WASTE COLLECTION STRATEGIES IN A LACUSTRINE TOURISM CONTEXT

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Abstract: The current research brings contributions to waste management in tourism contexts. The study area is Lake Garda, one of the main Italian tourist destinations. It serves as a hinge between three different Italian zones allowing the analysis of a multitude of municipalities belonging to different realities. Various aspects related to separate collection, the municipality's dedicated commitment, and the tourism impact are presented and analyzed. Data relating to lower and higher tourist influx in pre-pandemic years and pandemic months of 2020 are compared. The critical issues that emerged during the inspections carried out in each individual municipality are also highlighted.

Keywords: lake tourism; waste management; selective collection; circular economy, app.

1. Introduction

In Italy, the tourist flow comes mainly from other European Union (EU) countries and alsohigh-income countries in all the seasons: reasons are relaxation, art, history, fashion, food, culture, cuisine, etc. [1-8]. The reduced distance and the same currency (Euro) are the main factors that attract EU residents to spend their vacations within the EU boundaries. According to Eurostat tourist statistics 2021, Italy is considered of the top destinations in the EU being placed second in its rank after Spain [9]. In Figure 1, the travellers increase starting from 2016 until 2021 is reported [10]. In Figure 2 data regarding travellers' destinations in Italy are reported. The effects of the pandemic are visible. The most desired is at the seaside, followed by mountains and cultural areas, without forgetting the Italian lakes which combine both natural and cultural resources [10].

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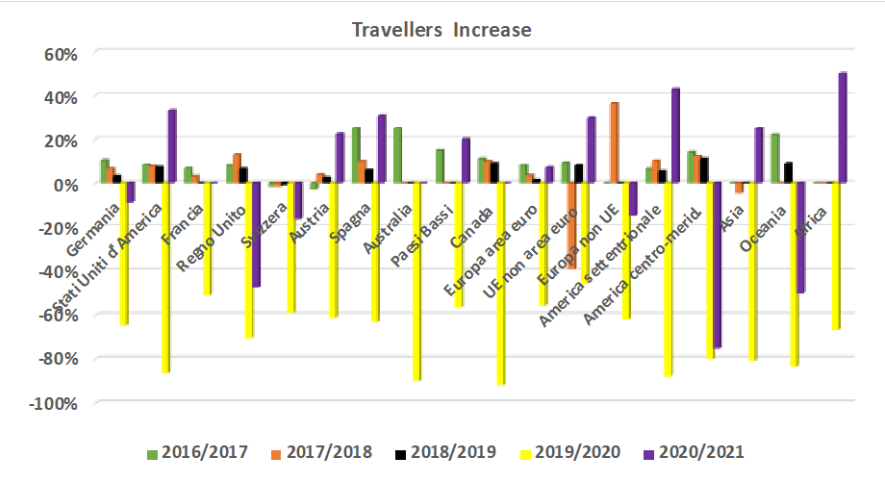

Fig. 1. Increase of foreign travellers in Italy by geographical area of origin. Data from [10].

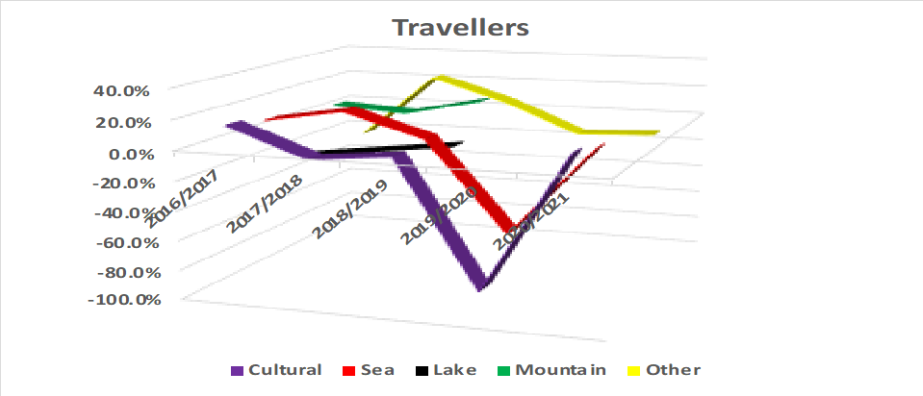

Fig. 2. Percentage of foreign travellers in Italy for tourist reasons. Data from [10].

