

ANALYSING WASTE MANAGEMENT STRATEGIES FOR RIOMAGGIORE, A MUNICIPALITY IN THE “CINQUE TERRE” AREA

ANÁLISIS DE ESTRATEGIAS PARA LA GESTIÓN DE RESIDUOS EN RIOMAGGIORE, UN MUNICIPIO DEL ÁREA DE “CINQUE TERRE”

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Abstract

The aim of this study is to analyse the relation between tourism activities in the “Cinque Terre” region, in particular in the municipality of Riomaggiore, and urban solid waste production and management. The choice of the topic is highly relevant as the region of “Cinque Terre”, located in the north-west part of Italian Mediterranean coastline, has been affected during the last decade by an unprecedented phenomenon of over-tourism and hence an overwhelming tourism waste, which endangers the national park and UNESCO heritage sites of “Cinque Terre”.

The research reviews the current situation in the region and the national and local legislative framework that conditions waste management. While this study is at an explorative stage of designing a strategy for a sustainable waste management, based on the analysis of both primary and secondary data focused on Riomaggiore, it still aims at a systematic understanding of the existing problematics that can be applied by the region stakeholders to improve the sustainability in concrete terms. Primary data come from interview with Head of the Technical Office of Riomaggiore. These data will be used to understand the actual management of waste and the real possibilities to reduce the environmental impact. Thanks to secondary data sourced from literature reviews, private and public reports, and legislative frameworks, the research provides an overview of the quantity of urban solid waste generated consistently by tourists and excursionists throughout the Cinque Terre from Easter holidays to late October area and its impact on the local population. As a support, the study utilizes data related to tourist movements (hotel and non-hotel arrivals and overnights) as well as a survey to be

conducted at the end of summer 2024. As an output, the study aims at evaluating possible strategies for the improvement of the currently implemented systems of waste management, using optimization approaches among other methods.

Keywords

Urban solid waste, environmental impact, tourism, stakeholders, cooperative behaviour, flow management.

Resumen

El objetivo de este estudio es analizar la relación entre las actividades turísticas en la región de “Cinque Terre”, en particular en el municipio de Riomaggiore, y la producción y gestión de residuos sólidos urbanos. La elección del tema es muy relevante ya que la región de “Cinque Terre”, situada en la parte noroeste de la costa mediterránea italiana, se ha visto afectada durante la última década por un fenómeno sin precedentes de overtourism y, por consiguiente, una abrumadora cantidad de residuos turísticos, que pone en peligro el parque nacional y los sitios del patrimonio de la UNESCO de “Cinque Terre”.

La investigación examina la situación actual en la región y el marco legislativo nacional y local que condiciona la gestión de residuos. Aunque este estudio se encuentra en una etapa exploratoria de diseño de una estrategia para una gestión sostenible de residuos, basada en el análisis de datos tanto primarios como secundarios centrados en Riomaggiore, tiene como objetivo comprender sistemáticamente los problemas que los stakeholders tienen que solucionar para mejorar la sostenibilidad en términos concretos. Los datos primarios provienen de entrevistas con el Jefe de la Oficina Técnica de Riomaggiore. Estos datos se utilizarán para comprender la gestión real de los residuos y las posibilidades reales de reducir el impacto ambiental. Gracias a datos secundarios obtenidos de revisiones bibliográficas, informes públicos y privados y marcos legislativos, la investigación proporciona una visión general de la cantidad de residuos sólidos urbanos generados consistentemente por turistas y excursionistas en Cinque Terre desde las vacaciones de Semana Santa hasta finales de octubre y su impacto a nivel de población local. Como apoyo, el estudio utiliza datos relacionados con los movimientos de turistas (llegadas y pernoctaciones hoteleras y extrahoteleras), así como una encuesta que se realizará a finales del verano de 2024. Resultado del estudio es la evaluación de posibles estrategias para la mejora de los sistemas de gestión de residuos actualmente implementados, utilizando enfoques de optimización, entre otros métodos.

