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Sustainable Environmental Waste Disposal Behaviour in Pre and Post Covid-19: A Case Study of Portugal

Compañamiento Sostenible en la Eliminación de Residuos Medioambientales Antes y Después de la COVID-19: Un Estudio de Caso en Portugal

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Abstract: This study focuses on the behavioral disposition of households to responsible consumption and disposal of waste products, before, during, and after the COVID-19 lockdown in Portugal. Among the challenges facing the world before the pandemic, there were the issues of air pollution and environmental degradation emanating from improper waste disposal and recyclable products. This became a threat to sustainable smart cities and urbanization hence it was included among the concerns of the United Nations (UN) for Sustainable Developmental Goals (SDGs), the goals Sustainable Cities and Communities (SDG-11), and Sustainable Consumption and Production (SDG-12). Consequently, there is an urgency in increasing the recycling of materials and reducing the differentiated waste in landfills. In Portugal, there have been campaigns for reasonable recycling of wastes by families long before the outbreak of COVID-19 pandemic. As traumatic events typically enable behavioral adjustments, this paper makes comparative studies of municipalities' contributions to domestic wastes disposal management in pre-; during, and post-COVID-19 lockdown, and their direct consequences on the environment; with possible ways to motivate positive enthusiasm for proper waste disposal in order to enhance sustainable smart cities.
Keywords: *COVID-19; environment; household-behavior; household-wastes; municipalities; Portugal; recycling; smart city; sustainability.*

Resumen: Este estudio se centra en la disposición conductual de los hogares hacia el consumo responsable y la eliminación de residuos, antes, durante y después del confinamiento por la COVID-19 en Portugal. Entre los retos a los que se enfrentaba el mundo antes de la pandemia se encontraban los problemas de contaminación atmosférica y degradación medioambiental derivados de la eliminación inadecuada de residuos y productos reciclables. Esto se convirtió en una amenaza para las ciudades inteligentes sostenibles y la urbanización, por lo que se incluyó entre las preocupaciones de las Naciones Unidas (ONU) para los Objetivos de Desarrollo Sostenible (ODS), los objetivos Ciudades y comunidades sostenibles (ODS-11) y Consumo y producción sostenibles (ODS-12). En consecuencia, es urgente aumentar el reciclaje de materiales y reducir los residuos diferenciados en los vertederos. En Portugal, mucho antes del brote de la pandemia de COVID-19, ya se habían llevado a cabo campañas para el reciclaje razonable de los residuos por parte de las familias. Dado que los acontecimientos traumáticos suelen propiciar ajustes en el comportamiento, este artículo realiza estudios comparativos de las

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contribuciones de los municipios a la gestión de la eliminación de residuos domésticos antes, durante y después del confinamiento por la COVID-19, y sus consecuencias directas sobre el medio ambiente, con posibles formas de motivar el entusiasmo positivo por la eliminación adecuada de los residuos con el fin de mejorar las ciudades inteligentes sostenibles.
Palabras clave: *COVID-19; medio ambiente; comportamiento doméstico; residuos domésticos; municipios; Portugal; reciclaje; ciudad inteligente; sostenibilidad.*

INTRODUCTION

Improper municipal domestic wastes disposal usually contributes to environmental degradation and has direct consequences to healthy living in cities and various settlements, as reported by many researchers around the world, (APA, 2024; Griggs et al., 2013). The concerns with waste disposal are embedded in the agendas of Smart cities. according to its current conceptual approach that encompasses multidimensional perspectives with emphasis on inclusion of social and environmental capital as promoters of sustainability (Han & Ponce Cueto, 2015).

Recent United Nations (UN) reports advance estimations that about 67% of World Population will live in urban and Smart cities by 2050, (Jalalipour et al., 2021; INE, 2025). This target is expected to be followed by increased smart quality of life; improvements in social capital and resource management; improved urban metabolism vis-à-vis smart waste management, among other factors. Hence, The UN had embraced as a goal, long before the emergence of COVID-19 pandemics, to put an end to poverty and making the planet a safe and healthy place to live by the year of 2030. This was evidenced with the definition of the Sustainable Developmental Goals (SDGs) (Zagozewski et al., 2011).

The SDGs puts forward the UN vision of achieving objectives that include 'making cities and human settlements inclusive, safe, resilient and sustainable'; that is SDG-11. This results into concrete objectives that are translated into indicators that include maintaining 'good air quality' emanating from municipal wastes management.' This is believed to have effects on the impact of cities on environmental capital, whereby all hands were on deck by most Governments of the World to support initiatives that can contribute to attaining such objectives.

