

Benchmarking indicators to assess the level of Circular Economy Strategy in Local Level

Loizia P.¹, Inglezakis V.², Pedreno N.J.³, Lasaridi K.⁴, Zorpas A.A.^{1,*}

¹Open University of Cyprus, Faculty of Pure and Applied Sciences, Environmental Conservation and Management, Laboratory of Chemical Engineering and Engineering Sustainability P.O.Box 12794, 2252, Latsia, Nicosia, Cyprus; +357-22411936

² Nazarbayev University, School of Engineering, Chemical Engineering Department, Environmental Science & Technology Group (ESTg), Astana, Kazakhstan

³Department of Agrochemistry and Environment, University Miguel Hernandez of Elche, Av. De la Universidad s/n, 03206, Elche, Alicante, Spain, jonavar@umh.es

⁴ Harokopio University, El. Venizelou 70, Kallithea, GR 171 76, Greece, Tel.: +30 210 9549164, klasaridi@hua.gr

*corresponding author: Antonis A. Zorpas :e-mail: antonis.zorpas@ouc.ac.cy, antoniszorpas@yahoo.com

Abstract

Several tools are available for evaluating the environmental level and/or performance of waste management in an area using several benchmarking indicators, such as life cycle assessment, multi-criteria decision analysis, compositional analysis etc. Often these tools are the simplifications of the actual facts as the waste management systems are complex and difficult to generalise from case studies. This research implements several benchmarking indicators such as compositional analysis of household waste, level of recycling index, participation in home composting, awareness activities, prevention activities in order to assess the level of the circular economy strategy in a Municipality (located in Cyprus). The results indicate that more than 75% of the citizens are participated in the recycling door to door program. However, the recyclable waste that are been collected are not clear as include other impurities. For example, the impurities in PMD is more than 20% indicated that a door to door training program is needed. Also, the concentration of PMD and Papers in the household waste count more than 18% indicated that the waste sorting at source needs further attention. Home composting seems to be a promising method to treat leftovers and other yard wastes and minimized the volume of organic waste that are dumped in landfills. The results of the compositional analysis highlighted the need to develop actions to divert specific waste streams such as recyclable, green and food waste, as well as the development of awareness activities.

Keywords: circular economy, benchmarking indicators, SWOT analysis, strategy development, environmental performance

1. Introduction

Sustainable waste management is an important global environmental agenda in the twenty-first century (Zorpas et al., 2018). The quantity of global waste increases as the population and the level of resource consumption rise over time. The increased generation of waste is also producing bigger environmental deprivation: in particular

pollution of land, water, and air due to uncontrolled and unsustainable waste disposal and management options. According to the Intergovernmental Panel on Climate Change, the waste sector contributes less than 5% of global GHG emissions, which is very low compared to the energy and industrial sectors (more than 65%).

Household waste is considered to be a significant part of the municipal solid waste (MSW) (Dangi et al., 2008). The quantity of MSW has been increased dramatically in urban centres of developing countries during last decades.

The solid waste management process is complex as it involves multiple actors and dimensions that dynamically affect each other and cannot be described from an isolated and static perspective. Waste management systems require adequate analysis tools and systemic approaches have proven useful in supporting policy decisions by providing a comprehensive representation of those systems, considering the interactions between their main elements and their evolution over time (Federica Di Nola et al., 2018). Remain unclear according to Zorpas et al., (2018) how the concept of Circular Economy would be adopted from small communities anywhere in Europe.

2. Material and Methods

In the Municipality of Sotera (Eastern Region of Cyprus) with a permanent population of 5474 citizens according to the last inventory report on 2011. The total waste production was 2326 t on 2016, 2314 t on 2014, 2494 t on 2015, 2535 t on 2016 and 2711 t on 2017. Other materials that could be recycled are collected from GDC (Green Dot Cyprus is an NGO focusing on the collection of recyclable materials according to the packaging waste directive). The recyclable waste (Papers, PMD, Glass) that had been collected from GDC for the same periods were 104603, 97112, 154574, 206505, 191281 kg respectively.

In order to evaluate the environmental performance of the Municipality the following benchmarking indicators were used: (i) Waste compositional analysis as indicated from

Zorpas et al., (2015) is a technique used to evaluate and estimate in detail the nature, scale and origin of any kind of waste and more specific for house hold waste. Through this household and local attitudes, social behaviour as well as socio-demographics are determined; (ii) recycling index; (iii) number of citizens who participates in home composting; (iv) awareness activities that Municipality announced; (v) existing prevention activities in local level.

