Decomposition Analysis of the Waste Composting in Croatia

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Introduction

Composting is a method of waste recycling based on the biological degradation of organic matter under aerobic conditions, producing stabilized and sanitized compost products [1]. In the year 2021, according to Eurostat estimate, 100 kg per capita of municipal waste was composted/methanised compared to the 530 kg per capita of municipal waste generated (18,96%) in the EU-27. In the same year in Croatia 22 kg per capita of municipal waste was composted/methanised compared to the 446 kg per capita of municipal waste generated (5,04%) [2]. The purpose of this paper is to analyze the increase in the quantities of biodegradable waste collected, the quantities sent for treatment to composting facilities and the quantities composted in the 10 counties of the Republic of Croatia in the period from 2017 until 2021. The data was decomposed to determine the five influencing components on above mentioned increase: changes in waste collection activity, collected waste in counties, mix of waste streams, total treated quantities of waste and composted quantities of waste.

Data Collection and Preparation

In this paper the data on the quantities of biodegradable waste collected, sent for treatment to composting facilities and the quantities composted in the 10 counties of the Republic of Croatia which have reported waste composting operations on their territory was analyzed. The 10 analyzed counties are Međimurska county, Grad Zagreb, Sisačko-moslavačka county, Varaždinska county, Osječko-baranjska county, Zadarska county, Koprivničko-križevačka county, Krapinsko-zagorska county, Zagrebačka county and Primorsko-goranska county. The analysis covered 29 different waste streams reported as collected and composted in the period from 2017 until 2021. The analyzed waste streams are specified by the European Waste Codes (EWC) in the Table 1. The data was collected from the Croatian Environmental Pollution Register (CEPR).

Table 1: Types of waste analyzed

	European Waste Code
WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING	02 01 01 sludges from washing and cleaning
	02 01 03 plant-tissue waste
	02 01 06 animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site
	02 01 07 wastes from forestry
	02 01 99 wastes not otherwise specified
	02 02 03 materials unsuitable for consumption or processing
	02 02 04 sludges from on-site effluent treatment
	02 03 01 sludges from washing, cleaning, peeling, centrifuging and separation
	02 03 04 materials unsuitable for consumption or processing
	02 06 01 materials unsuitable for consumption or processing
	02 07 01 wastes from washing, cleaning and mechanical reduction of raw materials
	02 07 04 materials unsuitable for consumption or processing
WASTES FROM WOOD PROCESSING, PULP, PAPER AND CARDBOARD	03 01 05 sawdust, shavings, cuttings, wood, particle board and veneer
	03 01 99 wastes not otherwise specified
	03 03 01 waste bark and wood
WASTE PACKAGING	15 01 03 wooden packaging
	15 01 09 textile packaging
	17 05 06 dredging spoil
WASTES FROM WASTE MANAGEMENT , WASTE WATER TREATMENT, PREPARATION OF WATER CONSUMPTION AND WATER INDUSTRIAL USE	19 05 01 non-composted fraction of municipal and similar wastes
	19 08 05 sludges from treatment of urban waste water
	19 08 12 sludges from biological treatment of industrial waste water
	19 08 14 sludges from other treatment of industrial waste water
	19 09 03 sludges from decarbonation
MUNICIPAL WASTES	20 01 08 biodegradable kitchen and canteen waste
	20 01 25 edible oil and fat
	20 01 38 wood
	20 01 39 plastics
	20 02 01 biodegradable waste

LMDI Analysis Model

By using the logarithmic mean Divisia index (LMDI) analysis model [3], the change in the total quantity of composted waste between two years was decomposed on five influencing components:

Waste collection activity effect (Dact) - the change in the total quantities of collected biodegradable waste between two observed years,