Data reported in Figure 3, present the results from a bibliometric analysis, from the Web-of-Science® database, on tourism and municipal solid waste (MSW) tourism and MSW selective collection [11]. Only a paper, published in 2016 refers directly to a tourist lakeside location. However, the bibliometric analysis revealed only a few studies that link the role of tourists' presence, MSW production, and management through selective collection [12-19].

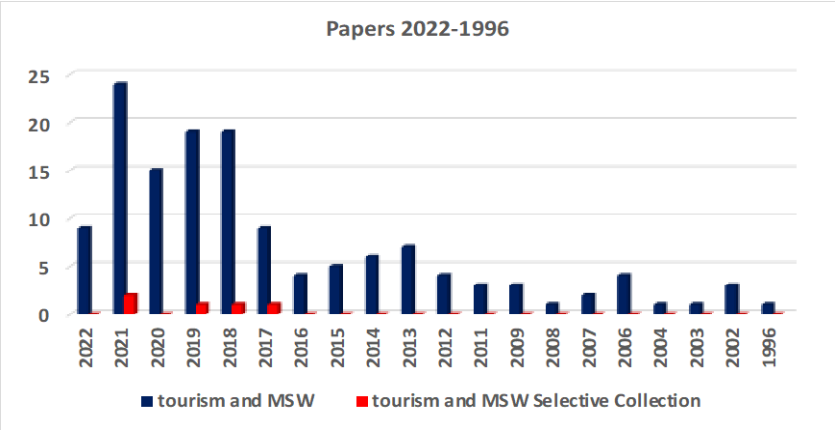

Fig. 3. Papers form Web-of-Science® data base. Data from [11].

COVID-19 is an infectious respiratory disease caused by the virus called SARS-CoV-2, which since its first appearance in December 2019 in the city of Wuhan, China, creates worldwide problems also connected with MSW production and Management [20-24]. Up to November 2021, over 259 million cases were confirmed worldwide and the disease caused more than 5 million deaths [25,26].

To cope with the rapid spread of the virus, in the first months of 2020, states worldwide have progressively decided to adopt stringent confinement measures, called in the media the Anglo-Saxon term lockdown, such as curfews, quarantines, and travel restrictions. These confinement measures have caused severe economic effects, particularly in the global tourism industry. In addition to the damage generated by the blocking of travel, the COVID-19 pandemic caused a somewhat unprecedented "travel fear" that may severely hinder the recovery of the tourism industry worldwide in the future [27]. In the pandemic context, international tourist arrivals decreased fell by 72% (900 million) in January-October 2020 respect to with 2019 [28]. Before the COVID-19 pandemic, it was expected to increase by 1.9% (9 million tourists) per year by 2030 [29]. Unlike past pandemics, the recovery of the tourism industry following the COVID-19 pandemic will take longer than the expected average recovery period of 10 months [30-33]. In particular, the scenarios for forecasting tourism demand show a decline in international tourism which may vary between 30.8% and 76.3% [34]. In Italy a decrease of about 67 million tourist arrivals in 2020 compared with 2019, was reported [35].

