



Full length article

## Social life cycle assessment of different packaging waste collection system



Eren Yıldız-Geyhan<sup>a,b,\*</sup>, Gökçen Alev Altun-Çiftçioğlu<sup>a</sup>, Mehmet Arif Neşet Kadirgan<sup>a</sup>

<sup>a</sup> Department of Chemical Engineering, Marmara University, Istanbul, Turkey

<sup>b</sup> Maltepe Municipality Environmental Protections and Control Department, Istanbul, Turkey

### ARTICLE INFO

#### Keywords:

Packaging waste  
Social analysis  
Social life cycle assessment  
Formal and informal collection

### ABSTRACT

Recycling is one of the most preferable tools of the sustainability concept considering its economic benefits and environmental effects. However, environmental and economic benefits are not always enough to accomplish a sustainable life concept. Social impacts, which basically focus on issues such as the well-being of humans, should be also considered. Regarding this concept; in this study we aimed to analyze the social impacts of different packaging waste management systems. In this context, we proposed eleven scenarios, which consisted of hypothetical formal and informal collection scenarios. All these scenarios were compared with the currently applied collection system in Istanbul, Turkey. The social analysis was conducted by using Life Cycle Assessment methodology. The results of this study showed that existing system and informal collection scenarios had socially fewer score than the formal scenarios in almost all impacts. Between the formal collection systems, there were slight differences caused by especially working conditions and socio-economic repercussion. However, formal collection scenarios showed more negative social impacts than formal-informal system integration. The result of this study showed that it was crucial to consider an amelioration on the informal collection system. In the integrated scenario (S11), some of the critical subcategories were idealized and improved taking into consideration to the long term modification issues. Although we couldn't minimize all negative social impacts; it was obvious that this scenario was still the best option. Finally, we may conclude that application of an ameliorated informal collection system would be socially more beneficial than formal and informal collection systems.

### 1. Introduction

Material recycling is an important concept considering increasing globalization and outsourcing all around the world. To achieve a sustainable resource management, it is necessary to recycle waste through each part of production-consumption processes. Compared to raw material extraction and processing, it may say that recycling is often more economical and reduces environmental impacts. Thus, GO (governmental organizations) and NGO (non-governmental organizations) focus on improving collection rates of these materials. In this point of view, environmental and economic impacts of recyclable material collection systems seem to respond sustainable development concept. However, environmental and economic aspects are only two of the three columns of this concept. To accomplish a sustainable development, not only economic and environmental impacts but also the well-being of humans and working conditions should be considered.

From an environmental and economic point of view, more material recycling is usually more effective. Previous part of this study (Yıldız-Geyhan et al., 2016) showed that collection of household packaging

waste (paper-cardboard, glass, metal, plastic) was environmentally advantageous in all different collection scenarios, for the researched area-Istanbul, Turkey. Even though the suggested scenarios had different amount of fuel, electricity and water consumptions, it didn't make any clear changes on environmental impacts. It was seen that collection of packaging material had always positive effect on environment. However, social impacts may be the negative side of these positive pictures. Because, recycling material collection system are mostly handled by informal collectors especially in developing countries. For example, Aparcana and Salhofer (2013a), indicated that in Peru 19.7% of the municipal waste was recycled by the informal collectors, e the overall recyclable material rate was 20%. Our previous study, Yıldız-Geyhan et al. (2016), also showed that only 2.09% in 20% of household packaging waste was collected by formally, whereas 17.91% was collected by waste pickers in the studied area—Istanbul. It is obvious that 90% of the collection system has been handled by waste pickers. Therefore, the many disadvantages of informal collection system; for example inappropriate working conditions, child labor, health and safety issues, etc., social impacts has to be taken into account.

\* Corresponding author at: Department of Chemical Engineering, Marmara University, Istanbul, Turkey.  
E-mail address: [nyildiz@yahoo.com](mailto:nyildiz@yahoo.com) (E. Yıldız-Geyhan).

However, determinations of the “social impacts” are not easy as “environmental impacts”. Unlike the environmental impacts, social impacts are not easy to determine by physical flows (Jorgensen et al., 2008). Thus, it is difficult to directly link a social impact to a process or a product (Dreyer et al., 2006). In recent years, many researchers have focused on the evaluation of the social life cycle assessment (SLCA) as a tool to measure social impacts. Most of these studies were especially deal with the evaluation of methodological and implementation issues because it was a new research area (Weidema, 2006; Griefhammer et al., 2006; Klöpffer, 2008; Jorgensen et al., 2008; Reitingner et al., 2011; Parent et al., 2010). To the best of our knowledge; in the literature, there are only a few SLCA case studies on waste management systems analyzed by: Foolmaun and Ramjeeawon (2013), Teerioja et al. (2012), Ferrao et al. (2013), Vinyes et al. (2013), Aparcana and Salhofer (2013a,b), Umair et al. (2013), Umair et al. (2015). Between these studies, Teerioja et al. (2012), Ferrao et al. (2013), Umair et al. (2015), Aparcana and Salhofer (2013a,b) were specifically focused on recyclable material collection systems. For example, Ferrao et al. (2013) conducted a social life cycle cost assessment of packaging waste management systems with regard to number of jobs created as a social issue. Aparcana and Salhofer (2013a,b) compared social impacts of formal and informal collection system in detail and proposed a formalized collection system. Also, Teerioja et al. (2012) compared social life cycle costs of a stationary pneumatic waste collection system with a vehicle-operated door-to-door collection system in Finland, however they only included the maintenance and operation cost of the systems.

