L'effetto del turismo sui rifiuti solidi urbani nelle province italiane

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Ravenna 2015, 20 maggio 2015

Outline

- We have investigated the heterogeneous municipal Waste Management and Disposal (WM&D) systems in Italy in 1999 and 2012
  - is it just a North-South divide that mainly explains the heterogeneous municipal WM&D systems?
- Is tourism an important driver of local waste generation and waste management choices?
- Our empirical analysis is based on **principal components analysis** and **cluster analysis** of a set of WM&D indicators of the **Italian provinces**
  - It is a descriptive-dynamic study that analyses the aggregation process of Italian provinces in similar "economic and institutional waste models"

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Contribution of the paper

- Existing literature mostly based on:
  - drivers for households' waste related behaviour (Hage-Soderholm 2008)
  - effectiveness of waste reduction policies (De Jaeger-Eyckmans 2008)
  - analysis of local 'hot spots' (Pasotti 2009-2010 for Naples)
  - positioning of waste disposal infrastrucure (Jenkins et al., 2004)
  - illegal dumping (Fullerton-Kinnaman 1995)
- only a few studies analyse the tourism-waste relationship (Maldives, Nepal, Taiwan, Crete, Spain etc.)
- Clustering WM&D performances (1999-2012) - Why?
  - to identify homogeneous areas and their dynamics
  - to identify plausible transitions
  - to identify specific policy efforts for laggard areas
- The clustering technique is able to highlight non-evident provinces' aggregation patterns
  - relevant applications in regional economic development, land-use change dynamics, agriculture

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Waste and tourism

- Environmental quality is one of the main inputs of tourism competitiveness (Bramwell 2004, Bardolet and Sheldon, 2008) and tourism can sustain high levels of employment and income, but the sector itself creates pressures on environment:
  - generation of municipal solid waste
  - pollution costs and congestions costs mainly due to transport issues and transport facilities (especially in urban destinations)

Waste generation drivers

- the absolute and per capita amount of waste and the share of separately collected waste depends on several factors:
  - income
  - household consumption habits
  - waste collection facilities
  - household collection behaviour
  - households size
  - population density
  - TOURISM

The Context in Italy

- Waste crises:
  - Naples (and Campania in general), Palermo, Rome, Calabria
- may be due to delays (or lack) in introducing:
  - more economically-oriented instruments (es. pays as you throw or similar systems, waste tariff instead of waste tax)
  - new and diversified tools in WM&D facilities (separated collection facilities, door to door, other disposal methods (e.g. Mech-Bio-Treatment instead of landfilling and incineration)).

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Waste management and disposal in the Italian provinces

- The **current opinions** suggest that there is a **North-South divide** in Italy for what concern income and several socio-economic aspects
- For waste:
  - strong heterogeneity in separate collection
  - different waste management (adoption of waste tariff (instead of tax))
  - different tourist pressures
  - different disposal opportunities and choices

