FACTORS AFFECTING MATERIALS RECOVERY FROM MUNICIPAL WASTE

A case study of Bologna Province

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Abstract

According to the 2008 data, recycling rates in 60 municipalities in Bologna Province vary in a very wide range from 15% to over 60%. In order to promote sustainable practices of resource (in this case, materials) recovery, it is important to identify factors that influence the attitudes and behaviour of citizens in this regard and clarify the differences among these municipalities. Starting from the findings of similar studies that have been carried out elsewhere, this research study is undertaken to investigate these factors in Bologna Province. Particular attention is paid to the role of information and awareness raising campaigns implemented in the municipalities under investigation.

Stratified sampling is used to select 17 municipalities that are representative of the Bologna Province according to relevant characteristics. Research methodology includes interviews with formal stakeholders such as municipal authorities and waste service providers, as well as a survey among residents. In addition, pertinent documents and campaigning materials are studied.

This paper presents the results of the study. The research reveals that several municipalities have very significantly improved their recycling rates in the course of the last year. The findings of the study provide insights into the factors that explain the difference in recycling rates among municipalities as well as those that have contributed to the increase of recycling rates in the recent period.

Keywords

Recycling behaviour, municipal recycling scheme, Bologna

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1. Introduction

Despite the scandals of bad waste management practices in some Italian cities and ensuing negative publicity in the world press that has affected the image of Italy, there are places with relatively good waste management and resource recovery. Emilia Romagna can be considered as one of these. In this north-eastern region the average recycling rate of 36.6% can be considered as relatively good. The capital of the region, Bologna, has a large province with 60 municipalities. While the Bologna province has an average recycling rate of 29.4%, the data reveal very large differences in the level of recycling amongst the municipalities. Even though they appear to have comparable populations, similar geographical characteristics and overall economic conditions, their recycling rates range from 15% to over 60%. This study aims at explain these differences.

The general research objective is to identify the factors that affect the recycling rate in the Bologna Province the most and can explain the differences among the municipalities. In addition, the research aims at formulating recommendations based on the research findings, for policy makers and local authorities on how to improve recycling in their municipalities. In order to meet these main objectives, the following specific objectives are formulated:

- Describe the current municipal solid waste management and recycling system in the Bologna Province,
- Identify actors involved in recycling; understand their roles and interactions,
- Identify differences in the recycling policies and practices in the municipalities,
- Propose measures that stimulate recycling behaviour in the Province.

2. Conceptual frameworks adopted in the analysis

2.1 Conceptual framework for waste management and recycling

This research uses two frameworks for the analysis. For the description and the analysis of municipal waste management and recycling systems in the municipalities studied, the concept of Integrated Sustainable Waste Management (ISWM) by Van de Klundert and Anschütz (2001) is applied. This concept distinguishes three dimensions of analysis: technical components of the system, sustainability aspects and stakeholders involved.

The main system technical components studied include waste generation, waste segregation at source for recycling, waste collection, treatment, incineration, and disposal.

The stakeholders include households and commerce as waste generators, local authorities in their responsibility to ensure that services are provided, service providers in charge of waste collection operations, and agencies and associations involved in recycling.

The main aspects addressed in this study include organisational, economic and social ones.

2.2 Conceptual framework for households' recycling behaviour

Households recycling behaviour has been extensively studied. The theoretical model used in this research draws on the Theory of Planned Behaviour (TPB) by Ajzen (1991), in which "the individual's intention to perform a given behaviour" is a central feature. "Intentions are assumed to capture the motivational factors that influence a behaviour; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour." In this analysis, factors that determine how households' intentions to recycle are formed, are divided into three main categories (Hornik et al., 1995; Barr et al., 2001; Tucker and Speirs, 2003):

- Situational or personal context (habits, general environmentally friendly behaviours, and socio-economic factors such as age, gender, education level, job, housing typology), (Vining et al., 1992; Tonglet et al., 2004);
- Internal (attitudes and awareness, personal norms and values, perception of difficulties), (Ajzen, 1991; Everett and Peirce, 1992; Thomas, 2001; Tonglet et al., 2004; Smallbone, 2005; Nixon and Saphores, 2008; White et al., 2009);
- External (information campaign, authorities' intervention, social influence), (Kok and Siero, 1985; Ebreo and Vining, 2000; Evison and Read, 2001; Barr et al., 2003; Mee et al., 2004; Steg and Vlek, 2009).