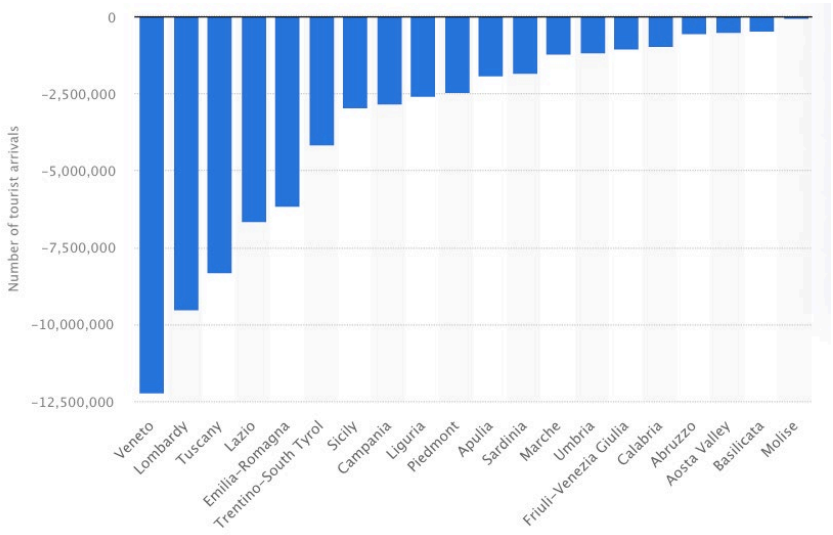

Fig. 4. Estimated impact of the coronavirus (COVID-19) pandemic on tourist arrivals in Italy in 2020, by region of destination [35]

As can be seen in Figure 4, Veneto was the region that recorded the highest decline with a decrease of about 12 million arrivals followed by Lombardy [35].

The Italian legislation, in art. 183 of Legislative Decree. 152/06 [36] and subsequent amendments, considering the EU legislation Directive 98/2008/CE [37], defines the term waste, as any substance or object that the holder discards or has decided or is obliged to discard. A further distinction can be applied within MSW, identifying recyclable waste and residual waste. Recyclable waste includes the fraction of urban waste (UW) that can be recovered through appropriate recycling techniques, such as paper, glass, and plastic. The Directive 2018/851/EU [38] which added further targets for preparing for reuse and recycling, to be achieved by 2025 (55%), 2030 (60%) and 2035 (65%).

The circular economy (CE) strategy is considered the most adapt way for improving MSW management [39-42]. By 2030 the EU key targets should be met: recovery of MSW (70%), packaging waste (80%) while landfilling remains the last desirable option (10%). Italy is one of the European Countries that included in the New Waste Management Plans the CE concepts.

In this frame, among the various Italian lakes, Lake Garda reaches to 25 million annual visitors, from which 80% are foreigners [43], being one of the most popular Italian tourist destinations [44]. The months of greatest influx are certainly the summer ones, but a good tourist influx can be observed from March to November, followed by a period of attenuation in attendance, to then resume during the Christmas holidays. The Garda Lake offers the possibility of examining a multitude of lakeside tourist areas belonging to three provinces and regions:

Lombardy (province of Brescia), Veneto (province of Verona) and Trentino-Alto Adige (province of Trento) [45].

The present paper wants to give a contribution to improve the sector of MSW management in lacustrine destinations considering the implications of the pandemic and lock-down periods and also the potentialities of the development of MSW source separation apps for travellers/tourists.

2. Materials and methods

The area selected as the ideal case study regarding the MSW management and selective collection strategies in lacustrine areas, thanks to the various municipalities located along the shores of Lake Garda which extends between three Regions, as presented in Figure 5.

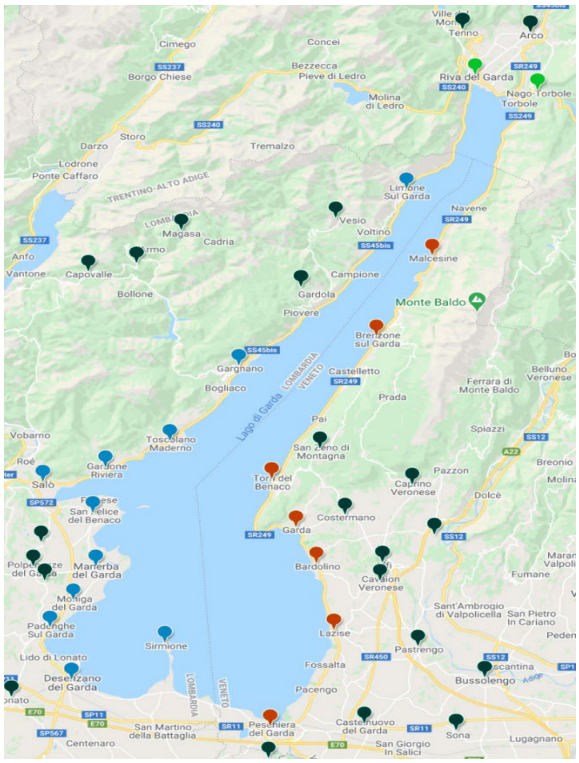

Fig. 5. Municipalities located along the Garda Lake shores, highlighted according to the region they belong to: Green - Trentino Alto Adige, Red - Veneto, Blue - Lombardy. (ref. Google Map)

