



Territorial vulnerability and local conflicts perspectives for waste disposals siting. A case study in Lombardy region (Italy)



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ABSTRACT

The interactions between economic activities and environmental quality is a field of research deeply explored since the second half of last century due to a growing public awareness about negative impacts of human actions on landscape. As shown by the large number of local communities' oppositions to the development of waste disposals, energy technologies and transport infrastructures, the loss in ecological value of environmental resources and the resulting decrease of human wellbeing are the most relevant concerns of opponents.

Within this context, the paper explores the existence of a relationship among territorial vulnerability and local controversies emerged around the localization of new facilities, in order to provide decision-makers with an analytical tool for siting controversial facilities. The research has been developed according to four different phases: 1) the assessment of territorial vulnerability and the development of a Vulnerability Index (VI); 2) the introduction of supervised Artificial Neural Network (ANN) with the aim of weighting the VI criteria; 3) the analysis of intensity and spatial distribution of local oppositions and the development of the Local Conflict Index (LCI); 4) the investigation of oppositions against waste disposals. The analysis has been carried on the Lombardy region (Italy) since it shows the highest number of oppositions in the country.

The results show that the synthetic territorial vulnerability assessment combined with the analysis of local conflicts could effectively be used for improving decisions about new facilities siting. The oppositions against waste disposals are relevant but mostly not directly linked to the territorial vulnerability.

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1. Introduction

The difficult balance among quality of life improvement and industrial development represents a crucial question for sustainable regional planning. In the last ten years local conflicts against waste disposals, energy technologies and transport infrastructures have been growing more and more. Conflict, in the definition given by Torre, is an opposition marked by an engagement between several actors or parties of the conflict, in relation to a logical material object (Torre et al., 2014).

There are several forms of local conflicts. Currently, there is a sort of assenting to an increase both in terms of quantity and quality (for radicalism and effectiveness) of local communities oppositions'

against the development of facilities and infrastructure projects. A mitigation of these oppositions will positively affect the development making it more environmentally, socially and economically sustainable (Yang et al., 2014).

The type of conflict that is going to be discussed is called NIMBY (Not In My Back Yard), a reaction against the decision-making processes arising from the construction of facilities and infrastructure projects considered by the local communities as polluting or potentially dangerous.

The NIMBY syndrome recognizes the usefulness of the infrastructures against which it protests, but does not want them to be constructed on its own community. Individuals oppose the development of a project to maximise their own individual utility by considering costs – that mostly burden on the hosting community, as loss in value of properties in the neighbouring area, environmental damage or potential risks on human health (Capolongo et al., 2011; Buffoli et al., 2012; Fehr and Capolongo, 2016) – and benefits that are largely diffuse.

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When social benefits are limited or uncertain, the probability of occurrence of the NIMBY phenomenon is higher because the total benefits enjoyed by a community is less than the sum of the disutility that it has to bear (Wittmer et al., 2006; Schively, 2007). The lower the perception of distributive justice, the greater the public attitude against facilities siting.

In Italy the phenomenon of NIMBY is monitored by the NIMBY Observatory, which edits a national database of infrastructure projects that undergo opposition. Through the monitoring of the media both printed or electronic the observatory figures an inventory of public works and industrial plants covered by the NIMBY protests and defines an annual report to maintain updated the national database. By monitoring the press, all disputes are surveyed according to the different sectors (energy, waste disposal, infrastructure, etc.) and type of protesters involved.

The motivations that determine the conflict and opposition from local communities are manifold: the possibility that infrastructures and plants have a harmful impact on the environment or human health; the lack of information or participation to decision making processes; the possibility that the infrastructures and plants are a source of illicit economic interests; feeling of injustice among the population.

Within this context, the paper defines a methodology aimed to support decision making processes regarding controversial facilities siting by a combined analysis of territorial vulnerability and intensity of local conflicts, targeted at Lombardy region case study.

Since the higher number of oppositions has been detected in the regions where urbanization and infrastructure development is high, exploring the existence of a potential relationship among territorial vulnerability and the arise of oppositions seems to be a promising research perspective.