A recycling behaviour is not only determined by the intention to recycle, but also by the opportunity in terms of facilities and infrastructure to act upon the intention. Therefore the Ajzen's model is expanded to include an intermediate element between behavioural intentions and the actual behaviour – barriers or facilitators. This element is here defined to represent the efforts and recycling infrastructure provided to the citizens by the authorities.
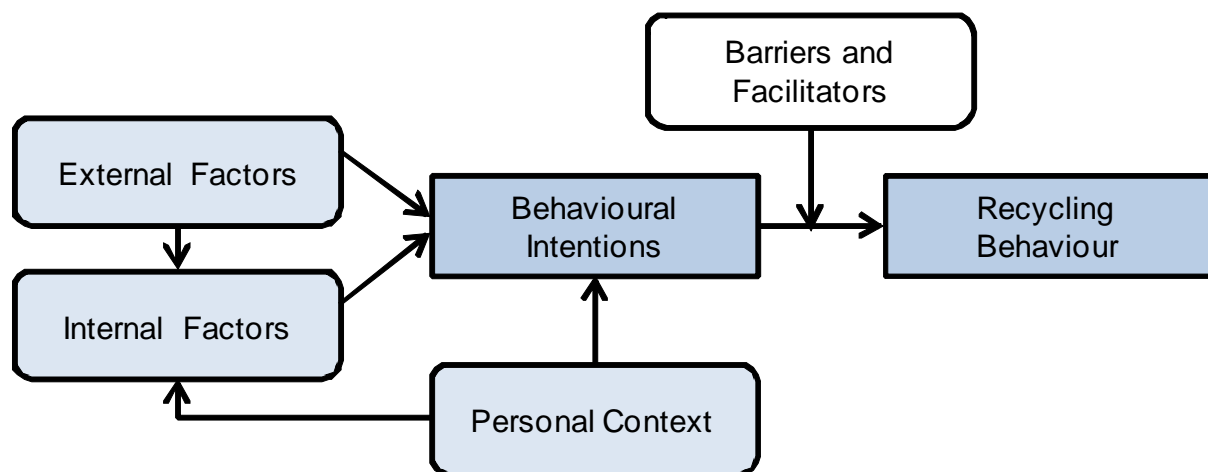

Figure 1: Theoretical model of households' recycling behaviour

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Finally, as interactions between individual elements are often complex and defy simple cause and effect relationships (Ebreo and Vining, 2000; Thomas, 2001; Barr et al., 2001 and 2003; Knussen et al., 2004), their mutual dependencies are also investigated to the extent deemed appropriate for achieving the study objectives.

The theoretical model used in this study for the analysis of households' recycling behaviour is presented in Figure 1 above.

3. Methods

In addition to the initial literature study, the methods used for data collection include document review for the entire Bologna Province as well as interviews with key stakeholders, questionnaire survey among citizens, and document review in the 17 towns selected as representative, out of 60 municipalities in the Bologna Province.

In selecting the sample of 17 towns, the city of Bologna is excluded as it incomparably bigger than any other town in the Province: it has 375,000 inhabitants whereas the second biggest town of Imola has 67,300. The towns are chosen based on two main characteristics: the recycling rate they achieve and their location. Regarding the recycling rate, four best and four worst performers are selected. Regarding location, two mountain towns are included: Monghidoro and Monzuno. This is because the preliminary analyses revealed that, among the three topographic regions: mountains, hills and plain, the recycling rates in the mountainous municipalities are significantly lower, as presented in Table 2 below. The two selected towns border on each other, have similar populations, geographical conditions, and the same waste operator, yet their recycling rates are very different: 41.6% in Monghidoro v. 25.6% in Monzuno. Finally, additional seven towns are randomly selected.

In these 17 towns, semi-structured interviews are held with the councillors responsible for the environment and waste services, in order to obtain information on the functioning of the recycling scheme adopted, how the community has responded to it, and what information campaigns have been carried out, if any. Moreover, the interviews serve to verify if and to which extent the issues raised by the public have been taken into consideration when planning the recycling scheme.

In these 17 towns, public documents are reviewed in order to evaluate external factors and identify the measures undertaken by the authorities in each town to promote recycling and raise awareness of the inhabitants.

Among the 17 towns, a sample of eight towns is selected to carry out questionnaire survey among citizens. The aim of the survey is to further investigate the factors which affect the recycling rate, through identification of internal, external and personal context factors and perceived obstacles to recycling behaviours. These eight towns are selected to represent

categories used in sampling of the 17 towns (thus, highest and lowest recycling rates, and mountain towns) as well as various waste collection schemes. In this way, kerbside collection, drop-off collection and combined systems are represented. Due to time constraints, the sample included between 0.30% and 1.02% of the population.

