

## **Source segregation of biowaste in Italy**

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### **ABSTRACT**

Recent policy developments have led to a fast growth for source separation and composting in Italy. The purpose of this contribution is to describe the effects played by recycling targets set out by latest laws and regulations on the growth of source collection systems; the contribution of organic waste to those recycling targets gets examined.

The document also provides some key notes about:

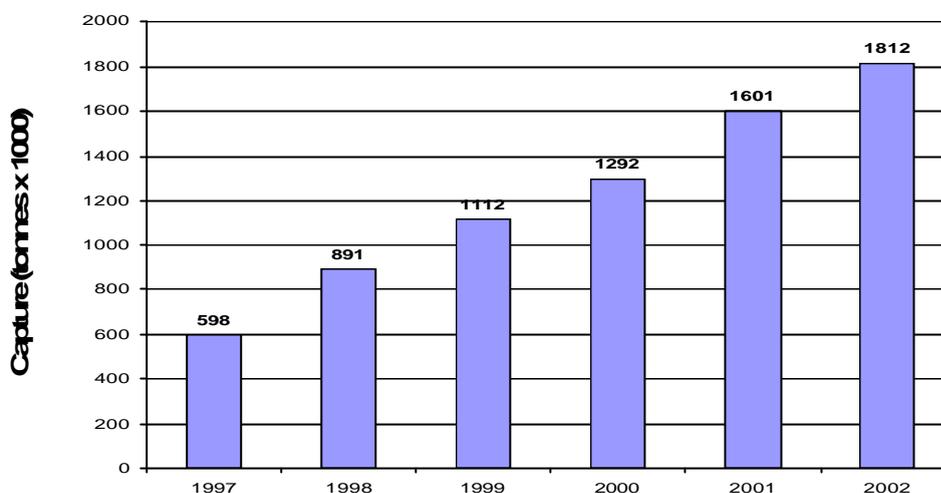
- features and performances (quality, quantity) of source separation systems for food/green waste in Italy as compared to other EU Countries.
- the current size of the “composting system” as to number of plants and their throughputs
- specific features of farming, and perspectives for use of compost in Italy as a Mediterranean Country

### **KEY FIGURES**

Composting in Italy is growing fast. About 600 Municipalities (out of 8000) were running source separation programs for food waste in late 1998. Recent updates report more than 1500 Municipal Programs for source separation of food waste, with a population covered of around 7 M inhabitants.

The total capture of source segregated biowaste (including food and garden waste) has been reported in 2002 at 1.812.000 tonnes, which is almost 4-fold, relative to 1997 (Figure 1). This implies an average capture, considering the total population of Italy (57 M inhabitants) of around 35 kilos/inhabitant a year. The average anyway hides a very varied situation, with Regions as Lombardia and Veneto (where source separation of biowaste is most diffused) showing a specific capture of 65 and 87 kilos/inhabitant. Anyway point data, referred to those Municipalities where source separation has been actually implemented, go well beyond 100 kilos.

**Figure 1: overall capture of biowaste from schemes for source segregation**  
 (Source: APAT-ONR, 2003)



Given the aforementioned captures, separate collection of biowaste shows to be one key driver to reach very high recycling rates, which may peak more than 70% in small towns, and more than 50% in densely populated areas; this is partly due to the important contribution of biowaste itself in terms captures and diversion from disposal; partly to the possibilities offered by operational innovation which often source separation of biowaste implies, with beneficial effects also on captures of other recyclables. Table 1 reports on aggregate recycling rates peaked in those Provinces where Municipal schemes are already widespread and strategies for source separation of biowaste “mature”. Numbers hereby reported are an average of Municipalities where source segregation is already implemented, and much lower rates in Municipalities where it is not rolled out, yet.

