

Alternative Management of Municipal Solid Waste of the Municipality of Serres

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Abstract – Main problem today in the management of municipal solid waste is that the designs made unfortunately sustain crucial problematic aspects of the current situation: a) preservation of the maximum fraction of municipal waste in composite form, b) failure to implement meaningful policies in prevention, waste reduction, separate collection, recycling and composting, and c) the deterioration of the public-social management resulting in the launch of the costs of waste management and municipal fees. In this paper is presented a local management plan of alternative management of municipal waste of municipality of Serres based on the principles of proximity and small scale. It emphasizes on decentralized management and presorting materials ensuring a management which is environmentally friendly and beneficial for citizens. Applying the principles of integrated management, which are: a) reduction at source, b) recycling, c) conversion and d) filling under the Greek and European legislation the percentage targets set by the National Waste Management Plan are achieved.

Keywords: Municipal Solid Waste Management, Local Management Plan, Sorting in the Source, Prevention, Recovery, Landfill residues

I. INTRODUCTION

Uncontrolled hazardous waste management, maintenance of huge landfills, the effects of combustion and widespread pollution of aquifers degrade environmental entire regions. Privatization in the whole range of management, loss of employee positions and social control, assignment of public infrastructure have a significant impact on society. The centralized waste management involves waste of huge public funds in order to build processing-combustion plants resulting to the proliferation of management costs (*Prosynat 2012*).

The ultimate objective of national policy in the management of municipal solid waste is the complete and rational management in a sustainable use of resources in order to reduce the quantities of waste and, where waste is generated to be managed so as to reduce impact on the environment and human health and also make a positive contribution to economic and social development.

Of particular importance for achieving this objective is the promotion of the hierarchy of stages of management. Priority must be given to **waste prevention** as the best option, followed by the **preparation for reuse, recycling, other forms of recovery** (eg composting biowaste) and **safe disposal** as the last management option (*Directive 2008/98/EU*).

The actions that need to be made in order to operate the local waste management environmentally safer for

municipalities with social and economic benefits for them and the citizens are :

- to include new actions at the level of the three main priorities of the hierarchy (prevention, reuse, recycling-composting)
- to maximize the rate of Municipal Solid Waste (MSW), whose management cycle will be completed at the level of municipality
- to minimize, consequently, the percentage of MSW, which will be managed in a super-regional infrastructure (usually in mixed treatment plants or landfills). (*Prosynat 2014*)

The purpose of this paper is on one hand, to capture and to present the current management of urban waste in Europe and in Greece and on the other the investigation and design of an integrated municipal solid waste management plan in the Municipality of Serres. This plan will be complementary to the Regional Planning Waste Management and the National Waste Management Plan. The proposed plan emphasizes in decentralized management and pre-sorting of materials, with a time horizon to 2020 and indicative targets by the end of 2025, in accordance with the directions/instructions of the National Waste Management Plan.

II. METHODOLOGY

This paper is developed in two parts:

In the first part, in order to form a complete picture of the existing municipal waste management at European but also at national level, the current Greek and European legislation is presented and extensive reference to the basic waste management principles is made. Also the objectives of both the National Waste Management Plan and the Regional Solid Waste Management Plan of Central Macedonia and the role of operators, liable for the collection and transportation of solid waste (FODSA), are analyzed.

In the second part, the proposal of alternative waste management in the Municipality of Serres is developed with the implementation of a local management plan, taking into account the specific characteristics (location, area, population and household distribution) of this municipality. The facts of the current situation of waste management are also been taken into account. It should be mentioned that the quantity of produced waste, according to the data of the municipality, is 33.284tn (*Municipality of Serres (2016)*).

III. SELECTED RESULTS

A. Local plan Phases

Phase A: Sorting at Source-Composting- Separation

In this phase the aim is to recover the maximum amount of recyclable materials through specific activities, with natural processes and techniques, rather than in complex mechanical sorting and processing facilities (Spanoudi Desp. 2015).

