

Waste management on small islands: A case study from Samothraki, Greece

Preliminary Publication

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Introduction

It all began with waste. Members of the local civil society group “*Samothraki in Action*” were concerned about effects on human health as well as environmental degradation caused by the lack of sufficient waste management on Samothraki. Waste was then deposited in open dumps or incinerated without control. In 2007, the concerned citizens approached a long term visitor of the island, who happened to be an environmental scientist, and asked for her support in finding more sustainable solutions. After nine years of collaborative research and local initiatives the island community embarked on a transformative journey towards engaging in more sustainable practices, in which the open burning of waste admittedly came to an end. Yet, the management of waste still poses a major challenge.

The north-aegean island of Samothraki has an area of 178 km² and is inhabited by 2.840 people (census 2011) of which the majority is occupied in the primary and tourism sector. Due to Samothraki’s mountainous morphology (most of it included in the EU Natura 2000 network), the numerous water streams and the plethora of archaeological sites, it is not possible to establish a landfill site on the island that would comply with national environmental and cultural regulations and would also have sufficient distance from settlements. Consequently, the approximately 1.100 t of annually generated waste, including 8% recyclable waste, need to be shipped to landfills and recycling facilities on the mainland at high cost (Municipality of Samothraki 2015). Treating waste on site as much as possible would relieve the budget of the municipality but solid waste management on islands often faces various challenges. Financing options are often limited, since the local tax base is low, and the small market size and the relatively low amounts of waste are additional barriers for businesses to recycle profitably. Moreover, businesses on islands face higher costs (e.g. transport to and from the mainland), have to deal with seasonal fluctuations (e.g. tourism) and cannot compensate demand or supply shortfalls easily, which makes them less competitive (Skordilis 2003; Chen et al. 2004; Eckelman et al. 2014). Due to a lack of income opportunities, the local population has been declining since the 1960s and the persistent Greek financial crisis impedes both maintaining and investing in local infrastructure (Fischer-Kowalski et al. 2011; Petridis and

Fischer-Kowalski 2016). Like most insular and coastal areas, Samothraki is also receiving marine litter and is affected by coastal pollution. In addition, waste containers get frequently destroyed by strong winds, which further disperse waste across the island, into water streams or into the sea.

The aim of this study was to acquire a better understanding of the waste system on Samothraki in order to assist the municipality in implementing the new waste management plan (Municipality of Samothraki 2015), as a basis for steering the local economy towards resource circularity (Haas et al. 2016).

Methods

In July 2016, the authors conducted five expert interviews in order to obtain a thorough understanding of the local waste management system, and to identify legal and illegal waste disposal sites and practices. Persons interviewed included (1) the vice Mayor, (2) a senior employee of the municipality responsible of waste collection, (3) a member of the local initiative *Samothraki in Action*, (4) a member of the social cooperative *Zathay* that manages the café at the municipal camping site, and (5) an expert in the field of Industrial Ecology from Yale University, USA. Moreover, we visited the central municipal waste treatment facility of the island, as well as eight legal and illegal waste disposal sites, and documented their use via GPS and photos. On top, we surveyed five municipal waste bins using composition analysis (Gidarakos 2005), by measuring the share of organic, plastic, paper, metal, glass and other waste in bins for mixed and recyclable waste. Finally, five shops were investigated to assess if there is a deposit system for glass bottles in place on the island and to which extent it is used by the local and visitor population.

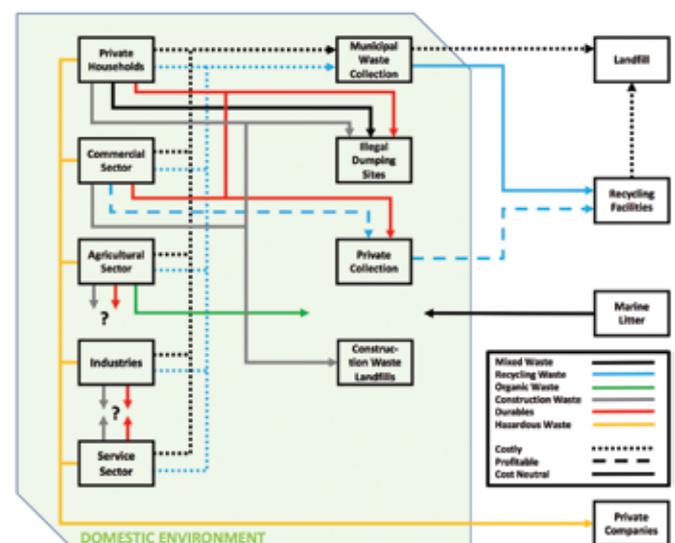


Figure 1. Qualitative waste flow chart of Samothraki.