**Table 1: recycling rates attained in various Provinces and Districts in Italy**

Area	Population	Rate (%)	Municipalities adopting separate collection of food waste
Province Bergamo	956.181	<b>42%*</b>	67 Municipalities (38% of population)
Province Lecco	307.507	<b>54%***</b>	83 Municipalities out of 89 (97 % of population)
East Milan District	364.227	<b>58%**</b>	All Municipalities in the District
District TV 3	195.414	<b>45%**</b>	23 Municipalities (80% of population)
Province Treviso	790.768	<b>39%**</b>	90 Municipalities out of 95
Province Padova	853.743	<b>33%**</b>	83 Municipalities out of 104

\* = 1998, \*\* = 2000; \*\*\* = 2002; sources: ARPAV and Ecosportello Province Lecco

Although strategies were started in North Italy in 1993, they are already fairly diffused also in Southern Regions, Abruzzo and Campania above all, where programmes defined by Governmental Task Forces (“Commissariati”) on waste management have boosted specific programmes and taken many Municipalities well beyond 50% recycling thanks to source segregation of food waste (best Municipalities hitting 75% in Campania).

Widespread diffusion of schemes for source segregation of food waste has shown efficacy of collection models, both in terms of quantity and quality, irrespective of where schemes are implemented. Otherwise speaking, the efficacy therefore depends much more on the type of scheme, than on local “cultural attitude”. Table 2 reports for example on results of various

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Municipalities near Naples, in South Italy, where an overall population of around 600.000 is already covered by schemes for source separation of food waste.

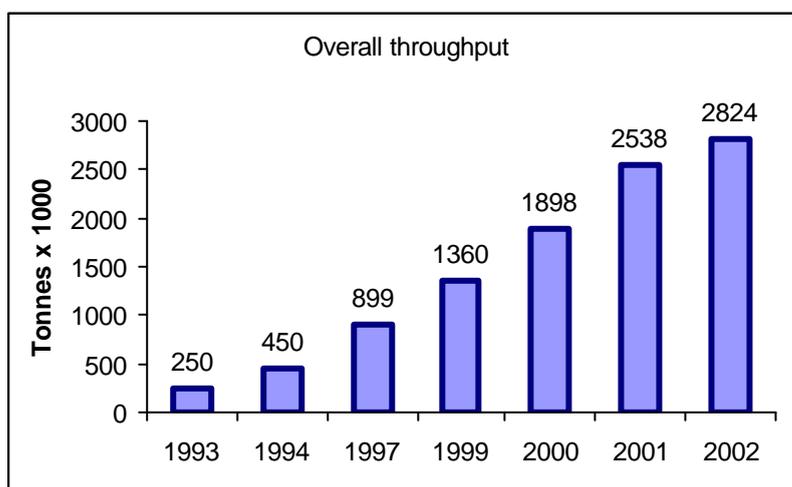
**Table 2: results in Municipalities with separate collection of foodwaste in South Italy**  
 Source: Legambiente (2002): *Dossier sulla raccolta secco-umido in Campania – anno 2001*;

Municipality	Population	Recycling rate %	Capture organic waste kg/inhab.year
VAIRANO PATENORA	5.930	78,00%	122
COMIZIANO	2.009	66,80%	123
CIMITILE	7.000	61,80%	130
GIFFONI SEI CASALI	4.086	60,90%	82
BAIANO	4.800	60,30%	79
SAN CIPRIANO PICENTINO	6.040	57,70%	71
CASAMARCIANO	3.600	54,40%	71
SAN VITALIANO	5.013	51,70%	137
SALA CONSILINA	13.182	51,00%	65
CAMPOSANO	5.640	43,80%	58
MANOCALZATI	3.200	38,30%	78

Source: Legambiente (2002): *Dossier sulla raccolta secco-umido in Campania – anno 2001*;

Concurrently, the number of composting sites for source separated materials is steadily growing, too: 100 industrial composting sites were recorded in 1997, whereas the number of facilities had grown up to 135 in 2001 and 140 in 2002; the throughput (including also organic waste other than municipal), on aggregate, was around 2,8 M tonnes in 2002 (Figure 2). The overall composting capacity (including the unexploited or recently built) has been reported in the same year at 5,2 M tonnes/year. Numbers do not include small sites that compost only garden waste and with a capacity of less than 1000 tonnes/y (which were 77 in 2001 and 97 in 2002).

**Figure 2: throughputs at compost sites in recent years**



(source: CIC, Italian Composting Association, personal communication; APAT - ONR, 2003)

The main cause for such a huge growth in composting of source separated materials has to be found in recent developments of environmental policy. Decree 22/97, the National Waste Management Act (Feb. 1997) sets a recycling goal at 35 % to be met within 2003. In the Waste Act, source separation of the organic waste is not compulsory, and it is just depicted as a “priority”. Still, source separation of biowaste *is a must do* in order to reach the medium-term recycling targets of 35 %. In effect, intensive collection of dry recyclables (paper, glass,

plastic, etc.) does not allow, on its own, local authorities to meet such a goal (it has to be noted that home composting and C&D debris are not included into the total figure of recycling rate). Thus, Regions and Provinces are including source separation of food waste in their Waste Management Plans.

