

# Potential for Recovery of Recyclables from the Mixed Municipal Solid Waste of the Municipality of Lesvos, Greece

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Municipal Solid Waste (MSW) separation at the source (e.i.: at household level) has been strongly promoted in EU countries; however, a large volume of recyclable materials is still disposed along with mixed MSW. The percentage of recyclable materials in the mixed MSW is a function of local infrastructure (availability of special collection points) but also depends on the habits of the people and on the promotion by the local authorities (Zorpas *et al.*, 2015). In many EU regions, the degree of separated collection of recyclables is far from the targets set by the Waste Management Directive 2008/98/EC (EU, 2008). In such cases, it is wise considering the separation of recyclables from mixed MSW (Cimpan *et al.*, 2015). The insular EU areas, and particularly the ones in the Mediterranean, are environmentally sensitive regions, with comparatively lower fraction of source separated MSW (compared with other EU regions) (Zorpas *et al.*, 2015).

Lesvos, is a Greek island at the Eastern Aegean, with population 86.436 inhabitants (census 2011), with average MSW production of about 40.000 tons/year. Currently, the MSW system of Lesvos island, includes source separation of recyclables, collected in recycling bins (blue bins), while the rest MSW (collected in green bins) is being landfilled. The collected amount of recyclables (in the blue bin) is far from achieving the targets set by the EU for 2020 (EU, 2008), while the Municipality of Lesvos loses significant revenue from non-sale of the recyclables contained in the mixed waste (instead it pays tipping fee for landfilling). The aim of the present study is to investigate the composition of the MSW generated in Lesvos, so as to propose alternative ways for a better utilization of the recyclable materials and for achieving the EU target for 2020.

Lesvos island does not have mechanical sorting facilities; thus, in order to analyze the composition of MSW, 40 tons of Lesvos' MSW, from the green bin, were shipped to Chania, Crete, Greece and sorted in the modern waste management facility of DEDISA (DEDISA, 2017), which is equipped with sensor-based sorting technology (Tomra Systems ASA, Norway). The MSW was loaded on trucks and was shipped overnight to Chania by commercial ferry boat. Loading and unloading of the MSW was made under strict conditions so as to eliminate interference with other materials. The MSW was sorted and various types of recyclable materials were separated: paper, board, films, FE, NE, PET bottles, HDPE, PP. The remaining organic fraction and residual materials were also quantified. The composition of MSW is shown in Table 1.

Table 1. Composition of mixed MSW transported for sorting from Lesvos to DEDISA facilities in Chania.

Type of material	kg	% (w/w)
Brown board > 250mm	570	1.35
Mixed paper 70 - 250mm	1,683	4.00
FE metal 0 - 250mm	590	1.40
NE metal 70 - 250mm	184	0.44
Film > 250mm	449	1.07
Mixed color film 70 - 250mm	1,891	4.49
PET bottles 70 - 250mm	387	0.92
HDPE 70 - 250mm	223	0.53
PP 70 - 250mm	182	0.43
Beverage carton	40	0,10
PS	63,12	0,15
Organic < 70mm	21,174	50.32
Rest > 250mm	720	1.71
Pre sorting	1,810	4.30
Residue 70 - 250mm	12,114	28.79
Total	42,080	100.00

The results revealed that approximately 5.527 tons of recyclables/per year are found in green bins and disposed in the landfill of Lesvos. The latter quantity is four times greater than the materials collected following the current recycling system implemented on the island (1285 tons/year). These recyclables instead of being landfilled, could be separated and traded using a number of solid waste shoring processes (Gundupalli *et al.*, 2017). The per capita amount of recyclables that is disposed to Lesvos landfill per annum is shown in Figure 1.

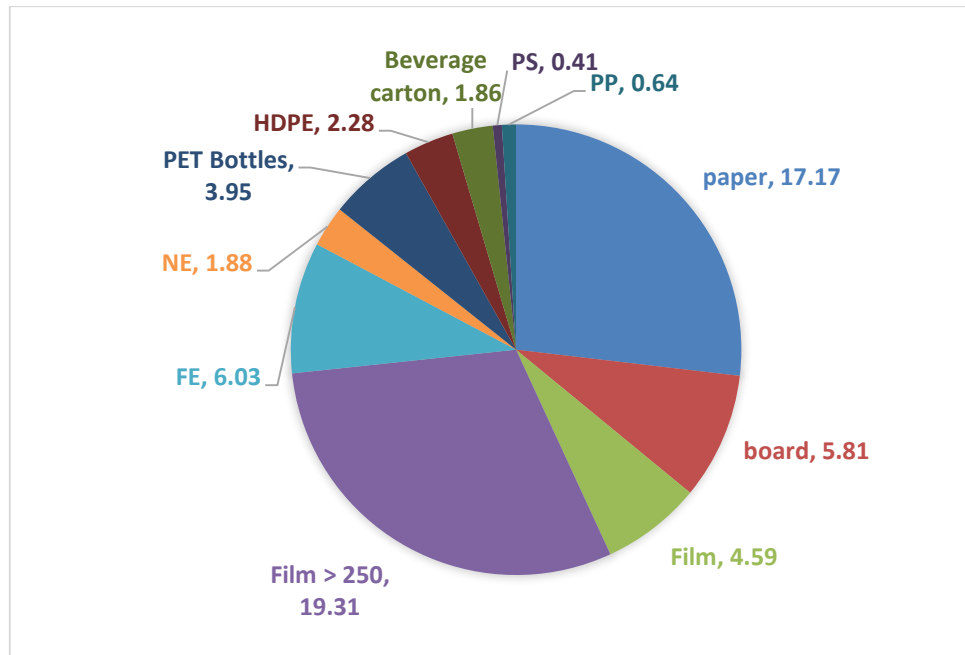


Figure 1. Per capita amount of recyclables, that is disposed in Lesvos landfill per year (kg/year).

In order to explore the most profitable solutions for the island of Lesvos there were two scenarios analyzed and compared to the current waste management system. The first option concerns a semi-automatic sorting plant which separates recyclables both from the blue bins (recyclables bins) and from the green bins (mixed waste bins), while the second includes sorting of dry materials (packaging and mixed waste) and composting of wet materials (including organic). The results highlight that the current system leads to 86% losses of recyclables. On the other hand, the implementation of a sorting solution would reverse this situation by recovering about 80% of the recyclables. The financial study of the possible scenarios also highlights the consequent differences between the revenues deriving from selling the recovered recyclables. It has been calculated that the current revenue from the recyclables is about 89.000 €/year while it could rise up to about 578.000 €/year or 600.000 €/year, by implementing the two different sorting scenarios, respectively. Comparing the two sorting solutions it can be observed that both are feasible and cost-beneficial, offering high recycling rates and revenues. However, the inclusion of the separation and process of wet/organic materials increases the total investment cost (CAPEX). Therefore, the first sorting solution appears more attractive.

Given the low recyclable rates recorded in Lesvos so far, this study suggests the necessity of a revised strategy regarding the waste management system and its priorities. An optimal solution should be applied in order for the Municipality to adopt a sustainable system in line with the relevant targets set by the EU.

## References

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