3. Results and Discussions

Figure 1 present the waste compositional of the Municipal Solid Waste. A percentage of 24% for recyclables (glass, paper, PMD), 36.4% of Inedible Food Waste and 10.8% of Green Waste ends in landfills, increasing both the environmental impact of the Municipality and its financial burden of collection and transportation.

The recycle index remain in a very low level as for 2014 was 4.03%, on 2015 was 5.84%, on 2016 was 7.53% and on 2017 decreased on 6.59% due the fact that the awareness activities were decrease too. Awareness activities include door to door information's from 2013-

2016 at least once per month, and per two month with the water taxes a specific informative material has been sent to the citizens from 2013-2015. The informative material cover details about the door to door collection of the recyclable materials, what can be recycle, what can be composted as well as prevention activities mainly of on the treatment of leftovers in order to reduce inedible food waste as well as information's about smart list for daily shopping from supermarkets. Moreover the Municipality has less than 5% of the population participating in home composting activities and from those that are participating the survey audit indicates significant issues such as unacceptable items into the compost bins like raw meat and raw fish as well as whole watermelon (when is in season) and lots of lemons (as it is well known that the pH decreased less than 4 and the composting can not start).

Concerning the targets set from circular economy strategy and more specific the target related with the reduction of Food Waste is clear that further actions must be adopted from the Municipality in order to reach the proposed actions.

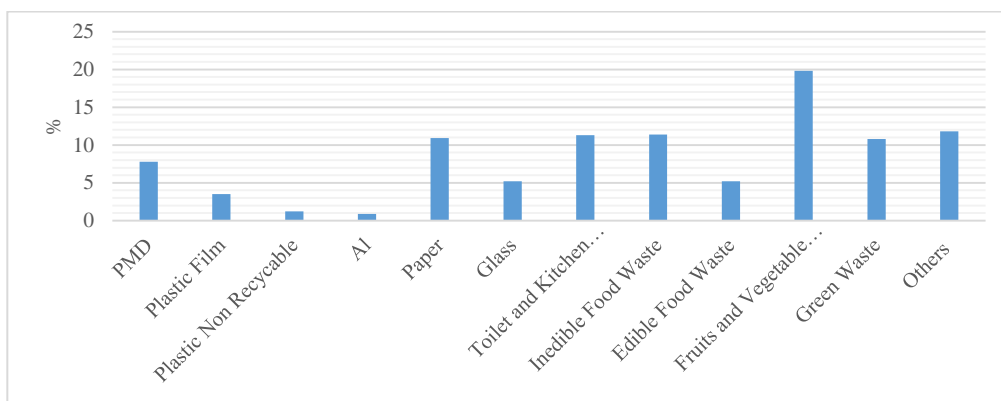


Figure 1. Waste Compositional Analysis

4. Conclusions

This research indicated that small Municipalities and or small communities in insular communities has difficulties to reach circular economy targets. This is due to the fact that awareness activities are not continually exist. The existing waste management plan needs further attention as the a huge amount of recyclable waste exist in the households. Moreover with the total organics (inedible Food Waste and Organics) are more than 38% and those can be reduced using home composting activities. The evaluation of the existing management plan indicated that among the main weaknesses is the level of educational program that are totally missed and the awareness activities while at the same time the prevention activities (beside home composting) needs further attention.

References

- Federica Di Nola M., Escapa, M., Ansah P.J. (2018) Modeling solid waste management solutions: The case study of Campania Italy, *Waste Management*, **78**, 717-729.
- Zorpas A.A., Lasaridi K., Voukkali I., Loizia P., Chroni, C. (2015). Household waste compositional analysis variation from insular communities in the framework of waste prevention strategy plans. *Waste Management*. **38**, 3-11
- Zorpas A.A., Lasaridi K., Pociovalisteanu M.D., Loizia P.(2018) Monitoring and evaluation of prevention activities regarding household organics waste from insular communities, *Journal of Cleaner Production*, **172**, 3567-3577.
- Dangi M.B., Urynowicz M.A., Gerow K.G., Thapa R.B. (2008). Use of stratified cluster sampling for efficient estimation of solid waste generation at household level, *Waste Management and Research* **26**, 493-499.