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Diagnosis of civil construction waste management from the reading of the urban landscape

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Abstract
Civil construction can be identified as one of the industries that mostly cause environmental impacts due to the exploitation of natural resources and high waste generation rates. The current study aimed to report the main areas subjected to inappropriate C&DW (Construction and Demolition Waste**)** disposal in Presidente Bernardes County-SP- Brazil, based on its characteristics and spatial analysis. Methodological procedures adopted to characterize these areas comprised visits to disposal points, photographic records, geographic coordinates' demarcation and direct observation of C&DW composition. Forty (40) irregular disposal points presenting more than 3 m^3 of deposited C&DWs were demarcated after a detailed investigation about the urban perimeter and its access routes. The county's area was subdivided according to urban features. All analyzed points presented Class A waste, whereas 82.5% of them presented Class B, and 47.5% presented Class C and D. In addition, 20% of the analyzed points had domestic waste, which evidenced the power attractiveness of C&DWs. Based on results in the current study, it was possible identifying the main irregular disposal areas, as well as estimating the discarded waste volume and its composition in order to substantiate the implementation of a differentiated waste management system in the county.

INTRODUCTION

Increased urbanization process, in association with population growth in different cities, has led to increased number of construction works both for housing and urban infrastructure purposes. Such expansion has direct influence on urban zoning due to the exploration of new areas, which has direct impact on local ecosystems (SILVA; RANIERI 2014, GOUVEIA, 2012). In addition, allotments' expansion is a worrysome factor for public authorities in cities that do not have resources to regularly provide the basic sanitation necessary for the countless residences to be implemented (GOMES et al, 2014). Water supply, sanitary sewage, rainwater drainage and solid waste management system are the main basic services susceptible to present deficiencies due to lack of planning and management.

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Urban solid waste (USW) management issues stand out among the aforementioned aspects due to the diversity and volume of materials composing this waste, which instantly affects disposal sites; thus, it must be discarded in a way to avoid minimum social and environmental impact. However, Brazil does not have a favorable scenario of environmentally correct disposal of it. According to data provided by IBGE (2012a), approximately 50% of Brazilian counties mismanage their waste and trigger a series of consequences for public and environmental health.

Construction and demolition waste, also called construction waste, stands out among a variety of solid urban wastes. According to the National Solid Waste Policy, construction waste is "[...] generated in the construction, renovation, repair and demolition of civil construction works, including those resulting from land preparation and excavation for these works." (BRASIL, 2010).

Accordingly, the present study emerged from the desire to understand how impacting Construction and Demolition Waste (C&DW) disposal has been on the environment, from its generation in urban areas to its logistics and final destination. Based on experiences lived in civil construction works, the amount of waste generated by different material types (plastic, cardboard, resins, paints, wood and plaster) is disposed in different places without the slightest concern with the environmental consequences arising from such disposal.

Thus, the current article aimed to report environmental impacts caused by inadequate C&DW disposal in Presidente Bernardes County (SP), based on landscape analysis. Impacts arising from irregular C&DW disposal are one of the dilemmas faced by the public power due to lack of proper disposal areas and to the need of making high investments to enable proper waste management systems.

Thus, the present study raises the folowing questions: What are the main environmental impacts caused by inadequate C&DW disposal in Presidente Bernardes County? What is the association between C&DW and disposal area type in the county?

First, the article addresses urbanization, landscapes and urban features. Next, it presents impacts caused by construction and demolition waste, and describes the methodological process adopted to perform the field research and to describe the object of study. Subsequently, it discusses the results, as well as presents the context of urban features and C&DW disposal points in Presidente Bernardes County-SP-Brazil.

URBANIZATION: LANDSCAPE AND URBAN FEATURES

According to Guimarães (2016), the urbanization process in Brazil has produced a series of distortions and imbalances that empirically happened in different ways; besides, it has generated of social exclusion and re-inclusion processes that led to regional, urban-rural and urban-urban imbalances.

Cities have different spatial configurations individually inserted in specific socio-spatial contexts where the presence, or absence, of certain features make them simultaneously similar and unique. Understanding them requires going through the urban space production and urbanization process (SILVA; SPOSITO, 2017).

Urban morphology is significantly associated with urban landscape studies, since it allows qualifying and comparing city landscapes. According to Carlos (2004), landscape enables understanding the visible-sensitive, as much as it qualifies it as a social product and as a formal manifestation of man's action. According to Santos (2006), space is something that houses geographical configuration, or its spatial configuration, whereas landscape refers to the way these objects take place.

Sposito (2011, p.137) has highlighted the need of revaluing the concept of urban morphology in the "sense of articulation among forms, processes and logics that give rise to structuring dynamics" and focused on the relationship between geographical situation and urban morphology.