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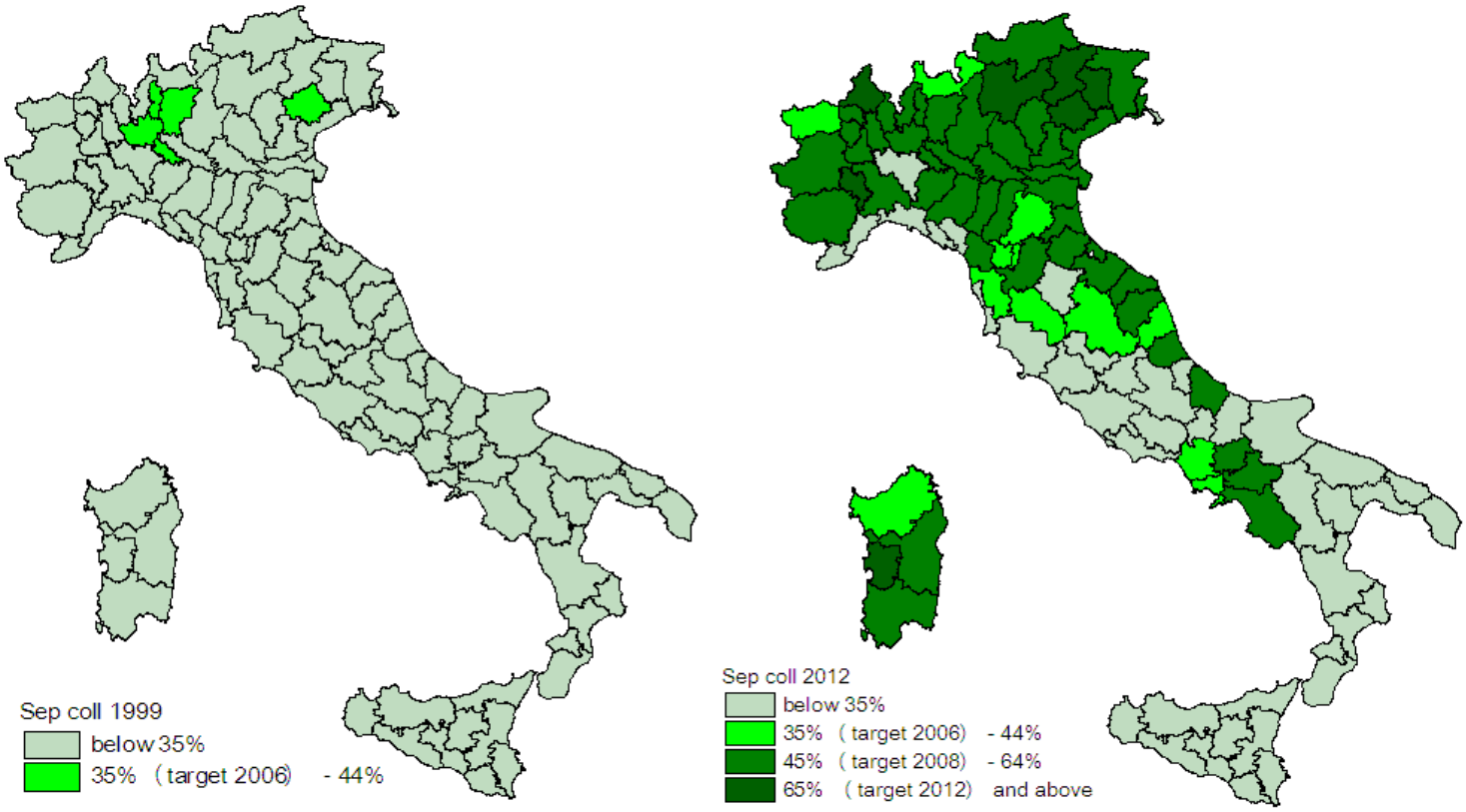
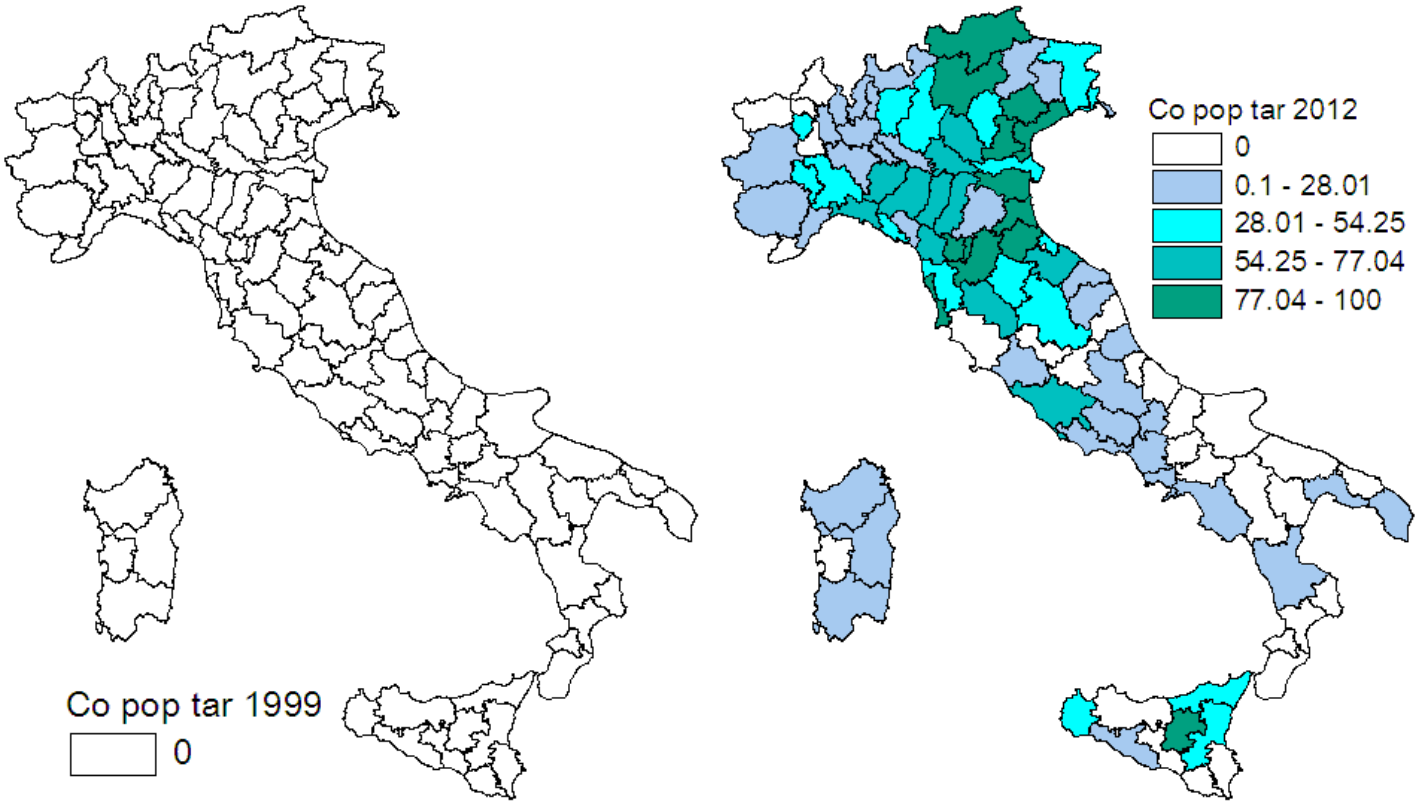
Heterogeneity in separate collection