Palabras claves

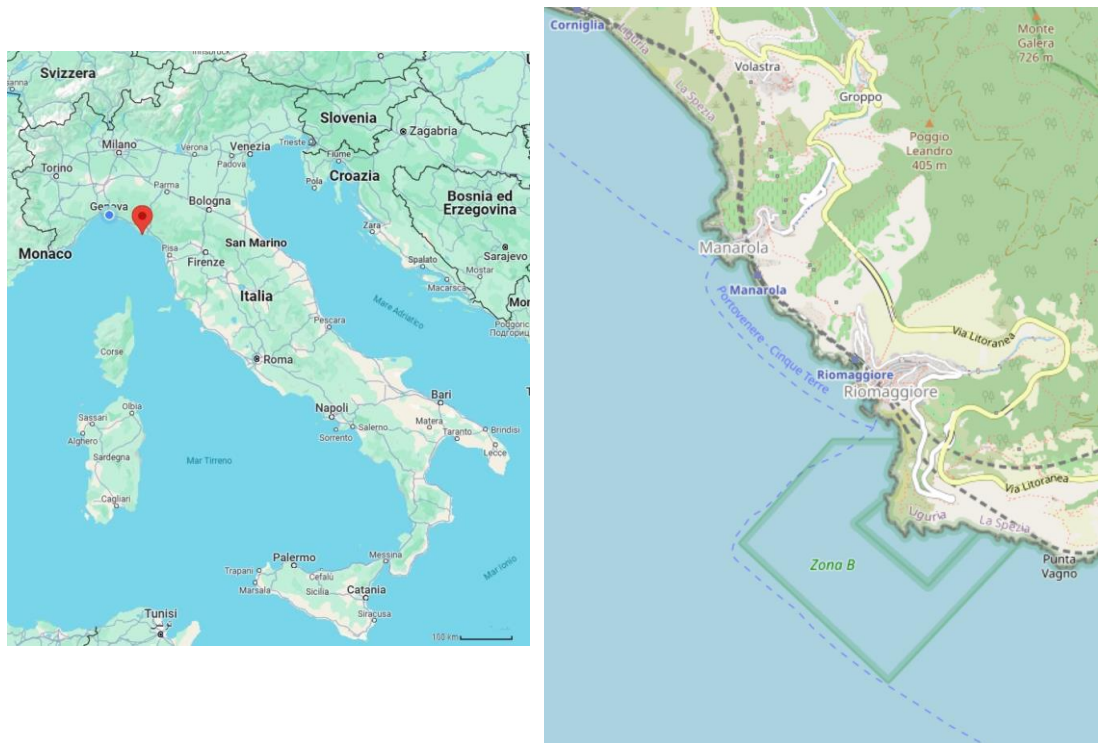
Residuos sólidos urbanos, impacto ambiental, turismo, stakeholders, comportamiento cooperativo, gestión de flujos.

1. INTRODUCTION AND METODOLOGY

Analysing the relations between tourism and urban solid waste is highly relevant for the “Cinque Terre” region. This region, located c. 90 km east of the city of Genoa, in the province of La Spezia, has been affected by over-tourism and tourism waste to the point that the national park and other sites of “Cinque Terre” (Del Cacho Estil-Les, 2023) have become endangered. The region meanwhile is a recognised UNESCO world heritage site due to its outstanding cultural value, exceptional scenic quality, and traditional way of life (UNESCO 1997).

The region, officially referred to as The National Park of Cinque Terre, instituted by the Italian government in 1999, includes the municipalities of Monterosso, Vernazza and its hamlet of Corniglia, Riomaggiore and its hamlet of Manarola. This study focuses on the municipality of Riomaggiore and its constituent hamlets of Manarola, Volastra, and Groppo (figure 1).

Figure 1. Riomaggiore and its hamlets: Manarola, Volastra, and Groppo.