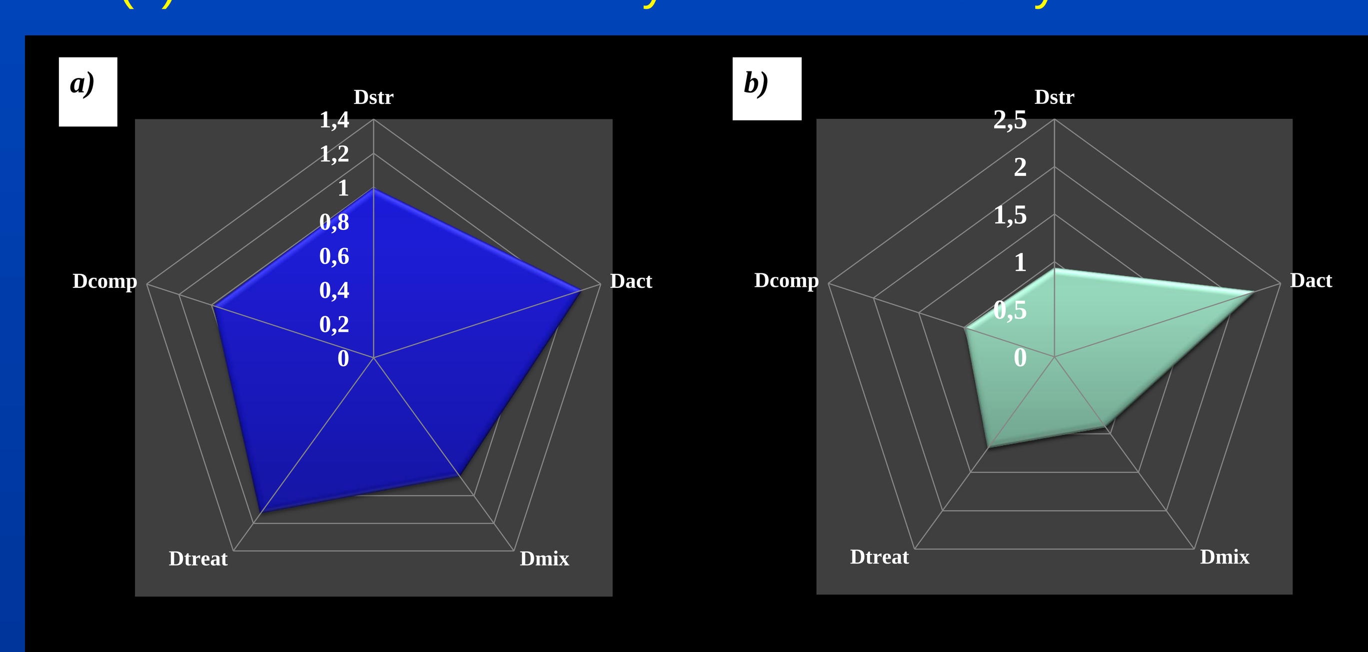
Structural effect (Dstr) - change in the amount of collected waste in a certain county in regard to all 10 counties,

Waste mix effect (Dmix) - change in a mix of waste streams collected in a certain county,

Treatment effect (Dtreat) - change in a share of a collected amount of a particular waste stream in a certain county which was sent to composting facilities and

Composting effect (Dcomp) - change in a share of a particular waste stream which was sent to composting facilities and actually composted (excluding other managing options and non-treatable residues). $D_c = D_c^b/D_c^c = D_{act}D_{str}D_{mix}D_{treat}D_{comp}$

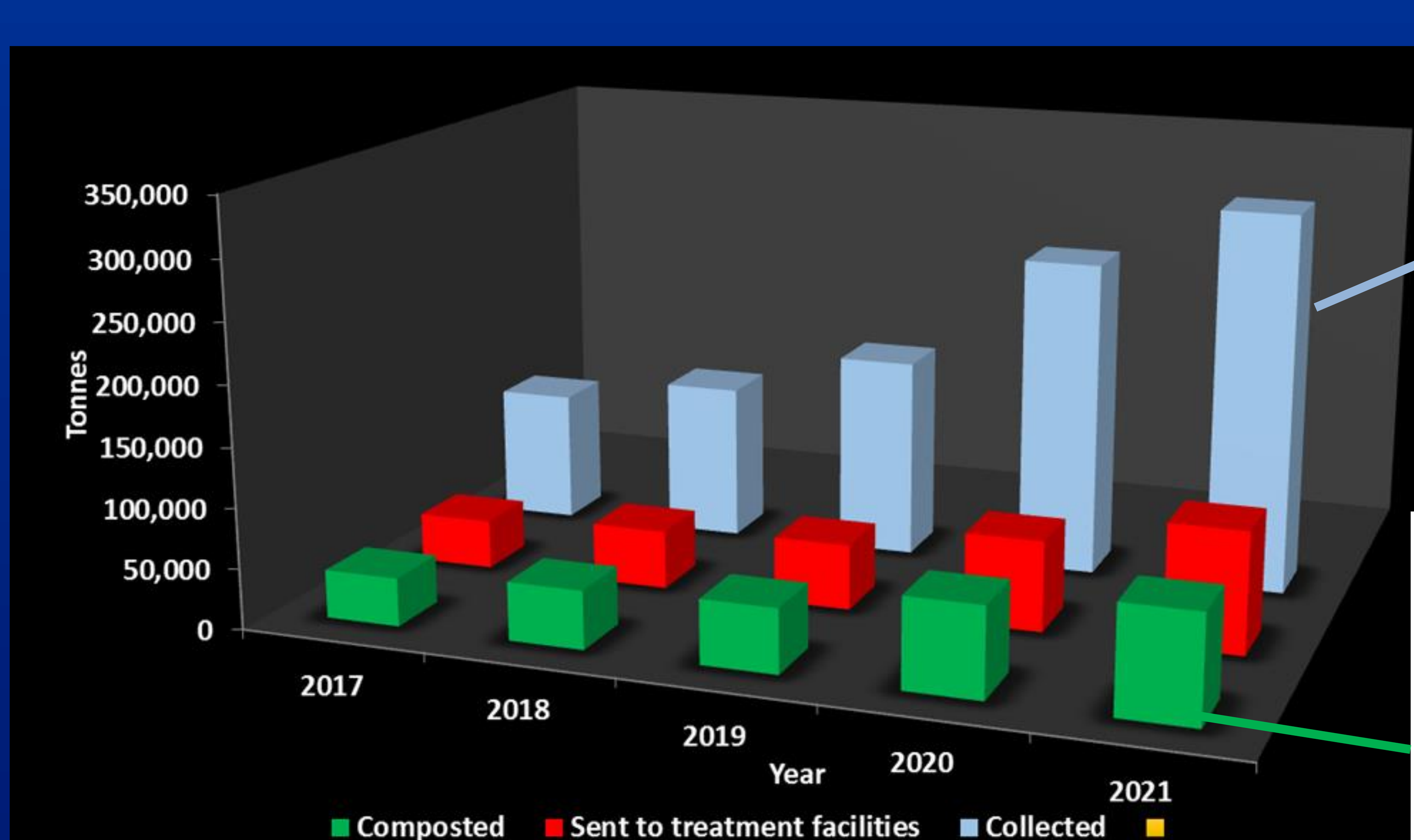
Figure 1. a) Average results of LMDI analyses in the period 2017 - 21; (b) Results of LMDI analyses between the years 2017 and 21.