Figure: Separate collection of waste (1999 and 2012)



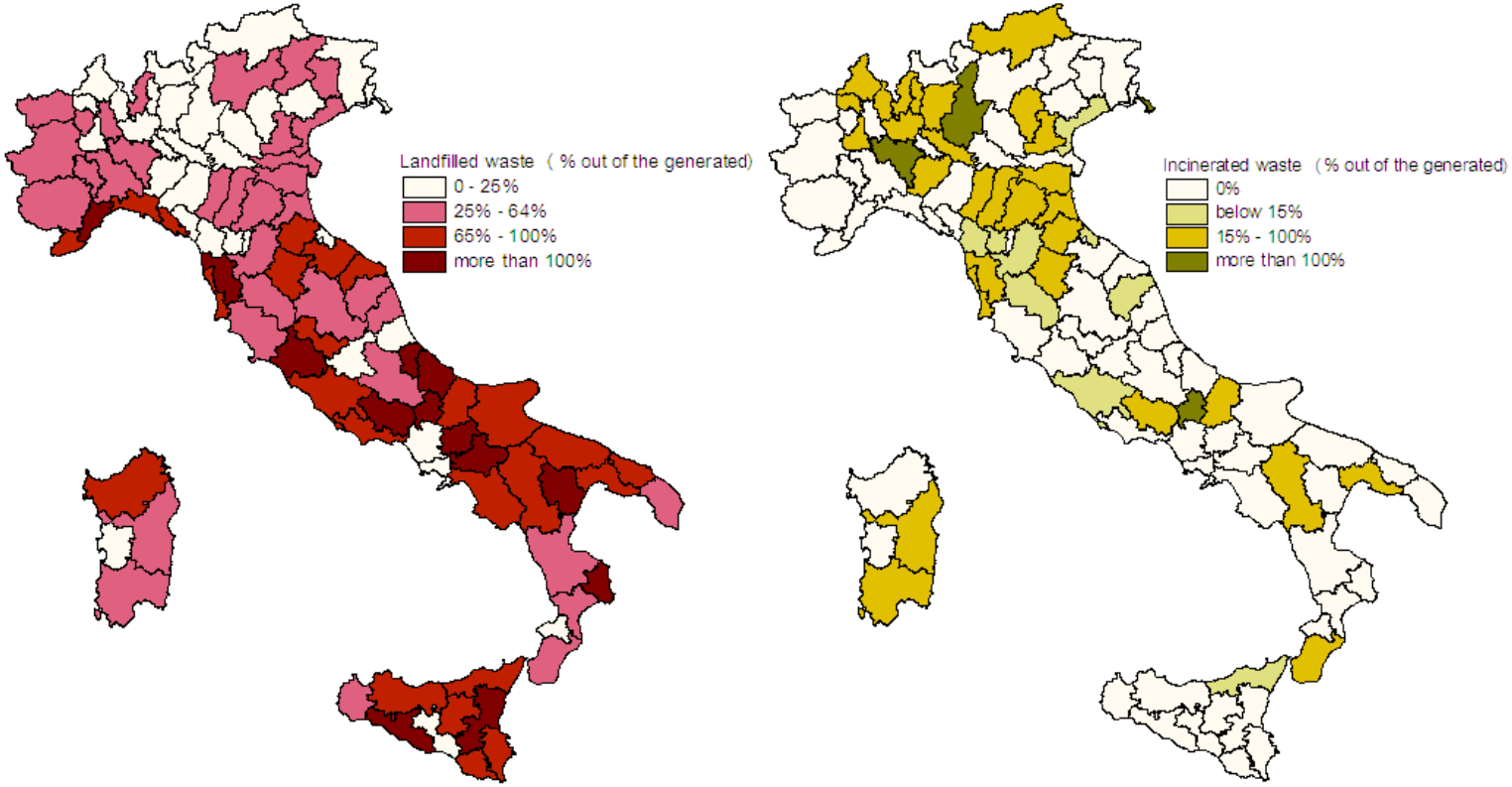
Different diffusion of waste tariff

Figure: Waste tariff introduction (1999 and 2012)



Different disposal choices

Figure: Landfilled and incinerated waste share (2008)



Our approach

A two-steps multivariate analysis

- Step I: Principal Components Analysis
  - to identify non correlated components
  - the number of principal components selected represents almost 3/4 of the overall variability
- Step II: Cluster Analysis (to identify clusters on the first-step principal components)
  - hierarchical procedure to identify the optimal cluster number (pseudo-F, CCC, pseudo-T^2)
  - non-hierarchical (k-means) aggregation procedure with the optimal cluster number as exogenous data
- Cluster profiles and Maps, two years (1999 and 2012)

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The Data

- **ISPRA** National environmental agency waste reports (waste reports): waste generation, landfilling and incineration by province
- **ISPRA** separate collection by province
- **ISPRA** tax or tariff adoption by province
- **ISTAT** tourist overnight stays by province
- **Ministero dell'Interno** electoral participation by province
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A simple indicator to measure the tourist pressure on waste generation

- Very often the MSW generation is measured in per capita term
- But, regular residents don't take into account:
  - overnight tourists
  - irregular residents
  - daily tourists
  - restaurants, bars, small shops
- Some studies, as we indicate in the paper, analyse the tourists overnight stays contribution to waste generation considering that the dynamics of municipal solid waste generation, especially in seasonal tourist areas, is affected by the addiction of a significant amount of equivalent population/inhabitants during a few months.