Urban shape and man's actions in the territory are linked to the urban space whose history is produced by social actors and collective subjects, who design and model it. The city creates its signs by building its own language according to its inhabitants and by adding values that attract capital and form urban networks; everything that is created is sold, which makes the space dynamic as if the city itself had a life of its own (LEFEBVRE, 2008; 2016)

According to Panerai (2013), urban fabric is the overlap of several structures acting at different levels, although it appears to be a system articulated with each part of the city.

As for Fernandes (2008, p.330), "the organization of contemporary cities presupposes taking into consideration nowaday's political, economic, social, cultural and technological

factors" in different temporal and spatial contexts.

Given this scenario, it is clear that urbanization, which is directly associated with population's social-economic growth, has led to the growth of the civil construction industry.

IMPACTS OF CONSTRUCTION AND DEMOLITION WASTE

Civil construction is an important Brazilian industrial sector, since it is directly linked to the country's social and economic development. Its importance results from the added value attributed to its activities, from the multiplier effect of income and from its structural interdependence (TEIXEIRA, 2010).

Construction and Demolition Waste (C&DW), also called construction waste (CW) or simply "rubble", derives from constructions, renovations, repairs and demolitions of civil construction works, as well as from land preparation and excavation processes: among them, one finds bricks, ceramic blocks, overall concrete, soils, rocks, metals, resins, glues, paints, wood and plywood, headliners, mortar, plaster, tiles, asphalt pavement, glass, plastics, pipes and electrical wiring (CONAMA, 2002).

C&DW is generated in all construction work stages, from earthmoving services to the final cleaning of the constructin site. According to Silva and Fernandes (2012) and Malia, Brito and Bravo (2011), this waste is overall generated in three different ways, namely: new constructions, renovations and demolitions. Large-scale losses in the civil construction industry mainly due to waste of construction materials (ZORDAN, 2002).

According to PNRS, Law N. 12,305 / 2010 (BRAZIL, 2010), integrated solid waste management is defined as a set of measures aimed at finding solid waste management solutions by taking into conderation economic, political, environmental, cultural and social dimensions, based on sustainable development principles. Such a management comprises a set of actions taken, either directly or indirectly, in solid waste collection, transportation, transhipment, treatment and final disposal stages, as well as in the final disposal of tailings, by keeping in mind that waste destination and disposal must be environmentally friendly, in compliance with municipal plans for integrated solid waste management (MARTINS, 2012).

Discussions about environmental issues involving C&DW are closely linked to the waste of natural resources and to the scarcity of waste disposal sites. Besides causing trouble to the population, improper waste disposal demands large financial investments, which places the construction industry at the center of discussions aimed at enabling sustainable development in its different dimensions (TANG et al., 2020).

According to Gomes et al. (2019), C&DW generation in large and mid-sized Brazilian cities accounts for approximately 41-71% of the total urban solid waste. According to Sanches (2004), the amount of C&DW generated in Brazil is approximately 400-500 kg/inhab./year; this production is directly linked to the construction culture.

Despite the legal instruments regulating C&DW management, several irregular or clandestine C&DW disposal areas continue to appeas; consequently, most C&DW produced in urban centers is discarded in public or private areas named by some authors as "clandestine dumps".

According to Pinto, Santos e Catunda (2015), several negative consequences arise from the irrational and uncontrolled flow of large C&DW volumes generated in different counties.

These consequences are identified when C&DWs are incorrectly managed and disposed, since their life is over when they are dumped in open landfills, a fact that leads to environmental damages such as the degradation and pollution of soils, waterbodies and springs; blockage of urban drainage systems; increased number of floods, disease proliferation, urban landscape degradation and other urban degradation vectors (KLEIN; GONÇALVES-DIAS, 2017).

According to Barros and Souza (2017), environmental impacts caused by poorly managed C&DW are neither small nor simple; lack of public policies to regulate waste disposal, in association with ineffective environmental management by some agents linked to C&DW management, leads to the need of implementing proper solid construction waste management systems.

According to Albuquerque (2015), another factor worsening the inadequate C&DW disposal lies on the fact that they are mainly launched in permanent preservation areas (PPA), i.e., in areas of paramount importance due to their environmental function.

Reducing waste generation at the source is the main action to be implemented by public authorities. Thus, the correct C&DW disposal must be based on the tripod "reduction, reuse and recycling", which are fundamental factors to help reducing the large amount of generated C&DW.

The part of it that cannot be reused must go to Civil Construction Waste Landfills duly licensed by environmental agencies, as indicated in CONAMA Resolution N. 307 and normalized by ABNT in NBR 15.113 / 2004.

METHOD

The herein adopted methodological framework was based on studies and publications about C&DW features and management, such as Marques Neto (2005), Fonseca (2008) and Albuquerque (2015).

Documentary research was carried out in Presidente Bernardes- Brazil Cityhall to collect information about irregular C&DW disposal points. A Honda motorcycle (model "NXR 150 Bross") was used as transportation means to visit the streets of the county in order to check all the exisiting disposal points on survey dates.

