

Waste Management on Islands

Potential Policy Changes Towards Sustainable Waste Management
Systems

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Konstantina Ouzounoglou

Abstract

In the last three decades insular areas are in continuous research because their unique characteristics indicate them as “ideal laboratories” for the application of different systems. Waste management systems in particular, are considered to be among the most intriguing of issues, because of insular specificities, such as remoteness, level of insularity (possibility of double or multiple insularity), and the social and economic aspects that are related to seasonality. The main objective of this research is to identify and suggest potential changes at both municipal (Municipality of Naxos and Small Cyclades in Greece) and European level that would facilitate the transition to more sustainable waste management practices on the islands. An examination of waste management practices in selected insular municipalities in Sweden, Denmark, Netherlands, United Kingdom, Spain, Malta and Croatia are used as input for the analysis of system changes in the main case study of Naxos and Small Cyclades municipality. The use of a framework built on the three pillars of sustainable development as a basic approach helped to bring together the approach for integrated solid waste management and the principles of waste hierarchy in terms of high level of resilience in order to reach long-term sustainability. The analysis and the structure of the research is based on methodological steps that focus on the identification of existing waste management practices and policy implications that are related to environmental, social and economic aspects. The main findings are related not only to potential lock-in effects or system dynamics, such as fluctuation of population and waste generated due to tourism, but also to lack of trust to the system and authorities, lack of cooperation between the relevant stakeholders and the difficulty of generalisation of waste management practices. The main findings point to the fact that there is a need of changing paradigms towards a bottom-up hierarchy that will be based in cooperation that would secure the social cohesion and active participation.

Keywords: Waste management, insularity, seasonality, transportation costs, resilience

Executive Summary

The main purpose of this research is to contribute by providing the reader with both good and bad experiences from waste management systems being adopted on islands of European countries and examine how these experiences could be used to enhance the waste management in the municipality of Naxos and the Small Cyclades in Greece. The study will further explore how islands are addressed in existing EU and national waste management policies and explore whether changes could facilitate the solution to local challenges on islands.

If a researcher takes a look at the current EU policies that are related to the islands, he will realise that until now there is no specific framework that addresses dynamic problems in relation to waste management. The concept of insularity is recognised relatively early because of the outermost regions that include the Canary Islands, Madeira and Azores, but not islands that are located to the north or in the Mediterranean Sea, even if they are placed in the periphery of the EU. Regarding the waste management sector, the islands are a category of territory that faces extensive environmental, social and economic stresses, because of dynamic factors, such as population fluctuation, finite natural resources, seasonality of economic activities due to extreme tourism, difficulties to employ large-scale solutions and high transportation cost. On the other hand, it is a great opportunity for the creation of a self-sufficient waste management system, because of the size of these islands that helps in the quick transfer of knowledge and the strengthening of the circular background. Ongoing continuous changes in European recycling targets and regulations could be considered as a great opportunity for restructuring the priorities that are anyway needed to be addressed and re-establishing the paradigms under which the waste management systems aim to serve.

To achieve the purpose of this thesis, the research conducted is based on the analysis of three research questions. Under the first research question, *“What are the features of the municipal waste management systems in European islands that are particularly well adapted to island conditions?”*, the brief outline of the European laws and policies for waste management works as a stepping stone to the review of MSWN practices on European islands. This review is based on desk research, interviews and articles in order to identify problems, challenges, and transferable examples. From Northern Europe, the islands of Tjörn in Sweden, Samsø in Denmark, Ameland in the Netherlands, and Shetland and Orkney in the UK are chosen. In the South attention was given to Formentera from the Autonomous Community of Balearic Islands in Spain, Gozo Island in Malta and the Island of Hvar in Croatia.

The research continues with the question *“How can the municipal waste management system in the municipality of Naxos and Small Cyclades be changed to be more sustainable?”* By exploring the current situation in the area of the South Aegean Region and focusing on the practices of Naxos and Small Cyclades Municipality, suggestions towards system changes arise with the use of the experience gained from the European islands.

Finally, to answer the third question *“How can policy changes on national and/or EU level facilitate the transition to more sustainable waste management practices on islands?”*, all the study cases are explored for policy implications that have already or still have to address. The findings and potential policy changes based on principals of diversification and cooperation are presented in the Sections 3.4 and 3.5.

The retrieval of data is based on documents through desk research and interviews. The documents include administrative documents, academic reports and articles, while the majority of the interviews were held with the use of Skype or phone call and are based in a semi-structured questionnaire sent in advance through e-mail to the interviewees. The interviewees

were mainly people from public agencies, companies or experts that are related to the waste management of the municipality under investigation (see Appendix III). In the case of the Municipality of Naxos and Small Cyclades, the snowballing technique is also utilised for the identification of a broader set of key informants (see Appendix III).

The choice of the seven case studies presented in the previous section ended up to be very useful, because they indicate different perspectives on what are the more sustainable waste management strategies. The first profound observation is that the approach that has been taken in waste management strategies of northern islands are towards pro-action in comparison to the southern islands that still have a reactive approach in order to keep up with the changes in EU legislation, even in the cases of southern islands that seem to do some improvements in the policy level and in networking. This behaviour is closely related to “lock-in effects” that are not including only the technical aspects but also concepts like “proximity”, “trust” and “learning” for the development of better local and regional waste management policies.

Looking into the policy implication, it is difficult for the insular to keep up with the changes in the EU legislation, this is why it would be much better to target for being beyond compliance, and this is not possible to be done if there is no change in living standards and change in the mind-set of how a society has to be structured. Moreover, the proximity issue in relation to the transportation costs and the absence of strict demands to producers and authorities for the implementation of EPR schemes in islands can create the opportunity of something similar to free-riding. Technological lock-in effects because of early investment on incinerators or biogas production when the capacities are still uncertain is another problem, as it influences the targets needed to be achieved.

Policy barriers related to the inability of creating indicators to relate the root problems with their effects are in place when we are talking about the social and environmental effects of extreme tourism. Physical characteristics of the islands indicate the uniqueness in terms of socio-cultural and economic development and environmental resilience, which means that there is need for the establishment of suitable criteria in order to facilitate the distribution of funds based on the actual needs and by taking into account dynamic factors like tourism. This indicates also that the generalisability of systems and practices are very difficult to be obtained. The level of political intervention in the system, in combination with the absence of different stakeholders during the policy and decision-making processes, limits information transparency and facilitates the establishment of a top-down hierarchy instead of a bottom-up. Finally, the absence of expertise in the islands might lead to difficulties in addressing complex environmental or social problems, such as exploitation of natural resources or lack of social cohesion, and adopt practices that would become a burden in the long-run.

In terms of policy changes, it is considered necessary to have a change of paradigms towards cooperation in horizontal and vertical governance, by redefining the goals and purposes towards enhanced social welfare and secured natural resources, instead of competition and fulfilment of individual interests. Cooperation will help in self-organisation of the system by keeping the potential open for new parties to enter and at the same time facilitate the establishment of a bottom-up hierarchy. There is need for ensuring feedback which would enable a “learning by doing” approach that keeps the system flexible enough to reformulate over time new policies that are based on realistic expectations and synergies for further development. At national and/or EU level, policy changes that could facilitate the transition to more sustainable local waste management practices on insular areas could be the establishment of a separate department at the EU level for managing issues arising on the islands such as the development of integrated framework for waste management and the

research for solutions for addressing the problem of transportation costs. Furthermore, the development and use of more dynamic indicators will reflect better the real social welfare, because currently seasonality and insularity are identified as concepts but not reflected in the current policies. Finally, the enforcement of mandatory EPR schemes on insular areas can be an important step for the promotion of synergies, Win-Win trading schemes and development of innovative system alternatives.

The recommendations for the Municipality of Naxos and Small Cyclades are focusing on both organisational and technical parameters with the most important to be the following:

- Reform the existing MSWM plan and establish new guidelines, goals and principles towards sustainability;
- Take the advantage of being part of “Pact of Islands”, where they can secure and expand the existing networking with other European countries and gain knowledge for improving indirectly the existing management practices and be consulted for awareness-raising campaigns and engagement of stakeholders in policy making and decision processes;
- Transpose practices from other countries by ensuring that the existing circular patterns will be protected and improved through job creation, economic affordability of new infrastructure based on living standards, and social acceptability by ensuring long-term environmental sustainability and social welfare;
- Strengthen the circularity of the fractions on the islands to ensure cost reduction with the use of monitoring and controlling processes, decentralisation of responsibilities, transparency on sharing information and cooperation with producers and institutions for innovative solutions.

The recommendations for future research is focused on the following seven points that according to the author are considered of great importance for the improvement and better understanding of a such complicated sector:

- Development of new dynamic indicators that take into account consumption patterns in relation to population fluctuation due to seasonality;
- Analysis of behavioural changes in consumption patterns and awareness after the use of low-cost waste management policies;
- Exploring how policy provisions for coastal and rural areas might influence the development of ISWM systems on islands;
- Explore examples of policies and practices on islands outside Europe that target to go beyond compliance in terms of European legislation and provide insights;
- Regarding cost reduction, ways for internalisation of transportation costs of different streams in relation to the level of involvement of private waste management companies in the MSWM plans and practices will provide great insights for the ways and conditions of better commercialisation of waste;

- Attention shall be given to the measuring and handling of marine litter as it could be considered as an additional fraction that is needed to be handled from the municipality.

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Abbreviations

C&D	Construction and Demolition
EC	European Commission
ESPON	European Spatial Planning Observation Network
EU	European Union
GDP	Gross Domestic Product
ISWM	Integrated Solid Waste Management
MBT	Mechanical Biological Treatment
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
POSEI	Programme d'Options Spécifiques à l'Éloignement et l'Insularité
UNEP	United Nations Environmental Programme
US EPA	United States Environmental Protection Agency
WM	Waste Management

1 Introduction

In this chapter, the reader is able to familiarise himself with concepts like insularity and seasonality and connect them to the generation of waste on islands. The challenges presented are accompanied with a brief initial discussion of opportunities for alternative solutions in insular systems. Finally, the aim, the research questions, the methodology and the limitations of the research are presented to explain how the research was conducted.

1.1 Background

During the last three decades, islands as part of the European territory started to attract researchers as places where simplicity and complexity are conflicting. The simplicity is related to the fact that islands could be characterised as “ideal laboratories” for research due to their defined size and flows (Spilanis et al., 2009). Complexity comes from how these defined in size systems face challenges like insularity and seasonality. Such complexity is met, not the least, if the focus is on waste management. In practice, these handicaps, such as small size, limited accessibility, remoteness and isolation and high dependence on small-scale economic activities with a small variety of local products, are issues that are challenging the resilience of the island systems more as compared to the mainland counterparts (ESPON, 2013b; POSEI, 2014; Royle, 2000). Furthermore, the finite natural resources in combination with vulnerable endogenous ecosystems and cultural environment impose the urgency of planning towards a high degree of environmental sustainability and protection (ESPON, 2013a).

At EU level, these vulnerabilities are first mentioned in Article 174 of the Treaty on European Union with the following statement: “Among the regions concerned, particular attention shall be paid to rural areas, areas affected by industrial transition, and regions which suffer from severe and permanent natural or demographic handicaps such as the northernmost regions with very low population density and island, cross-border and mountain regions”(ESPON, 2013a). In 2008, the Green paper on Territorial Cohesion recognises the challenges of islands towards development by stating that: “Island regions, which in many cases are mountainous and more than half of the population also live in a border region include 6 of the 7 outermost regions. (...)Their diversity makes generalisation difficult. These regions vary markedly in population size and GDP per head. Their GDP growth has also varied, reflecting differences in their economic structure with some being wholly dependent on tourism and others with strong diversified service sectors. The population increased in most of these regions between 1995 and 2004. Yet, many islands remain confronted with problems of accessibility, of small markets, and of high cost of basic public service provision and energy supply”(European Commission, 2008).

Insularity is not related only to one island but also to groups of islands, such as, for instance, Cyclades Islands, Shetland and Orkney Islands. Double insularity indicates the distances between the island and the closest mainland and other islands. Triple insularity is used for very small remote islands that administratively belong and depend on a bigger one and as a result look like satellites, such as the Small Cyclades (the islands Irakleia, Donousa, Schinoussa and Koufonisia) around Naxos Island in Greece. Exploring in depth factors such as insularity we can understand more how environment and society, in terms of diverse natural systems and quest for reasonable living standards, challenge policy-makers and decision-makers over the design of socially acceptable waste management plans.

Problems emerging from insularity, as well as those related to marginalisation, can be identified also to coastal islands and islands with permanent link to the mainland (Planistat

Europe, 2003). Based on these facts, the definition of islands is already considered incomplete, as it relies on Eurostat's criteria that determine that "islands must have an area of at least one sq. km, be at least one kilometre from the continent, have a permanent resident population of at least 50 people, have no permanent link with the continent, not house an EU capital" (Planistat Europe, 2003).

1.2 Problem Definition

The European Spatial Planning Observation Network (ESPON) has a supportive role to the Members States towards their development. The programmes developed from ESPON aim to "Support policy development in relation to the aim of territorial cohesion and a harmonious development of the European territory by (1) providing comparable information, evidence, analyses and scenarios on territorial dynamics and (2) revealing territorial capital and potentials for development of regions and larger territories contributing to European competitiveness, territorial cooperation and a sustainable and balanced development" (ESPON, 2007). The indicators used for the description and the analysis of economic effectiveness, social cohesion and environmental conservation in the islands are the following: GDP per capita, active population rate as percentage of the total population, unemployment rate, percentage of population older than 65 years of the total population and the percentage of artificial land of the total area (ESPON, 2010).

Population is a dynamic indicator because social characteristics and the type of economic development contribute to fluctuations. For example, every island has a permanent population that faces reduction because of, for instance, lack of educational institutions to provide higher education to students. This can aggravate the problems of aging population in the islands if the market cannot absorb such students after graduation, or the educational level might remain on the secondary level because people stay on the islands in order to work in the fields/farms or in the tourism sector. Extreme tourism in a specific period of time can cause overexploitation of natural resources and raise the imports and consumption of other than local products. This phenomenon does not lead only to increased quantities of Municipal Solid Waste (MSW) but also to the increase of specific waste streams, such as aluminium cans, glass bottles and paper and plastic packaging (Gidarakos, Havas, & Ntzamilis, 2006). This does not mean, on the other hand, that large-scale solutions are needed. The first reason is already mentioned – tourism is a seasonal phenomenon, and as a result, the quantities produced the rest of the year are not the same – and the second is the fact that as far as it is possible, the old type of rural economy that is based on circularity of resources is often still in place. In essence, all wastes, including biodegradable waste, need to be handled somehow on the island, on another island or the mainland. For waste fractions that should be recycled this typically results in a challenge of who is going to bear the transportation costs, which in many cases exceed the revenues from the commercialisation of the waste.

Furthermore, in the area of waste management, there are frequently inconsistencies in terms of monitoring and in the statistical data that may influence what strategies will be chosen and plans developed by decision-makers. The reasons for such inconsistencies are numerous. Explanations could be found in the ways that EU regulations have been transposed into the national legislation, as well as, in the definition of terms and different practices and indicators for calculating recycling, landfilling, etc., , what is included in municipal solid waste, or if the outcome of Mechanical Biological Treatment (MBT) is characterised as compost (Zero Waste, 2014).

In the case of islands, these problems are accompanied with vulnerability to come in line with the frequent changes in EU waste legislation, guidelines and policies causing problems to local and national administrative bodies on creating more effective and efficient plans and strategies. These factors indicate to us the challenge of adopting a conventional waste management system used in the mainland on an island, or adopting one type of system on all islands. Waste management is also frequently a considerable cost for local municipalities. Consequently, it is important to find cost-effective solutions to waste management that can be employed on local level.

On the other hand, opportunities for self-sufficient waste management systems may be easier adopted and appreciated on islands. Communities are smaller so the time for transferring knowledge is shorter, while the background of circularity in agricultural areas can help the adaptation of systems that correspond to new consumption trends. Continuous changes in recycling targets could be considered as a great opportunity for restructuring the priorities needed to be addressed and re-establishing the paradigms that the waste management systems aim to serve.

1.3 Aim and Research Questions

The contribution with this study is to provide the reader with both good and bad experiences from waste management systems being adopted in islands of European countries and examine how these experiences could be used to enhance the waste management in the municipality of Naxos and the Small Cyclades in Greece. The study will further explore how islands are addressed in existing EU and national waste management policies and explore whether changes could facilitate the solution to local challenges.

