

# Chapter 48

## Sustainable Waste Management System and Reverse Logistic Network Design in Plastic Industry: A Case Study of Turkey

**Emel Kizilkaya Aydogan**  
*Erciyes University, Turkey*

**Nigmet Uzal**  
*Nigde University, Turkey*

**Nuray Ates**  
*Erciyes University, Turkey*

**Fulya Zaral**  
*Erciyes University, Turkey*

**Petraq Papajorgji**  
*European University of Tirana, Albania*

### ABSTRACT

*The shortage of natural sources and the threat of the bad trend have forced the industries to find environmentally-friendly alternatives and ecological approaches in their production line. In some countries, regulations have been issued for industries about this subject. Due to these reasons and more of them, logistic firms have been forced to take into consideration decreasing material and energy consumption and minimizing waste production in planning their network designs. In practice, it might be necessary to simultaneously optimize more than one conflicting objective to obtain effective and realistic solutions. In this chapter, current logistics network design of a plastic industry in Turkey has been investigated and reverse logistics network design has been developed to minimize waste production and to achieve green production. This chapter presents a mathematical model which is a fuzzy goal programming model for imprecise goals for reverse logistic network design with multiple objectives in plastic sector. The considered objectives are to reduce cost in reverse logistics, to improve product quality, and to provide environmental benefits by minimizing waste production.*

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## **1. INTRODUCTION**

Rapid urbanization and population growth in parallel with industrial development is rapidly increasing the pressure on environment. Natural resources are increasingly destroyed and each product manufactured is finally transformed into waste. Both in the production and marketing phases, through minimizing the production of waste materials, the excessive pressure on the natural resources should be prevented; of course in the consumption phase, the production of wastes should be minimized and the remaining waste materials should be recycled and transformed from waste to an input to the economy. This is the main priority policy objective increasingly adopted all over the world, which is called as “sustainable development,” and in this approach; the concept of sustainable waste management is of great importance. In Turkey, municipalities are assigned as the main implementation authority for the waste management and policy making and directing the implementation at national level are today carried out by the Ministry of Environment and Forestry. It is clear that if the appropriate approach is considered half of the waste we generate can be reused and recycled, and transformed from a problem into an asset. Hence, considering the additional capacity brought by waste, which is a rich source for production, in the areas such as employment, etc, the big potential of recycling for the enrichment of national welfare should not be underestimated. When recycling activities become widespread, the financial load over the municipalities will be reduced since they have to allocate 40% of their budget for the waste management according to data obtained from the Ministry and also they would be able to generate income from recycling activities (Kose et al., 2007). The plastic wastes are one of the major components in MSW composition and the major source of plastic waste is considered as households. The studies have shown that %82 of plastic waste originated from households rather than from commercial,

institutional, or industrial sources (Al-Salem et al., 2009). Waste recycling shall contribute to the money saved not only in the natural but also in the energy resources. For example, the energy spent for recycling of metallic and plastic packages is 5% of the energy used for the first production of these materials. In other words, a saving with a ratio of 95% can be achieved by means of recycling (Kose et al., 2007). In this study, current logistic network design of a plastic industry in Turkey has been investigated and reverse logistic network design has been developed in a plastic plant to minimize waste production and to achieve green production.

## **2. SUSTAINABLE WASTE MANAGEMENT**

The term of waste including solid, liquid, and gaseous emissions is defined unwanted by-products of human activities. In the last century, waste production has been one of the most important problems in all countries (Al-Salem, 2009; Al-Salem et al., 2009). Among the produced wastes in communities, Municipal Solid Waste (MSW) is the most complex solid waste stream due to resulting from households, industrial or agricultural activities. According to European Union (EU) reports, MSW generation per capita in the EU-27 had been increasing until 2006 (from 499 kg in 1997 to 523 kg in 2006), but since 2006 appears to be stabilizing at between 523 and 525kg (EC, 2010). In Turkey, MSW generation per capita has been as 420 kg (1.15 kg/d.ca) in municipalities based on Turkish Statistical Institute 2008 data (TURKSTAT, 2008). In Kayseri, the waste generation per capita is 498 kg (1.15 kg/d.ca). The waste composition comprises 68.5% organics, 10% paper and cardboard, 11% plastics, 3.8% glass, 0.4% metal, 2.9% textile, 1.7% yard waste, and 1.7% others (Personal Communication with Municipality authorized). Composition and generation rate of MSW depend on many factors such as social pattern, income, level of life-style, education and

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