Procedures consisted of visiting disposal points, making photographic records, demarcating geographical coordinates, on-site observation of the construction and demolition waste composition (GONÇALVEZ-DIAS, 2009).

The geographic coordinates of disposal points were recorded as Latitude and Longitude - in Degrees, Minutes and Seconds - with the aid of GPS - Global Positioning System (Garmin, model Etrex 10).

A fieldwork was carried out in order to check the urban features of Presidente Bernardes County (SP- Brazil), as well a to define the urban perimeter-occupation types. The classification of areas by building type was based on photographic records and on the interpretation of urban features (FONSECA, 2008). The observed aspects comprised construction pattern, size of the building, land and neighborhood features, local urban infrastructure (curbs, sidewalks, pavement conditions) and purpose of the building - residential or commercial.

Object of study

The study was carreid out in Presidente Bernardes County – SP.Brazil – at geographic coordinates: latitude 22°00'22" S and longitude 51°33'11" W; altitude of 429 meters. The local population comprises 13,667 inhabitants; the county's total area corresponds to 749,233 km² (IBGE, 2012b) and it is located 578 km away from São Paulo State's capital of Brazil (Figure 1).

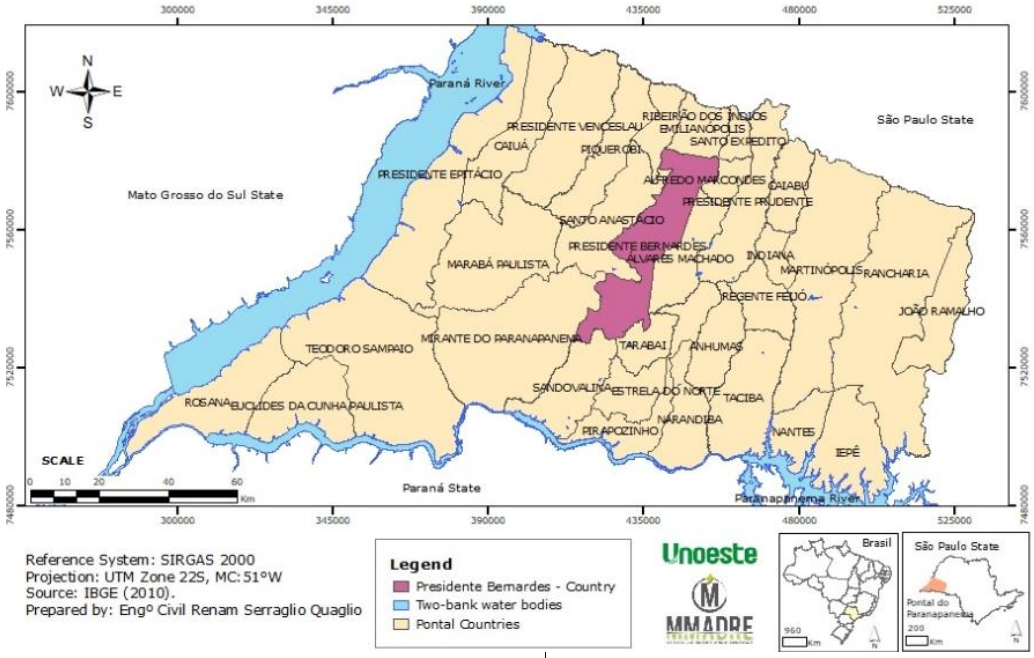
The county's economy is mainly based on the service sector, which accounts for the largest share of local gross domestic product (GDP); it is followed by agriculture and by the industry sector. The mean monthly income of the population in 2015 was approximately 2 minimum wages and 17.8% of the total local population was employed (IBGE, 2015).

The study site was set in the urban perimeter of the county, as well as in peripheral accesses to it, since many initially pointed out disposals were carried out on rural roads and in the extension of city roads. It was done in order to enable the comparative analysis between irregular construction and demolition waste disposal and the possible environmental impacts arising from it.

RESULTS AND DISCUSSION

The featuring of construction types and patterns based on the reading of urban features in Presidente Bernardes County (SP- Brazil) aimed at associating the waste disposal points with the region they were located in. Buildings' pattern and size, land and neighborhood features, local urban infrastructure (curbs, sidewalks, pavement conditions) and purpose of the building - residential or commercial – were the aspects observed in the current study. It is worth emphasizing that the county does not have any urban zoning map and that information about occupation rules and patterns are briefly described in the Master Plan (Law n. 2.115 from March 2nd, 2010), which does not list the territorial zones in the county that are restricted to expansion. Based on these conditions, the county was divided into five occupation classes, namely: downtown, residential allotments, residential neighborhoods A and B, and housing estates (PRESIDENTE BERNARDES, 2010).

Figure 1 - Map showing the location of Presidente Bernardes County-SP- Brazil.



Source: IBGE (2015). Organization: Quaglio (2017).