As the area of European waste management policies has been subjected to continuous changes and the topic is very broad to be investigated in detail in this study, the research conducted is based on the following questions:

- What are the features of the municipal waste management systems in European islands that are particularly well adapted to island conditions?
- How can the municipal waste management system in the municipality of Naxos and Small Cyclades be changed to be more sustainable?
- How can policy changes on national and/or EU level facilitate the transition to more sustainable waste management practices on islands?

1.4 Delimitations and Audience

Taking into account the limited extent that this research needs to have, several boundaries were set in order to limit the scope. Some of them were set in the beginning of the research, but others occurred during the progress of the research in the form of methodological challenges. In the first case, the scope was delimited by setting as geographical boundary the European continent, because I wanted to have as common point of the study cases the European Legislation for Waste Management. From Northern Europe, the islands of Tjörn in Sweden, Samsø in Denmark, Ameland in the Netherlands, Shetland and Orkney in the UK are chosen. In the South attention was given to Formentera from the Autonomous Community of Balearic Islands in Spain, Gozo Island in Malta and the Island of Hvar in Croatia. The choice of these islands was made because of many reasons. Firstly, through the initial desk research these islands were promising in terms of useful experiences to be

communicated, secondly their location might bring up signs of polarisation of specific issues and finally, the “polynesian” character of some municipalities could be a factor that complicates the practices being adopted, but well reflects the situation of Naxos and the Small Cyclades.

Recent changes to EU policies signify the need to be careful on how academic papers are used because they might be outdated and not reflect these changes and their results. On the other hand, they might identify problems that still have not been addressed and suggest solutions. The retrieval of objective and realistic data from statistics and monitoring processes or opinions on current circumstances could be considered as challenging because of the involvement of several interest groups in the managerial processes and general lack of consensus on how data is defined, collected and compiled. However, these data were, when possible, verified from several sources. In certain countries, linguistic barriers and time constraints of stakeholders could be considered as further limitations of the interviews, leading to some information gaps. These gaps were addressed with further desk research on the topic of interest.

The outcome of this research is primarily directed to policy and decision-makers in the municipality of Naxos and the Small Cyclades, as a support for the development of a waste management system by providing an overview of waste management practices in the European territory and familiarise them with the concept of seasonality and how it is connected to the local waste situation. However, this does not exclude other policy-makers and stakeholders, such as the general public, students, researchers and waste management companies and organisations. The personal ambition for targeting such a broad audience is to motivate students and researchers to investigate further the up-scaling of local systems, as well as the rest of the stakeholders to understand the strength of an integrated local system and its capabilities to provide important input in the cases of expanded boundaries.

1.5 Research Process and Methodology

1.5.1 Framework

As municipal solid waste management gets more complex in terms of how it is developed and implemented, researchers have recognised the necessity for the establishment of a more integrated approach. Different definitions on the term of “Integrated Solid Waste Management” (ISWM) are presented by researchers, such as “(...)the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency” (UNEP, 2007) by UNEP (see Figure19 in Appendix I), “(...) a comprehensive waste prevention, recycling, composting, and disposal program. (...) involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions.” (US EPA, 2002) by US EPA (see Figure20 in Appendix I) or as “the concept of ISWM strives to strike a balance between three dimensions of waste management: environmental effectiveness, social acceptability, and economic affordability” (Marshall &Farahbakhsh, 2013) (see Figure 21 in Appendix I). In this study, the analytical framework is based in the three pillars of sustainable development (see Figure 1), which combines the holistic approach of ISWM and the main principles of the Waste Management Hierarchy as introduced in the EU Waste Framework Directive.

This framework works as a guide for how the various cases should be examined and, based on these, general guidelines have been identified, as well as, particular implementations as solutions for the Municipality of Naxos and the Small Cyclades. This means that the research approach, and, consequently, the adopted framework, does not have an evaluative character of existing systems. The reason for choosing such a framework was the fact that it gives a perspective of addressing waste management in islands by taking into consideration the special characteristics of the islands to ensure that the suggested systems will be sustainable in all aspects, which means that apart from the implications in environmental, social and economic context, the level of resilience¹ will be high.



Figure 1: Pillars of Sustainable Development

1.5.2 Research Methodology

The methodology for retrieving all the necessary information, organise and analyse it in a structured way plays a key role for the clear understanding of the topic. The study is based mainly on qualitative data and an important part of the research involves describing and analysing the experiences of various islands based on documentation and interviews. In this study, the three research questions determine the four steps of the framework (see the numbers in Figure 2) applied for the facilitation of the analysis.

Step (1) – It answers the first research question “What are the features of the municipal waste management systems in European islands that are particularly well adapted to island conditions?” in two stages. Firstly, the current European legislative framework and policies related to waste management are explored for the reader to have a brief oversight of the current situation in the EU level. Secondly, through desk research, interviews and articles, the MSWM practices are reviewed, and problems, challenges, and transferable examples are identified and discussed.

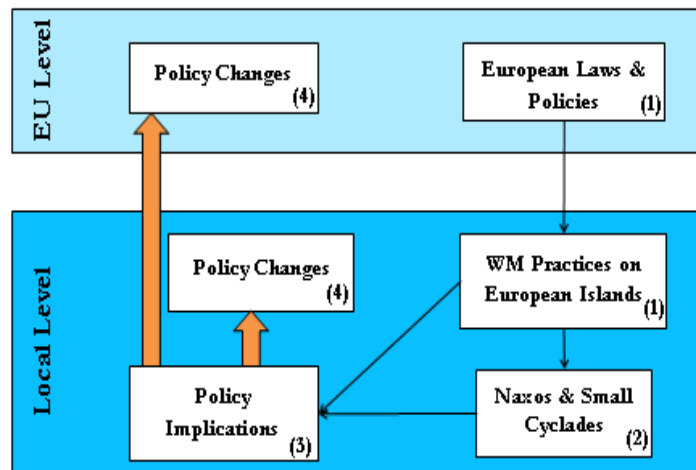


Figure 2: Research Methodology

¹ Resilience is defined here as “(...) a measure of a system’s ability to survive and persist within a variable environment” (Meadows, 2008)

Step (2) – The second question “How can the municipal waste management system in the municipality of Naxos and Small Cyclades be changed to be more sustainable?” is answered by exploring the area of the South Aegean Region and in particular the current waste management practices of the Municipality of Naxos and Small Cyclades, while examples that could potentially be transferred from European islands analysed in Step (1) are discussed.

Step (3) & (4) – These steps are both included in the Chapter 3. Firstly, all the study cases are explored for policy implications in the third question “How can policy changes on national and/or EU level facilitate the transition to more sustainable waste management practices on islands?” is answered in the Sections 3.4 and 3.5 by exploring and identifying policy implications that case studies still have to address and potential policy changes based on principals of diversification and cooperation are presented.

The documents include: administrative documents, academic reports and articles. In particular, the administrative documents include regional waste management strategies and municipal waste management plans retrieved from the official sites of the regions and municipalities under investigation. Statistics were retrieved from the official websites of national statistical agencies or the official websites of the region or municipalities. The purpose of data used was to cover the answer to the first research question, and present how the waste management of specific islands work, as well as a brief presentation of the broader context under which these plans work. These data were confirmed partially by the interviews conducted or by articles related to the area under investigation.

The majority of the interviews was held with the use of Skype or phone and are based on a semi-structured questionnaire sent in advance through e-mail to the interviewees. The interviewees were people mainly from public agencies; companies or experts that are related to the waste management of the municipality under investigation (see Appendix III). In the case of the Municipality of Naxos and Small Cyclades, the snowballing technique is also utilised for the identification of a broader set of key informants (see Appendix III).

Additional academic literature was retrieved from Internet searches performed with the use of the electronic search engine LOVISA of Lund University, the EU official website and the Google search engine. In the cases that translation of documents was needed Google Translate was used as a tool and for clarification, people with knowledge of the language were asked.

1.6 Disposition

Chapter 1: Introduction – It works as a backbone for the reader to understand the topic of this thesis, by defining the research problem and how it is investigated through the creation of research questions, delimitation of the scope and application of a specific research framework for the collection and organisation of data.

Chapter 2: Waste Management in European Islands – In this chapter the main European legislative framework and policies are described, as well as the existing waste management practices of the following European case studies: Tjörn Municipality in Sweden, Samsø Municipality in Denmark, Ameland Municipality in the Netherlands, Shetland and Orkney Islands in the UK, Formentera in the Balearic Islands, Gozo Island in Malta and the Island of Hvar in Croatia. The main practical problems and challenges in relation to the objectives of the regional strategy are identified and discussed.

Chapter 3: Waste Management System Changes in the Microscope – Here the current situation of waste management in the South Aegean Region is presented as well as the legal framework that determines the practices implied. The study case of the municipality of Naxos and Small Cyclades is described and practices that could be transferred or not in the municipality from the study cases of the Section 2.2 are discussed. Moreover, policy implications from the study cases of Chapters 2 and 3 are identified and potential lessons from islands for the enforcement of policy changes in local and national/or EU level are discussed.

Chapter 4: Conclusion – Here a summary of the findings and the results from the analytical parts are presented, as well as recommendations for policy changes in insular areas, for system and policy changes in the municipality of Naxos and Small Cyclades, and for further research are provided.

2 Waste Management in European Islands

In this chapter there is a brief description of the existing European laws and policies for waste management and how waste management practices work on several European islands. In particular, the laws and policies that will be described are the Waste Framework Directive, the Circular Economy Package, the Waste Shipment Regulation, the Landfill Directive, the Packaging and Packaging Waste Directive and key components of the Europe 2020 Strategy. The cases chosen for investigation in the Section 2.2 are the islands of Tjörn in Sweden, Samsø in Denmark, Ameland in the Netherlands, Shetland and Orkney in the UK, Formentera from the Autonomous Community of Balearic Islands in Spain, Gozo Island in Malta and the Island of Hvar in Croatia. General characteristics are presented as background, followed by the MSWM practices adopted, accompanied with the problems that they managed to address and challenges that still endure. Finally, the transferability of these systems and solutions is discussed.

2.1 EU Policies

With the ratification of the Accession Treaty, all the Member States signed to be in compliance with a series of directives and regulations. Their role is to coordinate the Member States, through legal requirements, harmonised targets and standards, in solving common environmental problems. This legislation is divided in three main groups: 1) Laws that establish guidelines, definitions and principles for waste management; 2) Laws that establish operation standards and treatment methods; and 3) Laws that provide actions for specific waste streams (European Commission, 2014c).

Despite the fact that waste management systems need to apply the provisions from all the legislation, four acts are the main that determine the frame for all waste management system: Directive 2008/98/EC on waste (Waste Framework Directive), Directive 1999/31/EC on the landfilling of waste (Landfill Directive), Regulation 660/2014/EC on shipments of waste and Directive 94/62/EC on packaging and packaging waste.

The **Waste Framework Directive**² is the cornerstone of the EU waste policy as it aims at the protection of the environment and human life. It provides the Member States with precise definitions of waste, by-products, waste management, prevention, recycling and recovery, and obliges the Member States to adopt in their waste management strategies the waste hierarchy (see Figure 13) by giving priority to prevention in order to encourage waste generators towards a lifecycle treatment of wastes and avoiding the reliance on recovery methods. Furthermore, it reiterates the “polluter pays principle” for the generator of wastes and the concept of “extended producer responsibility” for

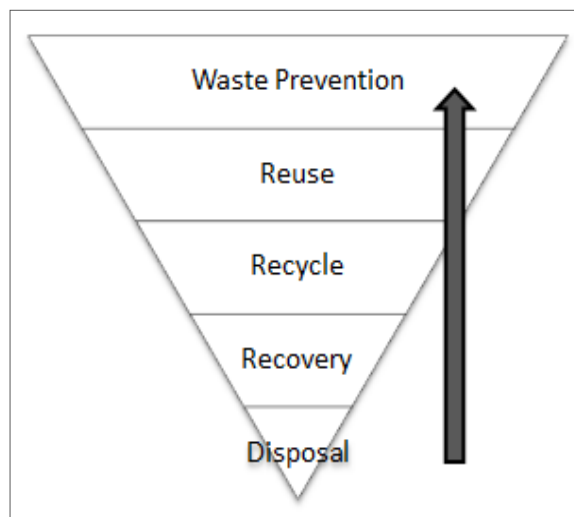


Figure 3: Waste Management Hierarchy

² Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste. OJ L 114, 27.4.2006.

strengthening the waste management hierarchy from the prevention phase to the reuse, recycling and recovery phase as it envisions the creation of “recycling societies”. The principles of “self-sufficiency” and “proximity” are considered key elements for establishing a network that will facilitate the safe treatment and disposal of generated wastes.

The Waste Framework Directive includes in its Annexes an amended list of wastes, provides provisions for all the types of waste and sets targets (see Appendix II). Regarding the distribution of responsibilities, it is recognised that the objectives of the directives would be easier achieved at community level, but it is, for instance, national authorities’ responsibility to decide how the principle of extended producer responsibility will be implied. Finally, the common EU legislation forces national authorities to encourage the implementation of the best environmentally sound waste management measures that are based on technical, economic, environmental and social factors and create additional incentives to the relevant stakeholders for investing in research and development.

This is supported with the adoption of the **Circular Economy Package** in July of 2014, which is part of the **Europe 2020 strategy** and the Seventh Action Programme. It sets as a priority to transform EU’s linear economy into a resource-efficient, green and competitive low-carbon economy (European Commission, 2014a). It introduces new targets for 2025 and 2030 (see table 2 in Appendix II), as well as provisions for full traceability of hazardous waste, improvement of the effectiveness of EPR schemes, clarification of the calculation of recyclable materials, reliability of statistics, support of SMEs and all of them under a list of aligned definitions and revised requirements (European Commission, 2014a). On the other hand, this economy package is criticised for the absence of social inclusion and short-term provisions that focus only for the exit from the economic crisis (Perella, 2014; Zero Waste Europe, 2014).

The aim of the **Waste Shipment Regulation**³ is to force the Member States to implement all the necessary procedures for the safe shipment and delivery of all types of waste (including hazardous waste) inside and outside their territory.

The **Landfill Directive**⁴, on the other hand, provides the Member States with measures, procedures and guidelines for the prevention and reduction of methane emissions and other greenhouses gases, as well as, the pollution of soil and ground water, aiming at the protection of environment and human health during the whole life-cycle of the landfill. Different categories of waste are defined (municipal waste, hazardous waste, non-hazardous waste and inert waste) and landfills are divided into three classes depending on the type of waste disposed (landfills for hazardous, non-hazardous or inert waste). Also it is based on the polluter pays principle in case of any environmental damage produced by the landfill, while measures for abandonment and illegal disposal of waste need to be adopted.

The operational and technical requirements set focus on the reduction of negative environmental effects by limiting the landfilling of biodegradable waste. To succeed with this, the Directive sets criteria for the procedure of waste acceptance in the landfills, passes the responsibility to the national environmental authorities for issuing permits, conducting inspections and ensuring that standards are met, and sets targets for the amount of

³ Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste

⁴ Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. OJ L 182, 16.7.1999.

biodegradable waste landfilled (see table 2 in Appendix II). Exemptions from specific articles of the Landfill Directive is applied for islands and isolated settlements. In the case of islands, if the landfills have capacity of non-hazardous or inert wastes up to 15 000 tonnes or are not exceeding an annual intake of 1000 tonnes, they may stay in use, unless the capacity is fully used and the new landfill has to comply with the new requirements.

Finally, the **Packaging and Packaging Waste Directive**⁵ is aiming to harmonise national management measures regarding the management of packaging and packaging waste. The main role is to encourage the use of less packaging with the set of new standards and introduction of new targets (see table 2 in Appendix II) for the recycling and recovery of packaging and packaging waste.

As an overarching policy, the **Europe 2020 strategy** is introduced from the European Commission as a successor to the 2000-2010 Lisbon Strategy in order to work as an “exit strategy” from the economic crisis, by prioritising smart, sustainable and inclusive economic growth, aiming to high levels of employment, productivity and social cohesion (COR, 2012). For better monitoring of the progress, Member States have to achieve the following targets:

Table 1: Targets of Europe 2020 Strategy

Employment	75% of the 20-64 year-olds to be employed
Research & Development	3% of the EU’s GDP to be invested in R&D
Climate change & energy sustainability	Greenhouse gas emissions 20% (or even 30%, if the conditions are right) lower than 1990 20% of energy from renewable 20% increase in energy efficiency
Education	Reducing the rates of early school leaving below 10% at least 40% of 30-34-year-olds completing third level education
Fighting poverty & social exclusion	At least 20 million fewer people in or at risk of poverty and social exclusion

(Source: COR, 2012)

In these the three types of growth that this strategy supports, seven initiatives are included in total. The Smart growth includes the initiatives digital agenda for Europe, innovation union and youth on the move; the sustainable growth includes the resource efficient Europe and the industrial policy for the globalisation era; and finally, the inclusive growth includes the agenda for new skills and jobs and the European platform against poverty (COR, 2012).