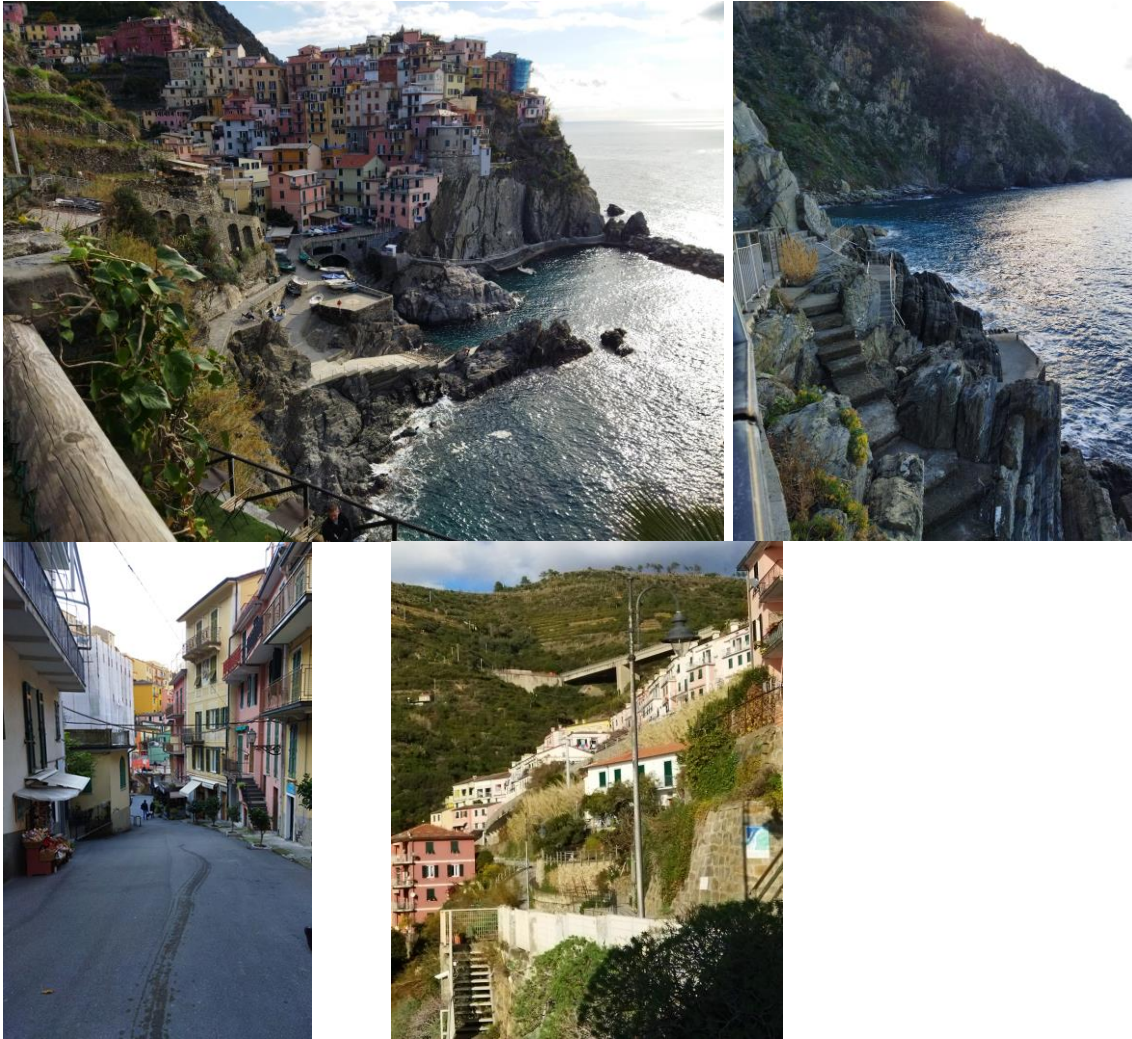
Source: Parco Naturale Nazionale delle Cinque Terre (<https://www.parconazionale5terre.it/map.php>), <https://www.google.it/maps>.

Riomaggiore – the southeasternmost municipality of the Cinque Terre – is located between the Ligurian Sea and the steep mountain range that branches off from the Apennines near Mount Zatta and descends south-eastward, acting as a watershed between the Val di Vara and the coastal area. It covers an area of 10.30 square kilometres.

The historic centre, whose original nucleus dates back to the 13th century, is situated in the valley of the Rio Maggiore stream. The settlement consists of parallel houses

arranged in towers according to Genoese tradition and follows the steep course of the stream. The new neighbourhood of the Station, dating back to the second half of the 19th century, is instead located in the adjacent valley of the Rio Finale stream. The two valleys on which the settlement extends are separated by the steep coast of Campiòne, on the lower part of which stands the castle of the village (figure 2).

Figure 2. In a clockwise direction the figure shows the complexity of Riomaggiore: a panoramic view, steep pathways, and the main street of the municipality.



Source: @DanielaAmbrosino.

The research reviews the current situation in the region and the national and local legislative framework that conditions waste management. Understanding if, how, and how much the municipality of Riomaggiore is committed to waste management allows to evaluate whether it is applying coherent policies and strategic planning within the framework of sustainable management of an environment as fragile and complex as the one studied.

This analysis is explorative and aims at a systematic understanding of the existing problematics. Based on the analysis of both primary and secondary data, this study contributes to designing a strategy for a sustainable waste management, that can be

applied by the region stakeholders to improve the sustainability in concrete terms (Bergantino *et al.*, 2021).