The area featured as urban center presents good infrastructure standards, high-quality paving, basic sanitation services, mid-sized buildings (most of them for commercial purposes), as well as large flow of vehicles and passers-by. According to Fonseca (2011) land subdivision is the initial urban structuring movement conditioning inhabitants' relationship with their city; it has strong influence on the physical structuring of urban social practices.

The second land occupation type - called residential allotments - refers to local areas expanded for residential purposes in Northeastern and Southern Presidente Bernardes County (SP-Brazil). Part of the allotments in these new neighborhoods (settled less than 10 years ago) remains unbuilt; in addition, the urban infrastructure has issues such as unpaved streets, lack of sidewalk and allotments subjected to waste disposal. These allotments present single-storey masonry buildings and can be considered of medium standard, since their area is smaller than 250 m². According to Wall and Waterman (2012), the capitalist system itself promotes the unequal distribution of resources and opportunities among individuals; thus, cities are naturally stratified into wealthier and poorer zones.

Based on a field survey conducted in 2019, residential class A neighborhoods are featured by large buildings and allotment areas larger than 400 m²; they present high-quality infrastructure - from sanitation services to paving. The construction pattern comprises two- or single-storey masonry residences; these places are occupied by citizens with the highest income concentration, as highlighted by Acosta (2016).

Residential class B neighborhoods have mid-to-small-sized buildings. They are occupied areas close to the downtown region and have deficient installed infrastructure and services (degraded pavements and sidewalks following variations in the terrain and hindering mobility). Benevolo (2012) has observed that social inequality leads to unbalanced access to infrastructure and to basic public services in cities, as well as that social disparities create inadequate and unworthy environments in comparison to the formal city.

Housing estates of social interest are another form of urban perimeter occupation in the county; they are formed through housing programs set by the public power to enable low-income population segments to have access to proper housing. These neighborhoods present standardized buildings; however, as the years go by they are enlarged without any control, which violates the minimum permeability coefficient of allotments. These places reinforce inequalities and social vulnerability, as highlighted by Penna and Ferreira (2014). They present good infrastructure, except for public sidewalks, which are often precarious or non-existent.

Figure 2 shows the sectorization of urban

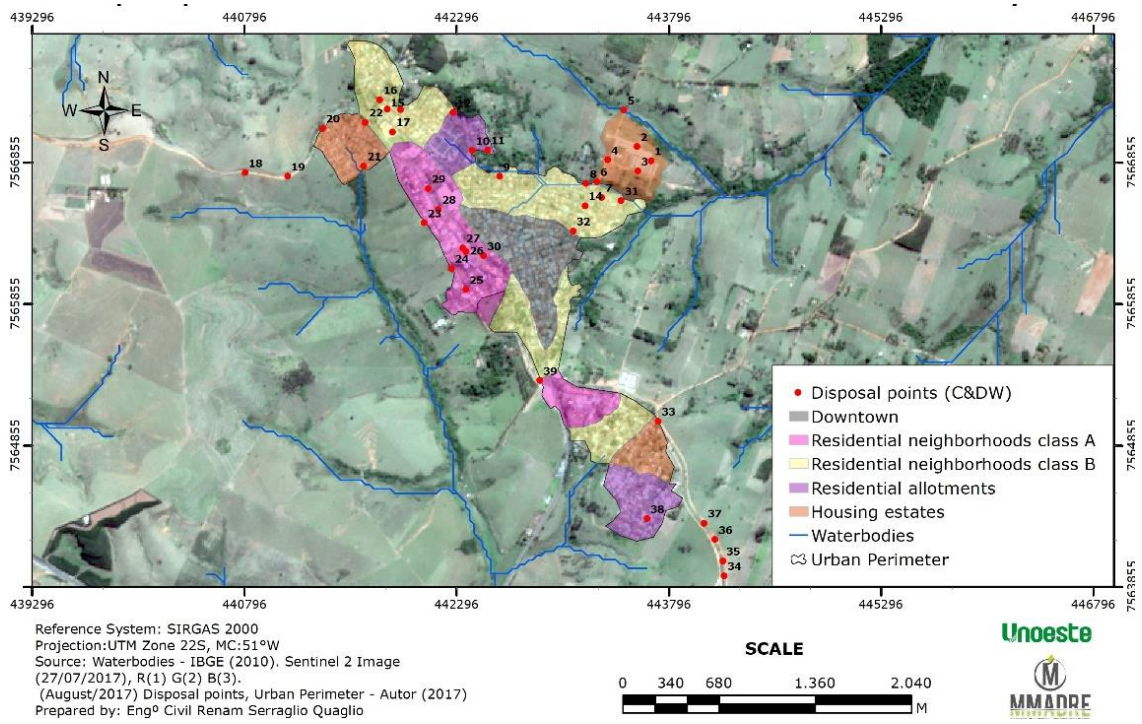
features based on inadequate C&DW disposal points in the county.