This study offers and exploratory analysis of waste management in Portugal over the last years with the purpose of stimulating the debate about the impact of societal circumstances such as the lockdowns that occurred with the COVID-1, to promote changes in individual behavior for the specific case of household waste management. The study explores the volume of waste recycling and landfill disposal at the level NUTS II- the second-level administrative subdivision of the country geography. The study involved the comparative analysis of data related to the regions on domestic waste disposal before,

during, and after the pandemic lockdown, using open available data. Released by national independent sources.

THEORETICAL BACKGROUND

The UN SDG-11 proposals on cities´ air quality and reduce practices that affect per capita environmental impacts on cities by the year 2030. Here, municipal domestic wastes management is an important contributing factor relevant for inclusive; safe; resilient and sustainable smart cities and human settlements as discussed by many researchers in literature across the World (INE, 2025; Mousavi, Hosseinzadeh & Golzary, 2023; UN, 2018).

In Portugal, there have been continuous efforts to stimulate the increase in recycling of wastes targeting the behavior of households. The management of urban waste involves both recycling and conversion to landfills. As such, over the years, the campaigns have focused on promotion of recycling behavior that can lead to reductions in the volume of waste that are directed to the landfill alternatives. In this context National Agencies were established, along with advancements in the legal framework, that have put forward several laws to encourage positive behavior of individuals and engage the population with the recycling agenda. On this vein, the Agency that is responsible for implementing environmental policies in Portugal, (Agência Portuguesa do Ambiente) implemented specific tax measures and fees concerning the management of wastes TRG (*Waste Management Fee*) with the purpose of increasing the awareness about the environmental burden of wastes, and stimulate the population to increase the adoption of recycling behavior and to promote positive attitude of inhabitants towards recycling and waste disposal management in general (Dugdh et al., 2018).

During the period of COVID-19 pandemics, the country observed a rise in the expectations about positive changes in behavioral disposition of individuals towards the adoption of sustainable wastes management practices, as recommended by the UN. These expectations were aligned with the circumstances of the lockdowns motivated by the pandemics, that prompted many to adhered to the debates and discourse about the need to promote more resilient and eco-friendlier environment, and to make the earth a safe place to live.

METHODOLOGY

This study resorts to open available data about wastes disposal data released by the Statistics Portugal (Instituto Nacional de Estatística) concerning the volume of urban wastes collected, detailed by geographical localization (NUTs) and the type of annual wastes collected – namely unsorted or recycled observed (Fernandez-Anez, 2016), for different years, before; during; and after the COVID-19 lockdown.

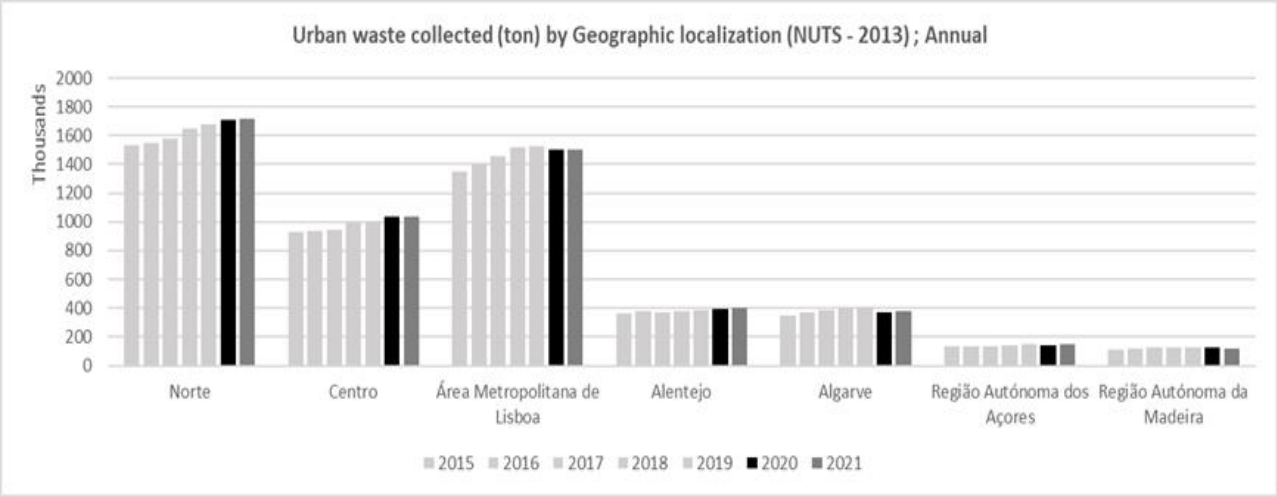
Also, the data for domestic waste disposal per Individual inhabitants made available were considered for comparison purposes. These data observed over the period under consideration, were critically analyzed in order to observe the adherence or otherwise of people or Municipals to SDG-11 for responsible consumption and waste disposal management to obtain a sustainable environment.