The primary data comes from interview with a municipality actor, in particular with the Head of the Technical Office of Riomaggiore. These data will be used to both understand the actual management of waste and the real possibilities to reduce the environmental impact (Koliotasi *et al.*, 2023), and improve the efficiency of the process, optimising the costs.

Thanks to secondary data sourced from literature reviews, private and public reports, and legislative frameworks, the research provides an overview of both the quantity of urban solid waste in the area and its impact on the local population, being consistently generated by tourists and excursionists who are present in the municipality and throughout the Cinque Terre from Easter holidays to late October. Data on tourist movements (hotel and non-hotel arrivals and overnights) and data collected from the people counter positioned in the tunnel under the railway are available until 2023, whilst the data related to the waste collection are available until year 2021.

By the end of summer 2024, the authors will conduct a survey aimed at understanding whether, how, and to what extent local stakeholders are satisfied with the numerous initiatives adopted by the municipality to make the collection of urban solid waste more efficient. Based on the survey results, the study will formulate possible strategies for improvement and/or strengthening of the existing systems of waste management, using optimization approaches.

2. LEGISLATION FRAMEWORK AND WASTE COLLECTION IN RIOMAGGIORE

2.1. Legislation framework

Waste management can be regarded as an integrated system that needs to be addressed at both regional and national levels. The Liguria region, in compliance with national waste regulations, has enacted Law 20 of 2015, titled "Measures for the development of separate waste collection and recycling," aimed at incentivizing municipalities to implement effective systems for intercepting recyclable waste.

The management of urban waste and similar materials destined for disposal falls under the jurisdiction of the municipality, which specifically oversees the following activities: collection and disposal of urban solid waste, including non-hazardous special waste assimilated to urban waste; bulky urban waste; hazardous urban waste; separate collection and recycling at authorized disposal centres; collection of external urban waste and street and sidewalk sweeping.

The Environmental Hygiene Service of the Municipality, which includes the collection and treatment/disposal of waste and the separate collection of urban waste, is managed through a contract in compliance with current regulations. The Service Manager is required to submit a declaration to the Province and provide statistical data regarding

the collection and disposal of urban waste and similar materials in the municipal territory to supervisory and control bodies upon request.

Specific regulations exist for the placement of containers, particularly for waste collection. Containers provided to residential and commercial users must be placed by the user in a public or privately-owned area accessible to the public, following the provisions of the collection schedule. The Service Manager will remove the waste at agreed-upon times with the Municipality, and the user is responsible for retrieving the empty container immediately afterward. To optimize the operations of the Service Manager, provided containers should be placed near the residence or commercial activity, in the nearest public access area. Depositing containers far from the property or activity is prohibited. Compliance with separate collection schedules is mandatory. More information is available at <https://www.comune.riomaggiore.sp.it/servizi-al-cittadino/ambiente/> and at <https://www.regione.liguria.it/homepage-ambiente/cosa-cerchi/rifiuti/osservatorio-rifiuti/rifiuti-statistica.html>

2.2. Waste collection in Riomaggiore

The interview with the Head of the Technical Office of the Municipality of Riomaggiore confirmed that the best practices adopted in other tourist areas are not efficient due to the particular morphological conformation, which makes the dynamics of various flow components particularly complex.

In particular, waste collection in Riomaggiore and its villages has been the subject of experimental and alternative collection methods to ensure greater cleanliness even in areas frequented by tourists/excursionists at different times of the day. As highlighted by the Head of the Technical Office of the Municipality, 2024 is a transitional year compared to the past.

In the three villages of the Municipality, micro-islands for waste collection have been set up, specifically for accommodation facilities whose waste disposal might not always align with scheduled collection times due to check-out schedules. Bars and restaurants also have a personalized collection system: in the summer season, the collection takes place in the evening and at sunrise for all categories of waste. Most of the collection containers have been renewed (figure 3), and in year 2025 the entire system is expected to be renewed.

Since spring 2024, street waste collection has been extended to include evening pickups, even in areas near the Marina inaccessible to vehicles. Specifically, glass collection is handled by an artisan. Glass collected during the night is transported to a designated area and subsequently removed.

These additional services have become necessary because after the last "official" collection, the area near the marina is often frequented by an increasing number of people who consume food and drinks by the sea. In residential areas, collection takes place door-to-door following a specific schedule regarding the materials to be disposed of on different days of the week.

Figure 3. Waste collection containers in Riomaggiore.