Table 1 shows, for each of these municipalities, the resident population on 1st January 2021, the extension in km^2, and the total number of accommodation facilities in each municipality [45,46]. Figure 6 points out the pressure on the territory associated with tourist attendance [45]. The most common

accommodation facilities in these locations are: Hotel (★ - ★★★★★), apartments, guest houses, bed & breakfast, farmhouses, and campsites [46]. 9 of the 50 Italian municipalities by tourist pressure, or by tourist presence per 1000 inhabitants are located along the shores of Lake Garda [45]. The MSW management and an efficiency selective collection represent one of the targets that the municipalities bordering Lake Garda want to achieve in concordance with Circular Economy principles taking into account also the citizens and traveller's needs and indications to improve it.

Table 1

Resident population and extension of the municipalities bordering Lake Garda [45]

Municipality	Inhabitants	Extension [km^2]	Number of accommodation facilities
Trentino-Alto Adige region			
Riva del Garda	17861	40.73	120
Torbole	2842	28.39	74
Veneto region			
Malcesine	3662	68.2	179
Brenzone sul Garda	2460	51.59	75
Torri del Garda	3030	51.4	58
Garda	4073	14.37	81
Bardolino	7181	57.33	129
Lazise	6954	63.15	91
Peschiera del Garda	10832	17.63	74
Lombardia region			
Sirmione	8121	33.9	89
Desenzano del Garda	29250	60.1	45
Padenghe del Garda	4661	20	7
Moniga del Garda	2581	14.65	7
Manerba del Garda	5295	28	17
San Felice del Benaco	3426	26	9
Salò	10521	29.75	23
Gardone Riviera	2662	20	23
Toscolano Maderno	7710	56	28
Gargnano	2815	76.75	24
Limone sul Garda	1141	23.03	51

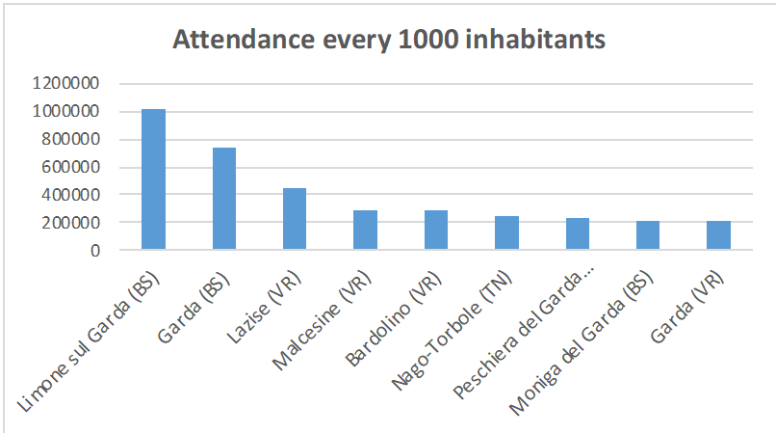

Fig. 6. Movement of customers in hospitality establishments, year 2016. [45]

In Italy, since 28 September 2017, the technical standard UNI 1686:2017 [47] was introduced aiming of standardizing the visual elements that identify the containers for the collection of MSW. In particular, the colours dedicated to the different fractions are the following: blue for paper and cardboard; yellow for packaging (plastic and cans); green for glass; brown for the organic; turquoise for metals; grey for unsorted waste (available for not recyclable factions).

From the images collected during the inspections of the municipalities, it was possible to observe how the municipalities have not fully adhered to the aforementioned standardization, causing multi-coloured choices between neighbouring municipalities and, in some cases, even within the municipality itself. This is the result of the wide freedom of management in collecting waste. In Table 2 some examples of the multi-colours bins on the roads and near the lake used in the area of the casestudy are reported. However, to help the citizens and the traveller multilingual instructions are used. The inspections were conducted starting from the territories of Trentino north of the lake and progressively descending along the Veronese shore until it is reconnected with that of Brescia. A more coordinated effort is expected soon considering the importance of the role of selective collection in the frame of circular economy strategies.

