

ODOUR CONTROL STRATEGIES FOR A SUSTAINABLE NUISANCES ACTION PLAN

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ABSTRACT

In everyday life people are simultaneously exposed to several annoying sources (sounds, vibrations and odours), which emerge from background of considerable variability of land uses, infrastructures, residential patterns, topography, meteorology condition, and standards quality of life.

The European Union has provided in recent years (and is going to update) several tools to harmonize noise mapping methodologies and relative Noise Action Plans through directives and guidelines. Unfortunately the same efforts have not been put in the harmonization of approaches in other annoying sources like odours. As a consequence, each European Member State at national or even at local level defined its own direct or indirect approach to limit odour impacts, usually considerably different one from the others.

The most common approach to deal with noise impact at a policy, economic and strategy level is the use of priority indices focused to highlight areas more sensitive and where mitigation actions will be more advisable or urgent. Locations that for their specific land use are more sensitive to noise impacts (e.g. residential areas) are generally also sensitive to odour impacts. According these, the aim of the present research is to provide a brief review of the most used European strategies in noise action plans end try to extend their approaches for the definition of a nuisance action plan, able to control both odour and noise.

The analysis underlines that is possible define, under the same set of nuisance indicators, the degree of sensitivity of areas according to population, land uses, levels of exposures and/or distance from the annoying sources. Nuisance acceptability levels are then definable according to the sensitivity degree of the locations.

Factors related to vibrations and visual perception of the landscape can further contribute to control total sensorial annoyance in the land planning.

Keywords: action plan; annoyance; environmental nuisances; land use planning, noise, odour.

1. Introduction

Odour and noise affect the quality of life. Many economic activities and land uses emit levels of odour and/or noise to the atmosphere that have the potential to compromise the liveability at the local or regional scale. Often in developed cities can be a real nuisance for communities and residents, especially those who are downwind from a specific plants and/or activities (composting facility, wastewater treatment plant, fast food, restaurant, traffic, animals, solid waste management, etc....). Complaints resulting from the impacts of such emissions are common (Belgiorno et al., 2013; Zarra et al., 2009) and the task of ensuring that development proposals are compatible with neighbouring land uses is an responsibility for regulatory authorities. Complaints often bring legal problems and in some cases can even lead to suspension of operations or even closure of the facility.

There are different definitions of both noise annoyance and odour annoyance, but the most common view of both is that they are indicators of nuisance, disturbance or disruption to intended or actual activities (Griffiths, 2014; Guski et al., 1999).

Place and environmental context refers to the unique combination of physical characteristics that influence exposure along with sociocultural characteristics that may influence environmental perceptions in different communities. The understanding how the physical environment influences cumulative exposures can aid environmental management to reduce health risks.

In recent years the European Union has provided (and is going to update) several tools to harmonize noise strategies in urban planning through directives and guidelines. Unfortunately the same efforts have not been put in the harmonization of approaches in the standardization of other annoying sources like odours that actively participates to total nuisances of residents. As a consequence, each European Member State at national or even at local level defined its own direct or indirect approach to limit and manage odour impacts, usually considerably different one from the others.

The most common approach to deal with noise impact is the use of priority indices focused to highlight areas more sensitive to annoying sources and where mitigation actions will be more advisable or urgent. Locations that for their specific land use are more sensitive to noise impacts (e.g. residential areas) are generally also sensitive to odour impacts. According these, the aim of the present research is to provide a brief review of the most used European strategies in noise action plans and try to extend their approaches for the definition of a nuisance action plan, able to control both odour and noise.

2. Noise control strategies

In 2002 the European Union issued the fundamental tool to tackle noise issues with a common approach between all the Member States: the European Directive 2002/49/CE, also called the END (Environmental Noise Directive) (European Union, 2002). The goal of this legislative instrument is *“to define a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise”*. To this extent several actions are needed by each Member State:

- evaluation of the population exposed to high levels of noise (not considering military activities, neighbourhood or occupational noise) by means of noise mapping activities;
- a proper information and communication campaign to increase the awareness of citizens and all the involved stakeholders about noise related effects;
- definition of common strategies to solve or mitigate noise problems and protect quiet areas.

Concerning noise mapping, the European Commission has decided to harmonise the methodologies that the Member States need to adopt by introducing CNOSSOS-EU (Common Noise aSSessment MethOdS) (Kephelopoulos et al., 2014). This common method should be fully operational for the next round of EU strategic noise mapping in 2017.

This section reports a brief review of the main indices proposed by researchers, private bodies, public administrations or states to define a sensitivity ranking of the areas where noise can be considered to produce more impact. These rankings are commonly used to give priorities to the mitigation measures proposed in noise action plans of transportation infrastructures or agglomerations, as the ones required by the END.

In the international literature we can classify indices:

- focus on the sound pressure level;
- on the land use (e.g. highest values are reached if schools or hospitals are included in the area);
- on the number of annoyed people and so on.