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- A few studies deal with the understanding of the added amount of waste generated by tourist population in specific tourist destinations but most of them dont take into account the difference between regular resident population and equivalent population
- The difference between the waste generated per resident (annual waste generated divided by the number of regular residents) and the waste generated per equivalent inhabitant (regular residents plus yearly tourist overnight stays divided by 365) represents the amount of waste that each yearly overnight tourist **add** to the waste generated by each regular resident

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A simple measure of Tourist MSW generation

Addition of tourist waste generation to regular resident

$$Eq\ inh_i = \frac{Ts_i}{365}$$

where Ts_i is the yearly overnight stays figure in the province i

$$MSWgap = \frac{TotMSW_i}{residents_i} - \frac{TotMSW_i}{residents_i + Eq\ inhabitants_i}$$

A simple indicator to measure the tourist pressure on waste generation

- This difference, thus, may be potentially bigger, where many overnight tourists, daily tourists and/or irregular residents are present and correctly inserted in the analysis
- or smaller if they are not accounted for or if they are not present in the considered area

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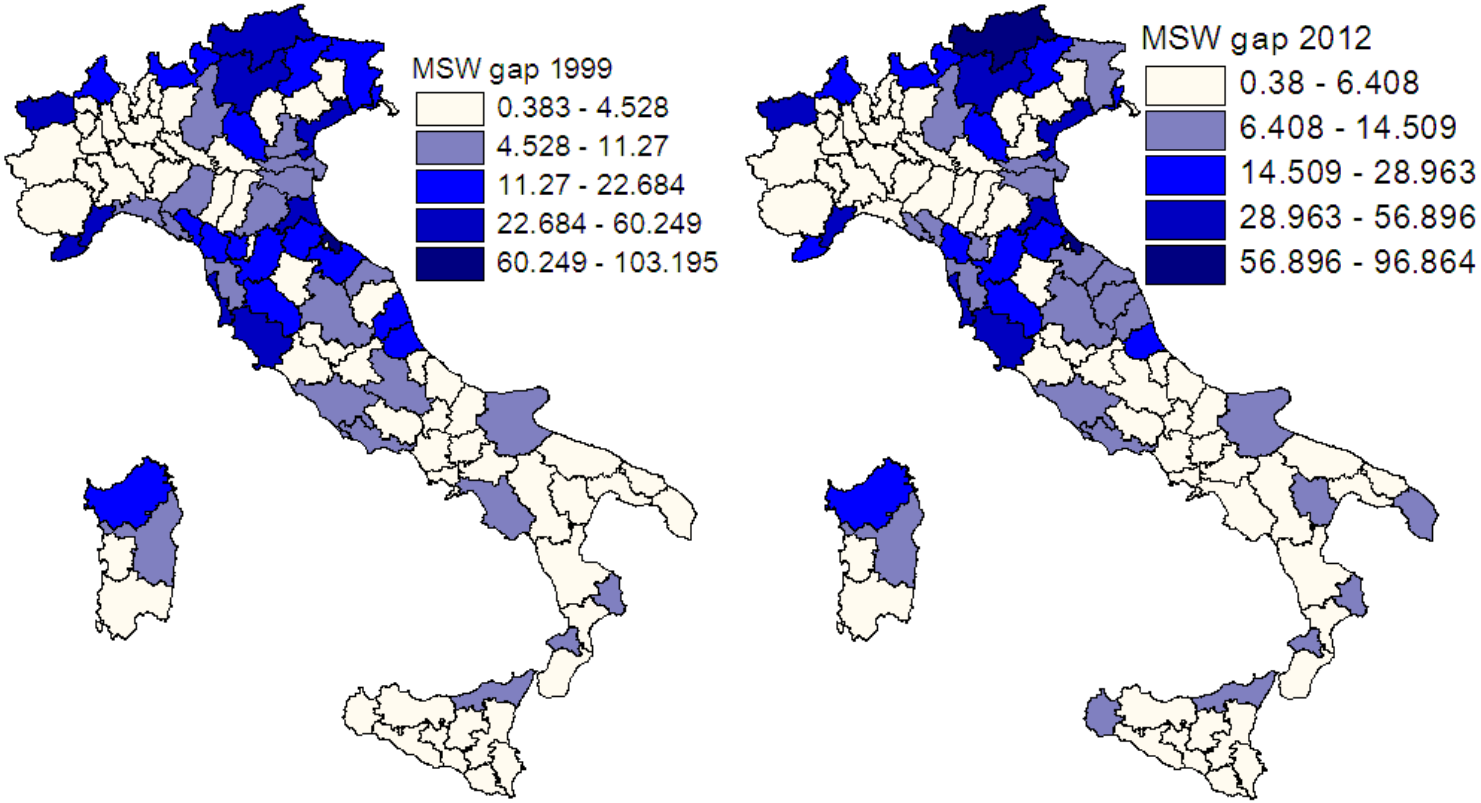
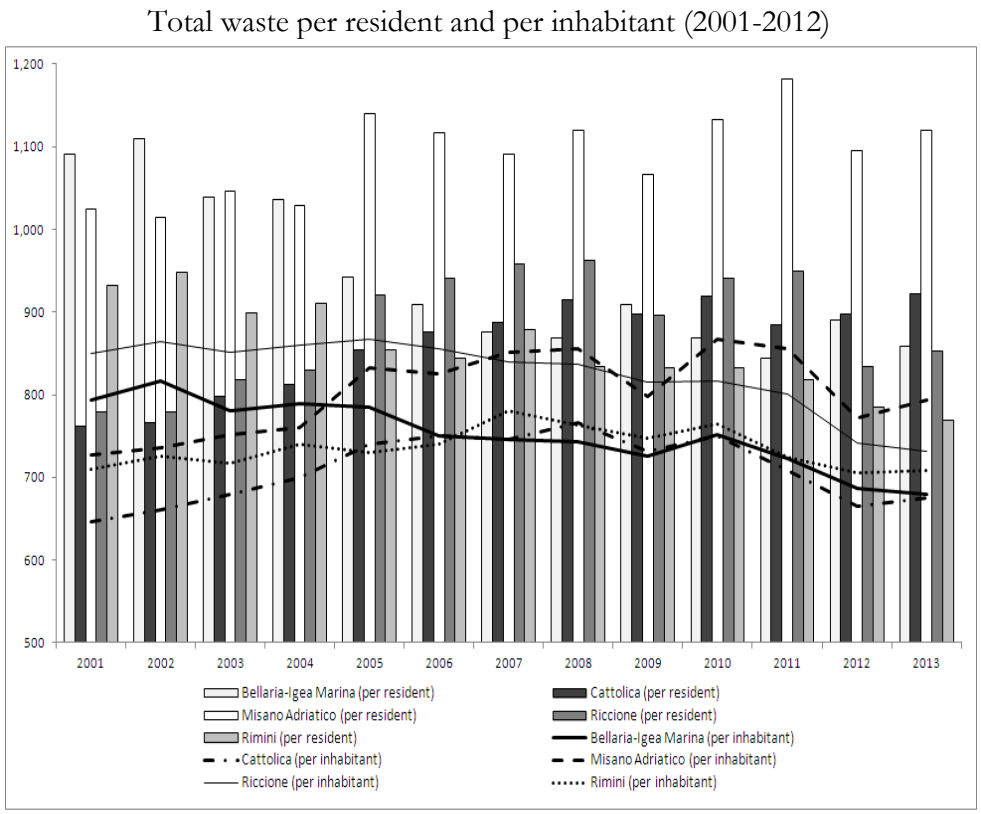
Different tourist pressures on per-resident MSW waste