4. Waste management and recycling system in the Bologna Province

4.1 Waste definition

According to the Italian law *D.Lgs. 22/97*, there are three different types of waste: Urban Waste, Special Compatible Waste and hazardous waste. Urban waste comprises household waste, street sweepings and residues from public green areas, and abandoned waste. Special compatible waste comprises waste from industrial activities that is similar to urban waste in terms of its characteristics and composition. Hazardous waste is considered separately from urban waste.

4.2 System components

In accordance with the theoretical framework of ISWM adopted, the waste management and recycling system is described. The components are presented in the process flow diagram (Scheinberg et al., 2010) in Figure 2 below.
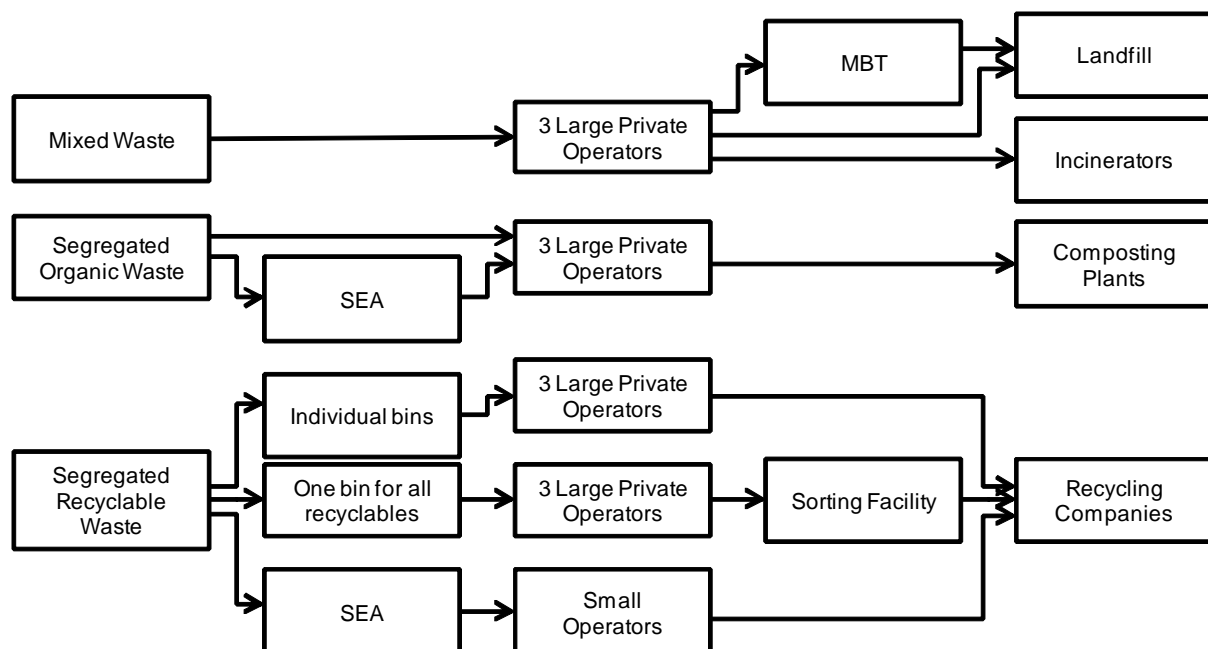

Figure 2: Process flow diagram of the Bologna Province waste management and recycling

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4.3 Stakeholders

ATO5

Since 2002 a newly established provincial agency has been operating in waste and water sectors: ATO5 (*Agenzia d'ambito per i servizi pubblici*). ATO5's Board of Directors consists of the Mayors of all 60 municipalities in the Province, plus a representative of the Province itself. It has been created according to the law *D.Lgs. 22/97* with "the main mission to reduce the costs of services through promotion of more efficient management, the application of criteria of economies of scale, unifying the provincial waste system and monitoring the operation in every sub-area". This latter also means that ATO5 is to ensure collection of comparable data on performance for benchmarking. ATO5 also supports municipalities in preparation of their strategic plans. While currently every town has its own prices and billing system, one of the purposes of ATO5 is to reach uniform costs. Finally, ATO5 examines and proposes locations for possible new waste facilities.

Waste operators

In 2004 ATO5 commissioned three companies to provide waste services until 2011: Cosea in the mountain area, Geovest in the North-western plain area and Hera in the remaining municipalities. A waste company can only operate according to the agreement with the municipal authorities and within the boundaries of the regulatory framework by ATO5. No room is left for unilateral decisions by service operators, they can only give support and consultancy upon request from the environment councillors of a town and propose alternatives. These three large companies contract smaller operators to provide "smaller" operations such as bin-cleaning and, in some cases, transportation of recyclable materials.