⁵ Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste - Statement by the Council, the Commission and the European Parliament. OJ L 47, 18.2.2004, p. 26–32.

Part of the Europe 2020 strategy is the **Roadmap to a Resource Efficient Europe** which is a policy framework towards sustainable growth by 2050, based on the decoupling of economic growth and environmental degradation, and provisions for better product design, cooperation between all the actors in the value chain, public investments, regulations and waste management processes that are aiming for a full recycling economy (European Commission, 2011). Finally, focusing on governance issues, the focus is on enhancing the dialogue between different authority levels; invest financially in the transition and the development of key indicators and targets after close cooperation between all the relevant actors (European Commission, 2011).

To support economically these policies the **Structural Funds and the Cohesion Fund** are introduced as the main economic instrument to minimise the socio-economic disparities between the different regions (European Commission, 2014b). In the principles of the Regulation No 1303/2013 the complementing character of the Funds to the national, regional and local interventions is underpinned with the use of eleven thematic objectives (European Council & European Parliament, 2013). In particular, the sector of waste is placed in the thematic objective of preserving and protecting the environment and promoting resource efficiency of the strategic approach and investments for sustainable economic and environmental development through relevant waste management plans and use of the ERDF and Cohesion Fund, in order to be consistent with the Waste Framework Directive (European Council, 2006).

Unfortunately, again there are no specific guidelines or framework for the cases of islands. The only guidelines provided from the European Commission for the waste management in the islands is the so-called Codes of Practice for Waste Management on Islands, which is a manual for local authorities of how to create a waste management plans (European Commission, 1996). Even though it tries to involve as many parameters as possible, still it could be considered outdated and insufficient, because new regulation are enforced, new technologies are available and current system dynamics are in need of integrated approaches.

Great interest for the case of islands is the Final Declaration that was presented in 2010, the Government of Balearic Islands presented proposals for improving the way regional policies are transposed by island territories through the Cohesion Policy (CRPM/CPMR, 2010). The solutions focus more on the creation of an integrated framework for islands that will be flexible enough to include dynamic indicators that will reflect and strengthen the diversification and be able to be applied in all sectors that have a territorial impact and at regional, national, and EU level, as well as the introduction of new indicators apart from GDP per capita that could reflect better the regional conditions (CRPM/CPMR, 2010). In the new Cohesion Policy introduced, there are provisions for rural areas that allow, according to Hahn (Hahn, 2014), flexibility for islands to create a policy mix based on the particularities of the region and enhance the development of new and innovative products. These provisions, on the other hand, still do not provide the islands with a specific framework that could address the problems caused because of insularity and seasonality.

2.2 Study Cases

2.2.1 Tjörn Island

Background

Tjörn Island is the sixth largest island in Sweden and the total area it covers is approximately 846 km² of which 168 km² is land and the rest sea water territory (SCB, 2014). The island is connected with bridges to the mainland and Klädesholmen Island, while the rest of the inhabited islands of the municipality (Tjörnekalv, Dyrön, Åstol, Härön, Flatholmen, Risø, Hättan and Brattön) are reached with ferries. The population during the winter is approximately 15 000 inhabitants (SCB, 2014). The main source of income for the inhabitants is based on the 1700 small contractors of the local industry and large shipping and fishery processing companies, and tourism (TjörnsKommun, 2014b).

MSWM Practices

One of the obligations of every municipality is to create a MSWM plan that includes targets and guidelines for all waste streams. The MSWM plan of Tjörn Municipality covers Tjörn Island as well as the smaller islands and was applied from October of 2011 with the time horizon of year 2020. It focuses on household wastes, but it also contains objectives for industrial wastes (TjörnsKommun, 2011). The goal is based on the five objectives of the regional plans, which are: the protection of human health and environment, the safety and working conditions, the cost effectiveness of waste disposal and treatment, the good services and finally the robust waste disposal (Göteborgsregionen, 2010).

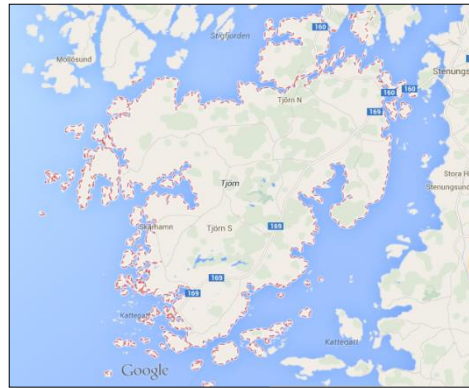


Figure 4: Tjörn Municipality (Source: Modified from Google Maps, 2014)

The municipality is responsible for the collection, handling and transportation of household wastes (especially the hazardous) to the treatment facilities. Renova is the main contractor for implementing the MSWM plan, in which Tjörn Municipality is a co-owner, along with another ten municipalities of the region (Göteborgsregionen, 2010). It is also responsible for informing the residents about the collection schemes for packaging waste and electrical and electronic equipment waste (WEEE). Property owners are responsible for paying the municipal fee that includes the costs for the collection, transport, recovery and waste disposal, as well as, sorting at source in the following fractions: combustible household waste, compostable waste, hazardous waste, bulky waste and packaging (TjörnsKommun, 2011).

The two main collection systems that are available is the recycling centres installed on Tjörn Island (with free entrance) and the kerbside collection in which waste is collected close by the property (TjörnsKommun, 2011). All combustible household waste collected is gathered at a transfer station from where they are transported to the treatment facilities for energy recovery. For the waste that is covered by the principle of extended producer responsibility, producers are responsible for the collection and disposal. Kerbside collection for packaging waste is an optional scheme that a property owner has to pay extra for and it is based on a

bag system⁶, whereas WEEE and bulky waste is collected mostly via the recycling centre (TjörnsKommun, 2014a). Finally, separation of food waste is also mandatory and is done through approved home composting equipment or through service collection that includes a brown bin and compostable paper bags (TjörnsKommun, 2011). To economically maintain this system a waste tariff is imposed that includes three types of fees. It is the basic fee that covers the equally allocated cost to all properties for recycling, administration, planning, records and conversion of landfill⁷, the consumption fee that includes the costs for collection and treatment and the supplement fee in the case of kerbside collection that is SEK 749 per year⁸ (Andersson T., personal communication).

The municipality has introduced specific provisions for MSW collection system from the smaller islands that are not connected with bridges. On these islands waste is collected the last week of every month, the household waste that is collected separately is transferred to the designated locations by the municipality and collected by Renova. On the islands Tjörnekalv, StoraDyrön, Åstol and Härön there is annual collection of bulky waste, garden waste and kitchen appliances where also hazardous and residual waste could be collected.

The equipment provided for the collection of combustible waste is a plate rack that can transfer the 210 litre sacks for the collection of bags of maximum 15 kg. For food waste there is a plate rack for a 60 litre sack in which residents put the 8 litre compost bags or the brown paper bags. Finally, for the kerbside collection of packaging waste, the sacks and the smaller coloured bags for packaging of metal, plastic and paper, while newspapers and glass are placed in containers (TjörnsKommun, n.d.).

Challenges

It should be noted that Tjörn Island is connected to the mainland with bridges. Consequently, the true island challenges are related mostly to the smaller islands included in the municipality. Tourism during summer months is one of the problems, because there is need to employ extra personnel in order to deal with the larger volumes⁹ (Andersson T., personal communication). The main challenges though are related to the collection system adopted. In particular, the collected wastes are transferred from the smaller islands to the bigger and then Renova takes care of the majority of the waste in Gothenburg. This system is partially addressing the problem of transportation costs, because of producers' hesitation to get involved in the collection scheme for the smaller islands and the high transportation cost is distributed to all the users (Andersson T., personal communication). On the smaller islands working environment is still challenging because no matter if property owners are responsible to provide transportation of household waste to the designated location, collection vehicles cannot be used and workers have to walk long distances.

⁶ For every kerbside collection point, the municipal contractor provides with AV-sacks and two types of coloured bags. One type is for the plastic the second for metals and both are put closed in the AV-sack with the paper and cardboard packaging. Finally, newspapers/papers and glass are collected in containers or designated points (Tjörns Kommun, n.d.).

⁷ The basic fee is slightly higher for the smaller islands (Tjörns Kommun, 2014c).

⁸ From May 1 to October 31, the cost for the islands Åstol, Dyrön, Härön and Tjörnekalv is SEK375 per year (Tjörns Kommun, 2014c).

⁹ The waste generated in the municipality this year were for January approximately 195 tonnes of combustible waste and 60 tonnes of food waste, for June 214 tons of combustible waste, 48 tons of food waste and for July 302 tonnes of combustible waste, 66 tonnes of food waste (Andersson T., personal communication).

Furthermore, in the case of food waste, it is promoted that collection from the municipalities is more preferable than home composting because such residues can contribute to the production of biogas in the mainland (Andersson T., personal communication).

Finally, it is observed that there is the trend of “living in tourism”, where people working and living in the cities alter their summer houses in the islands to permanent residences (Andersson T., personal communication). This fluctuation in the permanent population is difficult to handle. The municipality has decided that all property owners shall have collection of waste throughout the year hence the fee is the same for both permanent residents and summer visitors (Andersson T., personal communication).

2.2.2 Samsø Island

Background

Samsø is a Danish island located in the Central Denmark Region, 15 km from the Central part of Jutland Peninsula. In the area of 112 km², the island supports a population of approximately 3 770 inhabitants with a density of 33 inhabitants/km² (Statistics Denmark, 2014). The main business activity sectors are the production of high quality of agricultural products and tourism (Business Region Aarhus, 2011). The implementation of renewable energy projects transformed it to a carbon-neutral and self-sufficient energy island, a factor that made it attractive world-wide and raised the tourism between Easter and October to more than 300 000 overnight visitors (Deiguesca, Mulders, & Smith, 2010; Renewable Energy for Europe, 2001). Samsø Island is connected with ferries from the ports of Sælvig and KolbyKås on Samsø to the port of Hou in Jutland and from KolbyKås to Kalundborg on Zealand (VisitSamsø, 2014).



Figure 5: Samsø Municipality (Source: Modified from Google Maps, 2014)

MSWM Practices

The MSWM plan is based on the objectives for the long-term period 2013-2020, which were introduced in the Waste Management Plan 2009-2012 and have to do with the increased focus on combustible waste and recycling of packaging waste, the establishment of a new recycling centre, as well as the expansion of the wastewater treatment plant at Harpesdal in the case of the expansion of the landfill's lifetime. This is aiming to a more sustainable development depending more on sustainable production and consumption (SamsøKommune, 2009). Shared responsibilities to all stakeholders are considered key for authorities, citizens and businesses to reach the goal of the system (SamsøKommune, 2009). In particular, the responsibility for citizens and businesses is to prevent, wherever it is possible, the waste generation and the correct sorting and disposal as they have to pay taxes for every waste streams delivered to the waste centre (SamsøKommune, 2009). Municipalities are responsible for conducting the MSWM plan, establish the collection systems and ensure the combustion and landfill capacity, as well as, the necessary capacity for incineration, while partnerships with companies and educational institutions are promoted as a main driver for innovation in environmental technologies (SamsøKommune, 2009).

Exploring deeper the practices, the refuse system is based on 1) trash bags, 2) racks and 3) containers. It is the property owner's responsibility to purchase/receive and use the designated containers for the collection of waste, as well as maintaining and keeping them clean. Containers/racks and included trash bags must not be overloaded and additional racks and bags can be purchased from the Waste Centre. The placement of the containers is done on waste racks that must be positioned on a firm flat surface and so that there is at least 2 m ground clearance and being set to maximum of 20 meters from the input lines (see Figure 6) aiming at access facilitation (SamsøKommune, 2014b).

The recycling scheme is based on the sorting of paper/newspapers/magazines, bottles/jars, and carton/cardboard at source, but the other streams, as well as, bulky and garden waste from households, need to be delivered to the Waste Centre (SamsøKommune, 2014a, 2014c). The opportunity is given to the property owners to go to the Waste Centre and get a compost bin to compost their green wastes, by following all the necessary guidelines provided by the municipality. Finally, in the case of more than 20 kg of hazardous waste, oils, chemicals and paints, individuals can deliver them to the Waste Centre free of charge (SamsøKommune, 2014c).



Figure 6: Placement of collection bins
(Source: Samsø Kommune, 2014)

Because of the characteristics of insularity, the municipality could landfill the combustible waste generated. In 2009 the collection system changed with the creation of a recycling centre for receiving the sorted waste that later on is delivered to the mainland for treatment (SamsøKommune, 2011). The combustible wastes are incinerated in Aarhus, prolonging in that way the existing sanitary landfill and controlling the capacities. Another problem that local authorities had to face was manure and the waste water from the dairy facilities (SamsøKommune, 2011). This problem was addressed with the creation of a small-scale biogas plant close to the dairy that could use as source the manure, the vegetable waste and the waste water sludge, producing at the same time liquid fertiliser for the crops. Furthermore, it contributes to the local district heating system and to the saving of shipping costs of organic wastes (SamsøKommune, 2011).

Challenges

There are side-effects that could influence the resilience of such a system. As mentioned above, Samsø has become a popular destination for tourists that have interest in energy self-sufficiency, transforming tourism to one of the main sources of income for the island (Renewable Energy for Europe, 2001). The related raise of income to higher levels than usual leads citizens to focus more on this sector (Deiguesca et al., 2010) rather than on agriculture. This aspect is accompanied with continuous population decline because of the lack of educational institutions, leading a lot of families to move away from the island (PlanEnergy&Samsø Energy Academy, 2007), challenging the resilience of the existing fields and farms (Deiguesca et al., 2010) and potentially the resilience of the existing facilities.

2.2.3 Ameland Island

Background

Ameland Island (see Figure 7) is the third largest island between the Western Frisian Islands in the province of Friesland in North Netherlands and it covers a total area of approximately 270km² from which only the 59% is land and the rest water territory (CBS, 2011). The population is almost 3600 inhabitants and the population density 61 inhabitants/km² (City Population, 2014). It is an island with rich cultural heritage and this is the reason that tourism is the main source of income. Ameland is connected to the mainland with ferries from the port of Nes in Ameland to the port of Holwerd in the mainland.

MSWM Practices

According to the MSWM plan, the collection service that is responsible for the collection of household waste can designate other collectors for the specific waste streams. More than ten waste streams are included for separate collection, while the collection system provides the property owner with collection containers emptied once every two weeks, designated location for 25 underground containers that were all used mainly during the touristic period, but limited number of them during winter, and collection facilities for farmers in every district area (Ameland Municipality, 2014c).

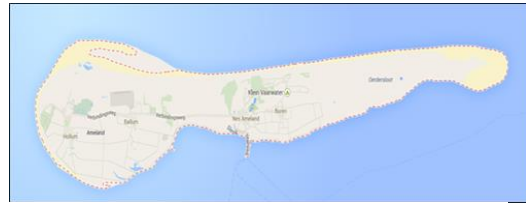


Figure 7: Ameland Municipality (Source: Modified from Google Maps, 2014)

All the households on the island have three types of containers for general waste, organic waste and paper (Ameland Municipality, 2014a). The collection system of household waste is designed with the use of one of the three ways: kerbside collection, underground containers or recycling points. The waste fee paid from the resident is for the operational maintenance of the whole system by renting the containers. These containers have a recording collar that facilitates the recognition of the containers of each property owner and two containers are emptied at a time (Ameland Municipality, 2014a). All supermarkets are equipped with collection containers for glass, paper and textiles where individuals can dispose these types of waste. For example, textiles are sorted into usable clothing and other textiles prolonging that way their lifetime (Ameland Municipality, 2014b). In the recycling centre, individual can deliver their waste. For most fractions there are no fees to be paid, apart from mixed waste, construction and demolition waste, debris, waste oils and tyres, whereas business have different charges (Ameland Municipality, 2014b). The separated wastes go to Omrin, a recycling company that is recycling them or processing them (Ameland Municipality, 2014b).

Challenges

Based on the practices we can assume that the island performs very well in the recycling sector. On the other hand, the national policy strives for adopting a circular economy. As a result, even if the recycling rates are good, they need to get improved, pressuring in that way the local authorities to adopt measures. To succeed there are many preconditions that need to be taken into account such as to provide better economic incentives to the residents and the other actors, awareness-raising in schools, businesses and houses can help the fragmented knowledge over insularity that exists to be developed. Innovation supported by economic incentives and collaboration is still in place, but capacity-building is more difficult to be achieved (Bastein, Roelofs, Rietveld, & Hoogendoorn, 2013).