Figure: Tourist pressure (1999 and 2012)



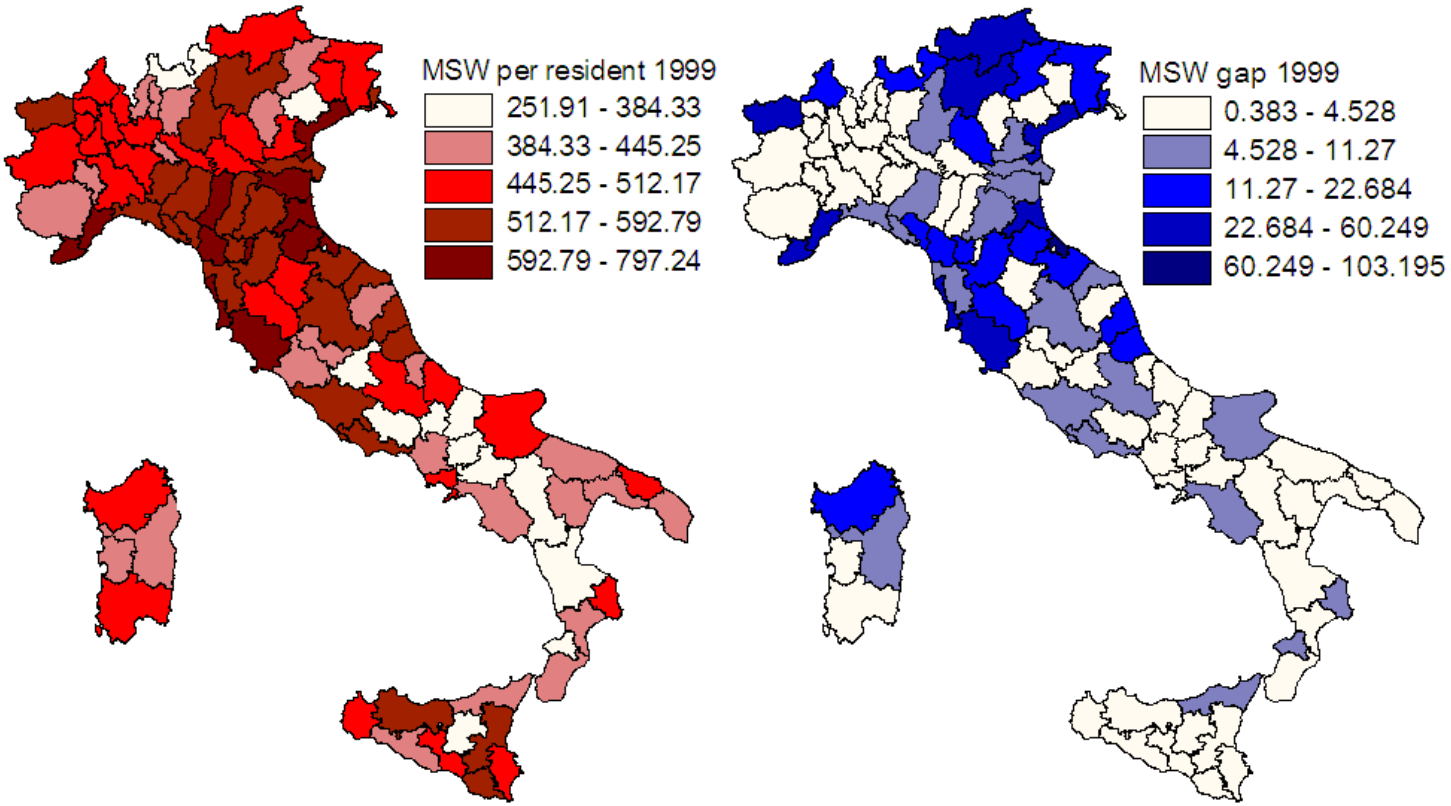
Different tourist pressures in some municipalities