Source separation of food waste has already allowed some Provinces, to meet the 2003 recycling goal (35%), with many single Municipalities overcoming 60 %. In general, strategies after their implementation prove to be effective and accepted by Local Authorities, since, as we're going to see, *the use of specific tools and systems for door-to-door source separation of food waste has proven to be effective with relevance to quantity and quality of food waste collected, and very cost-competitive.*

The collection of yard waste is even more developed, above all in such regions as Lombardia, Veneto and Piemonte (around 4000 municipalities, 17.750.000 inhabitants) where it has been made compulsory since the early 90's. Lately also Sicily issued a ban for landfilling of yard waste. Many other Regions, such as Emilia Romagna and Tuscany, also are reporting a wide extension of programs to collect yard waste, even though they have set no obligation in such respect

## **OLD STRATEGIES AND INNOVATIVE WASTE MANAGEMENT**

Waste disposal in Italy - as in general in Southern Europe - still largely relies upon landfilling. Waste Reports referring to 1997 (ANPA, 1999) showed that landfilling was still largely the most used way to dispose of waste. In 1997 source separation and material recycling averaged 9.5 % of national MSW production. As for final disposal, these were the figures:

<b>landfilling for untreated MSW</b>	79.9 %	total MSW
<b>biological treatment</b> (mixed MSW composting)	9,4 %	“
<b>incineration</b> (mostly without thermal recover)	6.6 %	“
<b>others</b> (inertisation, mixed MSW sorting, etc.)	4.1 %	“

Such percentages described a situation in which MSW was basically landfilled *as such*. In 2001 (APAT-ONR, 2003) landfilling had dropped down to 67,1%, and recycling, on aggregate, was hitting 17,4%.

Wide differences among Regions have anyway to be stressed. The average recycling rate in Southern Italy in 1997 was 1,4 % (1,1% the year before) with Regions as Calabria (pop. 2.000.000) and Sicily (pop. 5.000.000) below 1%. Meanwhile, in Northern Italy, recycling rate averaged 17 % (12,71 % in 1996), with Lombardia (9.000.000 inh.) reaching 26.9 % and 4 Provinces reported in 1998 at more than 35% (Milan, Lecco, Bergamo and Lodi).

Remarkably, by 2002 (i.e. after only 5 years), 2 Regions had been reported beyond 35% (Lombardia, pop. 9.000.000, 36,4% and Veneto, pop. 4.500.000 , 39,1%) and quite a few Provinces were already beyond 50% (highest figure: Lecco, 53,6%)

As source separation grows up, we get important suggestions about items on which efforts have to be concentrated in order to reach high recycling rates. (Consorzio Provinciale della Brianza Milanese, 1997; Legambiente, 1998; Provincia di Lecco, 1997; Provincia di Lodi, 1998; Provincia di Milano, 1998 a).

Traditionally, source separation systems were considered to be simply *added* to common MSW collection. Recycling paper, glass and plastics by means of road containers did not imply structural changes in the MSW collection. With such systems, separation rates range between 2 and 15%, depending above all on the frequency of distribution of road containers, with frequencies of less than 500 inhabitants/container - per each material - performing best. Table 3 reports on the *maximum* specific contributions of such systems for different waste materials .

**Table 3: Maximum specific contribution of different materials (values in  $\text{kg inh}^{-1} \text{y}^{-1}$ ); situations with optimum frequency of distribution of containers (1 every 400-500 people)**

<b>Material</b>	<b>Specific contribution (<math>\text{Kg inh}^{-1} \text{y}^{-1}</math>)</b>
Glass (mixed)	20-30
Paper	20-30
Plastic (containers)	4-5

More recently, *integrated* source separation systems have been introduced. “Integrated” source separation means that higher separation rates and above all the segregation of compostable fractions such as food waste, *imply also a change of collection of Residual waste*. In such respect, a central role is played by source separation of food waste. In Italy the contribution of food waste alone – when run through “door-to-door” systems - accounts for some  $60\text{-}90 \text{ kg inh}^{-1} \text{y}^{-1}$  (Consorzio Brianza Milanese, 1998); these numbers have to be added to yard trimmings (generally run with specific collection systems, different from schemes for food waste) whose contribution ranges between 30 and  $150 \text{ kg inh}^{-1} \text{y}^{-1}$ , depending on type of dwellings and diffusion of home composting. The overall contribution of compostable fractions therefore averages by itself a 20-40% recycling rate.