Source: @DanielaAmbrosino.

Furthermore, to reduce plastic consumption, especially bottles, the positioning of three "water houses" is planned. These "water houses" will dispense controlled drinking water in the three main villages of the municipality and will be managed by a third-party operator. The water will be provided for a fee with differentiated rates for residents and tourists. Water will be sourced directly from the local aqueduct and subsequently purified.

An improved street cleaning has also been arranged; in the summer period, streets and elevators are swept several times a day, thanks also to the recruitment of local cooperatives that assist the company responsible for ordinary management.

3. TOURIST PRESSURE AND CONSEQUENCES ON WASTE MANAGEMENT

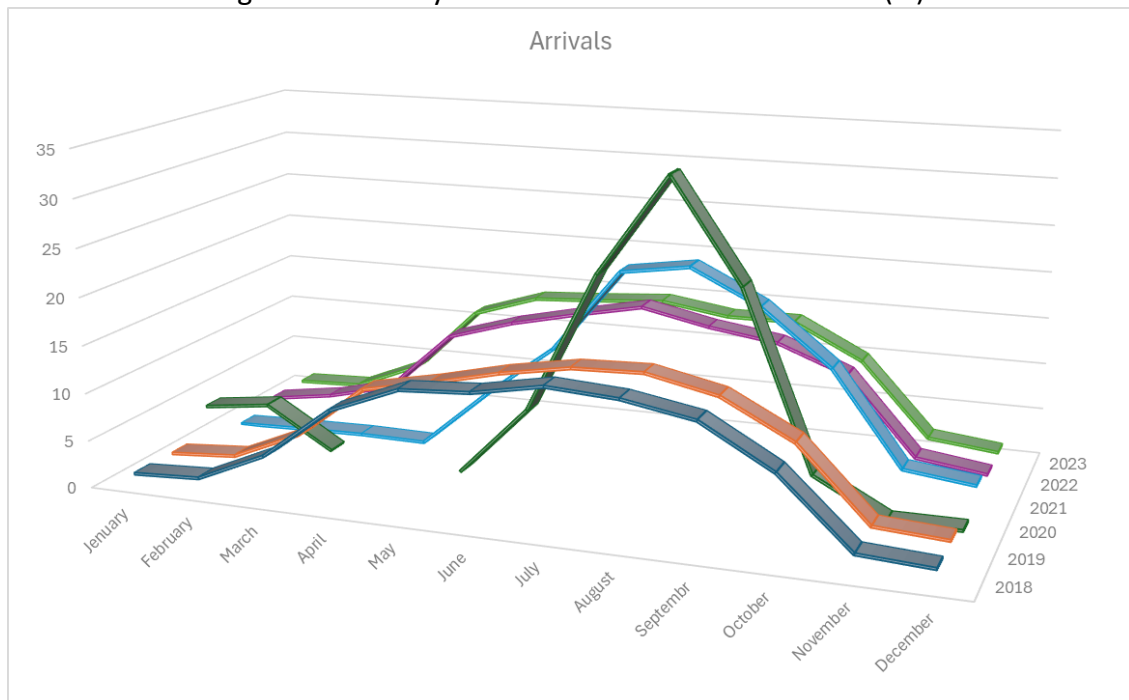
Waste collection in Riomaggiore is extensive and frequent due to the terrain and a very high number of tourists/excursionists who crowd the Cinque Terre Park and its easternmost municipality from spring to autumn. In fact, the small municipality has a rather small population, amounting to 1,332 in 2022 (of which about 300 in Manarola and about 1,000 in Riomaggiore). This population does not justify such a specific policy regarding urban solid waste collection. The areas of maximum concentration of the resident population are also those where almost all of the 307 accommodation facilities are concentrated (with 1,546 beds in 2022), in 94% of cases of non-hotel type (289 for a total of 1,315 beds, accounting for about 85% of the total).

The same area contains almost all of the dwellings: 2,085 of which 36%, at least theoretically, are occupied by residents and the remaining 64% are unoccupied. The latter are presumably used as holiday homes, but the tourist movement generated by them is not recorded in official tourism statistics. The tourist movement generated solely by hotel and non-hotel structures between 2018 and 2023 shows a growing trend,

despite the significant contraction recorded in 2020 and 2021 due to the Covid-19 pandemic. In fact, looking at the percentage increase in arrivals and stays between 2018 and 2023, a significant increase can be observed, respectively amounting to 9.7% and 17.6%. The tourist movement is growing, and therefore the territory is subject to increasing pressure. As can be observed from figures 4 and 5, the pre- and post-pandemic years show that the pressure essentially concentrates during the summer months: in particular, between June and September, it accounts for between 55% and 57% of annual arrivals and between 58% and 60% of stays.