Sorting at Source (SaS) assures lower operating costs, greater environmental gains and more job opportunities. It depends mostly on the information and participation of citizens, while the infrastructure of this phase is based on a network of separate bins and «green points». The network of green points should be created in places, preferably nearby housing sectors (Prosynat 2012).

i) Activities of Sorting at Source (SaS) in residential level

Citizens and institutions contribute the most at this phase of the suggested local plan; to achieve this goal it is highly required the daily support of the municipalities through information and communication.

Activities of enforcement of sensibilisation to be developed are:

- Promotion and projection of informative spots from media
- Organization of school activities-updates on environmental and recycling issues. Presentations, lectures in schools, clubs, etc.
- Organization of local events under the auspices of Municipality Authorities such as concerts, screenings information days etc.
- Mobile information kiosk of SaS systems and registration of user's problems.
- Press releases on municipality's website and announcements in the local press (print and distribute brochures)
- Distribution of reusable recycling bags and composting bins

The over mentioned activities will take place in 2017 and be repeated per regular periods.

Also is required the social participation in consultation process for the elaboration of this draft sub form of meetings, discussions and meetings with associations and authorities.

ii) Activities of SaS in Municipal level

Suggested activities below concern prevention and Separation at Source aiming the wise management of the largest percentage of waste.

More specifically, it concerns:

- Bin network for presorting of recyclable material and biodegradable waste in distinguished categories

The creation of a four bins network is established, in combination with simultaneous existence of green bins for composites, hosting the non-distinguishable waste. Full development of bins will take place in high priority areas such as squares, central streets, malls and gradual augmentation is planned in first semester of 2018.

The network of bins will include:

- a) **Yellow bins** for paper selection. Specially designed on top insert for **printed paper** bins, in capacity of 330lt, will be placed where is mostly produced, such as schools, banks, printing centers etc, and simple bins in capacity of 1100lt for selecting **simple paper and paperboard**. Selecting frequency of bins containing printed paper will take place once per week and three times per week for those containing paper and paperboard.
- b) **Blue bins** for selecting **metals**, in capacity of 1100lt, with selecting frequency once per month.
- c) **Red bins** for selecting **plastic**, in capacity of 660lt, μ with selecting frequency once per week.
- δ) **Brown bins** for selecting **biowaste**, in capacity of 230lt or 330lt with selecting frequency once per week.

Regarding the glass, the existing sorting system of bell-type bins will be enhanced in places like factories, bottling, packaging, entertainment, hotels and restaurants. The glass collection frequency is once every 15 days.

Also by the end of 2017 mechanical and household composters will be installed at specific points of interest.

- Green Waste management

Green materials from pruning, gardening etc (green waste) are valuable raw material that will be used to produce soil improvers - compost. Separate collection of this waste is enhanced, in order not to get mixed with bulky waste. Green waste will be placed for treatment in a designated area of Decentralised Waste Management Facility.

- Collection-Transfer System

For the collection of recyclables is necessary to purchase new vehicles in order to reinforce the fleet of the repaired vehicles and those to be released from the collection of mixed because of the gradual reduction. In order to select the appropriate means of transport should be borne in mind that each type of vehicle exhibits the maximum performance of a specific type and quantity of materials.

The requirements of the proposed collection system are: a) four biowaste collection (no compression) vehicles, b) two new waste collection vehicles, c) Crane drive unit for collecting glass, d) truck, e) bucket washer.

Recruiting new staff for collecting waste is also estimated

- «Green Point» network

«Green Point» is a spot within the urban area, where citizens can bring recyclables, bulky (eg furniture, electrical and electronic equipment), waste such as batteries, paints, etc., green waste and other categories aiming to prepare for reuse or recycle. «Green Points» are places at specific spots, signaled, known and accessible to citizens (Prosynat 2012).

It is estimated that a total of 7 «Green Points» will be established in the Municipality of Serres, with a service radius of approximately 5-8 Km. They will be placed gradually and their operation will start by the end of 2019.