Very often, where the source separation of food waste gets implemented, also the introduction of door-to-door collection of paper is considered. This allows separation of some  $40\text{-}60 \text{ kg inh}^{-1} \text{y}^{-1}$  waste paper (Legambiente, 1998), that means 2 to 3 times more than the specific contribution of collection through road containers. In general, we may say that *door-to-door collection (also worded as “collection at the doorstep”) is a powerful way to reach high recycling rates; this applies above all to those materials whose contribution is relevant such as paper and food waste*. Incidentally, we have to remark that such 2 waste materials are the most important biodegradable fractions by weight, hence their high capture may fulfil targets of the Landfill Directive (which will be shown later on)

Fermentable material (food waste) accounts for a major percentage of MSW; and this is particularly true in South Europe. In Northern Italy percentages of food waste range between 25 and 40% out of total MSW; in Southern Regions they are in the region of 35 to 55%, mainly due to lower presence of packaging and the habit to have meals at home with a lower use of convenience food (which implies production of less food waste).

## KEY PERFORMANCES OF COLLECTION SCHEMES FOR FOOD WASTE IN ITALY

### *Quality*

As to *quality* (table 4), the material collected through collection at the doorstep shows on average a 97-98% purity, well beyond a suitable target that could be set at a 93-95% purity, depending on equipment for screening and refining available at the facility; it has to be noted that with a 97% purity and more it is possible to tip the material directly to the composting section, without any pre-sorting step (e.g. a primary screen, or a hand sorting section).

**Table 4: purity of food waste in some Italian areas and municipalities**  
(sources: Provincia di Milano, 1998 b; Favoino, 2000; Bigliardi, 1998)

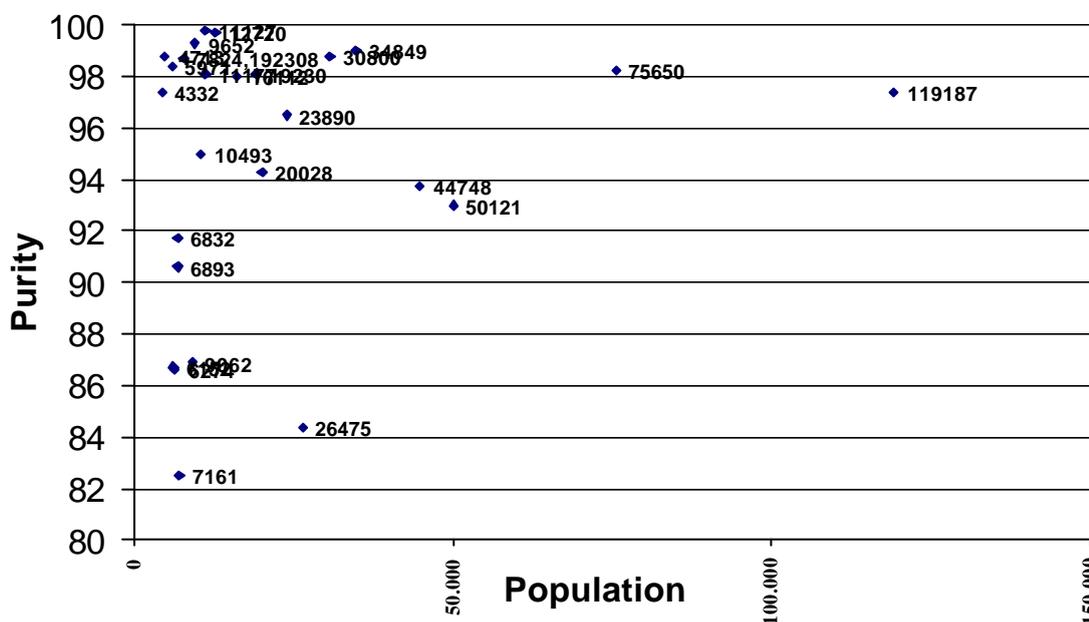
Area/Municipality	Inhabitants	Purity (Compostable materials) % w/w
<b>Milan Province</b>		
<b>(March '98):</b>		
Albate	4.713	98.8
Arese	19.230	98.1
Bellusco	5.971	98.4
Biassono	10.493	95.0
Brugherio	30.800	98.8
Buccinasco	23.890	96.5
Castano Primo	9.652	99.3
Cinisello Balsamo	75.650	98.2
Cologno Monzese	50.121	93.0
Desio	34.849	99.0
Melegnano	16.112	98.0
Monza	119.187	97.4
Novate Milanese	20.028	94.3
Paderno Dugnano	44.748	93.7
Rosate	4.332	97.4
Trezzo Sull'adda	11.177	98.1
Varedo	12.720	99.7
<b>“Padova1” Basin</b>		
<b>(March '98)</b>		
26 Municipalities	203.429	98.7