2.2.4 Orkney and Shetland Islands

Orkney and Shetland Islands (see Figure 8 and 9) are two different complexes of islands that are located in the North Atlantic in the area between Scotland and Norway and at a distance of approximately 6 and 160 km from the Scottish mainland respectively (SEPA, 2003). The main sources of economy are agriculture, fishing industry and tourism, but oil and gas, aquaculture and knitwear are also sectors of great importance (Shetland Islands Council, 2013). In both cases of Orkney and Shetland Islands, there is a continuous slight fluctuation in the population every year, with the permanent population reaching approximately 21 500 and 23 000 inhabitants respectively, contributing by 0.4% each to the total Scottish population (National Records of Scotland, 2014; National Records of Scotland, 2014). In both cases, the population aged between 16 to 29 years (15.4% in Orkney Islands and 16.1% in Shetland Islands) is smaller than the Scottish average of 18.3% and the people aged older than 60 (28.2% in Orkney Islands and 24.1% in Shetland Islands) is more than the Scottish average of 23.7%, factors that influence future social changes (National Records of Scotland, 2014; National Records of Scotland, 2014). An interesting fact is that the unemployment rate in both islands hardly reaches 1%, even with the slight increase of permanent population (Shetland Islands Council, 2013).

In the sector of waste management, the case of these islands is quite unique. First of all the councils of the islands formed together the Area Waste Plan that constitutes the framework of waste management for these islands. It is based on the principles of the waste hierarchy, proximity, self-sufficiency and best practicable environmental option (SEPA, 2003). This explains the requirements that both groups needed to fulfil for MSW such as 1) education and awareness-raising towards prevention and the adoption of practical support to communities, 2) introduction of recycling collection schemes, 3) the expansion of the provision for recycling facilities and home composting, 4) capacity support from Orkney Islands to Shetland for the continuation of energy recovery from the existing plant, and 5) the disposal of small quantities of MSW residues to landfills (SEPA, 2003). Finally, it is noted that the policies included have been designed corresponding to specific needs identified in the islands and resulted in two different MSWM practices (SEPA, 2003).

MSWM Practices in Orkney Islands

In Orkney Islands a kerbside collection system is adopted for the household wastes (Orkney Islands Council, 2014). All the packaging and packaging waste is encouraged to be sorted at source and delivered to the recycling centres by following some guidelines for specific streams, such as cardboard that should be flattened and tied or taped with no side measuring more than one metre, because they are provided with designated containers for all waste streams (Orkney Islands Council, 2014). A second option exists from 2012, where property owners can take out of their property their bin for recyclable waste and vehicles responsible for this fraction will pick them up according to the schedule announced (Orkney Islands Council, 2014).



Figure 8: Orkney Islands (Source: Modified from Google Maps, 2014)

In more detail, the recycling is done in one of the five recycling centres distributed in the Orkney mainland. Here there are all kinds of marked bins not only for packaging but also for domestic waste, batteries, WEEE, oils, scrap metal, building materials, bulky waste etc. Special provisions though concern asbestos waste and garden waste as they face different treatment processes (Orkney Islands Council, 2014). The green cone is encouraged to be installed in the households. It is not a garden composter but a digesting system for food waste, which helps them to reduce the food waste entering the waste stream from the source (Independent Consultants, 2006). Generators of bulky waste can transfer them for free to any recycling centres or call for a collection services to pick them up and charge them based on the number of items or the type of loading (Orkney Islands Council, 2014). For the disposal of commercial waste, including agricultural waste there are certain provisions that need to be taken into account and property owners have to come in contact with the department of Development and Infrastructure (Orkney Islands Council, 2014).

Finally, the Waste Transfer Site is where all the domestic waste collected and the waste that cannot be buried at the local landfill are packed and shipped to Shetland Islands Council's incinerator for providing hot water for the local district heating scheme (Orkney Islands Council, 2014). The entrance is restricted for property owners, so waste that needed to be dumped are taken to one of the Recycling Centres or by an arranged special refuse collection.

MSWM Practices in Shetland Islands

Looking first in the fraction of household waste, and the fraction of domestic waste, a kerbside collection system is adopted. Once a week, there is scheduled collection of the black rubbish sacks, provided for the domestic waste, but broken glass and sharp objects need to be placed in cardboard box labelled as "Sharp objects" (Shetland Islands Council, 2012). This trash need to be protected from the weather and animals, so the property owners have to use black sacks and put them in 240 litre 'wheelie bins' (green plastic bins with wheels that fit three to four sacks), in 'bruck boxes' (wooden boxes that fit five or seven sacks depending on the size of the box) or cover them with nets (Shetland Islands Council, 2012). After their collection, waste is transported to the Energy Recovery Plant for supporting the local District Heating Scheme (Shetland Islands Council, 2012).



Figure 9: Shetland Islands (Source: Modified from Google Maps, 2014)

Recycling on the other hand can be done at all the recycling centres in Shetland for packaging, products under producer responsibility, and textiles that could be sent to the local charity shops (Shetland Islands Council, 2012). Aluminium and steel are then crushed and shipped to a processing plant in the UK, plastic bottles are recycled in Shetland, bicycles are collected and bulky waste delivered to the recycling centre and waste management facility, while the uplift collection is available in the area every six weeks, where up to six items can be collected for GBP 30 (Shetland Islands Council, 2012).

Finally, by law, hazardous waste, such as paints, household and garden chemicals, fluorescent tubes/energy saving bulbs, waste oil, batteries, car batteries and gas bottles, must be handled and disposed correctly, and this is the reason that additional help and consultation is provided by the relevant authorities, while these fractions can be safely disposed at specific Waste Management Facility and Recycling Centres (Shetland Islands Council, 2012).

The establishment of the company called Enviroglass in 2003 was one of the most successful examples of recycling companies. At first, it was using waste glass to produce basic aggregate substitute. After the cooperation with members of Glasgow Caledonian University's Natural Energy Efficiency and Sustainability (NEES) Project, Richard Atkins of the Royal Incorporation of Architects in Scotland (RIAS), and John Easton of SUSTaim, the equipment was upgraded in order to produce high quality and environmentally sound building products such as paving slabs, garden ornaments, and bespoke fireplaces (Enviroglass, 2013; Griffiths, 2013). That way they avoid the shipment costs to the mainland and solved the problem of disposal, with a minimum environmental footprint.

Challenges

Orkney and Shetland Islands are two cases of local waste management systems highly affected from changes in the national strategies. In 2010, Scotland established the new Zero Waste Strategy challenging the councils and local authorities to work harder in order to succeed the new targets of 70% overall recycling and composting with 5% maximum landfilling of the waste generated by 2025 (The Scottish Government, 2010). This Strategy replaced a number of policies and local waste management plans as it includes specific guidelines (The Scottish Government, 2010). The challenge arises to the performance of the incineration plant in Shetland Islands because it cannot use plastics and papers that burns well because of their composition, and it is obliged to import waste not only from Orkney Islands but also from the other councils of Scotland (Bevington, 2013). This is considered as a business opportunity for the owners of the incinerator as they are paid to take the wastes (Bevington, 2013), but according to the latest statistics, Orkney and Shetland Islands councils are lagging behind compared to the rest of Scotland (Herald Scotland, 2011, 2013).

Another major challenge that both Orkney and Shetland Islands had to face in order to maximise the efforts towards the zero waste was the creation of educational opportunities for every social layer. In Orkney Islands the "Orkney Zero Waste" local charity is in place, guiding practically the communities through workshops and events communities to adopt recycling solutions (Orkney Zero Waste, 2014). In Shetland Islands, there are several options of awareness-raising activities for schools, youth groups, the public and businesses, such as events, talks, workshops or even visiting the Energy Recovery Plant and the Gremista Waste Management Facility and Recycling Centre, or encouraging the schools to be part of the Eco-School initiative (Shetland Islands Council, 2012). This means that students are getting involved with sustainability issues and strengthening the bonds between schools and communities (Shetland Islands Council, 2014).

The "Shetland Amenity Trust", which is a charity trust and the "Orkney Zero Waste", a voluntary organisation, are those that are closer to the local communities by conducting awareness-raising programmes for recycling, reuse and waste minimisation and prevention (Orkney Zero Waste, 2014; Shetland Amenity Trust, 2014b). One of the main activities of Shetland Amenity Trust in term of recycling is to find ways for increasing the traded activity, in order to reach an increase of 500% in production capacity and a 60% reduction in unit costs (Griffiths, 2013). On the other hand, for aluminium cans this could be considered questionable because with the "Cash for cans" recycling scheme, aluminium cans frequently collected by schools, are stored and sold from the Shetland Amenity Trust and the funds are paid to the group or the nominated charity by a check (Shetland Amenity Trust, 2014a) and it is not mentioned if these volumes are included in the statistical volumes or not.

2.2.5 Formentera Island

Background

Formentera Island (see Figure 10) is part of the Autonomous Community of Balearic Islands. With the enforcement of the New Statute of Autonomy of Balearic Islands in 2007, the Insular Council of Eivissa replaced the existing Insular Council of Ibiza and Formentera allowing Formentera to establish its own government (Jefatura del Estado, 2007). Formentera is the southern island of the complex in a distance of 6 km from Ibiza and the municipality is extended to the whole island that covers an area of approximately 83 km² (Official Tourism Office, 2014). The permanent population is approximately 11 400 inhabitants from which 12% is aging over 65 years and population density is approximately 138 inhabitants per km² (Ibestat, 2012). Tourism is the main source of income. Formentera does not have an airport, but it is connected to Ibiza with ferries.

MSWM Practices

The current MSWM plan for the municipality is based in the principles of the common Sectorial Plan for waste management of the Insular Council of Ibiza and Formentera that prioritise prevention and waste minimisation and in the case of continuation, valorisation through reuse, recycling or energy recovery and as a last treatment option sanitary landfilling (Consejería de Medio Ambiente, 2001). The collaboration between the two islands towards waste management is continued even after the administrative change in 2007. With the enforcement of the new ordinance for the management and transportation of waste, the municipality is responsible for the collection of household and commercial (cardboard) waste and household bulky waste, and to transport and discharge them at the Transfer Station (Consell Insular de Formentera, 2013). Cleaning and maintenance of containers and emptying of vehicles for the recycling of waste are the rest of the municipal obligations with Giref to be the contractor for the implementation of the services. Property owners, on the other hand, are obliged to separate waste in containers according to their type in sealed bags in order to avoid leachates and production of odours. It is prohibited to destroy or remove the containers from the designated areas and deposit waste or liquids that may melt itself (Consell Insular de Formentera, 2013).



Figure 10: Formentera Island (Source: Modified from Google Maps, 2014)

The waste collection system includes coloured recycling bins for four main fractions paper/cardboard, packaging, glass and mixed waste in designated areas (Formentera Neta, 2013). But they can use the facility for selective waste, the so called Dot Net, to dispose specific waste streams (see Figure11), whereas for furniture, appliances, electronics and bulky waste, individuals need to call the home collection of the municipal services and it has a space limitation of 2 m³ (Formentera Neta, 2013). Finally, for the collection of household hazardous waste the mobile dot net should be informed, and they will come with a specific vehicle that accepts some of the fractions, when there is need for special treatment. All these wastes are transferred to the publicly-owned transfer plant in the area of Cap de Barbari and they get prepared for their shipment to Ibiza, since from 2006 the local landfill is closed.

For commercial paper and folded cardboard and during summer months in the town of EsPujols a door-to-door service for collection of commercial waste is applied, because it is considered to be more effective for an area where collection vehicles cannot move around. The commercial production of waste is high, so there is potential for increased separation of waste at source (Formentera Neta, 2013). Finally, there is a scheme for vehicle decontamination, where vehicles at the end of life are considered hazardous waste and as such must be decontaminated. The useful parts and materials are extracted, and the rest are treated according to their composition (Formentera Neta, 2013).



Figure 11: Dot Net Waste Streams (Source: Formentera Neta, 2013)

Challenges

The main challenge that Formentera Municipality had to face was the lawsuit of the waste management company, UTE-Giref, who was the contractor for the implementation of the MSWM plan (Consell Insular de Formentera, 2012). This lawsuit had to do with the inability of the municipality to cover the expenses of waste management, because they had insufficient financial capacity to cover the shipment of waste to Ibiza (Consell Insular de Formentera, 2012). The suggestion for imposing an additional cost of EUR 119 per tonne caused a reaction of local authorities over the rights of residents of Formentera that have to suffer the consequences of the double or even triple insularity (Convalia, 2012, 2013; Roig, 2014). On the other hand, in 2013 UTE-Giref that was responsible for the transportation reached the limit of bankruptcy for continuing transporting waste from Formentera (Convalia, 2013).

2.2.6 Gozo Island

Background

Malta is one of the island Member States of the EU. It consists of three islands: Malta Island, Gozo Island, and Comino. In 2011, Gozo and Comino accounted for approximately 31 000 inhabitants that corresponds to 7.5% of the total population and approximately 450 inhabitants per km² population density (National Statistics Office, 2012). It has been observed an increase of 2.6% in the population aging over 65 years compared to 2005 and a decline of 2.4% of the population aged up to 14 years (National Statistics Office, 2012). The economy is based mainly on tourism, but agriculture also contributes to the income of the inhabitants in Gozo (Briguglio, 2008a, 2008b).

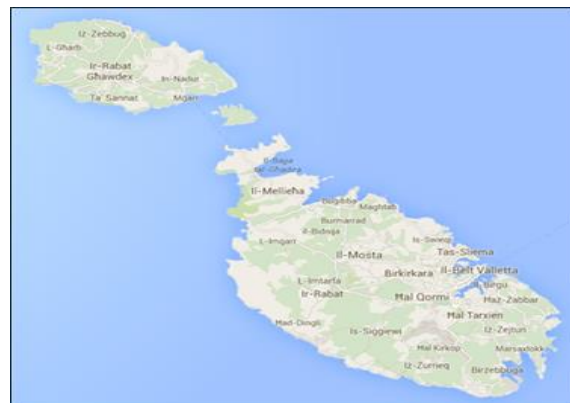


Figure 12: Malta (Source: Modified from Google Maps, 2014)

MSWM Practices

The base for the current waste management practices in Malta is the national Solid Waste Management Strategy that is focusing on sustainable development and the principles of proximity and self-sufficiency, the precautionary principle, the polluter-pays principle, the priorities of the waste hierarchy and the concepts of best practicable environmental option, and extended producer responsibility (Aspinwall & Manor, 2001). The consulted document that revised the Strategy set Gozo Island as the most strategic option of area for business opportunities towards innovative waste strategies for self-sufficiency (Parliamentary Secretariat for Tourism the Environment and Culture, 2010). Finally, the national Waste Management Strategy for the period 2014-2020 sets new targets, objectives and integrated policies towards sustainable waste management and prevention (Ministry for Sustainable Development the Environment and Climate Change, 2014).

Practically, a kerbside collection system is used for producer responsibility schemes accompanied by more than 800 bring-in sites that are installed in public areas and schools in both Malta and Gozo to facilitate the segregation of recyclable materials (plastic, paper, metal and glass) (Ministry for Sustainable Development the Environment and Climate Change, 2014). Property owners are responsible for sorting the waste at source while mixed wastes are collected three times weekly from the local councils and the recyclables from private sector under extended producer responsibility schemes (Ministry for Sustainable Development the Environment and Climate Change, 2014). In the Civic Amenity Site installed, residents can bring and dispose to a trained workforce household bulky and garden waste (Ministry for Sustainable Development the Environment and Climate Change, 2014). That way there are greater possibilities towards optimisation of collection of certain types of waste and increased recovery of secondary materials. All the collected recyclable wastes in Gozo are received in the Waste Transfer Station for sorting, processing, interim storage and are later transported to the Materials Recovery Facility at Marsascala for further sorting, baling and export (Ministry for Sustainable Development the Environment and Climate Change, 2014). In this facility, the organic waste is separated and composted, the recyclables are separated in order to be sold, while the rest of them end up to the thermal treatment plant or the landfill with the residues rejected from the other processes (WasteServ Malta, 2010).