Figure: Tourist pressure in 5 coastal municipalities (Rimini province)



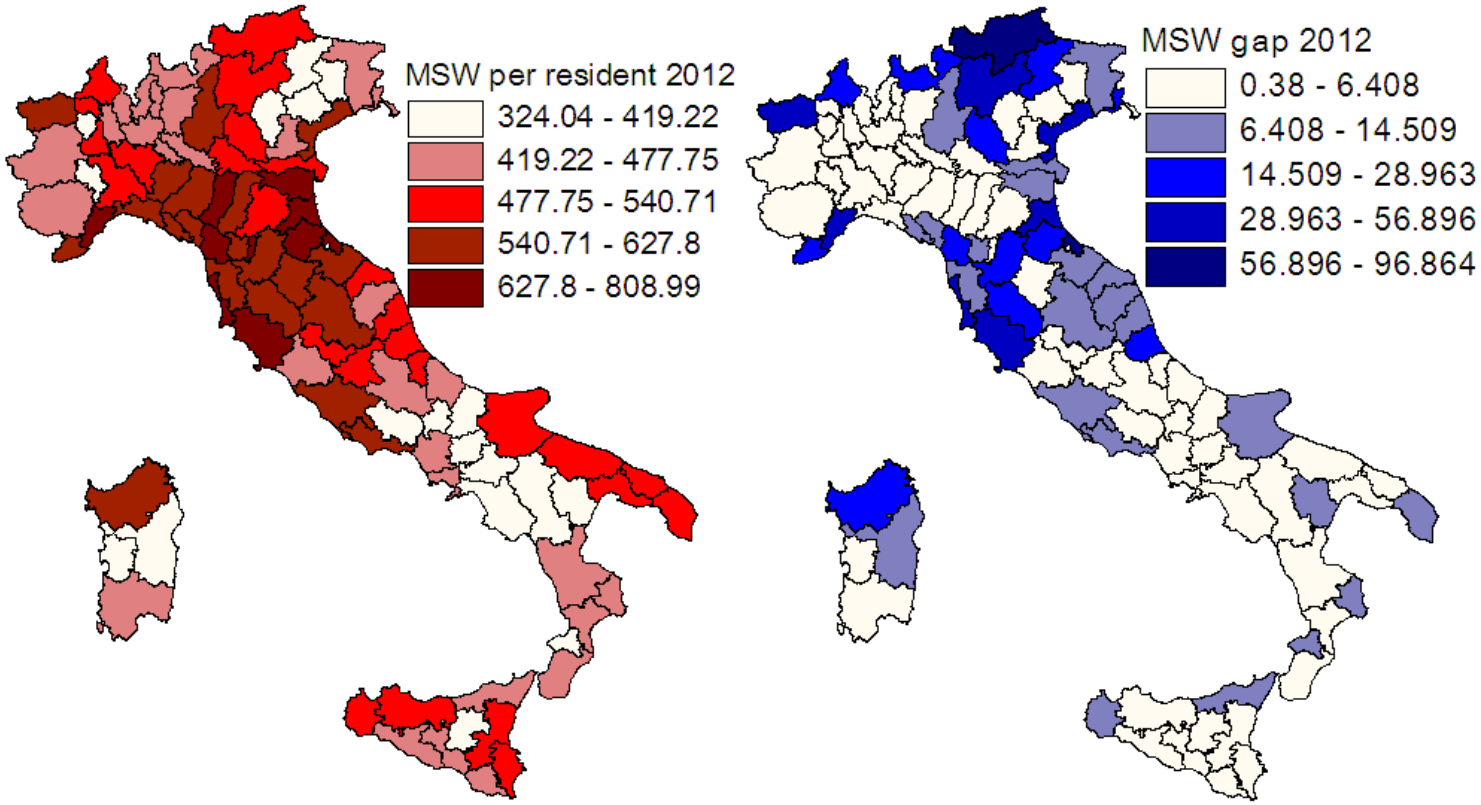
Different per capita MSW and tourist pressures 1999