It may be noteworthy that, according to the 2<sup>nd</sup> EC Working Paper on Biowaste, source separation of biowaste should be implemented, besides in rural areas and small municipalities, also in big cities (with possible exceptions only in inner cities). Such a provision could be disputed since in general, it is argued that purity of sorted food waste tends inevitably to get much lower in densely populated areas. Actually, *the quality of collected biowaste seems to be much more dependant on the system adopted for collection than on the size of towns*, and many situations are reported where schemes prove to be successful also in big towns and inner cities. Numbers about purity of separated biowaste (percentage of compostable materials) reported in various sorting analysis performed across Italy have been plotted against the size of concerned cities (figure 3). What turns out is that no relation can actually be detected between the size of the city and the purity.

This means that other factors are affecting purity more than the size of the town and its population (which likely affects the type of dwellings); the *type* of the scheme is on the contrary much more relevant; doorstep schemes generally perform much better than schemes run through containers on the road.

Statistical treatment of numbers yields a very low correlation index ( $R^2 = 0,0174$ ), and even at a glance, it is easy to get aware of the presence of cases of high purity in medium to big towns, besides low purity, sometimes, in a certain number of small villages (where collection of biowaste through road containers has been implemented).

**Figure 3: purity of collected food waste plotted against population**  
 (numbers near dots refer to population)



In general, where door-to-door collection of food waste is on place, yard waste gets collected on a different, less intensive scheme; this is most often done through direct delivery by households at Civic Amenity Sites (“Piattaforme Ecologiche”) or with a specific kerbside collection, but with a separate collection round and a much lower frequency than for food waste; this is deemed to make deliveries of garden waste not so easy and thus have yard waste managed by households as a home-compostable material to the largest possible extent; *this helps keeping low the overall MSW production figure.*

***Captures and their relevance to fulfilment of targets of Directive 99/31/EC***

Typical captures for collection at the doorstep are in the region of 50-90 kg/inhabitant a year. Higher captures are normally detected, anyway, in South Italy, due to a much higher presence of food waste in MSW.

Captures of garden waste are much more variable, and tend to depend not only on the type of dwellings (with an obvious tendency of areas with detached houses to yield higher captures) but – even more – on the type of scheme. Peak figures of 200-400 kg/inhabitant a year (which

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tend to be in line with captures often recorded in Central Europe) have been reported as an undesirable result of *intensive* collection with large-volume bins at the doorstep. This implies, on the one hand, higher recycling rates, but shows, as a downside of it, an increase of waste arisings, and higher costs for collection and treatment.

As to efficacy of captures of food waste, one should consider that source separation of dry fractions and packaging materials determines – as an undesired side-effect – the concentration of the fermentable material inside “residual waste”, for food stuffs which are not captured through source separation (this can be worded as the “concentration effect”). For instance, in the Netherlands and Germany, the percentage of food waste inside “residual waste” is often reported to be at 30-50% (Wiemer and Kern, 1995; Baden Baden Amt für Umweltschutz, 1996); in Austria it tends to drop down to around 20% (range 15-25%) thanks to a wide diffusion of backyard composting.