This is a very different situation from the previous one, where 10 companies were involved in the services: waste collection and transportation, waste treatment, and street sweeping and cleaning. The possibility of contracting out each service separately had been established to create competition and so give the chance to inhabitants to pay less. However, due to poor management and coordination of the waste services, the result was high costs, different services in each town, and low recycling rates averaging between 21% and 24%.

CONAI

CONAI (Consorzio Nazionale Imballaggi, National Packaging Association) was created in 1998 as a voluntary association at the national level, with the main purpose of ensuring that the recyclable waste is reused or recycled rather than landfilled. With the creation of this agency, waste generators such municipalities, public institutions and commercial companies,

are connected with recycling industries, including both small and large operators. CONAI has an agreement with the Ministry of Environment and ANCI, the National Association of Italian municipalities, which guarantees that the recyclable packaging and wrapping materials are sold to the recycling companies (members of the Association) at predetermined prices. This arrangement contributes to preservation of natural resources, reduces pressure on disposal capacities, and provides a financially preferable option compared to costly landfilling for municipalities. Over 90% of the Italian municipalities have a direct agreement with CONAI.

NGOs and CBOs
The impact of environmental NGOs on recycling in the Bologna Province seems to be negligible. There are offices of large international (WWF) and national (Legambiente) NGOs but their focus is not on recycling. The situation is similar with local "green" associations. Local parishes collect second-hand clothes and other goods for people in need, but as the participation in religious events is limited to the elderly, the amount of material collected is insignificant in the total picture of the Province.

4.4 Waste collection schemes
There are two waste collection systems within the Province: the kerbside, adopted by just four municipalities, and the drop-off collection scheme, used by the remaining municipalities representing 95% of the population. A few municipalities have combined schemes.

The kerbside service is strictly provided to facilitate recycling while the drop-off system may or may not have such provisions. In the kerbside scheme the citizens are required to keep the waste segregated in their homes until the day designated for collection of the specific material at the doorstep of each house (in other words, at the kerbside). A drop-off scheme can have a single bin for all waste or additional bins can be provided for various recyclable waste materials. The latter is adopted by ATO5 as the standard collection system for the Bologna Province. Within this recycling scheme, citizens bring their waste to the so-called *eco-points* (or *ecological islands*), which are equipped with bins for recyclable materials and are continuously accessible. Either there is a separate bin for each type of recyclable material or there are only two bins for recyclables – one for organic matter and one for dry materials (plastic, paper, glass…), the latter requiring sorting before further processing.

A common feature in all towns, independently from the collection scheme adopted, is the existence of so-called SEA (*Stazione Ecologica Attrezzata*). It is a place in the municipality where households, private enterprises, and other waste generators from that municipality

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can bring valuable used products and recyclable waste materials and dispose of them free of charge. SEA is normally used to bring large amounts of glass, paper, plastics, and garden waste, bulky waste such as household appliances, furniture and mattresses, and used oils. Some municipalities give incentives to encourage citizens to use SEA so as to reduce the amount of waste requiring collection and to prevent dumping along roads.

5. Recycling practices in the entire Bologna Province

5.1 Changes in recycling rates

Regarding the recycling rates, all but four municipalities have increased their recycling rates in the period 2006-2008 (Table 2). It should be noted that the top five performers, which all score above 65%, all have kerbside collection. They all introduced this system in 2006, 2007 and 2008 and are the only ones in the Bologna Province. Two of them experienced a dramatic increase of 56 and 60%.

Table 1: Recycling performance in the entire Bologna Province

Performance	Town	Recycling rate in 2006 (%)	Recycling rate in 2008 (%)	Difference (%)	Waste in 2008 (kg/capita)
Best	Monte S. Pietro	23.7	79.3	55.6	419
	Sasso Marconi	16.1	76.2	60.1	521
	Argelato	47.8	71.8	24.1	546
	Monteveglio	58.7	67.5	8.8	564
	Crespellano	19.0	65.1	46.1	454
	Mordano	31.4	55.4	23.0	886
	Crevalcore	52.3	49.8	-2.5	601
Median	Castelmagiore	25.8	34.7	8.9	556
	Casalfiumanese	16.6	36.4	19.8	642
Worst	Grizzana Morandi	11.3	21.0	9.7	511
	Lizzano in Belv.	18.00	19.8	1.8	825
	Minerbio	22.3	19.8	-2.5	523
Average	Bologna Province	27.9	38.1	10.2	609

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Interestingly, the higher the recycling rate before the introduction of kerbside collection scheme, the smaller the increase: Monteveglio had had 58.7% in 2006 and had an increase of only 8.8% in 2008. Regarding municipalities with drop-off system, the highest recycling rates are 55.4% and 49.8%, which is still significantly lower than the lowest rates of 67.5% and 65.1% among municipalities with kerbside system. Clearly, the municipalities with drop-off system hardly exceed 50% recycling.

