MUNICIPAL SOLID WASTE MANAGEMENT IN ITALIAN AND ROMANIAN TOURIST AREAS

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Tourism is a great source of employment and income in the economies of many regions, but also a source of environmental impacts. The main consequences are the increase of generation of Municipal Solid Waste (MSW) and the effects in their management. The tourist presence affects the territory in terms of amount produced of MSW, but also of quality of Selective Collection (SC). In this paper three case studies are analysed in order to see the possible criticality in waste management about these areas and also taking into account strategies of energy recovery from Residual Municipal Solid Waste (RMSW). The case studies concern a tourist area in the North of Italy and one in the South of Italy, while another one in a Romanian region. In the summer season (June-August) the increase in waste production is clearly visible according to the Italian data. The opposite behaviour is observed for percentage of SC. The tourists' behaviour influences negatively the SC's efficiency, above all in the South Italy case.

Keywords: municipal solid waste, selective collection, tourist area.

List of abbreviations:

- ATO: Ambito Territoriale Ottimale/Optimal Territorial Area
- MSW: municipal solid waste; -SC: selective collection;
- RMSW: residual municipal solid waste;
- EU: European Union; - SRF: solid recovered fuel;
- BMT: bio-mechanical treatment.

1. Introduction

Tourism can sustain high levels of employment and income in the economies of many regions. However, the sector is a source of environmental impacts; one of the most important impacts of tourism is the generation of municipal solid waste (MSW) [1]. Many studies have reported this phenomenon where MSW increases with the seasonal population of the tourist areas [2,3,4,5].

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The MSW sector has been under revision in the last years in the European Union (EU). New directives were issued in order to achieve high efficiencies of recycling and recovery through selective collection (SC) implementation and thermal treatments. Energy recovery concerns mainly residual municipal solid waste (RMSW) as is or Solid Recovered Fuel (SRF) obtained from RMSW. The 2008/98/EC directive has introduced several innovative aspects in the urban waste policy, with a considerable impact on local policies [6]. This regulation was transposed in Italy through the Legislative Decree n. 205 of 10 December 2010 [7], introducing significant changes to strengthen the principles of precaution and prevention in waste management, maximizing recycling - recovery and to ensure that all the operations of waste management, starting from collection, must be carried out in accordance to the environmental standards. In the Directive there are targets for recycling and re-use to be achieved by 2020.

The same Decree also changed the sector of SRF. The Decree suggests its utilization in different industrial plants taking into account three main parameters: lower heating value (economic parameter), chlorine (technologic parameter) and mercury (environmental parameter) content [8, 9]. Each parameter is divided in 5 classes, where the first one is the best and the fifth the worst. Of course the conventional waste-to-energy option, i.e. incineration, can be still performed according to more and more stringent regulations.

Tourism can affect quantity and quality of MSW and can modify the management of existing plants as incinerators [10,11]. In particular, in tourist regions the significant presence of tourists and the consequent accommodation facilities (which often do not organize SC) are one of the main causes of the bad results in terms of SC performance [12,13]. Other causes of inefficiency are lack of awareness of the citizens, lack of correct information by public administration, etc [14, 15, 16, 17].

At Romanian level one of the most recent legal documents that have as main purpose the transposition of 2008/98/EC directive is GD no 870/2013 regarding National strategy for waste management between 2014 and 2020 [18]. Through this strategy, short terms and long terms objectives are established. Tourism development increases the amount of waste generated in various tourist destinations [19, 20, 21, 22], threatening the local environment due to improper waste management facilities [23].

In this paper three case studies are analysed in order to point out some criteria useful for a correct MSW management in tourist areas. Also the influence of SC on the future and present strategies of energy recovery are analysed and discussed. Indeed, one of the aims of this paper is to show the link between the tourist streams in some areas and the change of MSW and RMSW production and its influence on the SC. Another aim concerns the comparative demonstration of the importance of specific data availability on waste generated from tourism.

2. Materials and methods

Two Italian case studies have been selected, one in the North and another one in the South of Italy; a third case concerns a Romanian area.

For each case study, when available, data about residential population, tourism stream that affects the area in exam and data about the monthly production of MSW for the year 2012 have been collected and analysed.

When available, through these data it is possible to determine the influence of the tourist stream on the MSW production and how SC changes during the seasons.