Based on Figure 2, the donwtown region of the county does not have irregular waste disposal points. This fact can be justified by the large flow of people and vehicles, which makes illegal actions unfeasible (ALBUQUERQUE, 2015).

Most diagnosed points were located in peripheral areas of the county, mainly in non-built-upon lands and in areas close to unpaved roads and accesses. According to Piovezan Jr. (2007), small C&DW generators use bucket vehicles such as horse carts, cars and pickup trucks to transport this waste in order to reduce the costs with construction works, since the cost with transportation is lower than that practiced by skip bin companies.

According to Albuquerque (2015), the dynamics of irregular C&DW disposal in Recife City (PE- Brazil) is directly linked to impacts of urban shape on the environment. The prevalence of this waste at irregular disposal points affects the spatial organization of the territory and the urban composition balance.

Figure 2: Disposal points and classification of urban features in Presidente Bernardes County-SP



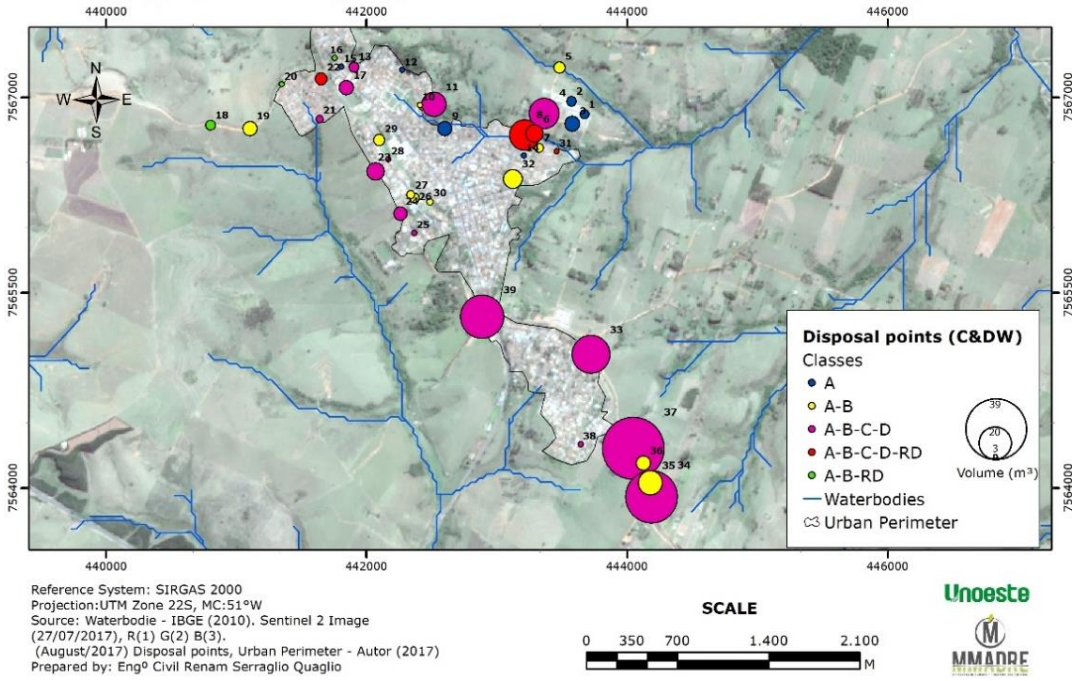
Source: Quaglio (2017).

Figure 3 presents the 40 points investigated based on waste featuring analysis, on the estimate about the amount of waste inappropriately disposed of, as well as on contributory percentages of waste deriving from each point. The volume of the municipal landfill was not estimated due to amount of other waste types deposited together, mainly of pruning and pneumatic waste.

Data presented in Figure 2 are worrisome due to irregularly discarded C&DW volumes and features, since this waste can compromise the environmental fragility of the area. The study by Albuquerque (2015) corroborates these data.

In addition, there was a large number of inadequate disposal points in the vicinity of housing estates. According to Córdoba, Martins Filho and Lino (2014), materials such as ceramic (55%), concrete/mortar (10%), cardboard (10%) and plaster (8%) have prevailed in the estimated composition of C&DWs generated in housing constructions in São Luís City – MA- Brazil. Such aspects corroborate the compatibility among larger-volume C&DWs deposited in peripheral areas identified as clandestine dumps (JOHN, 2010).

Figure 3: C&DW classes and volumes at collection points in Presidente Bernardes County-SP-Brazil.



Source: Quaglio (2017).

Currently, there is a single company providing C&DW collection service for a fee. However, this company does not have a licensed area to dispose of the C&DW; according to information provided in November 2017 by the Environment Secretariat of Presidente Bernandes – SP- Brazil, part of the collected waste is used to recover rural roads and in erosion control processes, whereas the rest of it is sent to the municipal landfill.

The multiplicity of disposal points in the vicinity of allotments and housing estates can be justified by the fact that these areas are under development process and present several construction sites, whereas housing units present expansion process as soon as they are delivered to residents (FERREIRA et al., 2014; PIOVEZAN JR, 2007).