In addition, this paper studied waste consumption chains at NUT II, with particular attention paid to the attitude of Inhabitants consumer products waste disposal and sorting at households' levels.

RESULTS AND DISCUSSION

Figure 1 presents the indicator "Urban waste collected (t) by Geographic localization (NUTS - 2013)" that quantifies the total domestic wastes disposal for Pre-COVID19 (from 2015 to 2019, light grey); during COVID lockdown (202, black); and post-COVID-19 (2021, dark grey). Data from 2022 is still not available. Here, it is observed that domestic waste to increase for most of the Portuguese regions with exception of Algarve and Madeira. In general, the pandemic of COVID-19 doesn't seem not have affected the behaviour of inhabitants of Portugal regarding waste disposal management and recycling. Meanwhile, it is observed through the result curves that, during the early years before the lockdown, awareness campaign was in place regarding eco-friendliness and sustainable environment as proposed by UN SDGs.

FIGURE 01: Urban waste collected (ton) by Geographic localization (NUTS - 2013) from 2015 until 2021.

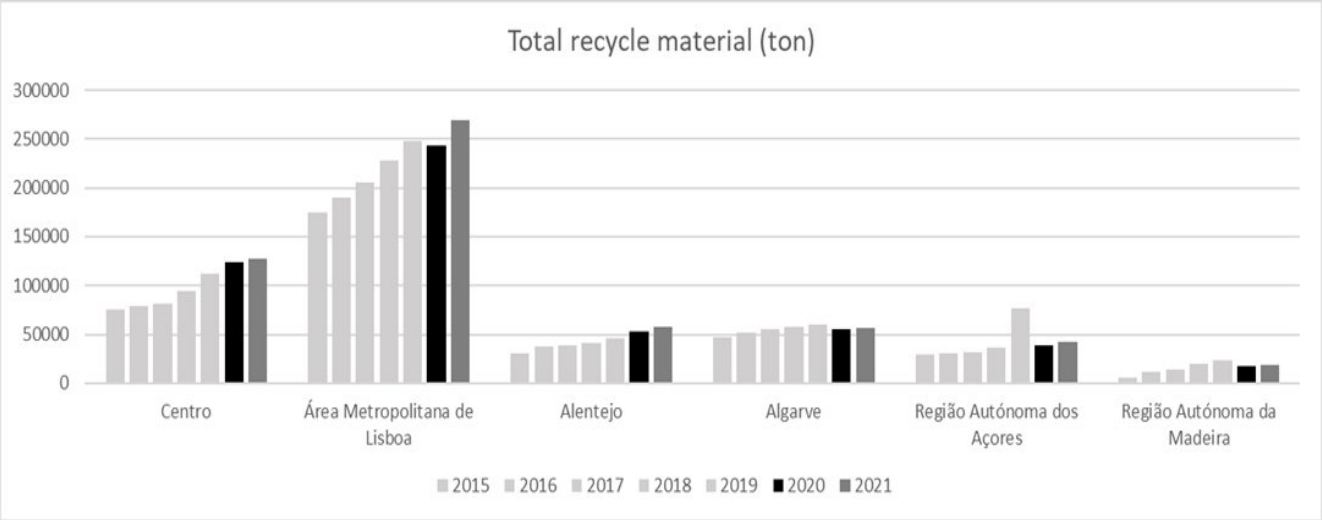


SOURCE: INE (2021).

The Pre Covid positive trend behaviour of the People towards wastes selection for the Pre-COVID-19 lockdown, and people resolve to be more resilient in the face of the lockdown, can be observed through Figure 02.

However, except for Lisbon and Alentejo areas, as the memory of the lockdown begin to fade, there is a gradual level of decline observed with respects to recycling wastes by different regions, although the level of compliance to either unsorted or recycle waste has never been uniform across them.