In some Italian regions SC is not yet optimized, thus the composition of the RMSW, i.e. the stream not collected separately for recycling purposes, is expected to change significantly in time [24, 25]. The two Italian areas have significant differences today, but a similar target for the future. Both the regions must face with the EU target of 65% of SC and at least 50% re-use and recycling [26, 27]. In the first case study, concerning Trentino, SC has reached significant results but in tourist areas some troubles must be solved yet [5]. In the second case study, concerning Apulia, SC has not yet reached a high efficiency, MSW collection in tourist areas must be optimized and an incinerator is present.

Trentino is an autonomous province of Italy located in the north of Italy. The province is divided into 217 municipalities. The province covers an area of more than 6,000 km^2, with a total population of 530,308 inhabitants. Tourism is a very important point in the provincial economy: the winter tourism is focused in the mountain areas for skiing and other activities related to snow, while the summer tourism is focused in the Garda lake area and in the mountain areas for trekking activities. For these reasons two different "Valley Communities" that take part to the province of Trento were chosen. The first case concerns a tourist area (48,667 residents) called Alto Garda e Ledro community. The second one is the Val di Fassa community (10.006 residents) concerned from both of kinds of tourism.

In 2012 more than 3 million of tourists arrived in Trentino, whose about 1.3 million arrived in the winter season (from December to April) and 1.7 million in the summer season (from June to September). From the data of PAT 2013 for the local tourism it appears that in the Val di Fassa Community there are concentrated 20% of the tourist arrivals in the winter season and 16% of arrivals for the summer season, while in the Alto Garda e Ledro community is concentrated 23% of summer arrivals [28].

In Trentino, the current system for waste SC is different from a municipality to another. Some municipalities are serviced by street containers for all the collected fractions; others are serviced by street containers (only for paper and packaging) and kerbside collection of RMSW and food waste; others are

serviced by kerbside collection (door to door collection) for every kind of waste. In the door-to-door collection each family has four containers respectively for the collection of paper (yellow container), glass (light green container), organic waste (brown container) and RMSW collection (dark green container) and these are collected two or three times per week. The multi material fraction (packaging waste) is collected in a blue bag once per week. Since January 2013 the new national legislation came in force for the management of the tariff on waste and municipal tax on services called TARES. The new rate will be calculated taking into account not only the surface of the house and the number of components (fixed fee), but also the average volume of residual waste produced (variable fee) [28].

In Table 1 the average composition of the MSW streams in Trentino for the year 2012 is presented.

Table 1

MSW composition for Trentino (RMSW and SC fractions) 2012 [28]

Waste Categories	Ton	%	Waste Categories	ton	%
Food Waste	49,395.8	18.3	Wood	11,036.94	4.09
Green Waste	18,318.9	6.8	Textile	909.91	0.34
Paper and Cardboard	42,402.6	15.7	WEEE	3,639.55	1.35
Mixed Material	29,466.2	10.9	Hazardous	1,001.60	0.37
Glass	10,957.0	4.1	Inert	8,596.73	3.18
Metal	3,858.5	1.4	Others	2,141.58	0.79
Plastic	2,854.4	1.1	RMSW	85,585.40	31.68

The second Italian case study concerns a region in the South of Italy (Apulia) with around 4.1 million of inhabitants and it comprises 19,345 km^2. The region is divided in 5 provinces and 15 ATO (Ambito Territoriale Ottimale/Optimal Territorial Area). Two different sub-areas of the region are examined, both characterized by a large stream of tourists in the summer months.

The first sub-area concerns a municipality in the ATO FG/1 (110,328 residents) called Vieste (13,601 residents). The second one is in the ATO LE/2 (260,923 residents) and is called Gallipoli (20,259 residents) [29]. In 2012 more than 3 million of tourist arrivals in the region were registered. The main stream is concentrated in the summer season (from June to September) and it arrives until above 60% of total yearly arrivals. In several areas of the region the tourist fluxes affect the local MSW generation with a noteworthy increase of inhabitant equivalent in summer. Some tourist areas increase their population up to 100% during the summer period. The not adequate summer waste collection system creates problems for the whole community and sometimes for the tourist development too. Both Gallipoli and Vieste fall within the top 15 cities in the Apulia region where there is the highest number of tourist arrivals for the year

2012; in particular Vieste is in second place with 246,000 tourist arrivals and Gallipoli in ninth place with 87,000 tourist arrivals [30]. SC has grown up only in the last five years, and now thanks to road and kerbside collection reaches 19.8%. Kerbside system is operated by three domiciliary visits per week for the different waste fractions. In the summer period, the kerbside collection increases to 4 times per week. Each family has four containers respectively for the collection of paper (blue container), plastic and aluminium (yellow container), organic waste (brown container) and residual MSW collection (grey container). Users are required to deposit containers near their homes in scheduled time to facilitate kerbside collection. However, in the summer period, due to the high number of tourists in the streets even at night, the system of kerbside collection could prove problematic.