However, for the management of the generated volumes of recyclable and recoverable wastes, it is not considered economically feasible to invest in local recycling and recovery facilities so they export them. The interesting fact is that according to the export information for 2009 and 2010 (Fenech M., personal communication), the types of waste sent to other European countries are mostly hazardous, while those commercialised in countries outside EU are mainly paper, non-hazardous metals and plastics, and textiles (Fenech M., personal communication). This choice is reflecting the prohibition of exporting hazardous waste to non-OECD countries, but be treated in good facilities in EU, and the commercialisation of these recyclables in better markets that are mainly outside EU (Lindhqvist T., personal communication). This on the other hand indicates the necessity of minimising the volumes of these streams; reduce the volumes ending to landfill and the additional transportation costs. To succeed with this, it is planned that the property owners will have to sort separately the organic waste (kitchen and garden waste) that will be collected two to three times weekly by the local council services that will transfer them to the two new MBT plants. The organic part of mixed waste will also be transported to the MBT plants and the rest for incineration with the rejected materials from the MBT plants and to landfill only the rejected waste from the thermal treatment plant will be disposed (Ministry for Sustainable Development the Environment and Climate Change, 2014).

Challenges

According to the Waste Management Strategy, Gozo Island had to face many changes in the existing infrastructure. The landfill in Gozo was planned to be transformed, while at the same time illegal dumping was flourishing on the island. With the help of EU funds (Malta Independent, 2006), the landfill was closed and the waste is now transferred to Malta in closed trucks. The new transfer station that was constructed was including most of the waste stream that households would produce, as well as space for bulky waste. This change contributed to the reduction, but not elimination (Malta Independent, 2010), of illegal dumping on the island and to the solution of basic transportation problems, because it was close to the port and the daily ferries that were used for the transportation of waste to Malta (Ministry for Sustainable Development the Environment and Climate Change, 2009).

Furthermore double insularity strengthens Gozo's dependence on sea with mainland Malta, rising that way the transportation costs, a factor that indicates the shipment of most fractions of recyclable waste. Seasonality of tourism is identified as a phenomenon that has both negative and positive effects (Briguglio, 2008a, 2008b). The existing problem with waste generation from the residential areas with high population density is intensified, while the extensive use of water resources stresses the natural aquifers. On the other hand, tourism has increased environmental awareness in the sectors of waste management, clean bathing waters, coastal zone management and well planned land-use as they are preconditions to attract tourists (Briguglio, 2008a, 2008b).

2.2.7 Island of Hvar

Background

The Island of Hvar (see Figure 13) is located in the middle of Dalmatian coast in Croatia and it is surrounded by the islands Brač (from the North), Vis (from the West) and Korčula (from the South), while its eastern end is only 6 km away from the mainland (Alpha Atestd.o.o., 2014). Within a total area of approximately 300 km², it inhabits almost 11 000 people and has a population density of 36 inhabitants per km² (Alpha Atestd.o.o., 2014). The main source of income is fishery and tourism, followed by agriculture. Administratively, the island is divided into four municipalities with Jelsa Municipality being one of them, located in the middle of the northern and southern coast of the island and covering an area of approximately 110 km² (Jelsa Municipality, 2012). Jelsa Municipality has approximately 3 500 inhabitants with 32 inhabitants per km² population density and the economy was traditionally based on fishery and farming (vines, olives and fruits), but after the 1960s tourism became the main source of income (Jelsa Municipality, 2012). It is calculated that the annual number of registered overnight stays was 280 000 with estimation of additional 100 000 undocumented (Alpha Atestd.o.o., 2014).



Figure 13: The Island of Hvar (Source: Modified from Google Maps, 2014)

MSWM Practices

The waste management practices in Croatia are based on the Strategy for 2005-2025 and its goals of the “establishment of an integrated waste management system, remediation of “hot spots”¹⁰ and closing of landfills, development and establishment of regional and county centres for waste management and complete computerisation of the waste management system” (Croatian Parliament, 2005; Government of the Republic of Croatia, 2007). These goals are transposed to the national Waste Management Plan for 2007-2015 that sets requirements for the management of specific fractions and technical requirements for facilities along with their distribution and deadlines for construction, and estimation of potential sources of funding. With the entrance of Croatia in the EU in July 2013, authorities are obliged to establish renewed MSWM plans aiming for sustainable waste management (Damjanić T., personal communication). An example is the target for sanitation and closure of the existing landfills by 2010, a deadline that was postponed for 2012 and transformed in order to illegalise disposal in the landfills after 2018 (Damjanić T., personal communication).

Regarding the waste management in the Croatian islands and coastal area, there are no separate provisions as they are covered under the Regulation on organisation and protection of the protected sea coast (OG 128/04) and the national Strategy with the prohibition of landfilling and the transfer of waste to the designated waste management centres (Alpha Atestd.o.o., 2014; Croatian Parliament, 2005; Government of the Republic of Croatia, 2007). To succeed with that, the waste is first collected and then sent to the transfer stations, where they are preliminary sorted, compacted and temporarily stored to facilitate the reloading on larger transport trucks for their shipment to the mainland. All the municipalities are responsible for the primary collection, temporal storage, local recycling and transportation of the waste that cannot be reused or recycled, to the designated regional municipality that is responsible for the final treatment based on MSWM plans that transpose the objectives emerged from the national Waste Management Strategy (Alpha Atestd.o.o., 2014).

In the case of Jesla Municipality, the municipality-owned company Jelkom Ltd. Vrboska is responsible for the collection, transportation and disposal on MSW and non-hazardous industrial and commercial waste (JELCOM d.o.o. Vrboska, 2014). Bulky waste is collected twice per month, and the mixed wastes collected are disposed at an official collection point/landfill named “Prapratna” that does not have the necessary infrastructure (leachate collection, storm drainage, degassing, scales, electricity), neither is fenced or guarded and in 2013 was loaded with approximately 3000 tonnes (Alpha Atestd.o.o., 2014).

With the entrance in the EU, all municipalities have to install “green islands”¹¹ and recycling yards by the end of the year as they are obliged to separate plastic, paper, glass, metal, textile and wood. While at least one recycling yard is needed to be installed in the municipality, facilities that are still not in place because of bureaucratic processes that are not finished (Damjanić T., personal communication). This means that separation has not started yet and the collection of mixed waste is done during the winter with two big trucks but during summer with five or six trucks because of the tourism, while the frequency is once or twice per month depending on the part of the municipality that is serviced (Damjanić T., personal communication). Households do not have their own bins because the narrow roads and stairs prohibit the entrance of the trucks, but with the instalment of the recycling yard, 15 green islands based on a dual system will also be installed to facilitate separation and

¹⁰ Locations in the environment which are highly burdened with waste

¹¹ Spots in public areas where citizens can bring their separated wastes.

collection (Damjanić T., personal communication). The charging calculation will be based in the volume of the bins and the number of waste collections during every month (Damjanić T., personal communication). The existing system is maintained through a monthly fee paid by all property owners, while specific fees are introduced for the collection of commercial waste and waste streams that need specific treatment (Damjanić T., personal communication). The recyclables are shipped to the mainland and sold in the market, apart from the metal fraction which is handled by a private company. Finally, for the remediation of illegal landfills and the built of new infrastructure, European funds are used (Damjanić T., personal communication).

Challenges

With tourism being the main economic activity of the island, significant pressures on the natural resources are challenging the efficiency of the existing infrastructures. The population is tripled by tourists and it is observed a peak load in the wastewater, difficulties to ensure safe and regular collection of waste and pollution of water and coast line from littering and boat discharges (UN, 2014). If these effects are combined with the absence of national framework and provisions specialised on seasonality and waste management in place to be the second source, social tensions are developed. Local municipalities are very poor and cannot contract private companies for the management of waste and extra services (Damjanić T., personal communication). This leads to the decision of establishing 100% municipality-owned companies, raising the vulnerability of political intervention on decision-making processes (Damjanić T., personal communication). Furthermore, the expenses of the extra equipment used daily during summer months are covered from the fees that property owners pay for the whole year that stay there only for the summer, creating that way problems of social injustice regarding the existing fee system (Damjanić T., personal communication). On the other hand, it is observed that there is lack of awareness and interest on participating on public gatherings, factors that contribute to the non-responsibility intensifying the problem of illegal dumping (Damjanić T., personal communication).

In general, the incentives given are limited and the residents are not penalised for dumping, because the company has no authority to charge and responsible is only one person for whom it is physically impossible to cover the entire municipality (Damjanić T., personal communication). In terms of commercialising the separated waste, the municipality has to send the trucks with the regular ferries whose ticket prices exceed the value of the waste collected and as a result they are sending to the mainland only when they have to take something back (Damjanić T., personal communication). To reverse this situation a suggestion to the regional authorities was to give a discount to the company for the shipment of waste, but there was no reaction (Damjanić T., personal communication). Finally, the only way that any EPR systems worked at some point more effectively was when producers offered 50 cents per bottle and people started opening the waste containers (Damjanić T., personal communication).

2.3 Ways for Better Transferability of Experiences

The choice of the study cases presented in the previous section ended up to be a very useful, because they indicate different perspectives of which are the more sustainable waste management strategies. The first profound observation is that the approach that has been taken in waste management strategies of northern islands are towards pro-action in comparison to the southern islands that still have a reactive approach in order to keep up with the changes in EU legislation, even in the cases of southern islands that seem to do some improvements in the policy level and in networking. This behaviour is closely related to “lock-in effects” that are not including only the technical aspects but also concepts like “proximity”, “trust” and “learning” for the development of better local and regional waste management policies (Polenske, 2004).

Looking first into technical aspects, it is interestingly observed that all islands in the north are locked-in with the engagement to secure the necessary volumes for incineration plants (Orkney and Shetland Islands for the incineration plant to Shetland Islands and Samsø Island for the incinerator to Aarhus) or biogas plants (Tjörn Municipality to the Renova’s biogas plant and Samsø Island to the local biogas plant), while established recycling facilities in place are still few in number (Shetland Islands, Orkney Islands, Ameland Island). This means that the physical characteristics and the geographical proximity from the mainland determine the infrastructure established because of the total costs (transportation and shipping costs) that elsewhere are needed to be paid and included to the municipal fees. At the same time, in all of them a more detailed collection system that includes recycling and transfer stations is adopted to secure operational functionality and the quality of the capacity that is intended for treatment in the designated plants and facilities. Going to the south, it is observed that islands start mimicking practices that are adopted in northern islands in term of collection systems that are considered to be effective, but geographical proximity problems to other islands, the mainland or other countries are greater, and consequently, internalisation of transportation cost is the most difficult problem that is still needed to be addressed, because in monetary terms the transportation costs exceed the value of the recyclable materials.

Critical concept is the one of “trust” that is a main characteristic of collective behaviour which take the forms of cooperation or collaboration between several actors. Trust between public authorities or between public authorities and private sector, educational institutions or organisations (including NGOs) is essential, but it is also dynamic over time or can “evolve from an ‘ascribed’ trust among those in the same social group within a region to ‘earned’ trust among outsiders in the global market” (Schmitz, 1996). In the cases of northern islands it seems to be very popular with the creation of strong and successful collaborative and cooperative relations through networking with other municipalities in the region, universities, private companies or voluntary organisations. Yet, this secured success and lack of establishing new relations with potential external parties, might “lead to an uncoupling from the external development of knowledge and impede new pioneering start-ups from within the network” (Grabher, 1993; Sornn-Friese&Sørensen, 2005). Trust levels seem to be lower in the southern islands compared to the northern, because of the ambitious targets set to Malta compared to its population density, the political influence to the practices adopted in the case of Croatia and in the case of Formentera the complete dependence to Ibiza for final treatment.

With cooperation and collaboration between many actors, information from different sectors can be provided and through the “learning” process policies that promote and incentivise innovation through partnerships could be developed (Asheim, 1996). Yet, there must be careful coordination and combination of expertise of actors, as growing asymmetry of

information based on dispersed knowledge might lead to market failure (Semlinger, 2008). Successful examples are those of Enviroglass in Shetland Islands, the container collars in Ameland Island, the collection system of Tjörn municipality to secure employee's working conditions and biogas plant in Samsø Island. In contrast, Malta is progressing, with the local universities and experts to work upon policies and authorities to cooperate with other countries (European and non-European countries) for trading recyclable and hazardous waste. Jesla Municipality is striving for cooperation with Austria for learning-experience exchange (Damjanić T., personal communication).

What is impressive is the fact that in both northern and southern islands it is a continuous challenge to establish waste management strategies and policies that could be generalised as a framework if local specificities are not identified and their effects are not taken into account in the planning phase. For example, the effects of tourism as one type of local specificities show that especially extreme tourism which determines the local economic activities as well as living patterns, needs and standards show that the seasonality has to be recognised and measured. This is still impossible as there are no specific guidelines for insular areas of how to proceed in the measurement of social, economic and environmental aspects that are seasonally dynamic and very diverse in each case.

A final remark on the issue of imposed guidelines should be noted. The existing "Codes of Practice for waste management on islands" (European Commission, 1996), suggest the following three main strategies for waste management on islands: the Single strategy, the Tandem strategy and the Joint strategy, recognising the possibility of combined strategies such as tandem and joint, without promoting them as an option. Consequently, the option of sanitary landfilling as basic management/treatment strategy in combination with the chance of countries to exclude their islands from certain provisions of the Landfill Directive might have worked in the beginning as an opportunity to avoid radical changes on the waste management system of low income countries, but now it works as a drawback with the new Circular economy package that sets ban on landfilling of recyclable materials from 2025 and elimination of landfilling by 2030 (European Commission, 2014a). This mean that the absence of guidelines for ISWM systems on islands emerge and at the same time can incentivise local authorities to up-grade their systems and go beyond compliance in order to avoid potential penalties.

3 Waste Management System Changes in the Microscope

This section is focused on the South Aegean Region in Greece and in particular, on the Municipality of Naxos and Small Cyclades. The current regional and municipal situation, legislation and practices regarding the waste management sector will be presented. Furthermore, potential system changes based on the experiences from the study cases of Section 2.2 are suggested for the case of Naxos and Small Cyclades Municipality. Policy implications from all the study cases are identified and policy changes in local and national/or EU level are reviewed.

3.1 Study Case: Greek Islands of the South Aegean Region

3.1.1 The South Aegean Region in Numbers

The South Aegean Region is one of the 13 regions of Greece and it extends from the east coast of the Attiki Region to the southern coastline of Turkey (see Figure 14). It consists of 79 islands from which 48 are inhabited and 178 are rocky islets, covering approximately 4% of the total area of the Greek territory (PSA, 2012). It is inhabited by approximately 310 000 residents (EL.STAT., 2014) and is divided into the two sub-regions (administrative units) of the Cyclades and Dodecanese. This



Figure 14: South Aegean Region (Source: Modified from Google Maps, 2014)

means that approximately 3% of the total population is distributed in a large number of islands. The South Aegean Region is one of the two developed regions of the country according to the European Commission for the planning period 2014-2020. The regional gross domestic product is higher than the average national level and reached in 2010 approximately 109% of the national average per capita (PSA, 2012).

In the waste management sector, the region contributes to approximately 6% of the total national amount of waste generated. According to the regional plan it is estimated that future amounts of waste might reach the levels of approximately 330 000 tonnes/year in 2018, 475 000 tonnes/year in 2028 and 670 000 tonnes/year in 2038 (PSA, 2008). In terms of waste composition, biodegradable waste constitutes approximately 28.5% of the total waste generated, with paper/cardboard and plastic and glass to follow with 27.7%, 20.7% and 7% respectively (PSA, 2008).

3.1.2 Most Common Practices

Waste management and final disposal of municipal wastes are challenges that municipalities and residents continue to face during summer months. In conversation with various stakeholders it is revealed that workers responsible for the implementation of waste management plans and practices do not know how to use managerial tools to facilitate and organise the actions needed to be taken to upgrade the local standards. Consequently, this

situation is more obvious and aggravated during summer months, with the entrance of tourists, as the volumes of wastes are increasing and the waste management system is not effective enough.

The absence of sanitary landfills, the inadequate control from local and regional authorities, and the different methods of monitoring and calculating the waste generated create space for less environmentally sound practices. Uncontrolled dumpsites are the primary common practice. Lack of awareness and mistrust to the existing systems led to dumping in open spaces that are close to streams or coastal areas (PSA, 2012). This phenomenon can cause contamination of the soil because the place is not prepared to receive these wastes or littering of coastal areas and marine life. Another reaction due to extreme increase of volumes during summer months is the uncontrolled burning. This measure produces dangerous emissions and odours which are harmful for human health and the residues can pollute the groundwater aquifers contributing in that way to the continuous degradation of the insular environment. Penalties for these measures are not applied and as a result there is lack of incentives to minimise these actions (PSA, 2012).