Five of the 40 investigated disposal points presented above-relevance percentage higher than, or equal to, 5%. Table 1 presents the aforementioned five points

Table 1: Relevant points with values equal to, or higher than, 5% of the Total Estimated Volume.

POINT	VOLUME (m³)	%
4	19.2	5.05%
33	24	6.31%
34	33	8.68%
37	39	10.26%
39	27	7.10%
TOTAL	**142.2**	**37.40%**

Source: Quaglio (2017).

Points 33, 34 and 37 were located on Rural Road PSB 030 - Railway Line; together they account for 25.25% of the total estimated value; these numbers corroborate the lack of compliance by the company responsible for C&DW collection, transportation and final disposal with the environmental legislation, as well as by Municipal, State and Federal Public Authorities, which are the inspection and regulation entities. The aforementioned rural road is seen by these actors as an area for construction and demolition waste disposal, as

well as for the disposal of other waste types already identified in the current research.

According to Klein and Gonçalves-Dias (2017), there is urban landscape deterioration resulting from improper C&DW disposal, since their life span is over when they are dumped in open landfills, a fact that leads to environmental damages such as the degradation and pollution of soils, waterbodies and springs.

By relating the estimated C&DW volume in the investigated disposal points and by subdividing them based on irregular disposal place, it was possible seeing the types of points where there was recurrent waste disposal in order to notify owners or legal guardians. Table 2 presents the association among number of analyzed points, typology they featured in and the percentage of each featuring in the sample.

Table 2: List of Locations based on their Featuring.

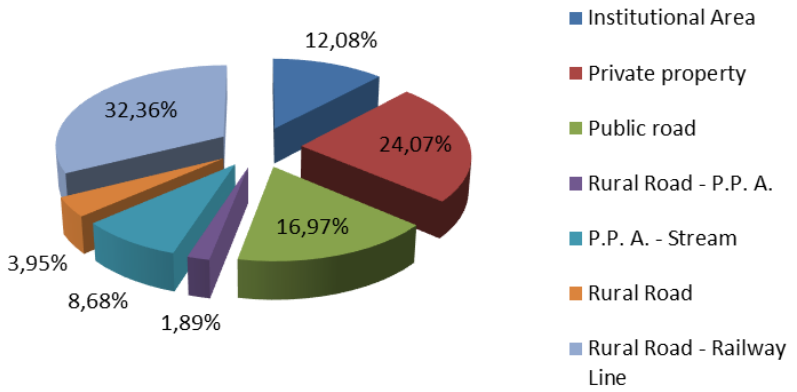
FEATURING OF THE LOCATION	POINTS	%
Institutional area	4	10
Private property	12	30
Public road	11	27.5
Rural road - P.P.A.	1	2.5
P.P.A. – Stream	3	7.5
Rural road	2	5
Rural road – Railway line	6	15
Municipal landfill	1	2.5
TOTAL	**40**	**100**

Source: Quaglio (2017).

Private lands configured as Private Property were the most recurrent disposal places (12 disposal points), i.e., they accounted for 30% of the inspected sites; they were followed by the county's streets and sidewalks (public roads) with 27.5%. It is worth taking into consideration that this disposal is extremely harmful to urban drainage structures, because rainfall events carry these materials towards gratings and galleries, which get obstructed and cause floods.

Pinto, Santos and Catunda (2015) and Piovezam Jr and Silva (2007) have highlighted consequences deriving from incorrect C&DW disposal, such as sedimentation of water courses, degradation of springs and permanent environmental protection areas, slope instability, obstruction of pedestrian and vehicle paths, as well as of drainage systems, among others. Figure 4 presents the percentage of waste disposed in each investigated area.

Figure 4: Percentage of C&DW volume calculated per disposal area type.



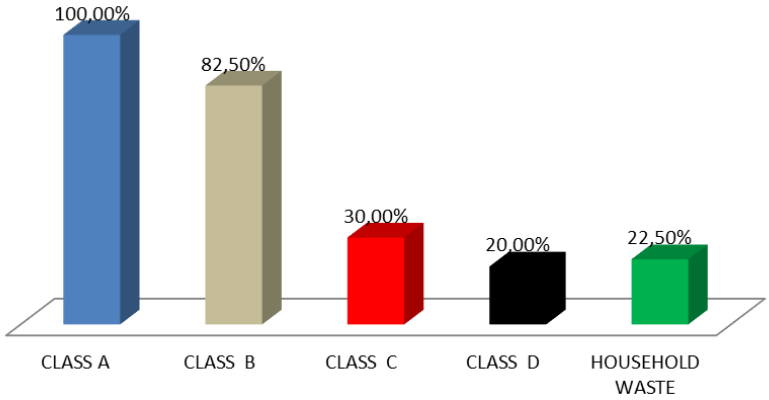
Source: Quaglio (2017).