Dstr: structure effect; Dact: activity effect; Dmix: waste mix effect; Dtreat: treatment effect; Dcomp: composting effect.

Results

The results show that in average the most dominant effect were the changes in the waste collection activity (Dact) – more of biodegradable waste collected led to more of it being composted. Also, the noticeable influence on the quantities of composted waste were the changes in the quantities of waste sent for treatment to composting facilities (Dtreat). The two effects (Dstr and Dcomp) had a negligible influence as their value is around 1 (Figure 1.(a)). If we look at a result of analysis of the first and last year of observed period, the value of the activity effect is even more pronounced, proving the collection of the biodegradable waste as a main driving force behind the increase in the quantities of composted waste (Figure 1.(b)).



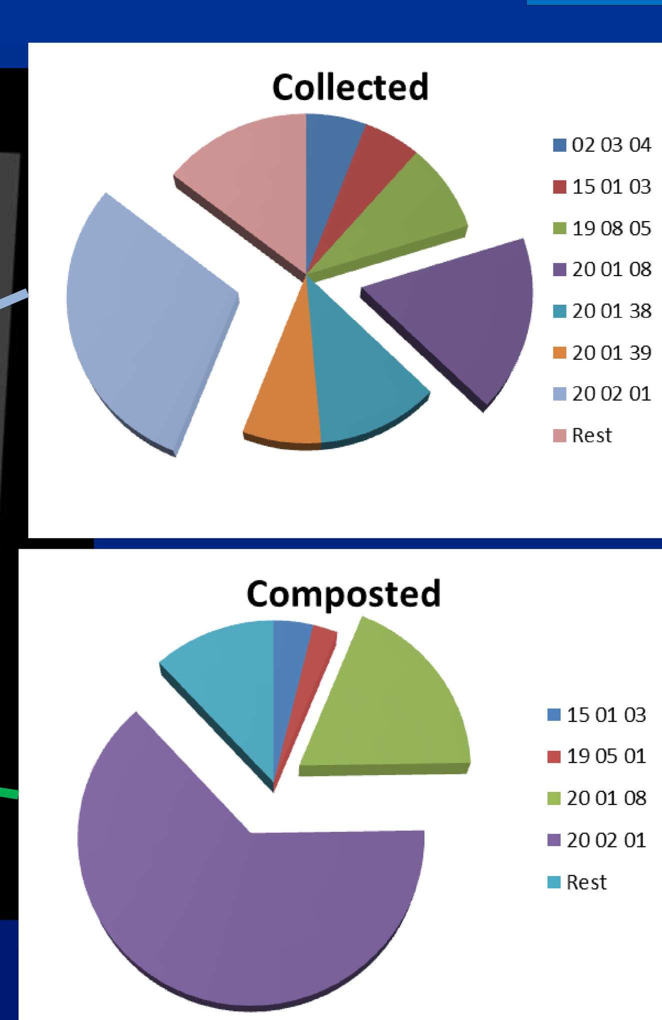


Figure 2. Quantities of biodegradable waste collected, sent to treatment facilities and composted in Croatia in the period 2017-2021

Change in the mix of waste as a negative driver

The change in the mix of waste streams (Dmix) has a slightly lower value than 1 meaning that the number of waste streams as well as the combination of waste streams changed in a way that it influenced lesser quantities to be composted. Data shows that the two types of waste which are mostly composted are EWC 20 01 08 and ECW 20 02 01 (around 80%) while they account for around 47% of the total collected quantities (Figure 2.). All this indicates that there are biodegradable waste streams less suitable to be composted (for e.g. EWC 02 03 04) and that increase of their share in the total quantity collected leads to smaller quantities of total composted waste, and the subsequent lower achievement of EU targets.

Literature

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[3] Ang, B. W., 2005. The LMDI approach to decomposition analysis: a practical guide. Energy policy, 7(33), 867 – 871.