Finally, regarding the management of specific waste streams, municipalities are often contracting private enterprises to manage these wastes (Synodinos N., personal communication). For packaging and packaging waste, they provide municipalities bins based on the system adopted. The most common is for paper, metal/aluminium cans, plastics and glass. Companies bear the transportation costs, but for batteries and accumulators, WEEE, waste oils, end-of-life vehicles and tyres, waste management companies cooperate with related businesses, so who covers the transportation costs depends on the contracts (Synodinos N., personal communication, Theonas V., personal communication). Mixed wastes, biodegradable and residues that cannot get shipped end up in local landfills (Synodinos N., personal communication).

3.1.3 Challenges

In the South Aegean Region many challenges are needed to be addressed in political, social, economic and technical level to achieve efficiency in the practices adopted according to the waste management plans.

Focusing firstly in the political aspects, waste management is not of the first priorities in the agenda of the political figures that take decisions, a fact that might possibly change because of the new penalties¹² that Greece have to deal with, due to the landfills that still operate (Synodinos N., personal communication). Furthermore, the strong influence of political parties in the decision-making processes converts the opportunities for cooperation with other islands to political cost. Finally, it is not given the proper attention to the concepts of insularity and seasonality, a fact that is practically seen in the legislation, where there are no specific provisions (Synodinos N., personal communication, Theonas V., personal communication).

Insularity also leads us to economic challenges, where there are the issues of unfeasible transportation costs, for which continuous pressure for legal changes is made, since commercialisation to neighbouring countries is considered impossible due to adverse political

¹² Penalties at a daily penalty payment rate of EUR 71 193 for each day after the second Court ruling until Greece complies with the judgment and a lump sum calculated on the basis of EUR 7 786 per day for the period between the first judgment and the day of compliance or the day of the second Court ruling (European Commission, 2013).

conditions, as well as, because there is absence of competition between shipping companies in the area, aggravating that way the communication problems of smaller and more isolated islands. The use of GDP as one of the economic indicator for the distribution of EU funds creates more economic challenges for the region (Synodinos N., personal communication). The reason is that GDP does not show how it is distributed in a fragmented region such as the South Aegean Region, neither in the period of one year. Seasonal tourism is the main factor that contributes to the rise of this indicator and as a result it does not represent the actual conditions in every island. This means that it will be a challenge for the regional agency to distribute the limited funds to upgrade the infrastructure and avoid bigger penalties from European Commission for non-compliance to waste targets.

Additionally, the mono-specialisation towards tourism services transforms and weakens the local economies by strengthening seasonal employment during summer months and high levels of unemployment the rest of the year. On the other hand, the geological characteristics influence this trend. For example, Naxos Island has mountainous features that divide the island in the middle and forcing the tourism to flourish on the west coast where the main port is located and limit the cultivation and the rest sectors of primary production to the eastern and part of the central area of the island.

Finally, the absence of a range of educational institutions in the South Aegean Region contributes to the depopulation of the area, the increase of the aging population and the lack of educated and specialised personnel. On the other hand, it is important to be mentioned that during the last few years of economic crisis there is a trend of decentralisation of population that could possibly change the existing rural standards.

3.2 Legal Framework and Waste Management Policies

3.2.1 National Legislative Framework

The national legislative framework on environmental issues and waste management could not be considered very old, but it has undergone numerous changes. The first law on environmental protection established in 1986 (Law 1650), setting the responsibility for waste management to local authorities. The first EU Waste Framework Directive was transposed as a Joint Ministerial Decision in 1996 (JMD 69728/824/1996). The latest waste framework directive has been transposed as a law (Law 4042) in 2012.

The JMD 50910/2727 on measures and conditions for solid waste management, established in 2003 was a major step because it introduced guidelines for waste management by taking into consideration the Law 2939/2001 on packaging and alternative waste management of packaging and other products and the JMD 29407/3508/2002 on measures and conditions for landfilling of wastes (transposition of EU Landfill Directive), as the first national solid waste management plan (JMD 14312/1302/2000) was criticised because it was not applicable to the existing local circumstances (Andreou, 2004).

The importance of the Law 2939/2001 comes on two issues: 1) the “other products” that are included and present the specific waste streams such as paper, glass, metal and aluminium packaging, end-of-life vehicles, tyres, waste oils, batteries and accumulators, construction and demolition waste and electrical and electronic equipment, bulky waste, and 2) the establishment of the National Organisation for Alternative Management of Packaging and other Products (EOEDSAP). With the programme ‘Kallikratis’ and the new administrative restructure (Law 3852/2010), the Law 2939/2001 is amended by the Law 3854/2010.

3.2.2 Regional Waste Management Plan

In 2012 the EU Directive 2009/50/EC was transposed in the Law 4071/2012 that sets provisions for social cohesion, local and regional development and the establishment of regional and municipal organisations for the management of solid wastes. This complicated partially the existing situation because the research for the regional waste management system was made in 2008 and came into force in 2011, making it harder for the municipalities to adopt new and more effective systems or transform the existing for obtaining the regional targets. The problem though arises from the lack of incentives created from the regional targets imposed, because if they are reached they still do not contribute substantially to the national targets and their role will be supportive only in the last year of the targets (2020)(PSA, 2012). The structure is based on the existing municipal waste management plan in relation to the manual for waste management practices introduced in 1996 from the European Commission and examples from other European islands.

According to Law 4071/2012, it is up to the municipalities if they are going to establish a municipal organisation that will be responsible for the implementation of the MSWM plan and the provisions of the Regional WM strategy. In any case, the municipality is responsible for the implementation of the regional waste management strategy. They are able to contract companies for alternative management of waste, and responsible for the collection, storage, shipment, usage and disposal of the waste generated locally (Synodinos N., personal communication). The role of the Regional Administrative Office is more supervisory in the ways the funds are distributed and used, how the guidelines are implemented and supportive regarding the public awareness programmes and campaigns (Synodinos N., personal communication). The regional organisation for waste management is responsible for the creation of the regional waste management strategy, but at this moment is considered understaffed and as a result the technical agency of the Regional Administrative Office contracts external consultants for the formation of the strategy (Synodinos N., personal communication). Finally, the Ministry of Environment, Energy and Climate Change is responsible for the establishment of legislative frameworks, guidelines and national waste management strategy, as well as the ratification of the regional waste management strategies (Synodinos N., personal communication).

3.3 Municipality of Naxos and Small Cyclades

3.3.1 The Municipality in Numbers

The municipality of Naxos and Small Cyclades is located in the centre of the Aegean Archipelago (see Figure14). Naxos is the biggest island of the Cyclades as its surface area is 442 km², and is surrounded by four smaller islands, Irakleia, Donousa, Schinousa, Koufonisia, of 19 km², 14 km², 9 km² and 5 km² surface respectively (see Figure 15) (PSA, 2012). The main source of income is cultivation, animal farming, commerce, marble quarrying and in the last 20 years, tourism (PSA, 2012).“Insularity” is a special characteristic, and in this particular case, we have “triple insularity” because of: the distance of Naxos from the capital of the Region, Ermoupolis, the distance of Naxos from the mainland and the main port of the country (Piraeus), and the distance of the four smaller islands from Naxos, Ermoupolis and Piraeus. This isolation contributes also to other difficulties, such as difficulties in transportation, communications, energy production and economic development in bigger markets. Local economy on the other hand is based mainly on tourism, but also on the production of local agricultural and dairy products, as well as small-scale fishery (PSA, 2012).

The permanent population of the municipality of Naxos and Small Cyclades reached the level of 19 000 in 2011, from which approximately 18 000 live in Naxos, 360 in Koufonisia, 200 in Schinoussa, 160 in Donoussa and 150 in Irakleia (PSA, 2012). The population starts rising from April and during summer months it is more than doubled until mid-October (Port Agency, personal communication), causing in that way serious problems for the existing infrastructure.¹³ It is estimated that for the year 2013 the quantity of waste generated was in total 11 000 tonnes, but during the year for Naxos it was estimated that municipal solid waste being produced were almost 7 500 m³ from October until March and 16 800 m³ from April until September, which shows that the seasonal population contributes very significantly to the waste generation (Triantafyllos M., personal communication). Regarding the recyclable materials, the volumes of special streams is considered to be difficult to measure, but are estimated to approximately 2%, but there is a reduction of the recycling rate because of lack of incentives for residents to recycle and the different schemes adopted (Triantafyllos M., personal communication, Pantazidis D., personal communication, Marinakis S., personal communication).



Figure 15: Municipality of Naxos and Small Cyclades (Source: Modified from Google Maps, 2014)

3.3.2 Current MSWM System

As mentioned in Section 3.2.2, the municipality is responsible to establish and implement a MSWM plan and include provisions for the collection, storage, shipment, usage and disposal of the waste generated in the municipality. Property owners are responsible to transfer the household and commercial waste to the designated points for mixed and recyclable wastes and keep the properties and the public area around their property clean (ΔήμοςΝάξου και ΜικρώνΚυκλάδων, 2011).

The existing plan for waste management is based on the following seven principles and goals: cleanliness of the town and communities, protection of natural environment, to secure public health, improvement of the town's functionality and residents' quality of life, upgrading of the areas of natural beauty, support for the attractiveness and functionality of commercial areas, support of alternative waste management practices that do not degrade the environment, and active participation of the residents (ΔήμοςΝάξου και ΜικρώνΚυκλάδων, 2011). The objectives are focused on keeping the main town clean, on securing public health and the correct and rational management of wastes and the report of relevant regulations and the results of the progress (ΔήμοςΝάξου και ΜικρώνΚυκλάδων, 2011).

Practically, in the municipality many different schemes for waste management are in place. From 2008 the municipality contracted the Hellenic Recovery Recycling Corporation (HE.R.R.CO) for the management of packaging and packaging waste (Theonas V., personal communication). HE.R.R.CO provided the municipality with coloured containers for the collection of paper/carton/cardboard, metal, glass and plastic and bears the shipping costs to the facilities in Attiki. The waste collection is done by municipality-owned trucks with cranes

¹³ These numbers demonstrate the tourism activity only for Naxos Island, because there are no offices in the smaller islands to do the same measurements.

to empty the containers, while the bins for mixed waste are emptied to larger garbage trucks (Triantafyllos M., personal communication, Pantazidis D., personal communication, Theonas V., personal communication). These containers are not placed by every property, but in locations designated by the municipality for common use. Household bulky wastes are also delivered to designated locations after a contact with the related municipal department (Marinakis S., personal communication). For WEEE there are no specific provisions, but there is a possibility to be accepted to retailers, while for batteries there are collection columns from AFIS in retailer outlets, schools, and other public and community buildings (Marinakis S., personal communication, Theonas V., personal communication). Cooked oils from three remote villages are shipped to Attiki and in return they take biodiesel and cleaning products (Theonas V., personal communication). The end-of-life vehicles, tyres and metal scraps have been taken care by authorised businesses, and food service businesses have the option of a deposit-refund system for beer bottles, which are returned back to the breweries through the retailers (Theonas V., personal communication).

Finally, it is encouraging and important to be mentioned that biodegradable waste especially in the villages could be considered as zero because they are used as food for the animals (pigs, goats, etc.) (Theonas V., personal communication) or they are used to generate compost for the fields. This means that the criterion of 1.1 kg/person/day that is used to estimate the waste generated is not reliable because it is a typical criterion for urban areas that includes provision for biodegradable waste, a factor that questions the reliability of the estimated volumes (Theonas V., personal communication).

Some particularities arise in the case of recycling bins that are mainly distributed in Hora, the town of the island, and the area of the central and south west coast, where most tourists are staying or visiting. As a result, the villages in the northern, central and eastern areas of the island, as well as, the smaller islands of the municipalities are not supplied with these bins (Theonas V., personal communication). That results to larger volumes of mixed wastes that end up in the landfills. Also, a door-to-door scheme is adopted, but only for the businesses located in the front face of the port and the first narrow street of the castle (Theonas V., personal communication, Marinakis S., personal communication). This choice causes a lot of problems to the rest of the businesses that are located also in the main roads of the town, as they have to transfer big volumes of waste for long distances to locations that are easily filled (Marinakis S., personal communication). Finally, the organic matter contained in the waste from the operations of olive mills, farms and cheese-dairy facilities, as well as agricultural waste are not disposed in an environmentally sound manner contributing to the degradation of the environment (Marinakis S., personal communication, Theonas V., personal communication).

3.3.3 Potential System Changes

The year 2014 is considered to be a very difficult year, because many practical changes and policy decisions are needed to be taken. In the municipality eleven landfills exist, from which six (all in Naxos) are out of service, while the other five are still open (one in each of the five islands) (PSA, 2008). The existing plans are related to the closure and rehabilitation of the ten uncontrolled landfills and the upgrade of the landfill in Naxos to sanitary landfill, while in the smaller islands, one transfer station (includes a press container and a tractor) for mixed wastes in each island will be installed (see Figure 16) in the today existing landfill after its remediation. In the case that these transfer stations are not installed, the landfills will be upgraded to small sanitary landfills (see Figure 17).

The press container for Naxos Island is placed temporarily in an area close to the centre of the island (Theonas V., personal communication), but not installed in the designated villages because the installation of such infrastructure was not socially accepted (Cyclades 24, 2014; Naxos News, 2014). According to the Regional Plan (PSA, 2008), it was suggested the instalment of a recycling centre in Naxos, but no actions are actually taking place.

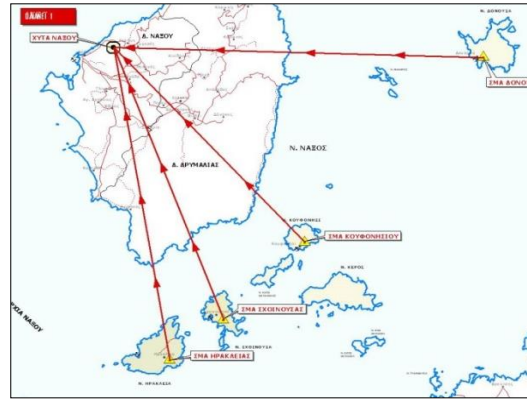


Figure 16: Option of One Main Sanitary Landfill and Four Waste Transfer Stations (Source: Modified from PSA, 2008)

Moreover, the engagement in 2011 of the municipality in the binding instrument “PACT of Islands” (Islepact, 2011) will provide the local authorities with the benefits of networking with other European islands for knowledge exchange over energy topics and alternatives that could potentially influence the structure and the operation of the existing waste management system. At the same time, there is an expressed interest from the side of the municipality for transfer of knowledge from Germany regarding thermal treatment facilities, such as incinerators, that leads to political conflicts (Naxos Now, 2014).

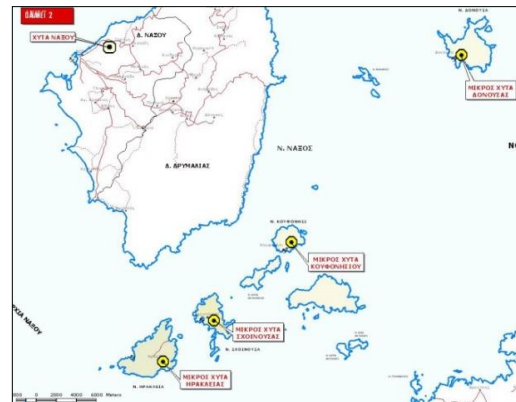


Figure 17: Option of One Sanitary Landfill and Four Waste Transfer Stations (Source: Modified from PSA, 2008)

Unfortunately, the main transition phase is related more to the integrated MSWM plan that is planned to be announced this September or October (Triantafyllos M., personal communication, Pantazidis D., personal communication), introducing provisions and practices that will be implemented after its ratification. At the same time, the new regional waste management strategy that had to be ready in 2012 has to be published and approved by the Ministry by the end of August, but due to bureaucracy it is estimated that it will be announced by the end of September and accepted by the end of 2014. This factor creates difficulties to elaborate more on the potential system changes, because it is not possible to estimate how the provisions of new European policies and political pressures will influence the final outcome.

3.3.4 Challenges

From the previous section it can be assumed that the nature of challenges that the municipality still has to face differs in context and covers environmental, social, political, economic, and technical aspects. The environmental aspects are closely related to the technical, because they determine the effectiveness of the system adopted and the potential alternatives. The reliance on landfilling in combination with weak recycling schemes, growing volumes of waste generated and financial pressures because of the penalties implied for non-compliance¹⁴, can potentially lead to a lock-in effect. In this case, local authorities, under the

¹⁴ Apart from EU penalties the municipality has to pay penalties imposed by the Regional Administrative Office for the operation of landfills to Koufonisia and Irakleia that reach the level of EUR 3 000 and EUR 1 500 respectively (PSA,

pressure to find quick solutions to the waste management problems, they might accept the installation of incineration plants that relying on continuous burning of specific capacity. The problem arises to the point of scale of this infrastructure and if the local capacities are sufficient taking into account the small volume of waste during the year, compared to the large volumes during summer. The compliance with the European provisions for prevention and reuse in combination with the fact that biodegradable residues are already used as food for animals, will result to even lower waste generation, setting incineration as a questionable solution especially if there are political provisions towards this choice.