Based on these data, the area identified as Rural road – railway line presented the largest C&DW volume, which was estimated at approximately 123 m³; it was followed by private properties (approximately 24.07%) and public roads (16.97%). It is essential taking into consideration that natural materials such as sand - which is often removed from rivers - also

harm the environment, since they change the geomorphology of river direction, decrease the quality of the water and increase the incidence of erosive processes in rural areas (NOGUEIRA, 2016). Thus, it is important keeping in mind the correct C&DW management (WEISSHEIMER; KERN, 2014) and the ways of recycling waste (GEHRMANN; HIEBEL; SIMON, 2017).

Figure 5 shows the recurrence of C&DW classes evaluated at irregular disposal points, as well as of domestic waste, in order to qualify the power of attractiveness of C&DW.

Figure 5: Recurrence of C&DW classes at the evaluated points.



Source: Quaglio (2017).

Class B materials were found in 82.5% (n = 33) of the investigated points; they comprised residues deriving from plastics, cardboard, metals, glass and empty packaging, which do not cause damage, or have negative impact, when they are irregularly disposed in the environment.

Souza, Marques and Araújo (2019) have also pointed out that another impact resulting from high C&DW generation and from its irregular disposal lies on the power of attraction C&DW disposals appear to have on other solid waste types.

On the other hand, Class C materials were identified in 47.5% (n = 19) of the investigated points; they comprised waste deriving from non-recyclable or reusable materials, whereas Class D materials, which were also found in 47.5% (n = 19) of the investigated points, comprised hazardous materials deriving from construction processes.

According to Córdoba (2010), although the percentage of Class D waste is virtually zero (0.1%), it is not possible ruling out the possibility that this waste may be incorporated to waste belonging to other classes, for example, the sludge from paints, solvents and oils absorbed by waste pores such as soil, sand, mortar, ceramic and concrete.

The approach to domestic waste in the current study was based on its recurrence in 20% of the investigated points, as well as on studies available in the literature, which pointed it out as environmental impact factor - the herein identified materials comprised plastic packaging, glass, paper and organic matter (GONÇALVES, 2016).

Albuquerque (2015) recorded values similar to the ones found in the present research, mainly for C&DW Classes A and B; this outcome indicates the great potential of these materials to be reused and recycled, as pointed out by Zordan (2002), Meng et al. (2018) and Hassan et al. (2019).

Thus, it is possible saying that the environmental impact caused by poor C&DW management is associated with non-committed collection and with lack of public policies to regulate waste disposal; all these factors, in association with ineffective environmental management by some agents responsible for managing C&DWs, force the population to live with a significant number of degraded areas named by Pinto and Gonzáles (2005) as clandestine dumps or irregular depositions.

According to Nogueira (2016), most incorrect disposal points often result from the disposal of waste deriving from small construction sites or from renovations based on self-construction processes, which generate small C&DW volumes. It is necessary making significant efforts to encourage the use of sustainable material-based products in construction sites in order to decrease waste generation, eliminate negative environmental impacts and promote sustainability in the civil construction industry (MENG et al., 2018).

It is important to emphasize that the

development of a differentiated management process based on actions aimed at solidifying environmental sustainability has benefits such as reducing costs with urban cleaning, reducing environmental impacts, increasing gains in public health, and replacing conditional aggregates by recycled ones (LONG, 2018).

Thus, it is interesting presenting the summary of results recorded in the study about C&DW impacts on Presidente Bernardes County (SP-Brazil), with emphasis on the investigated disposal points.

Chart 1: List of environmental and health impacts on inappropriate disposal points in Presidente Bernardes County.

Environmental and health impacts	Description	Points
Attractive to other waste types	Accumulation of waste from other sources together with irregularly disposed C&DWs	All points
Sedimentation of streams	Soil and other materials are carried by river flow, which leads to river devastation	5,6,8,9,31
Degradation of permanent preservation areas	C&DW allocation in permanent preservation areas	5, 6, 8, 9, 10, 11, 12, 21, 31
Vector attraction (rats and insects)	Vector proliferation in C&DW piles	All points
Noise and dust in irregular disposal sites	Carriers' displacement in disposal sites	33, 35, 36, 37, 40
Soil erosion	Soil transport at disposal sites	5, 6, 8, 9, 10, 11, 12, 18, 19, 21, 31, 33, 35, 36, 37, 40
Changes in water quality	Increased amount of material dispersed in water	5, 6, 8, 9, 31
Degradation of irregular disposal areas	Changes in the physical and biological features of different areas	All points
C&DW disposal in the local landfill	Overlapped waste hindering the recovery of the landfill area	40

Fonte: Quaglio (2017)

Based on the analyses and interpretations presented in the current study, it was possible understanding that C&DWs cause environmental damages such as the degradation and pollution of soils, waterbodies and springs; blockage of urban drainage systems; increased number of floods; disease proliferation; urban landscape degradation and other urban degradation vectors.