Table 2

MSW Bins in some of the areas of case-study

Examples within the same municipality found during the inspections	
	
Light packaging - Riva del Garda (TN)	Paper and cardboard - Torri del Benaco (VR)

Examples of road containers in neighbouring municipalities or just a few km away

Packaging - Torri del Garda (VR) and Bardolino (VR)

Paper and cardboard - Torbole (TN) e Malcesine (VR)

VR

TN

3. Results and Discussions

For a better understanding of the MSW generation and management, the seasonal tourist fluctuations in 2019 and 2020 were established as presented in Figures 7 and 8 [48,49]. During the low season tourist period (Jan-Feb) the area of Lake Garda and its hinterland had been characterized by a positive result of tourist income + 16% During the first lockdown period (Mar-May 2020) a -98% drop (Italian -91% and foreigners -98%) had occurred. With the progressive mobility between regions (June-Sept 2020), the decline had downsized at -46.2% (Italian +11% and foreigners -62%) but had returned to higher levels with the subsequent closures in the period from Oct-Dec 2020 reaching -59%.

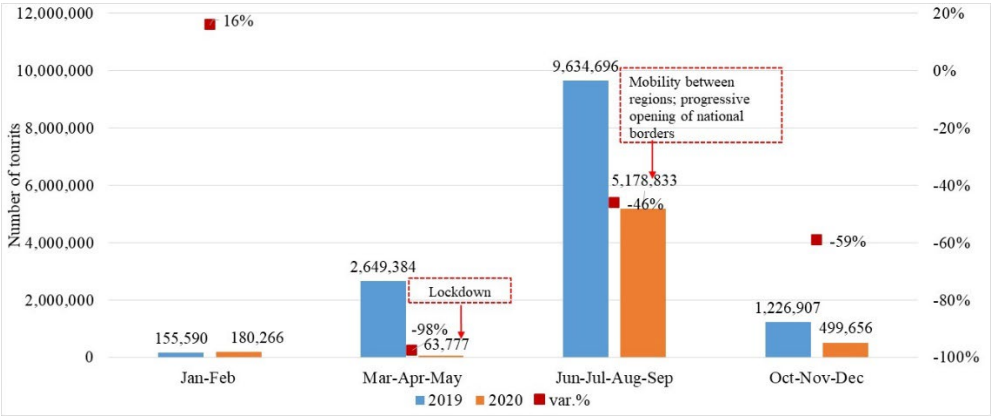

Fig. 7. Analysis of tourists' fluctuation (Italians and foreigners in the municipalities of Lake Garda in 2019 v.s. 2020). Data from [51]

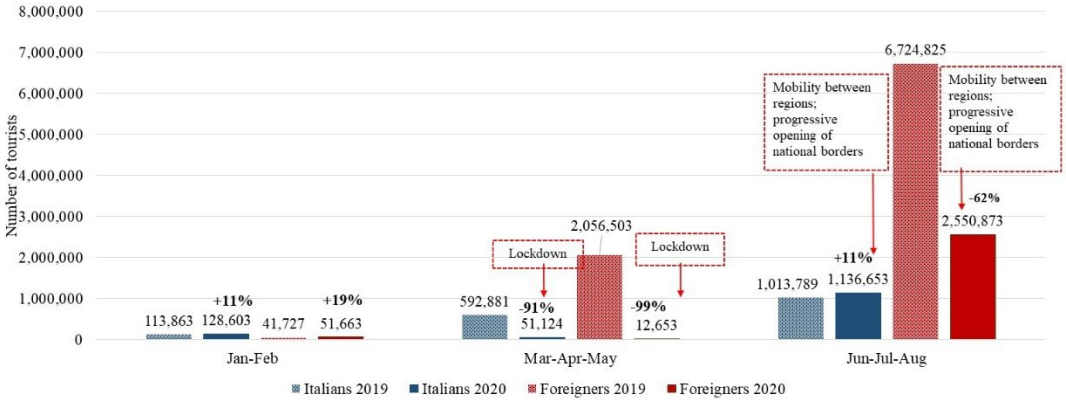

Fig. 8. Analysis of Italians and foreiners tourist fluctuation in the municipalities of Lake Garda in 2019 v.s. 2020. Data from [51]

The data acquisition on MSW selective collection (SC) state before and after the pandemic period in the various coastal municipalities had led to an elaboration of a comprehensive analysis to highlight the following aspects:

- trend of MSW selective collection in the last decade;
- variation of MSW between the months of least and greatest tourist presence;
- effects of the lockdown periods on waste production;
- proposal of an MSW source separation app for travellers/tourists.