The high temperatures, in combination with the mountainous characteristics that limits the accessibility and the limited space in the houses will challenge the recycling scheme that will be more applicable, because many fractions in small houses can be counterproductive even if it is required from a policy perspective. Another characteristic that contributes is the dispersed development of built environment because it is observed that people that don't have a house but a field outside a village of certain dimensions are able to build a small house. This phenomenon can create problem to the development of an effective waste management plan because there is no organised plan for development of residential areas and it is more expensive to build such infrastructure later. Costs for infrastructure, transportation costs and the maintenance of equipment can arise as waste management should cover the entire municipality even if the settlements are sparsely distributed.

In a political context, the first challenge that arises is the policy resistance (Theonas V., personal communication), because of discrimination between stakeholders in terms of incentives given and of distrust to a system that is based on legal, institutional and operational inconsistencies. This can lead to ineffectiveness and controversies between the stakeholders as well as strengthening of the informal economy. Furthermore, strong influence of political parties in decision-making processes may lead to further inaction and unwillingness to bear the “political cost” of radical changes or collaboration with other municipalities (Synodinos N., personal communication). Finally, the inadequate monitoring and controlling of processes challenge policy-makers to create strategic plans based on reliable data, especially in the cases of continuous changes in policies or the introduction of new policies that could be socially acceptable. This is closely related to the level of information transparency and delays in announcement processes, as they can provoke public pressure if the results are negative and there are no actions for improvements.

Looking into the social perspective, the “Not In My Back Yard” or NIMBY syndrome is observed in the island as residents do not know how to handle farm residues or packaging and mixed (Synodinos N., personal communication), but at the same time they do not activate themselves on solving waste management issues. The lack of awareness on how the waste management system works in reality is making them resist potential changes and challenge local authorities to find proofs for their choices. On the other hand, this could be a sign that residents might have the tendency to pass the responsibility for waste handling to anyone but themselves which is determined also on the right and transparent way of responsibility distribution.

2014a, 2014b), while a penalty of EUR 42 500 was also imposed for the uncontrolled disposal of waste in the active landfill in Naxos Island, the non-completion of rehabilitation processes of all municipal landfills, the collection and transportation of solid waste without having the necessary legal permit and the operation of storage and transfer facility for recyclable solid waste, without Environmental Impact Assessment Approval or Pilot Environmental Commitment (Τριάντης, 2014).

The major economic challenge that islands face is the funding assigned for infrastructure and education and awareness-raising, because the distribution of funds is based on indicators like population fluctuation and GDP (Synodinos N., personal communication). Furthermore it is questionable if the right economic incentives are given to stakeholders, or how penalties for non-compliance with European regulations will influence the regimes of stakeholders over waste management practices. Also, there are not economically examined small-scale recycling alternatives that could minimise the overall transportation costs for the municipality itself but also for the rest of the islands in the region.

Finally, in the case of establishment of every type of new infrastructure there are historical barriers that could potentially block all the procedures. Naxos Island has a long history with continuous inhabitation from the 4th millennium BC (Naxos Island, 2014) and as a result there are great possibilities during the preparation of the installation for new archaeological findings to be revealed, even at a small depth. For this reason, during the planning phase it is mandatory to take the permission from the relevant public agency that the area is “clean” from archaeological findings and is in compliance with the relevant legal framework.

3.3.5 Alternative System Solutions

Looking into the challenges mentioned in the previous section and the study cases explored in the previous chapter there are some solutions that will be suggested in this section to facilitate for policy-makers and decision-makers in the possibility of future changes in the current waste management system.

A lesson that could be learned from the case of Tjörn Municipality is the importance of including in the waste management strategy specific provisions for the workers, and the conditions of their working environment. By securing their health conditions, the municipality minimises the social aspects that could be related to workers such as social discrimination and give potential for more jobs to be created in the sector. This could be nicely combined with structural policy changes similar to what Croatia and Malta were forced to do due to their late entrance to the EU. National authorities had to reform the existing strategies by redefining the goals, principles and objectives of waste management plans or regulate the sector if there is not adequate legal framework (Fenech M., personal communication) that are targeting the higher levels of waste hierarchy of prevention and waste minimisation. That way they will be able at municipal level to strive directly for prevention and activate second hand SMEs, cultural associations or the church for reuse as an action towards waste minimisation.

From Samsø Island the option of a small-scale biogas would be an interesting alternative for the island, for many reasons. The existence of olive mills, farms, and cheese dairy facilities produce organic waste of high consistency in matter. It is also observed that because of the financial crisis there is a tendency of young people to return permanently in their villages and focus on primary production, a fact that will help to secure the capacity needed. The slurry produced, can be used as a high quality liquid fertiliser for the fields, while the heat produced could be used directly in the existing greenhouses, avoiding that way these streams to end up in the landfill. Furthermore, small-scale “Bio-booster” wastewater treatment plants (European Commission, 2012) could be used in the smaller islands to support the irrigation system and the separated sludge could be transported as contribution for the production of biogas.

It is estimated that during summer months the volume of glass wasted is rising (Gidakos et al., 2006). With the method introduced in Shetland Islands by Enviroglass, the bottles will be transformed to building material that could be used in constructions or even as an inert material during the rehabilitation processes of the existing landfills in the municipality. It is also a great opportunity to enhance the glass making industry and support local beverages. This innovation was financed by Highlands and Islands Enterprise and LEADER programme, while the Shetland Amenity Trust is committed for helping increasing its production capacity and minimise the operational unit costs, which-means that there are funding opportunities for small-scale recycling facilities (Enviroglass, 2013; Griffiths, 2013).

Controlled use of underground containers of specific waste streams as in Ameland would be an applicable solution for the islands, if in the waste streams biodegradable, organic and mixed waste are not included. The main reason is the big difference in the temperatures. In Greece, there is need for quick disposal and short storage of these fractions, because the high temperatures during summer accelerate their decomposition, produce odours that are harmful for human health and attracts insects and animals. On the other hand, a food-digester such as the Green Cone from the Orkney Islands (Independent Consultants, 2006) could be a better option for households that want to minimise their biodegradable waste and especially those that cannot be composted or given to animals. This can contribute to higher separation levels of biodegradable waste from recyclables at source and less waste landfilled.

If all these alternatives are illustrated as a system that could enhance the existing circularity patterns, then the following diagram (Figure 18) can be suggested as part of a better waste management system.

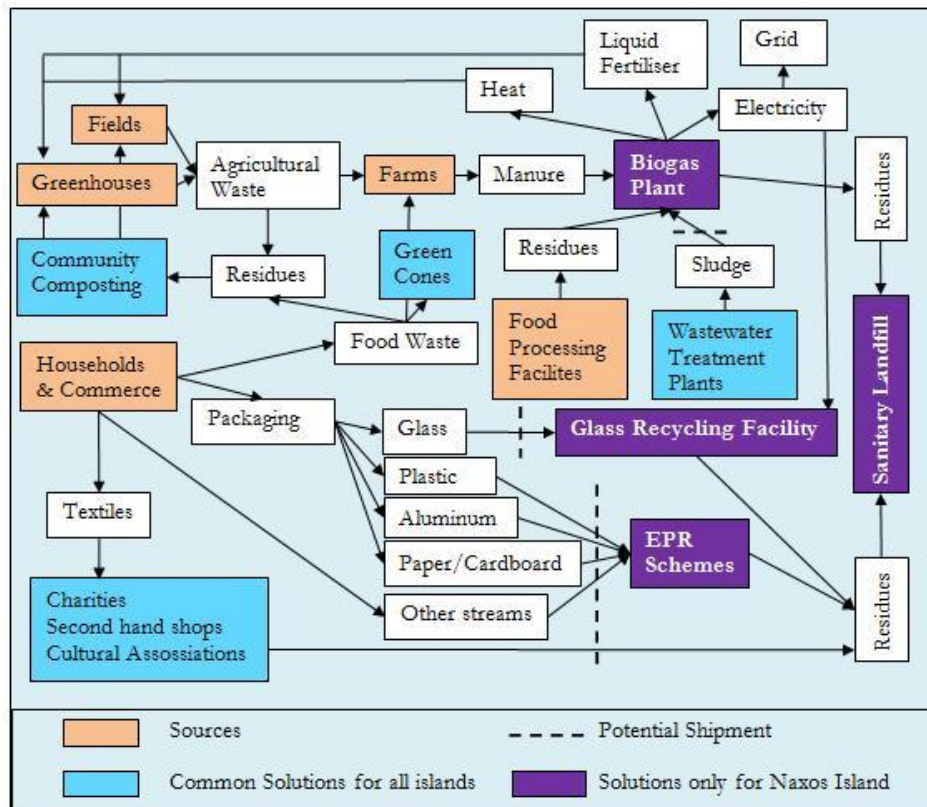


Figure 18: Suggested System Change

In practical terms, with the continuous changes in the European policies, a reactive approach will not be as effective as a proactive. This means that focusing on end-of-pipe solutions to minimise the consequences of the existing problem will not solve the problem itself. The existing targets for reuse and recycling, in combination with the potential rise of the municipal fees because of the penalties, emphasises the necessity for public awareness. Strengthening the existing circular pattern at community level, municipal level or regional level and collaboration with other islands that recycle specific waste streams, will minimise the residues for final disposal in the landfills, the transportation costs and if there are explicit guidelines of how to sort in the existing fractions, it will also reduce the volume of combustible waste. Educational programmes and campaigns towards prevention will modify the consumption trends towards reuse (Nilsson R., personal communication). To measure the effectiveness of this type of campaigns is difficult (Nilsson R., personal communication), especially if they are organised in the wrong period of time. For example, if the campaigns are done in all the villages in the end of the touristic period with the right means, it would be easier for the residents to be engaged in the system and start involving some of the visitors during Easter and be prepared for the summer. If the campaigns are done close to the opening of the season, there will not be enough time for anyone. Educational level, age and diversified social layers should be taken under serious consideration because this will determine the information tools that are going to be used. For example, Eco-Schools from Shetland Islands could be considered an interesting initiative for the schools of the municipality, with one small difference. Instead of using the element of competence, to use the element of cooperation between the schools of each village and through children to expand the bonds between the villages, supporting and strengthening that way the social cohesion of the local communities.

Finally, one way to reduce the policy resistance is if the strategic plan clearly defines the goals, the objectives, and is based on shared responsibilities. By involving other stakeholders in the policy-making processes, the local authority is not the only one responsible for the outcome, but so are the stakeholders involved. This will give ground to transparency and the actual involvement of the public, changing the hierarchy of roles from the top-down to a bottom-up tense. That way the responsibilities are decentralised facilitating the governance of the commons, minimising lobbying and redefining the ways of political interventions. The choice of economic instruments that might be introduced should be very careful and precise and should be accompanied with additional incentives. The vulnerability of insular economies, the level of the penalties that already have been imposed and the austerity measures adopted from the beginning of the economic crisis and potentially be introduced can intensify social turbulences that will result to political instability.

3.4 Policy Implications

Being in compliance with the European policies mentioned in the Section 2.1 will be challenging for both northern and southern islands. To make the islands not be vulnerable to these changes, it is better for them to go beyond compliance with the existing regulations and targets and create societies that are self-organised and resilient. This is not possible to be done if there is no change in living standards and change in the mind-set of how a society has to be structured. By taking the sector of MSWM and embedding into it this need, the first question that arises is what are the policy barriers or elsewhere policy implications that local and regional institutions have to face?

Looking at the cases one by one, we can see first of all that in Tjörn Municipality the EPR system doesn't work properly because of the unwillingness of producers to get involved to waste management issues in areas that do not have significant impact on attainment of the national targets, creating that way disincentives for recycling at source in the first run. In the case of Shetland Islands and Orkney Islands as well as Samsø, the local authorities have to face technological lock-in effects because of their early investment on incinerator or even biogas production that their capacities are uncertain. They may need to import waste if they are not already doing it, which means that the targets for recycling and reuse are even more difficult to achieve. That way they remain in the bottom of statistical rates (BBC, 2013) and with high dependence on external help for supporting the existing system. These rates are closely related to the economic activities that islands rely on. In most of the cases, if agriculture or fishery is not the main source of income for the residents, it is tourism that could be seen in various forms, with extreme tourism to be the most aggressive not only because of the social impact they have but mostly for the environmental stress that it creates to the natural resources. In both cases, the policy barriers are related to the inability of creating indicators to relate the root problems with their effects.

Political intervention is also a difficult topic that is needed to be addressed. It is observed in Croatia and Greece that elections might influence the MSWM practices that are in place (Damjanić T., personal communication, Synodinos N., personal communication). This phenomenon most of the times leads to negative symptoms of social reactions, such as lack of awareness and interest and lack of mutual trust between the residents and the existing or potential system, because of the tendency of satisfaction of personal interests rather than enhancement of social welfare or creation and achievement of the broader goals that are accepted from all the relevant actors.

This raises also the issue of how vertical governance functions. Nowadays, there is a top-down type of governance, where environmental issues are addressed with complete harmonisation or generalisation of specific system models or economic models, which are not desirable for many reasons. By regulating everything the legal framework does not remain flexible to continuous changes, and can fast be outdated. Economic models are difficult to be adopted everywhere because of the differences in the national, regional and local markets and the structures of communities. For example, by estimating the volumes of wastes in islands according to indicators used for urban areas in the mainland without including indicators for the effects of extreme seasonal tourism can be crucial for the waste management systems being adopted. Furthermore, the indicator GDP per capita, that is used for the determination of a region's eligibility to absorb EU funds, does not reflect sufficiently social, environmental and territorial aspects, such as education, innovation, seasonality and distribution of touristic activities. As a result, the diversification of new waste management systems is unable to be mapped and generalised, factors that influence the transposition of EU legislation to the national legal framework and later on to the regional and local plans.

Finally, it is a common trend in insular areas that the rate of population older than 65 years is relatively larger than the population of more productive ages as compared to national averages. If this case is related to the lack of young experts coming back to the islands to implement their expertise, it means that the educational level might remain very low (because most of the times islands lack educational institutions) and especially in key actors such as local authorities, the absence of expertise might lead to difficulties in addressing complex environmental or social problems, such as exploitation of natural resources or lack of social cohesion, and adopt practices that would become a burden in the long-run.

3.5 Policy Changes

From the previous sections it is observed that currently the main modes of governance of the commons are hierarchy or market based. The problem with these two modes is that they demonstrate two completely different options of structures. Hierarchy, on the one side, has a static structure and the decisions are made directly by the authority that can be based both on egoistic and non-egoistic rationale that is enforced to be adopted with the possibility of knowledge loss due to centralisation of information (Semlinger, 2008). On the other side, market is a very dynamic structure that is based in monetary values, market incentives towards competition between stakeholders, supporting that way egoistic rationale and potential loss of knowledge due to opportunism (Semlinger, 2008). The golden line between these seem to be cooperation as it is a dynamic mode of governance that is based on communication between the stakeholders through familiarity and supports the concept of bounded autonomy that is related to self-control and framing of both egoistic and non-egoistic rationale (Semlinger, 2008). That way it will be possible to create a mode of governance that can secure both the social welfare and the environmental protection, keeping at the same time the potential for cooperation with new parties that could help in self-organisation of the system. This potential is explained clearer by Meadows (2008), who presents the fact that if subsystems (lower levels of governance) can be largely self-organised, self-regulated and self-maintained and at the same time serves the larger system that coordinates and enhances the functioning of the subsystems, the whole system itself becomes more stable and resilient. As a result there is need for balance between flexibility, duties and welfare of the different governance levels.

The reset of goals and the purposes of the system are considered as essential leverage points because they can twist the behaviour of the system, as well as the potential outcome of the system (Meadows, 2008). These new goals shall be carefully redefined, as well as the indicators used for the reflection of the real welfare of the system, because elsewhere it won't produce the needed results, but rules that are inefficient and questionable if they are followed (Meadows, 2008).

Even if the system doesn't represent the highest standards but it is affordable for the local communities, it is based on realistic expectations and promotes synergies for further development with other islands or the closer mainland, it can be considered that the specific solution is sustainable, since it enables a "learning by doing" approach and it does not remain passive (Schübeler, Christen, & Berne, 1996). This solution will result in social cohesion between communities and other islands of the regions through networking, and increased public awareness contributing to an equal share of responsibilities between the stakeholders. If the EPR schemes on islands are legislated as mandatory, then producers will be forced to take the responsibility for specific fractions. In that case, many benefits arise for municipalities and producers. Producers can share knowledge for how to handle the waste on the island, securing that way innovative practices that could absorb funds, and later force cooperation between insular municipalities, a fact that will minimise political intervention,

increase information transparency and transform the existing political costs to opportunities. Opportunities for local authorities will be created because the environmentally friendly way of waste handling can be socially acceptable and economically affordable factors that will create trust to the system and political sustainability.