Figure: MSW kg per resident and tourist pressure (1999)



Different per capita MSW and tourist pressures 2012

Figure: MSW kg per resident and tourist pressure (2012)



Top 10 provinces in Italy by waste generated

Figure: Top 10 provinces by per resident MSW 2012 (kg)

Province	MSW_xres	MSW_GAP
Rimini	808.99	96.86
Forlì-Cesena	734.60	25.84
Ravenna	717.54	30.85
Reggio Emilia	702.92	**2.31**
Livorno	694.48	43.67
Prato	675.64	**3.83**
Grosseto	666.65	41.24
Savona	655.17	32.00
Lucca	651.81	16.12
Ferrara	646.48	12.57
Italy	504.46	

Top 10 touristic provinces in Italy

Figure: Top 10 provinces by MSW gap 2012 (kg)

Province	MSW_gap	MSW_xres
Rimini	96.86	808.99
Bolzano	66.38	**482.36**
Venezia	56.90	573.24
Livorno	43.67	694.48
Grosseto	41.24	666.65
Aosta	38.79	604.92
Trento	37.32	**498.92**
Savona	32.00	655.17
Ravenna	30.85	717.54
Siena	28.96	583.07
Italy		504.46

Our empirical analysis

- **The clustering processes**
- Waste Generation, waste disposal and tourist indicators (only) (10 variables) + waste tariff adoption indicators (2 variables)

- **Clusters' profiles**
- the same variables above + electoral participation and population density variables

- **Optimal clusters' number**
- 4 clusters, both in 1999 and 2012

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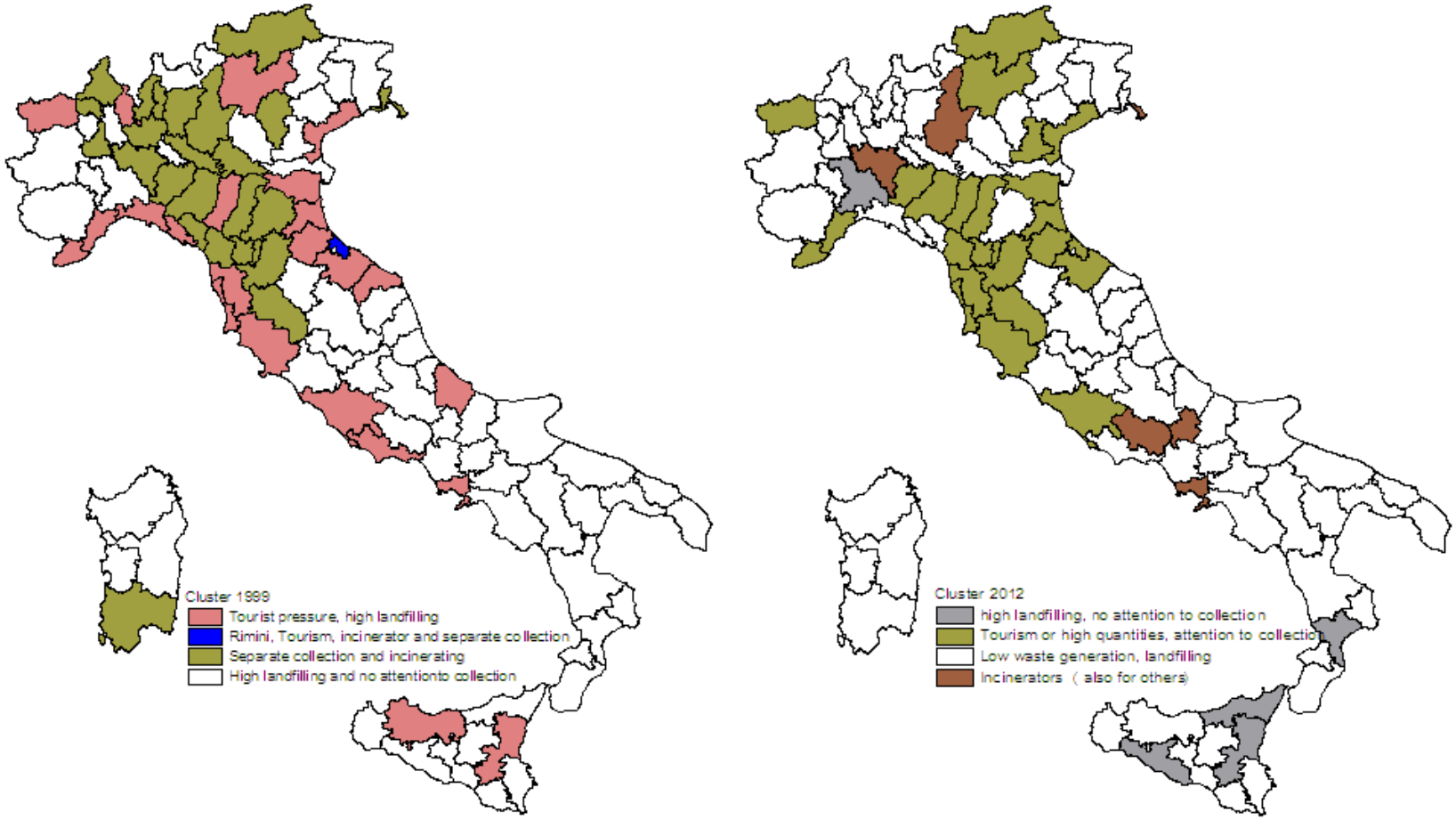
Map (waste management and disposal systems when tourism is considered)