In Table 2 the MSW composition is presented for the Apulia region. Compared to Trentino, the dominance of RMSW is clear as a consequence of the low value of SC.

Table 2

MSW composition for Apulia (RMSW and SC fractions) 2012 [31]

Waste Categories	Ton	%	Waste Categories	Ton	%
Food Waste	59,544.8	3.1	Wood	3,046.5	0.2
Green Waste	14,136.4	0.7	Textile	5,138.8	0.3
Paper and Cardboard	113,252.6	6.0	WEEE	7,509.4	0.4
Mixed Material	20,281.8	1.1	Hazardous	380.7	0.0
Glass	48,918.6	2.6	Inert	1,185.0	0.1
Metal	28,627.9	1.5	Others	49,301.8	2.6
Plastic	23,742.0	1.3	RMSW	1,517,023.4	80.2

A case study will be presented also for a tourist area of Romania, more precisely for the Neamt County for a comparison with the Italian ones. Neamt County's rural territory has a high tourist potential, including protected areas (national & natural parks, protected areas), spa resorts, monastic complexes, monasteries and churches as historical monuments [22]. Romania is part of the new EU members where most of the quantities of MSW collected are disposed of in landfills, whilst recycling and recovery operations are used to a very limited extent. The food waste percentage in MSW is about 50%, as a consequence of a limited use of packaging [33,34]. During the years different studies for proposing an environmental friendly management of MSW were developed [32, 33, 34, 35].

3. Results and discussion

In Trentino, the regional average efficiency of SC is high (SC=68.2%, 2012) but the tourist areas in the region are facing with the problem of

guaranteeing the quality of the SC streams. The present average SC efficiency in the district of Alto Garda is 57.8% and in the Val di Fassa district is 64.9%, both lower than the regional average [28]. The efficiency of SC and the monthly per-capita generation of MSW and RMSW during 2012 are presented in Figure 1 and Figure 2. It is clear that the arrival of tourists gives a change in the SC efficiency and monthly pre-capita generation in the summer season (mostly in August) in the two communities. A partial explanation is that significant part of tourists comes from aboard, with consequent problems of understanding of the SC criteria and relative increase in MSW and RMSW generation. For the community of Val di Fassa is possible to see other peaks of MSW/RMSW generation in the winter months; this happens because the district is interested by winter tourism.

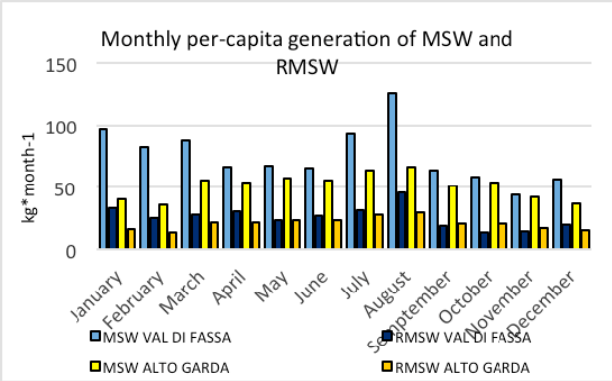

Fig. 1: Monthly per-capita generation of MSW and RMSW in the Val di Fassa and Alto Garda e Ledro community. [28]

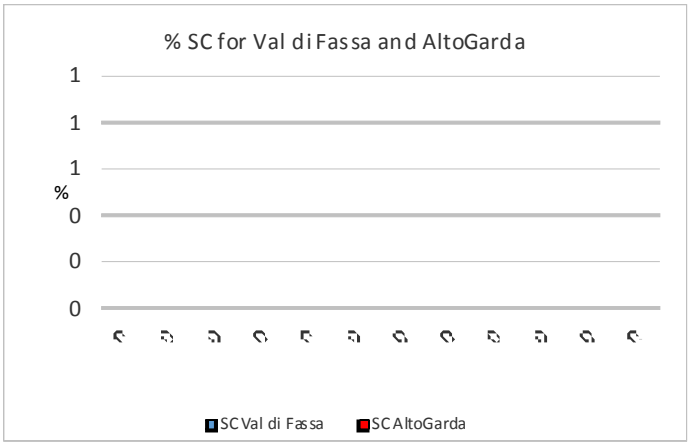

Fig. 2: Percentage of SC during 2012 for the Val di Fassa and Alto Garda e Ledro community [28]

Even if the Alto Garda area shows SC efficiency in agreement with the EU targets, the local results are considered regular compared to the highest

performances obtained in most of the region [24] (in the Val di Fassa area the % of SC is highest). The main problem of this area concerns the difficulty that tourist users have to be accustomed to a waste collection generally quite different to their area of origin. A tourist could have a too short time to learn the rules of the collection system before the end of the holiday. This effect is not present in the area of Val di Non, its means that the mountain tourist are more careful about the SC compared with the other.