The calculations on the annual variation of MSW selective collection and the seasonal variation of the effects of the lockdown were carried and some data as a casestudy from each region was considered and reported in this paper.

In particular, the first calculations that have been conducted concerning the variation of the annual total collection from 2010 to 2020 in the municipalities that recorded the greatest growth for each region: Desenzano del Garda (BS),

Lazise (VR) and Riva del Garda (TN). Data can be seen in Figure 9. The growing trend highlights the commitment dedicated to SC by these municipalities. In almost a decade, significant changes have been recorded.For example the case of Desenzano del Garda the SC rate registered an increase of almost 48%.

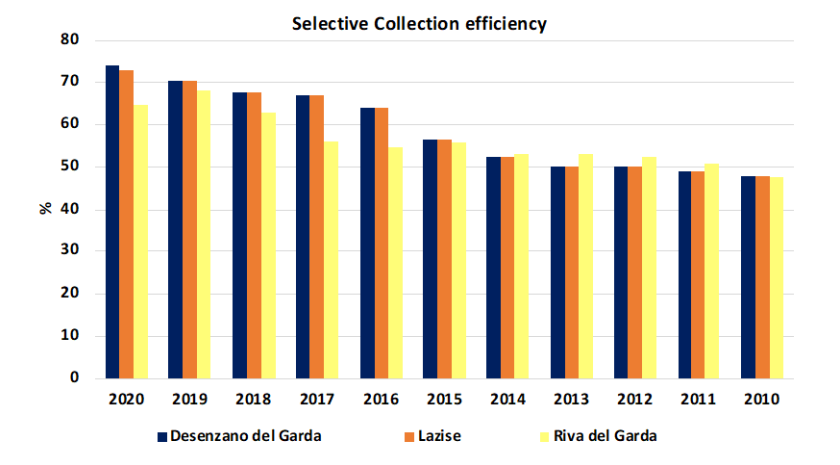

Fig. 9. MSW Selective Collection trends in the last decade for the selected case-studies [49]

In Figure 10 the yearly variation of the collection of the main MSW fractions before and after the pandemic situation is reported for Desenzano del Garda (BS) case. In particular, in Figures 11 and 12, the monthly MSW production for the main fractions, considering also the months of lowest and highest tourist turnout, February and August respectively were compared.

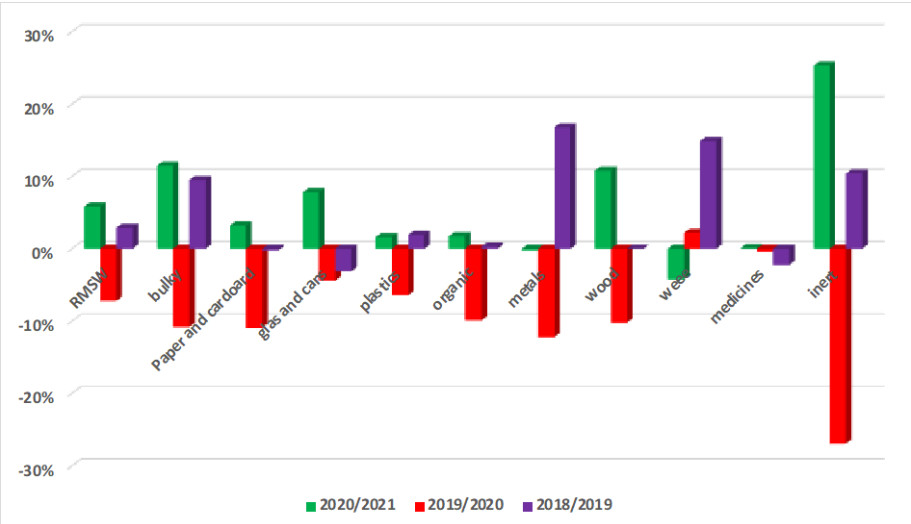

Fig. 10. MSW production variation before and after the pandemic period for Desenzano del Garda. Data from [50].