5.2 Recycling rates in three topographic regions

The Bologna province has three distinct topographic regions: mountains, hills and the plain. It is clear from Table 2 that the mountain municipalities have difficulties to achieve higher recycling rates. Difficulty of terrain, scattered houses, and related cost of infrastructure all affect recycling success. Statistically, the location accounts for 30% of the variation among the municipalities. Even though this constitutes a significant result in explaining the factors that contribute to the differences in recycling rates, this may be less relevant in proposing measures to increase the overall recycling in the Province, as these municipalities constitute only 8.6% of the population and less than that of the waste generated in the Province.

Table 2: Recycling rates per topographic region

Region	Number of municipalities	Population of the Province (%)	Weighed recycling rate (%)
Plain	29	79.1	37.2
Hills	10	12.3	48.0
Mountains	21	8.6	29.4
Total	60	100.0	37.9

6. Recycling practices in sample towns

6.1 Waste collection schemes

The results from 17 sample towns confirm topography to be an obstacle to achieving high recycling rates. In addition, infrastructure is difficult to organise in narrow streets of historic centres. Concerning the difference in recycling rates in 17 towns between the last two years, 13 have increased their rates, two have no change, while two have decreased: Argelato and Sasso Marconi, for very different reasons. Argelato faced a political crisis directly related to waste management, which affected citizens' recycling behaviour. Sasso Marconi reached an

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extremely high recycling rate of 76.2% in 2008 after the introduction of the kerbside collection scheme, due to "*an unexpected enthusiasm by the population*". After this initial stage, the citizens have gotten used to the new system and the recycling rate decreased to a "normal" level of around 70% in 2009, which is expected to be maintained in the coming years. Amongst the other towns, three achieved an increase of more than 10% between 2008 and 2009: Zola Predosa, Casalecchio and Pianoro. The first two introduced the kerbside collection for some recyclable materials, thus switching to a combined collection system. Pianoro however still uses a drop-off collection system, but introduced bins for organic waste in late 2008, which facilitated segregation of organic waste.

Table 3: Characteristics of the 17 sample towns

Town	Population	Topography	Recycl. rate in 2008 (%)	Recycl. rate in 2009 (%)	Difference (%)	Collection scheme	Separate collection of organic waste
Monteveglio	5261	Hill	67.5	72.0	4.5	Kerbside	Yes
Crespellano	9572	Hill	65.1	71.9	6.8	Kerbside	Yes
Sasso Marconi	14596	Hill	76.2	70.2	-6.0	Kerbside	Yes
Argelato	9580	Plain	71.8	61.0	-10.8	Combined	Yes
Zola Predosa	17760	Hill	41.4	52.5	11.1	Combined	Partially
S. Giovanni in P.	26679	Plain	49.0	50.3	1.3	Combined	Yes
Crevalcore	13456	Plain	49.8	49.8	0.0	Drop-off	Yes
Casalecchio di R.	35287	Plain	35.3	47.5	12.2	Combined	Partially
Bentivoglio	5030	Plain	47.2	47.2	0.0	Drop-off	No
Monghidoro	3922	Mount	41.6	45.0	3.4	Drop-off	Yes
Pianoro	17096	Hill	30.2	44.7	14.5	Drop-off	Yes
Medicina	16292	Plain	34.5	43.1	8.6	Drop-off	Partially
San Lazzaro	31034	Plain	37.6	42.0	4.4	Drop-off	Yes
Molinella	15618	Plain	28.8	31.6	2.8	Drop-off	No
Monzuno	6408	Mount	25.6	30.6	5.0	Drop-off	Yes
Bazzano	6820	Hill	23.1	30.0	6.9	Drop-off	No
Minerbio	8615	Plain	19.8	21.6	1.8	Drop-off	No

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Adoption of a kerbside collection scheme, even for only some of the materials, appears to be a significant factor for achieving high recycling rates in the Bologna Province. In particular, introduction of the separate collection of organic waste, constituting 20-25% of household waste by weight (Ministero dell'ambiente, 2004), gives a significant contribution for higher recycling rates. These results are in agreement with the work of Dahlen and Lagerkvist (2009) in Sweden who found that in an area with fairly uniform socio-economic conditions, recycling rates are higher in municipalities with a kerbside collection scheme. Still, in the Bologna Province the recycling rates in the towns with a drop-off collection scheme vary in a wide range from 20% to 50%. This difference needs to be explained by other factors.