Finally, legitimate measurement is crucial for the control and the improvement of the system, and this will not be able to be achieved without new dynamic indicators. The special geomorphologic characteristics of islands and their uniqueness in terms of socio-cultural and economic development and environmental resilience indicate the need for the establishment of specific eligibility criteria for the better understanding of the existing developing characteristics of islands (CRPM/CPMR, 2010) and their actual needs.

4 Conclusions

4.1 Concluding Remarks

Sustainability of MSWM systems, in the sense of combining the approach of ISWM systems and the principles of Waste Management Hierarchy to achieve high levels of resilience, is considered the keystone for the design of new systems and further policy changes at local, national and European level. This thesis has shown the difficulty of addressing the problem of waste management in insular areas and suggesting policy changes if the interrelations between socio-economic, geomorphologic, environmental, cultural, political and technical aspects are not explored in the first place. Change of paradigms as a starting point for setting strategic goals, cooperation between stakeholders and respect to the unique characteristics of each area under investigation can help in the better governance of the commons.

The three aims of this research were to identify both good and bad experiences from waste management systems being adopted in islands of European countries that could be transferrable to the context of Naxos and the Small Cyclades Municipality; provide the municipality of Naxos and Small Cyclades with insights of how to use the identified experiences to improve their existing waste management system; and proceed to policy changes and explore how islands are addressed in existing EU and national waste management policies and explore whether changes could facilitate the solution to local challenges. To achieve these aims three additional questions were developed:

- What are the features of the municipal waste management systems in European islands that are particularly well adapted to island conditions?
- How can the municipal waste management system in the municipality of Naxos and Small Cyclades be changed to be more sustainable?
- How can policy changes on national and/or EU level facilitate the transition to more sustainable waste management practices on islands?

With a retrieval of data based on desk research and interviews with stakeholders, it was managed to collect necessary information for the analysis of the research questions and provide insights for emerging policy implications on evolving existing systems that could be addressed through policy changes. A brief presentation of findings for each question follows.

Research Question: *What are the features of the municipal waste management systems in European islands that are particularly well adapted to island conditions?* Through the description of seven case studies (see Chapter 2.2 and 2.3) it is observed that proactive systems are easier to be adapted on islands compared to reactive systems, as long as there are actions that improve monitoring, support awareness-raising programmes and promote cooperation and shared responsibilities between stakeholders. Technically, only small-scale infrastructure in combination with good separation at source can help islands to deal with main fractions on the island, taking into account the population fluctuation and change of consumption patterns due to seasonality of economic activities. The good functionality of the systems will create trust that will result in social acceptability of the practices.

Research Question: *How can the municipal waste management system in the municipality of Naxos and Small Cyclades be changed to be more sustainable?* According to the current situation in the South Aegean Region and the municipality itself, system alternatives based on experiences from

other island in Europe can be transferred (see Chapter 3), but to achieve long-term sustainability, cultural aspects should be respected, ensure public awareness and stakeholder involvement on policy-making processes and strengthen economic activities and system trends that embrace patterns of circularity.

Research Question: *How can policy changes on national and/or EU level facilitate the transition to more sustainable waste management practices on islands?* To answer this question, policy implications and ways for better transferability of experiences are used as basis. With penalties to be the main economic incentive, the absence of clear guidelines from both national and European level and the possibility of non-compliance to the new targets because of “lock-in” effects as a second set of incentives, policy changes can be held through cooperation between stakeholders and administrative authorities and social acceptability that can be derived through knowledge-exchange, legitimate monitoring and controlling processes, information transparency and sharing responsibilities.

The contribution of this research was to offer a background to policy and decision-makers of Naxos and Small Cyclades Municipality on the development of a waste management system through insights from waste management practices in other European islands and recommendations for further research to students and researchers of the field. In any case, it should be stated that there are no best practices that could be generalised in all the islands, but the up-scaling of a localised system could be incurred in respect to local specificities and by securing cooperation as a way of governance of the commons and use of market as a tool for win-win trading schemes.

4.2 Recommendations

4.2.1 Policy and System Changes in the Municipality of Naxos and Small Cyclades

Taking into account the policy changes recommended in the previous section, the Municipality of Naxos and Small Cyclades has to focus on both organisation and technical aspects. With the reform of the existing MSWM plan it can establish new guidelines, goals and principles towards sustainability for all the islands that are in its jurisdiction.

By using the opportunity of being part of “Pact of Islands” they can secure and expand the existing networking with other European countries that can support them with knowledge exchange and get improved understanding not only of waste-to-energy issues, but generally on practices for waste handling. Furthermore, they can be consulted for awareness-raising campaigns for different social layers that would facilitate the operation of system, with schools and stakeholders in key positions to be in the first line. Part of this knowledge exchange can be on how to engage stakeholders in participating in policy making and decision processes, securing that way cooperation between actors in the community, municipal and upper administrative levels.

When adopting measures and practices from other countries, three elements need to be ensured. Firstly, the improvement of the existing rural economy through job creation, secondly economic affordability through the installation of small-scale infrastructure as the municipality has still to deal with high levels of penalties compared to the living standards and, finally, social acceptability in terms of reaching goals of social welfare through the environmental protection that is one of the main source of income for permanent residents and ensure their compatibility with the local reality.

Practically, as illustrated by Figure 18, the circularity of the waste fractions on the islands can ensure cost reduction only if monitoring and controlling processes are in place. Realistic and incremental results can be facilitated with the decentralisation of responsibilities, transparency on sharing information and cooperation with producers and institutions for innovative solutions.

4.2.2 Future Research

The up-scaling of insular waste management systems is not possible to be achieved with the current indicators used for measuring and collecting data. Further research on dynamic indicators regarding seasonality and particularly the increase and decrease of consumption in relation to population differentiation can help to retrieve more reliable data. If monitoring processes are decentralised to community level, it would facilitate the adoption of these indicators and maximise the reliability of the results.

Moreover, working on the analysis of behavioural changes in consumption patterns and awareness after the use of low-cost waste management policies that are human-oriented as opposite to those that are market or industry-oriented. That way, it will be more feasible to tackle social problems, such as poverty, and secure continuous improving changes even in periods of economic crisis. By exploring examples of policies and practices on islands outside Europe that target to go beyond compliance in terms of European legislation great insights could be identified.

Provisions for islands might be included in policies regarding coastal or rural areas, sectors that are not explored in detail in this paper. In this case, care should be taken in the characteristics of the areas, as there are several definitions of the term “island” and related categories.

Finally, in the case of complexities of islands it would be necessary to research further the issue of transportation costs of both recyclable and mixed wastes. To do so, it is necessary to understand first what is the optimal level of involvement of private waste management companies in the MSWM plans and practices and under what conditions. Also it would be interesting to investigate if the commercialisation of waste is better to be done between privately-owned contractors, municipality-owned companies or the municipalities themselves. This will entail different needs for distribution of responsibilities, public control, and flexibility measures for readjustment to the local social, economic and political changes. If attention is given to the type and number of fractions, it would be interesting for a researcher to provide insights for the fraction of marine litter that its existence is related not only to visitors and inhabitants, but also the litter released in the sea and reached in the coastal areas.

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Appendices

Appendix I: Integrated Solid Waste Management

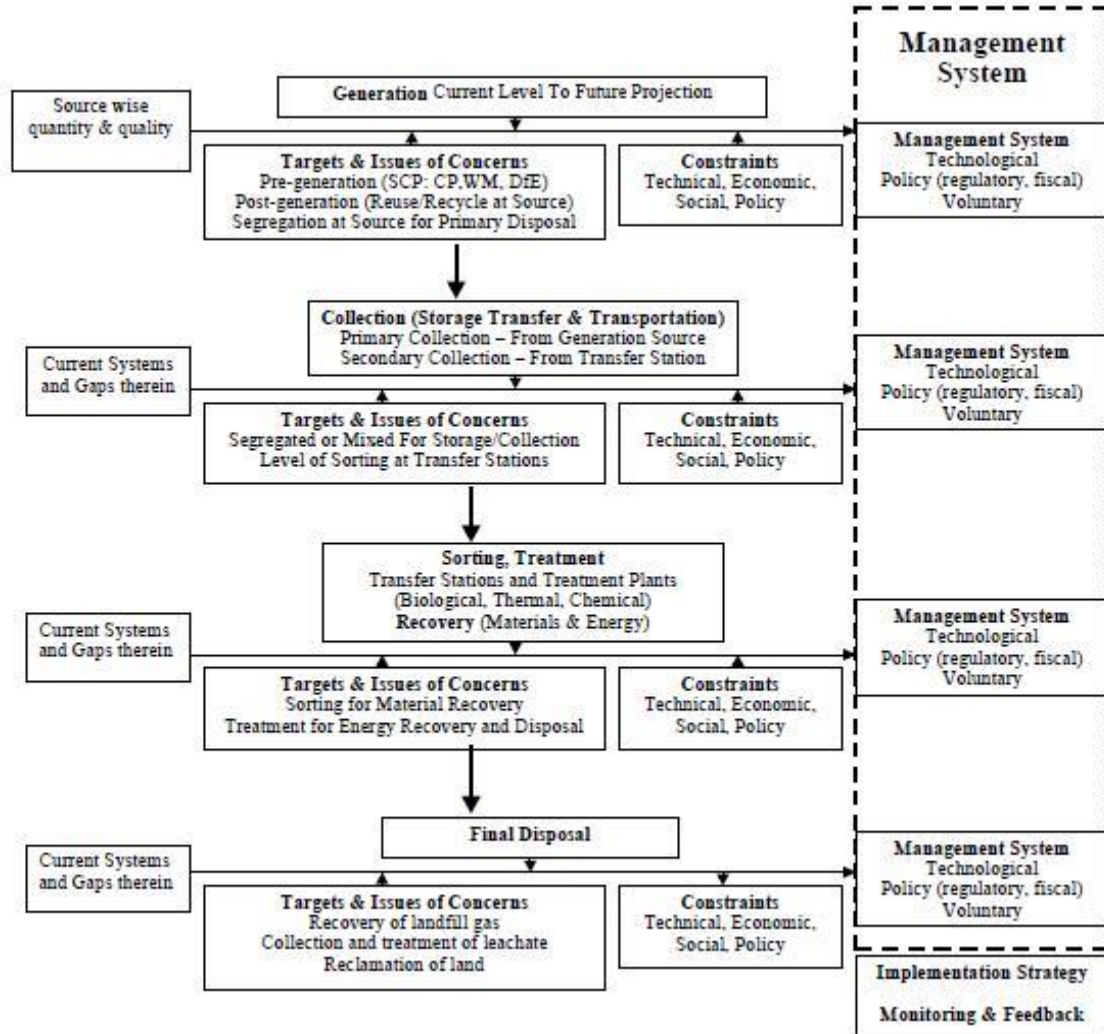


Figure 19: Outline of ISWM Plan(UNEP, 2007)



Figure 20: Integrated Solid Waste Management (US EPA, 2002)

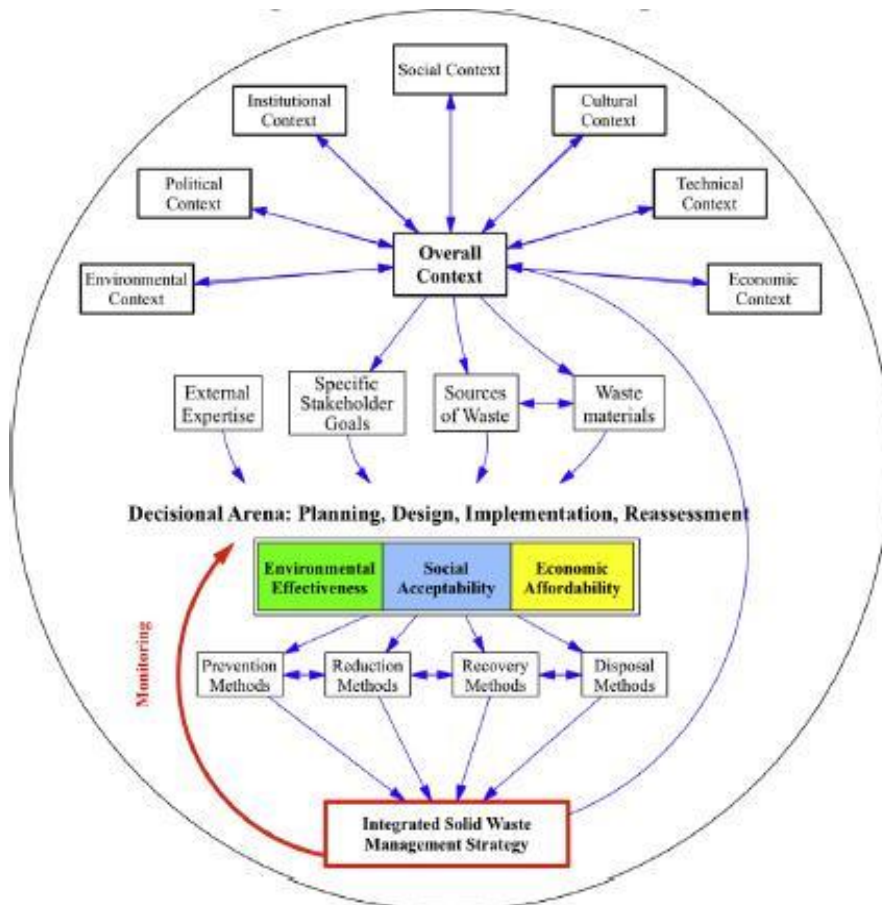


Figure 21: Integrated Solid Waste Management (Marshall & Farahbakhsh, 2013)

Appendix II: Targets of EU Directives and Policies

Table 2: Targets of EU Directives and Policies

	Packaging and Packaging Waste Directive	Landfill Directive	Waste Framework Directive	Circular Economy Package
2001	between 50 and 65% by weight of packaging waste had to be recovered or incinerated between 25 and 45% by weight of the total of packaging materials contained in packaging waste had to be recycled and with a minimum of 15% by weight for each packaging material	-	-	-
2008	at least 60% by weight of packaging waste had to be recovered or incinerated between 55 and 80% by weight of packaging waste had to be recycled <ul style="list-style-type: none"> • 60% for glass, paper and board • 50% for metals • 22.5% for plastics • 15% for wood 	-	-	-
2010	-	reduction of BMW to 75%	-	-
2013	-	reduction of BMW to 50%	-	-
2020	-	reduction of BMW to 35%	minimum 50 % by weight for re-use and the recycling of waste materials minimum of 70 % by weight for re-use, recycling and other material recovery of non-hazardous C&D waste	-

2025	-	-	-	30% for food waste generation 70% for recycling/reuse of packaging waste including targets for specific materials Ban on landfilling of recyclable materials
2030	-	-	-	70% for recycling/reuse of municipal waste 80% for recycling/reuse of packaging waste including targets for specific materials Elimination of landfilling

*the targets of 2008 were extended until December 2012 for Greece, Ireland, Portugal and all the new EU Member States and December 2013 for Malta

Source:

Appendix III: List of Interviews

Informant	Position	Method of Interviewing
Thomas Lindhqvist	Associate Professor at IIIEE	Multiple interviews during research period
Rustan Nilsson	Communications Officer at SYSAV Industry AB, Sweden	Interview in person 26 March 2014
Toni Damjanić	Director of JELKOM d.o.o. Vrboska bb, Croatia	Interview on Skype 27 June 2014 E-mail Contact 4 September 2014
TovaAndersson	Solid Waste Engineer in Tjörn Municipality, Sweden	Interview on Skype 1 August 2014 E-mail contact 28 August 2014
Margaret CamilleriFenech	Waste researcher, Malta	E-mail Contact 19 June 2014
Michalis Triantafyllos	Director of Technical Agency in the Municipality of Naxos and Small Cyclades	Interview in person 10 June 2014
Dimitris Pantazidis	Civil Engineer in the Municipality of Naxos and Small Cyclades	Interview in person 10 June 2014
Nikos Synodinos	Environmental Management Consultant on the Regional Administrative Office in the South Aegean Region	Telephone Contact 19 June 2014
Stelios Marinakis	Architect Engineer	Interview in person 9 June 2014
Vasilis Theonas	Environmental Manager	Interview in person 29 July 2014