Table 1. Descriptive statistics of inputs and outputs (Year 2006)

Variables	mean	min	max	sd
Input (000 of euros)				
Total collection costs	4,346	29	382,000	21,400
Desirable output (tonnes)				
Municipal solid wastes	21,475.76	167.04	1,670,425	87,044.86
Undesirable output (tonnes)				
Not-Separated wastes	17,422.24	136.12	1,460,214	74,165.33

Source: Ecocerved

and costs of management are from EcoCerved[6]. The sample is geographically well distributed over the national area and it covers 182 municipalities in the Northern regions, 97 in the Centre, 150 in the South and 60 in the islands. The sample represents over a third of the Italian population.

From a methodological point of view, DDF is applied in a non-parametric setting, by using economical data from balance sheet (focused on the costs side) and environmental data for each Decision Making Units (waste collection enterprises in our case). One input, given by the total amount of cost by collection activities then by combinations of labor and capital, is implied during the production process in order to obtain a total amount of collected wastes (MSW) and a physical quantity of not-separated wastes (NSW). The costs includes the sum of the cost of sweeping and cleaning the streets, the cost of NSW and differentiated solid waste (DSW) collection, the cost of separated waste collection management and the cost of capital[7]. MSW represent the items of the desirable since the company wants to maximize the quantity of collected wastes showing an increasing capacity of waste collection per unit of labor and capital. NSW represents the item of the undesirable output that a company wants to minimize for many points of view[8]. First, NSW could generate the problem of saturation of the landfills with consequent problems in terms of risk fir the wealth of the people and environmental damage. Second, a higher NSW generation means an increasing of the opportunity cost to not reuse or to not recycle parts of these wastes since from recycling can come the decreasing of the overall generated wastes. Total production of waste (MSW) is around 21,475 tonnes (470 kg per capita) per year on average, with the share of separated waste collection around 20 per cent, on average. There is quite high variability in the sample according to total amount of waste collected and waste sorting policies. Indeed, while some municipalities do not have a serious recycling programme (more than 100 municipalities – mainly in the South - register less than 5 per cent of separated waste collected in 2006), others have achieved as much as 76.5 per cent of waste to recycling. The following table shows some statistical findings about and inputs and outputs used to run the efficiency model (Table 1).

[6] EcoCerved is an Italian company that, among other functions, organizes and collects data on waste management from municipalities.

[7] In our treatment, we exclude the cost of treatment and disposal.

[8] We consider MSW = NSW + (D)SW.