In Italy, very low percentages of organics in residual waste are achievable – and are actually being achieved – where “intensive” collection of food waste is performed through relatively high frequencies of collection at the doorstep and the use of watertight bags as a tool to make the system comfortable. In such experiences, widely diffused in North Italy (e.g. Treviso Province, East Milan Waste Management District, Cremasco Waste Management District) and under development in the South of Italy, percentages around 10% have often been reported, with lowest figures around 5 to 7 %; as it is shown in table 5, such captures, alongside that of other biodegradable waste fractions (such as paper, textiles, nappies), already fulfil by themselves the long-term targets of the Landfill Directive (65% diversion of biowaste from landfilling in 15 years’ time).

More frequently, anyway, a higher percentage of biodegradable waste is normally found in residual waste (see table 6, reporting on results of sorting analyses in Milan Province, compared with typical German and Dutch figures)

**Table 5: assessment of captures of biodegradable waste fractions relative to targets of the Landfill Directive 99/31/EC; case: East Milan Waste Management District (2002)**

	A=% in MSW	B = % in residual waste	C = B x 0,4
<b>Fines (a)</b>	10,39	3,84	1,54
<b>Food waste (b)</b>	29,65	5,73	2,29
<b>Paper and cardboard (c)</b>	23,46	33,83	13,53
<b>Yard waste (d)</b>	2,48	1,11	0,44
<b>TOTAL = 0,8a +b+c+d</b>	<b>63,90</b>	<b>43,74</b>	<b>17,50</b>

**Overall capture:** = (TOT a – TOT c) / TOT a = (63,90 -17,50) / 63,9 = **72,62%** (> 65%)

*Notes:*

- 80% of “fines” (waste fraction passing through a sieve hole = 20 mm) is assumed to be biodegradable, since such percentage is normally composed of food scraps
- Rate of source separation in the District is around 60%, therefore residual waste is 40%; percentages of various waste fractions in residual waste have therefore to be multiplied by 0,4 in order to assess percentages of biodegradable waste materials in residual waste, relative to the total amount of MSW.

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**Table 6: percentage of food and yard waste in residual waste in various Municipalities around Milan and typical German and Dutch figures.**  
(Sources: Wiemer and Kern, 1995; Baden Baden Amt für Umweltschutz, 1996; Provincia di Milano, 1998 b )

Municipality	%	Municipality	%
Albairate	14,9%		
Albate	14,4%	Melegnano	19,9%
Arese	24,6%	Misinto	14,7%
Biassono	16,6%	Monza	30,8%
Brugherio	36,5%	Novate M.	22,9%
Buccinasco	28,6%	Paderno D.	17,0%
Castano P.	29,8%	Rosate	10,5%
Cinisello B.	17,8%	Trezzo s/A	21,4%
Cologno M.	11,0%	Trucazzano	28,9%
Corbetta	21,7%	Varedo	21,7%
Desio	18,0%	Villasanta	24,4%
Lainate	16,9%	Vimercate	13,9%
GERMANY	30-40%	NETHERLANDS	40-45%

Transitionally, high percentages of food scraps inside residual waste are also normally expected in those Districts where source separation has not yet been widely diffused or fully implemented.

### **Costs**

Thanks to the optimisation tools made possible where door-to-door schemes are in place (lower frequencies of collection for residual waste, use of bulk lorries instead of compactors for the collection of food waste, as bulky yard waste is not allowed to be delivered inside receptacles for food waste, etc.), the collection system has proven to be cost-competitive.

In general, it could be said that *where optimised door-to-door collection systems are run, the overall waste collection costs (i.e. for food waste + restwaste + dry recyclables) tend to be similar (or sometimes even lower) than the previous costs of mixed MSW collection.*

In a nationwide survey in 1999, we already recorded an average cost for mixed MSW collection of some 30-34 €/inh.year; overall costs for door-to-door systems sorting food waste were at some 25-30 €/inh.year . Single case-histories have confirmed positive trends on the reduction of overall collection costs, following the implementation of door-to-door source separation (e.g. Cinisello, 75.000 inh., having fallen from 2,35 Million € to 2,15 Million €). In the following scheme (table 7) we sum up those tools that are making it possible for many Municipalities to cut down overall collection costs with door-to-door schemes.