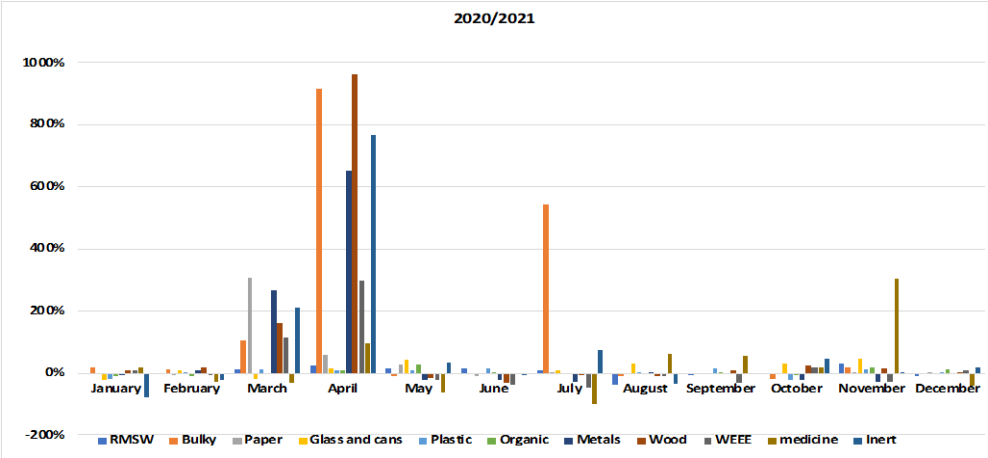

Fig. 11. Monthly MSW fractions production variation after the pandemic period for Desenzano del Garda; years 2020/2021. Data from [51]

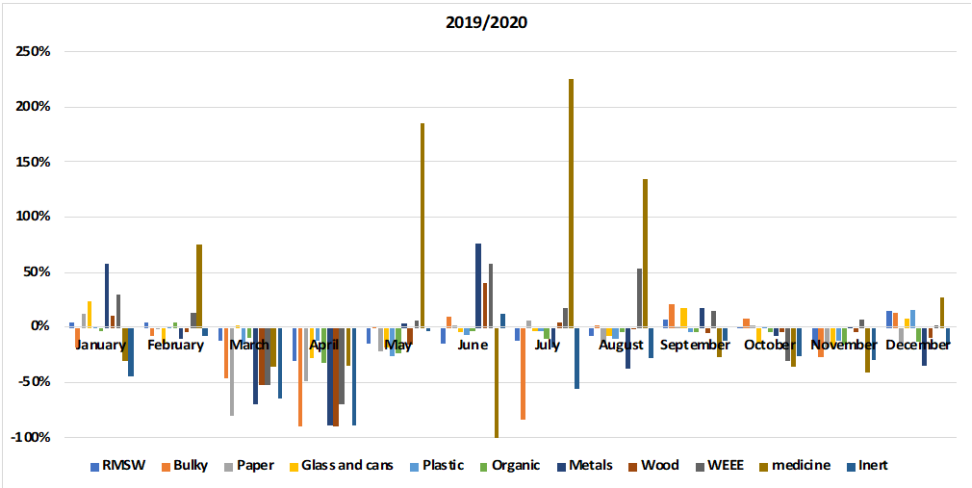

Fig. 12. Monthly MSW fractions production variation before the pandemic period for Desenzano del Garda; years 2019/2020. Data from [51].

In the Lake of Garda area, the pandemic situation that led to the tourists decrease had a notable effect on the MSW generation as presented in Figure 13. Respect with 2019, in 2020 the amount of MSW generation dropped with -29%, reaching an average value of -16% when comparing 2019 v.s 2021 and 2020 v.s. 2021. Overall, the selective collection rate has not been affected by registering ± [1-3%] range.