In conjunction with the «Green Points» the area of Serres Municipality Depot will still operate, as a bulky waste collection area.

– *Recyclables Sorting Center*

A municipal management facility will be created, called KDAY and will be the reception area of the discrete recyclable flows (paper, plastic, metals and glass). The particular area will include:

- a) Roofed surface area of approximately 400m² for collection, separation and disposal of recyclables
- b) Roofed surface area of about 100m² where the repair workshop-laboratory of mechanical, electrical parts and electronic appliances, furniture, etc will operate.
- c) Surrounding area of approximately 2acres, where the collection and management of bulky (demolition materials pallets, used tires, appliances, machinery etc) will take place.

– *Pre-sorted biowaste composting unit*

This unit will be located in the same area with KDAY, for better and more economical operation of the system. Composting of biowaste will take place in this area, by aerobic process for both pre-sorted biowaste at source (brown bins) and organic fraction recovered from the treatment of composite. As a result of the above process two kinds of soil improvers will be produced: high quality compost from pre-sorted biowaste and CLO from composites.

During Phase A (Sorting at Source-Composting-Separation), actions such as special telephone hotline operation, distribution of questionnaires, printed and electronic information of the citizens about the program will be carried out in order to monitor its implementation.

The infrastructure provided at this phase will be completed and will operate by the years 2018 and 2019.

Phase B: Mechanical Processing

At this phase the processing aims to recover recyclable and organic materials from the flow of composite waste, to repair and to supply useful material (furniture, appliances, etc.). These processes take place in a mechanical separation unit that will be installed in a common area with the infrastructure of the first phase (KDAY-Composting Unit) resulting in creating a single Decentralized Waste Management Facility. The infrastructure of the second phase will be operational in year 2020.

TABLE I
QUANTITATIVE TARGETS ACHIEVED IN PHASES A & B

Material Category	Quantitative Targets of Phases A & B			
	2017	2018	2019	2020
Organic	10	20	30	80
Paper, Plastic, Metal, Glass	20	35	50	75
Wood	15	25	35	80
Other Recoverable	35	45	55	75
Other-Disposal	-	-	-	-
Phases A & B Percentage % of total Municipal Solid Waste	15	26	38	74

Phase C: Residue Landfill Area

The amount of waste that will be left over after recycling and sorting at source will be driven to the Residue Landfill Area. The landfill area of Paleokastro, can be operated for as the Residue Landfill Area.

TABLE II
QUANTITATIVE TARGETS ACHIEVED IN PHASE C

Material Category	Quantitative Targets of Phase C			
	2017	2018	2019	2020
Organic	90	80	70	20
Paper, Plastic, Metal, Glass	80	65	50	25
Wood	55	75	65	20
Other Recoverable	65	55	45	25
Other-Disposal	100	100	100	100
Phase C Percentage % of total Municipal Solid Waste	86	74	62	26

B. Economic measures

In order to test the viability of the proposed plan the final cost was estimated, resulting from administrative costs and expected revenues, up to the year 2025.

i) Management Costs

TABLE III
ANNUAL TOTAL MANAGEMENT COSTS (€)

Year	Management Costs					Total
	Collection	Recycle	Composite Processing	Disposal	Tax Burial	
2017	3.400.378	122.500		903.987	996.835	5.423.700
2018	3.316.189	402.500		781.058	984.320	5.484.067
2019	3.231.936	574.100		658.065	932.985	5.397.086
2020	3.044.521	771.764	239.100	278.899	439.350	4.773.634
2021	2.998.171	836.304	244.320	229.544	397.760	4.706.099
2022	2.951.371	886.646	258.780	180.029	340.320	4.617.146
2023	2.904.541	937.036	273.240	130.483	246.660	4.491.960
2024	2.890.261	952.587	277.560	115.375	218.100	4.453.883
2025	2.848.441	1.002.929	278.010	71.129	134.460	4.334.969

ii) Expected Revenue

The main expected revenue derives from the process of recycling and disposal of recyclable materials and the use of solid improver.