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Findings

Figure 1 shows a first effort in producing a qualitative waste flow map for Samothraki. We identify five main sectors producing waste: household, commercial, agricultural, industrial and service. The municipality provides blue bins (blue dotted lines) for recycling (glass, metals, plastic, paper) and green and/or black bins (black dotted lines) for mixed waste. The composition analysis revealed that the municipal waste bins contain a relatively high share (mixed 59%; recycling 35%) of organic waste and confirmed indications that the system is not used efficiently (*expert interview 1 & 2*). On average, one mixed waste bin with a volume of 1.100 lt is provided per 6 inhabitants by a government regulation (*expert interview 2*). These are collected by one of 6 garbage trucks and delivered to the municipal waste collection site, from where waste gets transported by ferry to the mainland to recycling facilities or landfills. The dotted lines indicate that these flows pose costs to the municipality. The local waste management system is financed only through waste taxes per m² of living/working space and, as those are fixed, this provides no incentive for waste separation (*expert interview 1*). As a side effect of the high cost of transporting the waste to the mainland, there is a lack of budget to hire sufficient personnel to manage the waste infrastructure on the island.

Solid lines represent cost-neutral flows, while dashed lines denote financial revenues from waste. The solid blue line from the municipal waste collection to recycling facilities on the mainland indicate that the cost of transport is leveled out by the revenues from recycling. The dashed blue lines from the commercial sector to private collectors indicate that private collectors buy recyclable waste from commercial enterprises (for example plastic bottles and aluminum cans collected at the municipal camping) and sell them for revenue (dashed blue line) to recycling facilities (*expert interview 4*).



Photo 1. Municipal waste collection site between Alonia and Kamariotissa.

Red solid lines from private households and the commercial sector to either illegal dumping sites or private collectors indicate flows of refurbishing materials or durables, which are cost neutrally disposed by these sectors. All four local interviewees confirmed that illegal dumping is a big problem on the island. Waste on illegal dumping sites consists of mainly construction waste (grey lines) but also plastics and durables such as TVs, bicycles, furniture and other household electronics. Dead animals and slaughtering wastes were also found, which pose not only aesthetic but also hygienic problems. As observed on two locations, construction waste is also used as rubble to level uneven landscapes. Red and grey solid lines from the agricultural, industrial and service sectors could not be traced during our fieldwork and need to be assessed in the future. The agricultural sector also produces a large amount of organic waste that is assumed to be reintroduced into the system as indicated by a solid green arrow into the domestic environment. An additional waste inflow on Samothraki are “floating imports of waste” brought by the sea, indicated by a black solid arrow from marine litter to the domestic environment. There is also waste dumping from fisheries and tourists on the islands’ coasts, which can be considered as illegal dumping. Finally, hazardous waste from all sectors like old batteries, oil, or hospital waste are collected by private companies from the mainland and are depicted by an orange line. Finally, our investigation from five supermarkets revealed that there is a functioning deposit system for bottles in place.

Conclusion

The systemic assessment of local waste flows shows that waste management on Samothraki is currently handled by a combination of municipal services and formal or informal business operators, often acting out of economic needs to reuse products as long as humanly possible. Some of the main challenges are to reduce the large share of organic waste in the municipal waste



Photo 2. Illegal dumping site between Kamariotissa and Chora.

containers, increase the share and “purity” of recyclable waste, and control illegal dumping sites – all reflected in the municipal waste management plan (Municipality of Samothraki 2015). In order to be able to assist the municipality in developing an action plan for a more efficient waste management system we identify four issues that warrant further investigation:

- Waste flows need to be analyzed in greater detail to identify opportunities for the use of secondary resources to “substitute for imports and simultaneously reduce waste generation” (Eckelman and Chertow 2009).
- The reasons behind the non-functioning recycling system need to be assessed via a qualitative survey of private households and local businesses.
- The economics of waste, not the least of which agricultural by-products, must be assessed through an in-depth analysis of all monetary flows linked to waste flows.
- The separation and minimization of organic waste may be reinforced by joint initiatives in collaboration with the local population, e.g. by establishing central composting sites in villages or schools. Citizen Science, a recent initiative to include citizens in the research process, can be a helpful tool in implementing such strategies (Fischer-Kowalski et al. 2016).

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Photo 3. Informal waste collection site contains mainly durables.

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Photo 4. Transport of waste containers to the mainland by ferry.