Concerning Apulia, in Figures 3 and 4 the dynamics of the amount of per-capita RMSW/MSW production and of the SC efficiencies for the two municipalities are reported. It must be noticed that the summer period shows the lowest values of SC and the highest values of RMSW/MSW generation. This can be explained by the inefficient behaviour of the tourists in SC activities and on the increase of population equivalent in the summer period. Compared to the Trentino cases, the peaks of August are more visible.

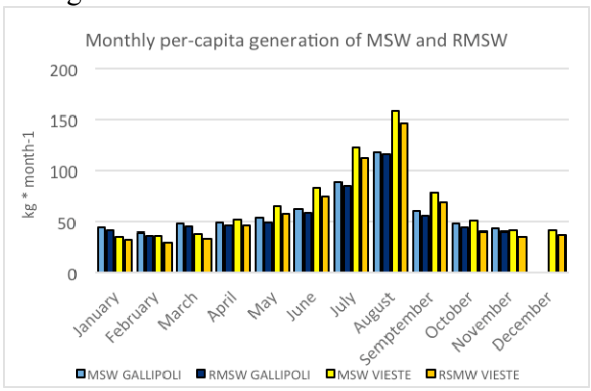

Fig. 3: Monthly per-capita generation of MSW for Gallipoli and Vieste (data on waste collection for Gallipoli in December were not available)

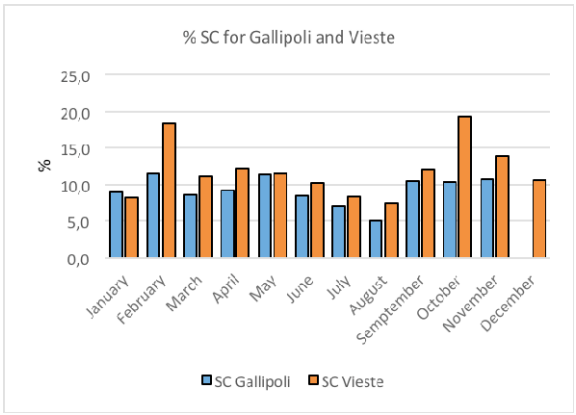

Fig. 4: Percentage of SC during 2012 for Gallipoli and Vieste (data on waste collection for Gallipoli in December were not available)

From the data analysis of case study of Apulia a decrease of the SC average in the four summer months (from June to September) compared to the remaining eight months of the year can be observed. For the year 2012 the % of SC result 19.8%. Values about the cases study are reported as follows:

- Gallipoli: from 51,7 kg RMSW (as average in 12 months) to 79.2 kg for the summer season (+53%). From 10.1 % of SC in the eight months to 7.7 % in the four summer months (-23.1%);
- Vieste: from 59.7 kg RMSW (as average in 12 months) to 100.6 kg for the summer season (+68.4%). From 13.1 % of SC in the eight months to 9.5 % in the four summer months (-27.6%).

In the Romanian case study, it was observed that the estimated amounts of waste generated by tourists in the year 2010, according to the National Institute of Statistic, are much smaller than those generated by urban population in a single day (Piatra Neam□, Roman, Târgu Neam□, Roznov) being almost equal in the case of Bicaz. In this context, tourism implications on local MSW management in urban areas are limited but may contribute to illegal dumping in the absence of a proper MSW management service. In rural territory, this impact is more visible due to a rudimentary waste management infrastructure in most of villages where tourism may be an alternative option for a sustainable local development [22]. Regarding the structure of MSW in Romania, according to the Environmental Ministry, the largest share is the household waste (about 64%), while street waste and construction and demolition waste have about the same percentage (10% and 9%), and only a little part regards the electric and electronic waste [36]. Over 90% of the collected waste is disposed of in landfills [18]. In what regards the estimated amounts of MSW generated by tourists expressed in absolute values (kg y^{-1}) values are higher in Bălțăteşti (32,150 kg y^{-1}) where the longest duration of stay for a tourist is registered, but which also has a smaller number of total tourists (4,105) than others villages (Ceahlău, Agapia, Alexandru cel Bun) but having a shorter duration of stay per tourist. Thus, it explains the differences between Bălțăteşti and others tourist villages [23]. According to the data obtained it is noticed that the current impact of tourism on waste generation is insignificant in most urban areas and also for tourist localities from rural areas, but it is expected to increase in the following years. Estimated quantities of the waste generated by tourists are less than 1% of the household waste generated by rural communities in a year. This share exceeds the threshold of 1% and 1-2% only for some areas like Agapia, and Ceahlău with 4.2%. The available data for this area resulted very limited compared to the Italian ones, demonstrating that the evolution of the sector of MSW management in Romania is not yet complete. Decision makes could have some difficulties at local level for lack of information. Different master plans were developed but a real implementation is not yet reached.