Year	2017	2018	2019	2020
Recycling Revenue	567.967	1.025.749	1.486.796	1.953.996
Composting Revenue	39.150	76.650	114.150	153.300
Total	607.117	1.102.399	1.600.946	2.107.296

Year	2021	2022	2023	2024	2025
Recycling Revenue	2.116.935	2.244.599	2.371.458	2.411.486	2.538.267
Composting Revenue	167.550	175.050	182.550	190.050	197.550
Total	2.284.485	2.419.649	2.554.008	2.601.536	2.735.817

TABLE IV
TOTAL ANNUAL MANAGEMENT REVENUE (€)

Summarizing the aggregated data of management costs and management revenue the following tables of final cost management are generated, in absolute terms and in amount/per ton (with reference to the total amount of MSW that is 33.284tn)

TABLE V
FINAL ANNUAL MANAGEMENT COST (€)

Year	2017	2018	2019	2020
Cost Management	5.423.700	5.484.067	5.397.086	4.773.634
Revenue Management	607.117	1.102.399	1.600.946	2.107.296
Final Cost Management	4.816.583	4.381.668	3.796.140	2.666.338

Year	2021	2022	2023	2024	2025
Cost Management	4.706.099	4.617.146	4.491.960	4.453.883	4.334.969
Revenue Management	2.284.485	2.419.649	2.554.008	2.601.536	2.735.817
Final Cost Management	2.421.614	2.197.497	1.937.952	1.852.347	1.599.152

TABLE VI
MANAGEMENT COST (€/tn)

Year	2017	2018	2019	2020
€/tn	144.71	131.65	114.05	80.11

Year	2021	2022	2023	2024	2025
€/tn	72.76	66.02	58.22	55.65	48.05

IV. CONCLUSIONS

The approach adopted takes into account the specific characteristics of the Municipality of Serres (geographical location, population, etc.) and institutional developments in the field of solid waste management, such as Law 4042/2012 on waste management, National Waste Prevention Plan (December 2014), the National Waste Management Plan (July 2015) and the under review Regional Solid Waste Management Plan of Central Macedonia.

The annual production quantity of MSW in the municipality of Serres for the year 2015 was estimated at 33.284tn. Related to the permanent population of the municipality (76.817 inhabitants according to the 2011 census) gives 433,29 Kg/year per citizen. Regarding the waste costs for the same year, it comes to 105.3 €/ tn.

The objectives achieved per plan phase are:

a) *Phase A: Sorting at Source-Composting-Separation*

Presorting will start the first semester of 2017 from 15% of total waste and will reach 50% in 2020, with a forecast to reach 65% by 2025.

b) *Phase B: Mechanical Processing*

Recovery with mechanical processing will start from the required 24% in 2020 and will reach 28% in 2025 (total of 74% for the year 2020 and 93% for the year 2025).

c) *Phase C: Residue Landfill*

Final disposal starting from 86% in 2017 will reach 26% in 2020 and continuing at the same rate, a percentage of 7% of total waste will be discharged to the landfill residue area of Serres.

According to the economics of the proposed plan the final management cost is gradually reduced from 2017 to reach at the end of 2020 80.11 €/tn, thus showing a decrease of 40% compared to the initial management costs (144.71 €/tn). At the final phase of the proposed plan the cost is particularly low 48.05 €/tn.

Furthermore, it is particularly important to note that this proposal:

a) does not maintain the logic of large centralized facilities at regional level (engineering facilities-biological treatment, large composting plants and landfills)

b) does not enhance the operation of Waste Transfer Stations. The installation of an adequate number of green points in the local district of the city as well as in local communities that belong to this prevents operation of transfer stations.

c) with the implementation of more environmentally friendly methods Subsurface Waste Burial Area is converted to Residue Landfill Area. A significant reduction of the quantity of disposal waste is achieved to 8,787tn in 2020 and 2,241tn in 2025.

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