It is interesting to note that, when asked whether there is a possibility to introduce a kerbside collection scheme, councillors gave answers that differed based on the recycling rate. The municipalities with a relatively high recycling rate above 45% were clearly more in favour of such a change than the ones with lower recycling rates. In these latter municipalities, councillors stated that there was an open opposition of the citizens to a kerbside scheme, which was the reason for them not to introduce this system in their municipalities.

6.2 Dissemination of information

All the key persons interviewed – councilors and managers of the waste companies – find dissemination of information important. The means deployed however vary largely from one municipality to another, as presented in Table 4 below. Leaflets / newsletters are deployed in all sample municipalities, followed by street advertising in over 80% (14 out of 17) municipalities. On the other end of the spectrum, none of the municipalities uses TV / radio, and very few use newspapers as communication tools. The main differences between best and worst performers appears to be in the use of direct contact with citizens, either in the form of public meetings, organised with the purpose of sharing information and discussing waste management issues with citizens, or staff going door-to-door to inform and instruct citizens about newly introduced recycling schemes. These findings confirm earlier research by Grodzinska-Jurczak et al. (2006) and Timlett and Williams (2007) that state that the use of door-to-door communication is the most effective to provide tailored information and detailed feedbacks on actual behaviours. Furthermore, the findings reaffirm the advice by Steg and Vleg (2009) to local authorities to not only inform and educate the public, but also to listen to them. This is confirmed by the citizens' responses to the survey questions regarding how much they assimilated and how much they remembered of the information shared. On the scale from zero to 4, the top two municipalities scored 3.14 and 3.31 respectively, versus 2.17 and 2.47 in the two worst performing municipalities.

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Equally, direct communication with primary school children emerges as an important discriminating factor among municipalities: recycling rates are higher in municipalities that have had campaigns tailored to schools children. In the top three performers, these campaigns include direct involvement of school children in recycling activities at school.

As one of the councillors pointed out, "*the involvement of pupils is not just important for their own education; it is also a means of reaching their parents, the adults. Children can be extremely persuasive and it is hard to say to them: No, I do not want to segregate waste.*"

Table 4: Information tools deployed in sample towns

Town	Recycling rate in 2009 (%)	Leaflet / newsletter	Street advertising	Teaching in schools	Public meetings	Staff door-to-door	Newspaper	Recycling in schools	Stall	Radio / TV
Monteveglio	72.0	X	X	**X**	**X**	**X**	X	X	-	-
Crespellano	71.9	X	X	**X**	**X**	**X**	X	X	-	-
Sasso Marconi	70.2	X	X	**X**	**X**	**X**	X	X	-	-
Argelato	61.0	X	X	**X**	**X**	**X**	-	-	-	-
Zola Predosa	52.5	X	X	**X**	**X**	**X**	-	-	-	-
S. Giovanni in P.	50.3	X	X	**X**	**X**	**X**	-	X	-	-
Crevalcore	49.8	X	X	**X**	**X**	**-**	-	-	-	-
Casalecchio di R.	47.5	X	-	**X**	**X**	**X**	-	X	-	-
Bentivoglio	47.2	X	X	-	-	-	-	-	-	-
Monghidoro	45.0	X	X	X	X	-	-	X	X	-
Pianoro	44.7	X	-	-	-	-	X	-	X	-
Medicina	43.1	X	X	X	-	-	X	-	-	-
San Lazzaro	42.0	X	X	X	-	-	X	-	X	-
Molinella	31.6	X	-	-	-	-	X	-	-	-
Monzuno	30.6	X	X	-	-	-	-	-	-	-
Bazzano	30.0	X	X	-	-	-	-	-	-	-
Minerbio	21.6	X	X	-	-	-	X	-	-	-

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6.3 Economic aspects

The analysis focused on three variables: charging system, charged amounts, and incentives. Until 2005, municipalities charged a tax that could have been used for any purpose. Since 2005, according to ATO5 decision, waste generators in the entire Bologna Province should be charged by a tariff that is determined based on the real costs of waste management, taking into account family size as well as the size of the house, and the people's behaviour, taking into account a pay-as-you-throw principle and rewarding recycling practices. Still, only six out of 17 sample municipalities have adopted this system, with a few in transition stage.