Usually the same effects cannot be expected for those situations where food waste gets sorted through ‘road containers’. In such situations, a much lower quantity of food waste gets separated – in general, by far less than 100 grams.inh<sup>-1</sup>.day<sup>-1</sup>, due to the less comfortable situations for households; this in turn doesn’t allow a less frequent collection for residual waste and the collection of food waste is thus an “added cost” to previous costs of MSW collection; furthermore, road containers allow a high delivery of yard waste, and this calls for compacting vehicles (packer trucks) to be used. Such systems are nowadays much diffused in

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such Regions as Emilia-Romagna and Tuscany; nevertheless, it often happens that Municipalities in those areas are turning to door-to-door systems, albeit slowly, given the wide diffusion of equipment and receptacles for collection through road containers.

**Table 7: main tools to optimise collection schemes for food waste**

<b>Tool</b>	<b>Details</b>	<b>Applies where.....</b>
Reduction of the frequency of collection for residual waste	Effective systems to collect biowaste – letting people feel comfortable - make its percentage in the residual waste fall down to 10-15 % and less..	...frequent collection rounds for mixed waste are adopted (warmer climates)
Use of bulk lorries instead of compactors	Bulk density of food waste on its own is much higher (.7-.8 kg/dm <sup>3</sup> ) than when biowaste is composed of both food and yard waste	...collection of food waste is kept separated from the collection of yard waste – use of small buckets at houses with gardens
Cutting the number of washing rounds	The use of watertight bags prevents the need for frequent washing	...“Personal bins” and bags are adopted

**COMPOSTING AS A TOOL TO RECOVER HUMIFIED ORGANIC MATTER: USE AND MARKET OF COMPOST IN MEDITERRANEAN AGRICULTURE**

Compost production in Italy in 1997 was reported at some 450.000 tonnes.y<sup>-1</sup>. Last unofficial updates put the overall production at some 700.000 tonnes. Most of it is actually sold to growing media producers, who mix it with other materials, bag and sell it. In such marketing conditions (Centemero, 1999), current prices for bulk sale range between 7 and 12 Euro.mc<sup>-1</sup> (product screened at 10-15 mm mesh size, sold in bulk at the plant).

Market conditions are favourable and provide a pretty sound confidence among the operators. It seldom happens that quality compost is given to users free of charge (e.g. in those situations where plant managers are already benefited by tipping fees or cost savings in comparison to landfilling or incineration); this happens, for instance, when a Public Company runs a plant and has not a good know-how for marketing the product. More often, good marketing conditions are fully exploited, above all when operators have established an effective marketing network.

It is noteworthy that it has not been unusual, so far, to have also compost coming from mixed MSW used and even marketed – above all in Southern, humus-consuming Regions; this holds true even though mixed MSW compost has to be land-applied only at a maximum loading rate and according to the principle of the so called ‘controlled use’, i.e. keeping a control on soil quality before and after the use. In recent times, however, the awareness that only quality composted products stemming from source segregated materials have to be considered to restore fertility is growing among farmers. Also legislation is being revised, so that the use of mixed MSW compost (now worded as “Biostabilized Material” or “Stabilised Organic Fraction”) will shortly be restricted to land reclamation, brown soils, revegetation of landfill sites and the like.

In order to ensure visibility and better marketing conditions for good products, the Producers' Association (CIC, '*Consorzio Italiano Compostatori*') is now about to promote the start-up of a Quality Assurance System mirroring what has already been long done in Central Europe (see, for instance, the BGK – Federal Association on the Quality of Compost, Germany, or VLACO, Belgium, or KGVÖ, Austria, etc.)

There is a great awareness, among composting plant managers and research centres, that in next future the use of compost in field crops has to be developed, beside that for potting mixes, in order to back up the growth of compost production, that is forecast to grow many more times as a mere consequence of provisions of Decree 22/97.

It has to be underlined that specific weather and cropping conditions determine – in general - a huge request for organic matter in Mediterranean agriculture. Warm and dry climates and the intensive, humus-consuming crops (e.g. horticulture, fruit culture) make soils hungry for organic matter; decades of chemical fertilisation as a complete substitute for organic fertilisation have made the overall situation worse. Many soils, not only in Southern Regions, but even in Northern flatlands, are reported at less than 1.5 % organic matter. Moreover, the recent Dakar Conference about desertification has shown that Italy - as many other Mediterranean Countries - is threatened by desertification.

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