During the pandemic, the concentration of movement in the four summer months reached peak levels: in 2020, accounting for 85.4% of arrivals and 87.3% of stays, and in 2021, albeit slightly lower, with values respectively at 74.1% and 77.2%. Undoubtedly, these are situations that have an impact both on the territory and on the local population, which has to deal with exponential growth of inhabitants, albeit temporary, in a socioeconomic context tuned to quite different needs.

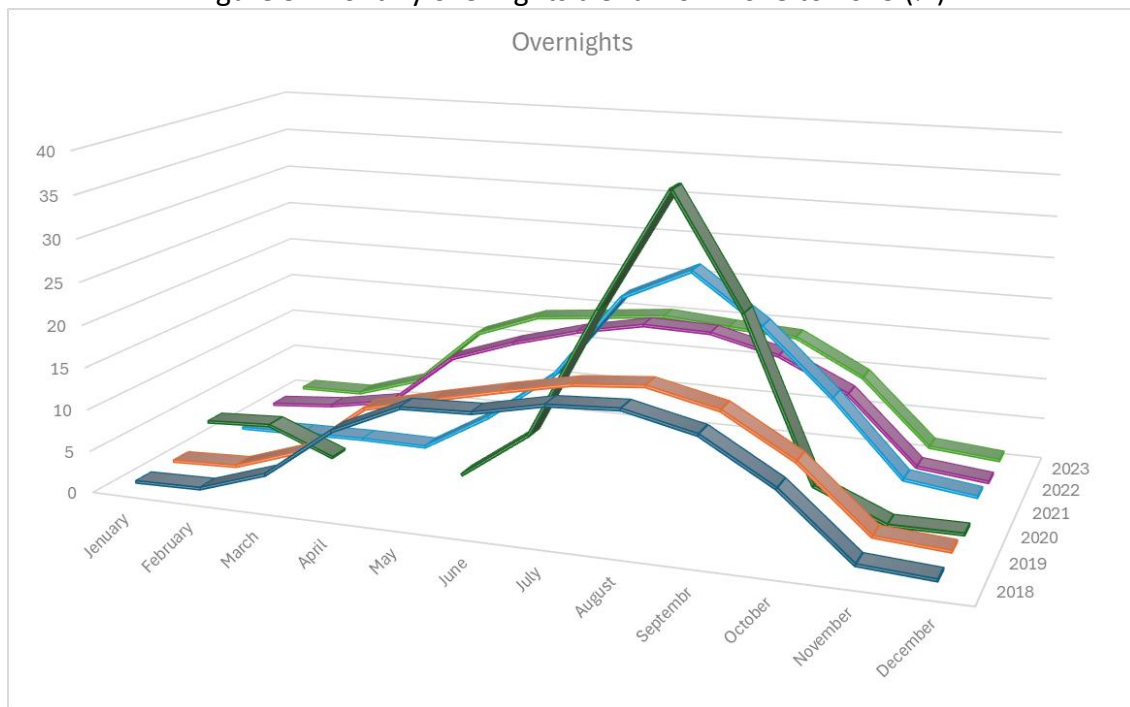
Figure 4. Monthly arrivals trend from 2018 to 2023 (%).



Source: Osservatorio turistico della Regione Liguria (2024). Own elaboration.

Furthermore, data concerning the people counter positioned in the tunnel of Riomaggiore station show remarkable values. This is a mandatory passage for all those who, even if they arrive by other means, head towards the sea. On any given day of the week between March/April and September/October, it records an average of 16,000 passages, roughly corresponding to 8,000 people. Therefore, the territory not only experiences pressure from residents and overnight tourists but also from those who transit and remain in the area for a few hours.

Figure 5. Monthly overnights trend from 2018 to 2023 (%).



Source: Osservatorio turistico della Regione Liguria (2024). Own elaboration.