Table 5: Economic aspects of recycling in sample towns

Town	Recycling rate in 2009 (%)	Yearly expenditure per inhabitant (Euro)	Charging system	Monetary incentives	Material incentives
Monteveglio	72.0	124	Tariff	X	X
Crespellano	71.9	125	Tax	-	-
Sasso Marconi	70.2	127	Tariff	-	-
Argelato	61.0	125	Tariff	X	-
Zola Predosa	52.5	118	Tax	-	-
S. Giovanni in P.	50.3	120	Tariff	X	-
Crevalcore	49.8	119	Tax	-	-
Casalecchio di R.	47.5	111	Tax	-	-
Bentivoglio	47.2	N.A.	Tax	X	-
Monghidoro	45.0	153	Tax	-	X
Pianoro	44.7	129	Tax	X	-
Medicina	43.1	120	Tariff	X	-
San Lazzaro	42.0	N.A.	Tax	X	-
Molinella	31.6	115	Tax	-	-
Monzuno	30.6	148	Tax	-	-
Bazzano	30.0	132	Tariff	-	-
Minerbio	21.6	116	Tax	X	-

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Regarding the charging system, better recycling performance seems to be related to the tariff system, where citizens' behaviour is rewarded. As opposed to this, recycling rates are statistically independent from expenditure per inhabitant (correlation coefficient -0.088).

The interviews revealed that some municipalities have had economic incentives in place ever since 1996 to stimulate citizens to segregate their waste and participate in recycling schemes provided. None of the sample municipalities has recently adopted or abandoned such incentives. Monetary incentives include a reimbursement of either 10% or 15 Euro on the yearly waste bill if citizens bring more than a certain amount of recyclables to SEA; or a discount of either 10% or 25% in the bill if citizens practise composting at home. Two of 17 sample municipalities give recycling-related gadgets to citizens who bring certain amount of recyclables to SEA. Even though the councillors interviewed reported enthusiastic responses by their citizens and assumed positive effects, this study found no effect of these incentives on the recycling behaviour of the citizens in the sample municipalities.

6.4 Citizens' reported behaviours, internal and external factors

Among the factors specified in the extended Ajzen's model shown in Figure 1 above, personal context of gender, age, education level, employment, housing typology (flat v. detached house with garden) is included in the questionnaire for completeness rather than as a direct source of information. This information could have probably been obtained for the entire population from the official municipal records and correlated with the recycling rates but the time did not allow for this to be included in the study. Here, the results are presented on the citizens' reported recycling behaviour, their attitudes and norms and values.

As usually the case, the reported frequencies with which people segregate their waste at home and at work do not correlate with the actual recycling rates achieved. Most respondents find themselves to be good recyclers (the answer associated with the score of 3 is "often"). Within the given range of scores, particularly the citizens of Minerbio, which has a recycling rate of only 21.6%, considerably overestimate their recycling efforts.

Notwithstanding the above, the responses pertaining to the reported recycling behaviour at work reveal less frequent recycling than at home. Respondents explained this by the lack of separate bins in working places.

In contrast to the reported behaviour, citizens' attitude toward recycling shows a correlation with their actual behaviour (correlation coefficient of 0.847). The results obtained here also confirm the findings of earlier studies (e.g., Barr et al., 2001 and 2003) that the correlation is present but a whole array of other factors influences the behaviour as well. Illustrative is the

case of Argelato, in which, despite a very high recycling rate of 61%, the attitude is lower than in most other towns due to the recent political crisis centred around waste management. Internal factors such as personal norms and values show a weak correlation (correlation coefficient of 0.584). Nevertheless, there is some difference between the municipalities at the top and at the bottom of the list: on the scale from zero to 4, the top two municipalities scored 3.10 and 3.08 respectively, versus 2.80 and 2.80 in the two worst performing municipalities. Monghidoro is a outlier, with its seemingly modest recycling rate of 45% and high score on norms and values of 3.11. But its situation can be better understood by taking into account that its recycling rate is the highest of all mountainous municipalities in the Bologna Province, which have topography against them to provide adequate infrastructure. Local authorities and community take pride in their recycling achievements, which may explain their high score in norms and values.

Table 6: Citizens' reported behaviours, internal and external factors in sample towns

Town	Recycling rate in 2009 (%)	Recycling at home [2]	Recycling at work [1]	Attitudes, concerns and awareness [10]	Norms and values [11]	Social influence [8]
Monteveglio	72.0	2.94	1.83	3.03	3.10	3.22
Sasso Marconi	70.2	3.07	2.06	3.13	3.08	3.15
Argelato	61.0	2.76	1.80	2.87	2.84	2.86
S. Giovanni in P.	50.3	2.88	1.94	3.08	3.16	2.85
Crevalcore	49.8	2.99	1.99	2.90	3.06	2.77
Monghidoro	45.0	2.85	1.80	2.93	3.11	2.86
Monzuno	30.6	2.49	1.88	2.73	2.80	2.19
Minerbio	21.6	2.89	1.90	2.42	2.80	2.90

* The number between brackets denotes the number of questions posed.