However, it is worth presenting information about likely environmental impacts on other Brazilian counties, as shown in Chart 2.

Cities have been facing serious issues associated with C&DW generation; consequently, lack of knowledge about C&DW disposal alternatives generates considerable disturbance to the population and to the environment.

Chart 2: Environmental impacts on other Brazilian counties.

Authors	Places	Impacts	Outcomes
Souza, Marques, Araujo (2019)	Brazil	It highlights prescribed regulations to be prioritized under legal nature	It helps decision-making processes involving solid waste
Albuquerque. (2015)	Recife County-PE-Brazil	Socio-environmental impact deriving from irregular construction and demolition waste disposal	Lack of Master Plan comprising environmental zoning (protection of green areas)
Córdoba (2010)	São Carlos County-SP- Brazil	Study about integrated management systems focused on construction and demolition waste	Little environmental awareness, harmed results
Córdoba (2014)	Morada do Sol. São Luís County-MA Brazil	management plan for social allotment construction waste	Construction of essential tools capable of transcending recycling
Pinto.; Santos dos.; Catunda (2015)	Parnamirim County-RN - Brazil	Perception about environmental legislation, C&DW (Construction and Demolition Waste) management and disposal	It addresses the key role played by adequate municipal legislations in C&DW disposal processes

Klein.; Gonçalves-Dias (2017)	São Paulo City-SP-Brazil	Irregular construction waste disposal	Results highlighted environmental consequences deriving from inadequate waste disposal
Morais (2006).	Uberlândia County-MG- Brazil	Diagnosis of clandestine construction and demolition waste disposal in peripheral neighborhoods	Results highlighted environmental consequences deriving from C&DW disposal
Martins (2012).	São Carlos County-SP- Brazil	Construction waste management and handling in large construction sites	The study site has planning instruments capable of promoting the construction of developments based on economic growth and ecological prudence.
Piovezan Jr. (2007)	Santa Maria County-RS- Brazil	Assessment of generated construction and demolition waste (C&DW)	The study allows rapid determination for C&DW evaluation and handling
Tanga; Lia; Tamb, Xue, (2020)	China	Advanced progress in recycling municipal and solid construction wastes to manufacture sustainable construction materials.	Results indicate that, despite C&DW inclusion in geopolymers' group, it can alleviate harmful effects and facilitate recycling progress when it is used at appropriate proportions

Fonte: Quaglio (2017).

However, it is worth mentioning that several authors (ALBUQUERQUE, 2015; CÓRDOBA, 2010; CÓRDOBA, 2014; PINTO; SANTOS; CATUNDA, 2015; KLEIN; GONÇALVES-DIAS, 2017; MORAIS, 2006; MARTINS, 2012) have highlighted environmental impacts caused by C&DW and focused on lack of management by public authorities. On the other hand, other authors (PIOVEZAN JR, 2007; TANGA et al., 2020) have claimed that most C&DWs are partly formed by recyclable materials that, once properly destined, can enable a resource-generating industry with full production scale-environment coexistence capacity. Presidente Bernardes County has also shown (Chart 1) several environmental impacts caused by waste disposal in inappropriate places, often in points away from the downtwon area; this practice was also pointed out in other studies (KLEIN; GONÇALVES-DIAS, 2017; CÓRDOBA, 2010; ALBUQUERQUE, 2015). However, there is lack of examples of integrated C&DW management mechanisms that take into consideration regional specificities, as well as their socioeconomic, cultural, geographic, educational and political features.

FINAL CONSIDERATIONS

The importance of conducting fieldworks was evidenced in the featuring of different waste disposal scenarios and in the interpretation of urban features in each irregular disposal point. It was possible observing different disposal site types, deposited volumes and natural resources damaged by the presence of C&DW.

The current study has emphasized the need of conducting proper C&DW disposal; it was possible seeing that lack of adequate C&DW management can has negative impact on the environment. The adoption of public policies aimed at recycling construction waste can help reducing the volume of rubble deposited in inappropriate places and enable reusing this material.

In addition, the environmental and sanitary impacts resulting from irregular waste disposals were mainly concentrated in peripheral areas and distributed in an unequal way; this distribution condition was addresssed by some authors in association with information about income ranges *per capita*. It is important highlighting that specific groups are affected by the result of environmental degradation in a disproportionate way.

Most identified issues result from lack of areas duly licensed for C&DW disposal, or for temporary disposal of it. In addition, the creation of ecopoints for the deposition of small C&DW volumes, in association with the development of a regular inspection policy, could help reducing the number of irregular disposal areas.

Recycling this waste should be taken into consideration as a solution to the aforementioned issues, although it is one of the countless possibilities that can be assessed within Waste Management applicability. Based on the diagnosis of this situation, it is possible creating and planning actions and projects aimed at formalizing a differentiated management system based on the reduction, reuse, recycling, efficient inspection and environmentally-friendly disposal of C&DW.

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