56	259,20	0,20
Metal	Aluminum	5,17	180,98	3,61
	Copper	0,30	9,53	11,00
	Iron	63,92	2.173,33	0,24
Others	Tetrapak	21,98	725,20	0,14
	Raffia	10,96	197,25	0,20
	Glass <sup>a</sup>	64,50	129	

Note: <sup>a</sup> registered in two cities.

Source: The authors.

It is observed, however, that the 12 municipalities that “do not” have a plan and the two who did not respond, has a population comprised of between a minimum of 1.833 and a maximum of 11.191 inhabitants and is, apparently, located in the exception provided in the PNRS, Art, 19, § 2: “in Municipalities with less than 20,000 (twenty thousand) inhabitants, the municipal plan of integrated solid waste management will be streamlined content, in the form of regulation”. The collection and sale of this material generates a total turnover<sup>5</sup> of R\$ 5,377,504.60 with an average turnover R\$ 158,161.90. There are, however, three municipalities outliers, as shown in Figure 2.

Figure 2 – Invoicing of waste pickers by landfill location



Source: The authors.

The municipalities with outlier behavior are Pinhalzinho (R\$ 1,181,504.00), Maravilha (R\$ 945,013.00) and São Carlos (R\$ 444,709.20). Taken from these three, the total turnover of the waste pickers of the 31 cities is R\$ 2,806,278.40, with an average of R\$ 90,525.11 / per municipality. This is equivalent to an average income calculated monthly gross of R\$ 2,286.98 per waste picker.

The associations, mostly (56.3%), reported that the PET collected for the city of Imigrantes – RS and the flexible plastics Celso Ramos – PR. Caxias do Sul – RS is the recipient of most associations for metals (66.7%), rigid plastics (64%), as well as for Tetrapak, cardboard and glass, with 56.3% of associations mentioning.

## DISCUSSION OF RESULTS

From the data collected it is possible to deduce that, although the average of garbage produced in the region (0.96 kg/day). Whereas in the state of Santa Catarina this indicator corresponds to an average of 1,140 kg / day / inhabitant. Our results approximates the national average (1kg/day) (BRASIL, 2013). The study region gives a treatment best suited to their waste than the national average. According to a report by the Brazilian Association of Public cleaning companies and special wastes – Abrelpe (TCU, 2018, p. 1), “Brazil has almost 3,000 dumps running in 1,600 cities”.

The per capita production of solid waste in Brazil, according to the Panorama report of Abrelpe (2017) is 1,035 Kg per day. In research developed by Hendges (2017), points out that the amount of waste produced in 2016 in the southern region of Brazil was 0.773 Kg per inhabitant and that in 2017 this amount decreased to 0.752 Kg per inhabitant. In the state of Santa Catarina there is a smaller generation, of 0.731 Kg per inhabitant (ABRALPE, 2017).

According to data from Abrelpe, 90% of Brazilian cities have garbage collection, but only 59% use appropriate landfills. This is not the case of the Western Region of Santa Catarina, in which all the cities designed their waste to the landfill or recycling. However, using calculation performed on the information provided by public agents, it was found that there are differences between the volumes produced and destined, although on average the difference is not significant. Anyway the disposal of waste in the region can be considered satisfactory/well, if compared with other regions. 61% of municipalities have waste management plan and designed approximately 23.8% of the waste generated is recycled. The use of five landfills to serve 59 cities indicates use of assembled structure (MINGORI, 2019), with potential for sustainable solutions to the management of solid waste (SANTOS; SILVA, 2016). Also contribute to sustainability in the social dimension, the gross income generated by recycling, benefiting approximately 802 pickers in 35 cities, with monthly income of R \$2,286.98 by maker, generating employment and income opportunity (SILVA; PESSALI, 2018).

On the other hand, there is the need to ensure the relationship between Government and society in the management of solid waste (RIBEIRO; PEREIRA, 2014), as the awareness of the population, notably in the separation of garbage, seems to be the greatest difficulty for correct disposal of waste, reinforcing the need for environmental education to the effectiveness of the PNRS (SANTOS; TEIXEIRA; KNISS, 2014).