Besides all these studies, when we search the environmental life cycle assessment (ELCA) literature, there are over 200 ELCA studies which only focused on the waste management system as a special issue. For instance, Laurent et al. (2014) listed 222 ELCA studies of solid waste management systems, in their literature review. Between these studies, Manfredi et al. (2011), Larsen et al. (2010), Hunt (1995), Merrild et al. (2012), Rigamonti et al. (2009) and Rigamonti et al. (2010) especially studied the ELCA of recyclable materials such as organic, plastic, paper, glass and Al waste. Rigamonti et al. (2009) pointed out the influence of source-separated materials on integrated waste management systems. Bovea et al. (2010) focused on the environmental impacts of pre-collection stage along with the integrated waste management system. Iriarte et al. (2009) compared the environmental impacts of the mobile pneumatic, multi-container and door-to-door collection systems. Larsen et al. (2010) also carried out an environmental and economic assessment of five alternative collection systems with the different efficiency for collecting recyclables in Denmark. Giugliano et al. (2011) analyzed four collection systems to determine the environmentally best performing scenario.

These literature reviews showed us how numbers of social life cycle assessment case studies are insufficient comparing with ELCA studies. We observed this literature insufficiency especially in packaging waste collection system which is our area of interest. We believe that this study will contribute to case studies on social life cycle assessment of packaging waste management systems.

The present work focuses on the social life cycle assessment of different packaging waste collection systems, for the first time in Turkey. Existing collection system, 8 different collection scenarios which environmentally analyzed by Yıldız-Geyhan et al. (2016), and two formalized system suggestions were compared to determine the social weaknesses and strengths of the system. The main goal of this study is to give a different aspect on decision makers of packaging waste collection system to accomplish a sustainable life concept.

## 2. Methodology

### 2.1. Goal and scope of the study

When initiating an SLCA study, a clear definition of purpose is

required. The UNEP/SETAC, (2009) guideline state that “The ultimate objective for conducting an SLCA technique is to promote improvement of social conditions and of the overall socio-economic performance of a product throughout its life cycle for all of its stakeholders”. Also, earlier studies classified goals into two part as comparison of product: “process” or “company” (Méthot, 2005; Schmidt et al., 2005) and identification of improvement potential of products or processes (Flysjö, 2006; Dreyer et al., 2006; Manhart and Griefhammer, 2006; Gauthier, 2005; Jorgensen et al., 2008). In the frame of these classifications, the goal of the study is defined in two parts.

The main goal of the SLCA in this study is to analyze the existing formal and informal collecting system and compare them with the alternative scenarios. Waste management systems, especially in developing countries, are socially weak services because of the informal collection. Therefore, the second goal is designed within finding these social weaknesses and strengths of the currently applied collection systems.

#### 2.1.1. Functional unit

Because there is not a direct correlation between “social impacts” and “processes”; it is quite difficult to link the functional unit with the results for SLCA (Dreyer et al., 2006; Hauschild et al., 2008; Klöpffer, 2008). For instance, Hosseinijou et al. (2014) indicated the social impacts would hardly be related to functional unit (FU) of the product if the inventory data is based on semi-qualitative and qualitative data. On the other hand; Kruse et al. (2009) pointed out even if the inventory data were quantitative, indicators still cannot be directly related to FU. Despite of these different views, it is still compulsory to identify a functional unit. And according to first guidelines of life cycle sustainability assessment (UNEP/SETAC, 2012), the same functional unit should be used for environmental, social and economic assessments to implement a complementary approach.

In the behalf of these researches, in this current study in this paper same functional unit previously determined by Yıldız-Geyhan et al. (2016) was used. Existing and proposed system were analyzed considering the collection of 1 ton packaging waste.

#### 2.1.2. System boundaries

Same as the functional unit, system boundaries for the environmental and social life cycle assessment should be the same. The SLCA scope of this study comprise collection, transportation and separation processes. Existing collection system and system boundary are given in Fig. 1. Regarding the identified system boundary, we analyzed the existing system and eleven alternative collection scenarios. Two of the suggested scenarios were designed considering the informal collection activity and an integration scenario. Nine out of eleven collection scenarios were proposed and environmentally analyzed by Yıldız-Geyhan et al. (2016) in the previous part of this study. Detailed description of the existing system and alternative scenarios are as follows;

*Existing System (ES):* Packaging waste was separated into 2 fractions as mixed packaging waste and glass waste. Mixed packaging wastes were collected by door-to-door system and glass wastes were also collected in drop-off points separately. In this system, packaging waste which were disposed in mixed waste container by residents were picked from curbside containers by waste pickers. So, in the existing system waste was collected both by formal and informal collectors. 95% of employees worked at illegal conditions.

In the scenarios from S1 to S9, waste collection by waste pickers was excluded in order to comply with country’s legal standards. Thus, separated waste was only collected by municipality. In all formal collection systems, collection rate is assumed 2.09% as in the existing formal collection system. This collection rate is assumed same in all formal scenarios, because it is directly related to public participation rate. And increasing public participation rate and so collection rate requires a long time period and new legal arrangements. In this study,

Download English Version:

<https://daneshyari.com/en/article/5118720>

Download Persian Version:

<https://daneshyari.com/article/5118720>

[Daneshyari.com](https://daneshyari.com)