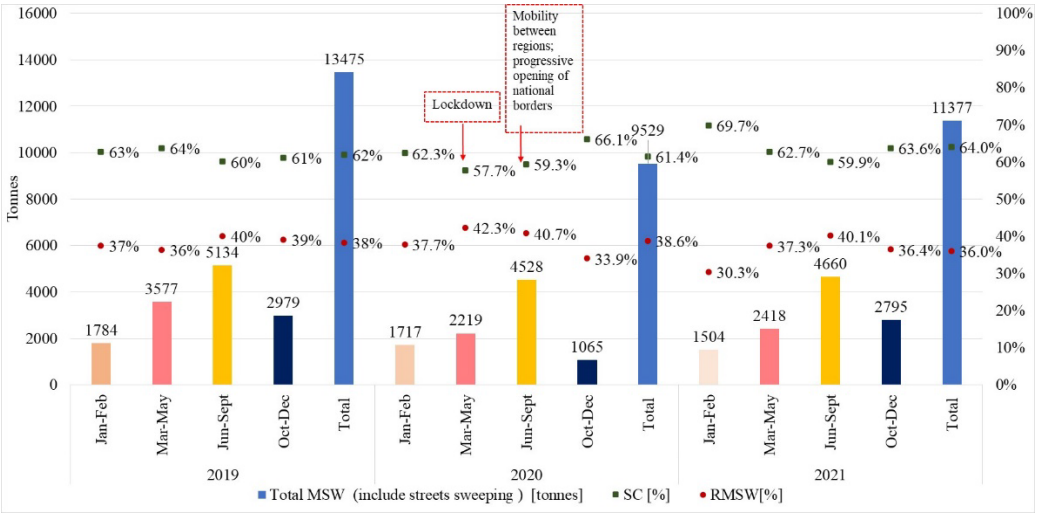

Fig.13. MSW generation, selective collection rate 2019-2021 Lake of Garda. Data from [51].

In this frame, the availability of a smartphone App to support source separation from residents and tourists can help in improving the results. An App used in the Lake of Garda region is the Junker one [52]. This App covers 26 municipalities of the area surrounding the lake. The App acts like a virtual assistant for waste sorting and circular economy. Its features include:
a) the collection of waste is assigned with a recognition feature from 1.6 million products unique barcodes or images;
b) waste disposal information;
c) details on packaging materials;
d) knowledge on waste sorting on local criteria;
e) reminders/calendars for kerbside collection;
f) geo-location system with maps with points of interest;
g) recycling rates and the quality of the separate collection of waste improvements;
h) option of reuse by offering local opportunities to freely exchange items they do not use anymore
j) 10 languages available (strategic for a tourist area like Garda Lake)
However, the use of this kind of Apps should be developed more homogeneous. For instance, in theGarda Lake area, another App was proposed and did not outlast at its first real-scale adoption

6. Conclusions

From what emerged in the present article, the analysis of the collection strategies in the Garda Lake's municipalities characterized by high tourist users, did not allow to highlight optimal guidelines to follow and carry out a rigorous selective waste collection. By analyzing the pre-pandemic situation, the following

can be highlighted. These observations and suggestions can be calibrated in other tourism contexts, beyond the lacustrine one.

• The municipalities tend not to follow the instructions provided in the UNI 11686: 2017 standard to unify the colours of the bins in different European cities, generating multichromatic chaos considering that a tourist migrates from municipality to municipality during its stay. Thus, the homogeneity of colours is a priority that should be more perceived in tourist areas from the administrators.

• As demonstrated from specific photographs, inherited collection strategies vary between neighbouring municipalities, from collection through road containers to kerbside collection service, creating an inhomogeneous approach. This is also a consequence of the idea that in the same municipality, areas with tourist fluxes must be managed differently from residential areas. In this case an effort should be made for guaranteeing homogeneity too.

• Changes in the strategies can cause a mix of containers with different characteristics and structure that affect the quality of the street furniture. In this case the problem is to develop a strategy of collection optimised from the beginning.

• From a technological point of view, innovations such as the smartphone application presented above, will make it easier to adapt tourists to local collection strategies. Again, the homogeneity in its use should be compulsory.

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