Among the actions developed by the municipal governments are the campaigns of waste collection, being mostly for the collection of electronics, tires and furniture and waste of tree powders, regarding the awareness of the population the only tool found was the creation of leaflets. A study on the effectiveness of municipal campaigns carried out may be a future research possibility

The management implications of the evidence from this study are associated with concrete indicators and primary mapping on the current panorama of waste management in the West end of Santa Catarina. This evidence can become guide guideline to establish appropriate legal, allocation of financial resources and technologies to seek the transformation of waste, as also predicts the SC Plan 2030. In this way, will be minimized socio-spatial impacts and create job opportunities and boost income and still building infrastructure that support appropriate manage the solid waste from the municipalities.

## FINAL CONSIDERATIONS

This work looks to analyze the profile, produced volume and destination of solid residues in local authorities of small transport in the inhabitant west of Santa Catarina. The data show up a middle production inferior to national average. There are opportunities for integrated management of the residues and reduction of the volume effectively destined to landfills. The solid residues are an element creator of social insertion and of income for the collectors. They provide worthy life, with income superior to many commercial and industrial establishments of the region. Healthy plastics, paper and cardboard the types of residues that produce bigger income to the collectors. But be opportunity for prices bargain road scales, since there is an articulation between actors, for marketing shared in his residues and competition by marketed volume.

The main practical contribution of the study is the presentation of a diagnosis of the type, volume and destiny of the residues produced in the inhabitant of the west Santa Catarina. Besides, it allows a theoretical contribution, showing up primary indicators of the collected volumes, since the official parameters, in his majority, work with extrapolation of averages. The benefits of these data for the public actors are associated to concrete elements for creation and articulation of public policies of strengthening of the programs of collection of residues and of campaigns of commitment of the population for a more and more efficient selective collection. The collectors can benefit through the awareness for a cooperation work inter-associations, which it can bring monetary benefits in for all the wrapped ones. And the society benefits for the integrated management of the solid residues and the pretty and clean city, which contributes in order that the quality of life and good is of the citizens.

Besides, this study contributes to the understanding of the area while reinforcing to what the Management of Solid Residues has to (and it can) be treated as an integrated form, considering all aspects of the sustainability. One of the factors limiting of this study is the space range. The considered results are not that you were overstepping to other regions. Also it can be considered a factor limiting to not identification and treatment of dangerous products. There are these topics like suggestions for future studies.

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## NOTES

- <sup>1</sup> Only 10,5 % of the investigated local authorities has annual budgets superior to R\$ 500,000.00.
- <sup>2</sup> The linear regression of the dependent variable Budget with the variable independent Population presents a marginal expense for R\$ 37.32 for individual. coefficient Stripes 37.32 (t=15,036, Sig 0.00).
- <sup>3</sup> These data are likened to the lifting carried out by the Public prosecution service (MPSC) in 2012 (G1, 2012). Available in (<http://g1.globo.com/sc/santa-catarina/noticia/2012/08/sc-tem-quase-metade-dos-aterros-sanitarios-em-otimas-condicoes.html>).
- <sup>4</sup> It is noticed, meantime, that 12 local authorities that have not plan and the two that did not answer, it has population understood between a minimum of 1.833 and a maximum of 11.191 inhabitants, being, apparently, when: “For Local authorities with less than 20.000 (twenty thousand) inhabitants, the municipal plan of integrated management of solid residues will have simplified content, in the form of the regulation” was situated in the exception predicted in the PNRS, Art, 19, § 2nd.
- <sup>5</sup> Value calculated by the prudent average of the price and quantity informed by each interviewed one.
- <sup>6</sup> Average test for value 1, results t =-0.422, df=56, sig = 0.675.
- <sup>7</sup> When it is grouped and compares the volume of collected garbage (urbane way + rural) and destined volume (I land + recycling) we check differences in 25 local authorities (42.3%), being that in three local authorities the difference is negative (indicating possibility of lixão). Meantime when the average is analysed, the test t for gaged tuns samples (Collected/destined) does not present significant statistical difference.
- <sup>8</sup> The present work was carried out with support of the Bottom of Support to the Maintenance and to the Development of the Superior Education – Uniedu/Fumdes.