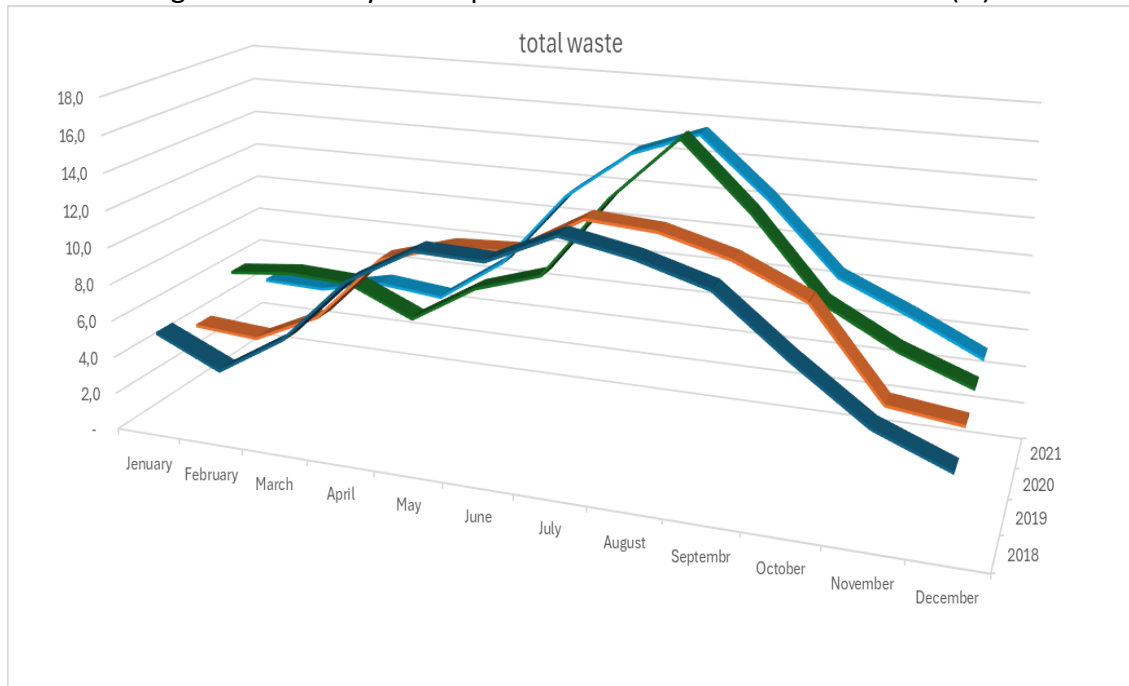
3.1 Consequences for Waste Management

The above-described situation obviously has a significant impact on waste production. In fact, observing the monthly trend of urban solid waste production (differentiated and non-differentiated) for the years from 2018 to 2021 (the last available data), a very similar trend to that of tourist movement is observed (figure 6): in 2020 and 2021, there is a more irregular trend with distinctly pronounced peaks in the summer months.

Looking instead at solid waste production in 2020 and comparing it with that of 2019, there is a noticeable decrease of about a third, a decrease that is around 18% when compared to 2021. This undoubtedly shows how tourist and hiking movements weigh on citizens in terms of solid waste management costs and environmental management.