The above reported considerations concern MSW characteristics, but the topic of tourism regards also the treatment plants.

In the case study of Trentino the incineration was planned with a capacity equal to the RMSW expected with a SC of 65%. This means no landfilling of RMSW when the plant would be operating. In the year 2012 the SC was equal to the 68.3% and the annual pre-capita amount of RSMSW 161.4 kg, for a total 85,591.7 t y^{-1} of RMSW. As a consequence of the recent increase of SC (expected to overcome 70% in 2014) the local Province decided to modify the RMSW strategy opening to the generation of SRF to be used in plants out of Trentino. Indeed the amount of RMSW has become too low to guarantee an economically sustainable incinerator.

The tourist fluxes affect the local MSW and RMSW generation in the community studies. The main results obtained are listed below:

- Val di Fassa: from 26.4 kg RMSW (as average in 12 months) to 31.3 kg for the summer season (+15.4%). From 65.0 % of SC in the eight months to 63.8 % in the four summer months (-1.8 %);
- Alto Garda: from 21.6 kg RMSW (as average in 12 months) to 26.1 kg for the summer season (+17.0%). From 58.9 % of SC in the eight months to 56 % in the four summer months (-5.14 %);

It is clear that a variability of the RMSW during the tourist seasons (winter and summer) could overload a centralised plant. In reality as the plant was proposed for the overall amount of RMSW at provincial level, the peaks of RMSW collection in some tourist areas are "diluted" in a wider amount of steady RMSW streams collected from more residential areas. The Lower Heating Value (LHV) of the input of the plant was assessed to be around 12 MJ kg^{-1} as effect of the low percentage of food waste. The generation of SRF will concentrate this energy in a lower amount of mass.

In Apulia, the low efficiency of SC in the area oriented the local authorities to a strategy based on a Bio-Mechanical Treatment (BMT), before combustion with energy recovery in the existing incineration plant. In 2012 in Apulia there are present 15 plants for the BMT that have treated about 1.5 million ton and 2 incineration plants [37]. The BMT was constructed and operates since 2006, in order to produce a refuse derived fuel from RMSW/MSW, and after 2010 it has been modified in order to produce SRF [7]. This is a typical BMT, exploiting the high percentage of food waste in RMSW (40%). The amount of SRF, produced by the BMT and treated yearly in the incinerator, demonstrates that the capacity of the plant is not calibrated on the total amount produced in the region (RMSW produced in the region for the year 2012 is 1,517,023.4 ton, while the waste treatment by incineration is 73,848.1 ton) [37]. That means that the variability of RMSW/MSW during the tourist season can be faced with a different use of landfilling (that compensates the limited incineration capacity). Indeed in

Apulia still 59% of the waste produced is disposed of in landfills. The role of incineration depends strongly on the efficiency of SC (thus it depends also on the presence of tourism, indirectly). Though the role of incineration is already quite important in Apulia, it should have a more crucial role in the MSW management due to the expected evolution of the SC service.

Concerning the Romanian case, although the role of tourism is still limited, tourists (and local population) contribute to uncontrolled waste disposal in the absence of organized collection services [23]. The present plant strategy is based only on the modernization of the landfills. However a deeper collection of data should be organized in order to be ready when tourism will develop its importance.

6. Conclusions

This paper analyses three case studies where tourism significantly affects RMSW/MSW generation and SC efficiency. In the first case study, two peaks are visible during the year and the MSW management is well suited for the tourist income increase. In the second case study, the high summer peak and the lack in the SC system result in some inefficiencies. The available data demonstrate that the fluctuations of RMSW can be significant, but on a wider area of collection the effect of "dilution" in more steady RMSW streams can reduce significantly the consequences on design and management of incineration.

Concerning the Romanian case, it was pointed out that the present contribution of tourism on the overall generation of waste is still low, but there is a risk of waste dumping.

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