Of all the factors examined, the external factor of social influence is found to have the highest correlation with recycling rate (correlation coefficient of 0.889). Visibility of kerbside recycling scheme, where neighbours can actually see each other's waste on the street, contributes to the high influence of social pressure. Interestingly, no correlation is found between social influence and population density. Thus, sample municipalities do not show "cul-de-sac effect" in narrow, densely populated streets (Shaw, 2008).

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6.5 Perceived barriers and facilitators

The efforts by the authorities can be seen both as an external factor that influences citizens' intentions to recycle and as a barrier or a facilitator that influences whether an intention will result in behaviour. Some correlation is found with recycling rates (coefficient of 0.870 without Argelato). However, while it is true that the scores are lowest in the two municipalities with lowest recycling, the highest scores are not reached in the municipalities with the best recycling. Rather, respondents gave the highest scores to the authorities' efforts in municipalities with the most recent developments: Sasso Marconi and San Giovanni in Persiceto both score higher (3.61 and 3.49 respectively) than the best recycling performer Monteveglio (3.18), which introduced kerbside recycling scheme already in 2005. The outlier Argelato shows that citizens do not appreciate the efforts if they are put in an atmosphere of political battle around waste issues. The results are similar regarding a related issue – the perceived efficacy of the scheme (coefficient of 0.840 without Argelato).

Table 7: Percieved barriers and facilitators in sample towns

Town	Recycling rate in 2009 (%)	Efforts by the authorities [2]	Ease of segregation [5]	Efficacy of the scheme [4]
Monteveglio	72.0	3.18	2.83	3.49
Sasso Marconi	70.2	3.61	2.76	3.37
Argelato	61.0	2.35	2.32	2.03
S. Giovanni in P.	50.3	3.49	2.99	3.33
Crevalcore	49.8	3.12	2.94	3.40
Monghidoro	45.0	2.92	2.92	3.02
Monzuno	30.6	2.37	2.85	2.21
Minerbio	21.6	2.11	3.00	2.60

* The number between brackets denotes the number of questions posed.

Concerning the perceived ease of segregation, somewhat surprisingly, no significant differences are found among the sample towns, regardless of their recycling rates – they all score in a narrow range between 2.76 and 3.00, except for Argelato that has a score of 2.32. It is not clear what makes the towns so close in terms of perceived difficulty (or ease) of segregation practices. A kerbside collection scheme is reported to require a higher degree of

effort by residents than a drop-off scheme (Tucker and Speirs, 2003) but this is not validated in our study. Some of the councillors interviewed offered an explanation that in many municipalities "*the concern for environmental issues is probably grown along with the recent implementation of the kerbside collection*".

7. Conclusions

The Bologna Province municipalities have put considerable efforts to implement European legislation and increase recycling rates in the recent five years. With an average increase of 10% across the Province's 60 municipalities in the last year, some municipalities have achieved dramatic increase from less than 20% to over 70% in the same short period.

Based on the findings of this study, this has been done mainly by introduction of kerbside (door-to-door) collection of recyclables and organic waste, accompanied by intensive and direct communication with the citizens and schools.

Municipalities with a kerbside waste collection reach and exceed recycling rates of 70%. Where the scheme is combined (door-to-door in some parts and drop-off in other parts of the municipality) the results are around 50-55%. The towns that are using the traditional drop-off collection system have recycling rates ranging from 20 to 50%, with a median value of around 35%. The high recycling results of kerbside collection have been enabled by adequate information and communication campaigns. While all sample municipalities deployed leaflets, newsletters and street advertising, the best recyclers also opted for public meetings, personal door-to-door communication by their staff, as well as teaching in schools accompanied by recycling projects with pupils. Somewhat surprisingly, this study did not validate findings of earlier research that kerbside collection requires more effort from citizens. Or the citizens in our study did not mind the additional effort as the enthusiasm raised in information and communication campaigns has compensated for that.

The study revealed importance of an additional – unintentional – effect of kerbside collection scheme. Its visibility in the neighbourhood becomes a strong means of social influence on recycling behaviour. Regarding other factors that are within the reach of the authorities, a charging system comprising a tariff related to the family size, house size and recycling behaviour seems to encourage recycling.

An important determinant of the success of the recycling efforts is the topography of the terrain – the best recyclers among mountain towns reach just about 45% recycling rates. However, this is not to say that the worst performers are in the mountains – they are equally spread over the mountains, hills and the plain of the Bologna Province. This is to say that topography cannot be used as an excuse for poor recycling results.

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