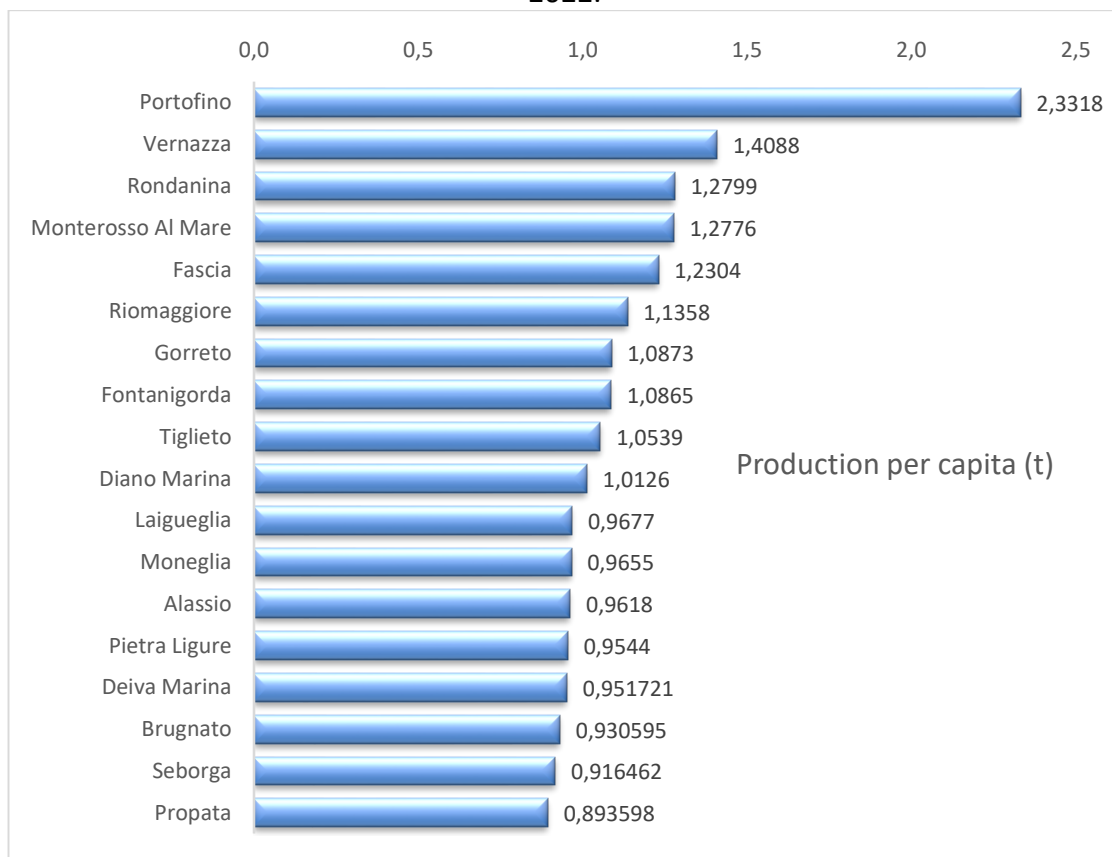
It is not by chance that Riomaggiore, although not one of the most populated municipalities in the region, ranked sixth in 2022 for per capita waste production (figure 7). Similarly, Vernazza and Monterosso, the other two municipalities that, together with Riomaggiore, fall within the Cinque Terre National Park, occupy respectively the second and fourth positions.

Figure 6. Monthly waste production trend from 2018 to 2021 (%).



Source: Comune di Rimaggiore (2024). Own elaboration.

Figure 7. Top 20 Ligurian municipalities in terms of waste production per capita in 2022.



Source: Censimento Rifiuti Urbani (2024). Own elaboration.

4. DISCUSSION AND RESULTS

The data related to tourist and excursionist movements, along with those regarding per capita waste production and monthly waste production, are certainly tangible signs of the phenomenon of over-tourism. We can see its consequences not only on natural environment but also on socio-economic one. Residents, in fact, live in an unsustainable territory and have to bear significant costs related to the management of urban solid waste.

As we have seen, efficient waste management requires additional services, which in turn require economic commitment. In recent years, the municipal administration has worked hard to streamline the waste collection and management system in order to make the territory more liveable not only for tourists but also for those who live there daily. It is indeed a practice that could be exported to similar contexts; structuring a tailor-made collection model in this case would be a necessity, as well as stimulating the use of water dispensers to reduce plastic usage. In this way, a dual result is achieved: reducing plastic bottles can protect the environment and over time can reduce the local investment allocated for plastic collection. The resources could then be redirected to the implementation of other policies that promote a more sustainable management of tourist flows, aiming to promote other areas less assaulted by the average tourist who visits the Cinque Terre municipalities. Moreover, increasing the train ticket price for non-residents on peak days helps to a certain extent. Investments, on the other hand, should aim to attractively communicate interior trails, which nonetheless have great potential.

The survey we will conduct at the end of the summer to evaluate the effectiveness of the municipality's policies regarding urban solid waste management, and will permit to understand how and if it is possible to optimize efforts by using alternative routes and possibly employing artificial intelligence or other advanced technologies.

Excel spreadsheets will be employed to evaluate both the current waste management system and the prospective one, utilizing a comprehensive cost framework that incorporates negative externalities associated with waste collection and distribution activities (Ghiani *et al.* 2021). Furthermore, an exploration of various waste collection scenarios arising from evolving tourist flows in Riomaggiore and its surrounding areas will be conducted. In fact, additional analysis appears to be necessary to propose itineraries that integrate the use of different means of transportation, and it is not excluded to share any results arising from the implementation of an optimization project for tourist flow management.

It is evident that to streamline the waste collection system in a context like Riomaggiore requires considering measures that not only focus solely on the waste cycle but also on the movement of people. Consequently, we will explore solutions that encompass both aspects.

RESPONSIBLE STATEMENT AND CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in relation to the publication of this article.

All three authors collaborated on the creation of the contribution, working together jointly.

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