Figure: Clusters, 1999 and 2012



Clusters profiles

Figure: Clusters profiles 1999

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Per resident MSW (kg)	574.8	797.2	513.9	434.2
Separately collecte MSW (%)	11.7	17.3	22.2	7.3
Per resident Landfilled MSW (kg)	619.7	0	155.8	355.2
Per resident Incinerated MSW (kg)	35.5	386.9	113.9	8.1
Incinerated MSW per incinerator (t)	13184.8	105235.2	52319.7	2801.4
Landfilled MSW per landfill (t)	109428.3	0	31930.4	41102.9
Landfilled MSW (%)	107.7	0	30.1	82.5
Incinerated MSW (%)	5.7	48.5	23.5	1.9
Municipalities with tariff (%)	0	0	0	0
Population in Municipalities with tariff (%)	0	0	0	0
Per *equivalent* inhabitant MSW (kg)	557.2	694	504.9	429.6
MSW gap (kg)	17.6	103.2	9.1	4.5
Population density (resident x kmq)	349.1	509.6	328.1	155.9
Voters (%)	83.8	87.7	85.4	79.2
Municipalities (no.)	23	1	25	54

Clusters profiles

Figure: Clusters profiles 2012

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Per resident MSW (kg)	484.6	622.5	464.3	474.9
Separately collecte MSW (%)	20.5	46.1	41.1	28.1
Per resident Landfilled MSW (kg)	924.1	237.1	154.1	203.1
Per resident Incinerated MSW (kg)	0	122.6	35	591
Incinerated MSW per incinerator (t)	0	52709.3	19186	329151.7
Landfilled MSW per landfill (t)	289183.6	46289.3	43542.5	48212
Landfilled MSW (%)	192.8	37.4	32.1	48.3
Incinerated MSW (%)	0	19.5	7.8	127.7
Municipalities with tariff (%)	21.2	45.8	8.9	7.6
Population in Municipalities with tariff (%)	27.5	66.7	17.3	11.5
Per *equivalent* inhabitant MSW (kg)	480.6	596.8	458.2	470.5
MSW gap (kg)	4	25.8	6.1	4.4
Population density (resident x kmq)	184.1	242.2	217.3	725.3
Voters (%)	67	79	73.9	75.4
Municipalities (no.)	5	25	67	6

Summing up

- We have analysed the aggregation of Italian provinces depending upon Waste Management and Disposal features considering tourism pressure too
- "(WM&D) Models" are changing (1999-2012)
  - reduction of landfilling
  - diffusion of the waste tariff
  - reduction of waste generation also with tourism pressure
  - strong role of the tariff and of the high results in the separated collection (in the observed gaps)
  - investing more in incineration (and other innovative waste disposal methods) could further differentiate good models
- The overall success of the decentralised system could be higher (2012: 67 provinces in the laggard cluster)

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- Our findings may help in the planning of waste management infrastructures and waste collection services in tourist areas where per resident or per equivalent inhabitant waste figures are very high
- Moreover the results suggest:
  - (i) that appropriate waste policy and virtuous population behaviors can reduce the environmental pressure of waste also in important tourist areas (Bolzano and Trento)
  - (ii) that irregular residents, and not only bad behaviors, could be an important hidden issue to be considered and discovered when appropriate per capita (per regular resident and per equivalent inhabitant) waste figures are analysed (e.g. Reggio Emilia and Prato, two densely populated provinces by irregular migrant workers and about negligible tourist overnight stays figures)

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  - (ii) that irregular residents, and not only bad behaviors, could be an important hidden issue to be considered and discovered when appropriate per capita (per regular resident and per equivalent inhabitant) waste figures are analysed (e.g. Reggio Emilia and Prato, two densely populated provinces by irregular migrant workers and about negligible tourist overnight stays figures)

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Limitations and further research

- further analyses:
  - the residents can be tourists too
  - do tourists care about the proper waste collection? (local data show they care less)
  - are the restaurants, small shops and bars the main responsible?

Do tourists care about the proper waste collection?

Figure: Separate collection in summer and winter (coastal and non coastal municipalities, Rimini province)

Total waste generated in the Rimini province (kg per day, 2012)

	waste per resident (summer months)	waste per inhabitant (summer months)	waste per resident (rest of the year months)	waste per inhabitant (rest of the year months)
All municipalities	2.43	1.03	1.86	1.55
separately collected waste %	*56.05*		*61.22*	
Coastal municipalities	2.77	0.94	1.96	1.53
separately collected waste %	*55.48*		*61.59*	
Non coastal municipalities	1.65	1.58	1.63	1.60
separately collected waste %	*58.23*		*60.21*	

Thanks

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