This paper is divided into four sections. The first describes the analytical framework of territorial vulnerability and local conflicts evaluation. Two different multidimensional indexes have been defined: the Vulnerability Index (VI) based on environmental and socio-economic criteria for providing a synthesis of territorial strengths and weaknesses; and the Local Conflict Index (LCI) for assessing the relevance of communities oppositions against infrastructures and plants. In order to assign weights to the VI criteria and to predict the occurrence of local controversies, given a certain degree of territorial vulnerability, Artificial Neural Networks (ANN) have been introduced. These indexes have been applied to the municipalities of Lombardy region. The second section points out and discusses the outputs of the previous analysis, the third

summarizes the main insights emerging from the case study and the fourth draws up final considerations and the future developments of the research.

2. Material and methods

The analysis of territorial vulnerability has been performed at the municipality level, in order to highlight the variability of possible determinants of local oppositions. Since environmental impacts are considered as the main reasons behind NIMBY syndromes, as surveyed by the Italian Permanent Media Observatory of Nimby Forum (Nimby Forum, 2012), the basic assumptions on which is based the proposed methodology are the followings i) conflicts against plants and infrastructures arise where the territorial vulnerability value is high; ii) territorial vulnerability is measured for each of the municipalities of the Lombardy region, that is one of the most developed Italian regions, in order to verify the degree of environmental, social and economic weakness of all the opponent municipalities, those who don't host plants included.

As abovementioned, the Vulnerability Index (VI) has been defined according to an analytical framework divided into thematic areas that reflect the three main dimensions of sustainability (Environmental, Social and Economic), which in turn are described by specific set of criteria, measured by indicators (Tables 1 and 2).

A first analysis of territorial vulnerability has been recently proposed in 2015 by Oppio et al. (Oppio et al., 2015) through the use of a multidimensional index defined by Toro (Toro et al., 2011) and applied at the province level. Differently from this first case study, the variables describing territorial vulnerability has been selected with the aim of paying more attention to social and economic aspects, typical of Italian context and based on data available at the municipalities level.

The environmental dimension is divided into the following criteria, reflecting those aspects whose presence should be considered critical for plants and infrastructures localization: Protected Areas (PA), Air Pollution (AP), Water Pollution (WP), Weak Areas (WA). Similarly, the social and economic criteria have been selected. The social dimension is described by the presence of listed buildings (CH), schools (Sc), foreigners (Imm) and the population's average age, weighted by the amount of population in each age group (AA). The economic aspects are represented by per capita incomes (PcInc), active companies (Bs) and workers, both in the private (Ws) and in the public field (PWs).

Table 2 shows the mean, minimum and maximum value for each

Table 1
Analytical framework of Vulnerability Index.

Topics	Criteria	Acronyms	Indicators	Unit of measure	Sources	Years
Environment	Protected areas	PA	Areas under protection	Kmq	Centro flora autoctona (Lombardy region)	2008
	Air pollution	AP	Air quality index	N°	ARPA lombardia: Regional agency for environmental protection	2011
	Water pollution	WP	Sewage treatment channelled into the drainage system	N°	ARPA lombardia: Regional agency for environmental protection	2011
	Weak areas	WA	Vulnerable areas on municipality land area	%	DUSAF 2.1 (Destination of use of agricultural and forest soils) Lombardy region	2010
Society	Cultural heritage	CH	Number of listed buildings	N°	Lombardy region	2011
	Schools	Sc	Number of schools	N°	ISTAT (Population survey)	
	Average Age	AA	Average age, weighted by the amount of population in each age group	N°	ISTAT (Population survey)	2013
Economy	Immigration	Imm	Foregneirs from Non-Eu countries	N°	ISTAT (Labor force survey)	2012
	Per capita income	PcInc	Average years of education of population over 15 years	N°	ISTAT (Population survey)	2001
	Business	Bs	Number of operating business on population	%	ISTAT (Labor force survey)	2013
	Workers	Ws	Number of operating workers on population	%	ISTAT (Labor force survey)	2013
	Public workers	PWs	Number of operating public workers on population	%	ISTAT (Labor force survey)	2013

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