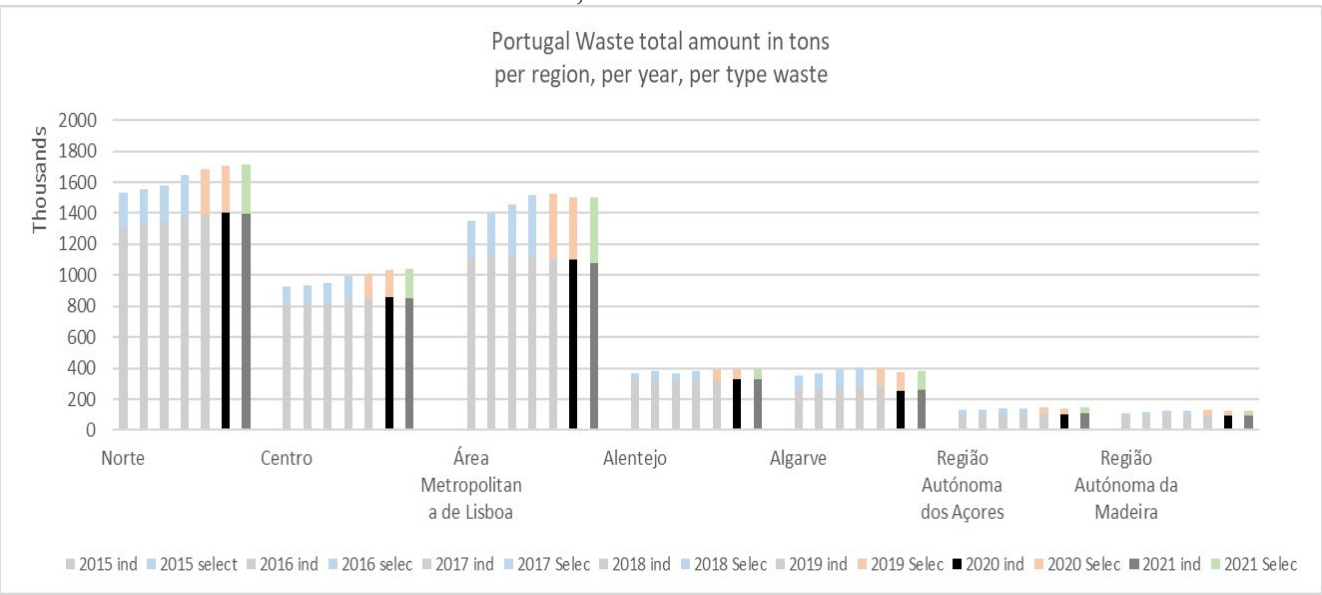
FIGURE 02: Urban waste collected (ton) by Geographic localization (NUTS - 2013) from 2015 untill 2021.



SOURCE: INE (2021).

The relation between indistinct collection and recyclable waste is presented in Fig.3 and also there is no relevant growth on recycling towards indistinct waste disposal after the COVID lockdown.

FIGURE 03: Urban waste collected (t) by Geographic localization (NUTS - 2013) and Type of collection; from 2015 until 2021.



SOURCE: INE (2021).

CONCLUSIONS

Many events accompany the COVID-19 pandemic such as the locked-down control measure adopted by the World Health Organization (WHO). Then, people were confined in their homes and movements of all sorts restricted to the barest possibility. Here, one would have thought that the environment would have been in danger of good air quality arising from domestic waste disposal, in addition to ravaging virus that was already a threat to the entire World. Thereby, promoting the compliance to the UN SDG- 11, which were geared towards the benefits of achieving 'Sustainable Cities and Communities'. However, this trend may gradually become relapsing as the memory of COVID-19 lockdown is fading. Hence, the campaign for re-awareness of municipalities about domestic wastes disposal management, responsible consumption and recycling of products, is an important endeavour among others, of the readiness for resilient, smart, and sustainable cities and human settlements in 2030 as proposed by UN SDG-11.

The resultant findings about the proportion of waste management decrease or improvement can be an indirect indication of the growth rate of the people participating in waste disposal management, under the period of consideration. This can be likened to municipalities' impact on environmental per capital waste consumption or disposal, as this varies through the period under consideration, and it is noteworthy because it determines the level of awareness of municipals as regards proper waste disposal, and in return the degree of urbanization of various smart cities.

The data suggests that there is a need to perform a detailed observation of the trends in different municipal contexts in in Portugal, and likewise worldwide, to achieve effective awareness about sustainable environmental waste disposal in order to support the UN-SDGs, to respect and protect the planet; and maintain 'sustainable cities and communities', as the lockdown experience continues to fade away.

As behaviours tend to modify after traumatic events, the COVID lockdown and the public awareness of the delicate ecosystems of Planet Earth didn´t show any practical result concerning the goodwill demonstrated in that period by media and social networks.

National and local governments had missed a good opportunity to implement new strategies towards the resilience potential of smart waste management in this first quarter of the XXI century.

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