A brief description of selected method used for the identification of noise indices is reported in the Table 1.

Table 1. Review of the analyzed methods used in noise action plans.

Method	Reference	Brief description
House depreciation index	European Environmental Agency, 2010	The value of house depreciation in terms of lost €/dB(A) can be used as a noise score to rank the buildings that are most economically affected by noise.
Building Prioritisation Score (BPS)	Scottish Government (2009)	This method evaluate the noise exposure of residential buildings; for each building and for each kind of source (road, railway and aircrafts) BPS is calculated in function of: <ul style="list-style-type: none"> • noise level at the considered building generated by the considered source; • the number of address points within the building; • population per address; • percentage of people annoyed.
Population Annoyance Index (PAI)	de Ruiter (2009)	The method requires to assign each building or dwelling to a noise exposure class (45–50 dB(A), 50–55 dB(A), etc.) considering its estimated noise level; then the central value of the noise class is assigned to each dwelling or building according to the number of the residence. This method takes into account only exposure to road traffic noise.
Multicriteria matrix	Dublin Local Authorities, 2013	The method propose a decision matrix that give a score at each area according to: <ul style="list-style-type: none"> • noise exposure, • land use or type of locations (e.g Urban centre, Commercial, Residential, etc.) • impacting sources or type of source (e.g. Road, Airport, Rail, Industry, etc.).
Noise Priority Index	Italian Ministry of the Environment, 2000	The index is calculated for each building and it takes into account: <ul style="list-style-type: none"> • number of people affected by noise; • sensitivity or use of the building (e.g. hospitals, schools, residential buildings); • differential between the noise level and the noise limit characteristics of the area.

3. Odour control strategies

The quality of the air is often affected by chemicals from the everyday activities of industrial and commercial enterprises. An exposure to those volatile compounds has become a part of modern day life in urbanized cities. However residential peoples find the odours annoying and objectionable and at some concentration or frequency may declare them a nuisance.

Community odours remain one of the most air pollution complaints to regulators and government bodies. An odour nuisance usually is a result of a series of odour episodes experienced by a residential people. The frequency of these episodes, the duration of each odour episode, the intensity of the odours, and the character or offensiveness of the odours all contributes to the nuisance experience.

From Region to Region, in communities across the Europe, and in other Countries odour issues are addressed by a variety of "odour laws", whether they are called an ordinance, rule, regulation, or policy. The "odour laws" address community odour issues in several approaches that generally utilize different compliance criteria:

- annoyance criteria (subjective categories and complaint criteria);
- ambient odour criteria (threshold or intensity);
- ambient odorant criteria (mass concentration of specific substance and/or Odour concentration measured in odour unit per cubic meter accorded to CEN 13725:2003);
- episode duration-frequency criteria;
- source emission criteria (threshold or mass concentration) and best available control technology criteria (i.e. industry standard).

The various approaches are not mutually exclusive and are sometimes combined in one "odour law". Underlying the approaches to odour laws are the basic elements that have been placed into successful regulations of noise action plan.

It is common for jurisdictions to assess the odour impact potential of development proposals by comparing model predicted odour exposure statistics at sensitive receptors against jurisdictional exposure limits or criteria. These criteria are typically specified in the form of a single concentration limit, percentile compliance level and averaging time, which act to limit the intensity and frequency of odour impact events that may be experienced at receptors.

All these existing approaches are useful in the practice of authorization by Local Authorities, for the evaluation of odour impact assessment in EIA, and in case to control odour emission with possible sanction to existing plants. On other way existing "odour law" underline a lack of uniformity of assessment and are not generally used in the urban planning.

4. Nuisances action plan

Different definitions, guideline and laws about both noise and odour underline that have the same receptors that could be subjected to nuisance, disturbance disruption. Odours and noises imply environmental pressures that could cause nuisance to people and ecosystems. The proposition of a Nuisance Action Plan, as an extension of the current and well regulated Noise Action Plan, can provide a complete framework to manage environmental odours and noises and control they annoying effects. It also aims to protect quiet and healthy areas in agglomerations (large urban areas) where the quality is good. Proposed framework for the definition of the Nuisance Action Plan is reported in Figure 1 and includes the following steps:

- Assessment of the Degree of Land Sensitivity to Nuisances (S). S degree is calculated for each homogeneous area of the territory and represents its tolerance to nuisance pressures (odour and noise). S degree is function of both urban and environmental ecosystems (UEE) and of actual and future uses of the land according to the overall framework of planning (PP).
- Evaluation of Nuisance Exposure Level (EL) of receptors (e.g. population) in each homogeneous area of the territory. This step is implemented downstream of monitoring of noise and odour levels representative of the area.
- Definition of Nuisances Standard Limits (SL) for each homogeneous area of the territory according to National and Local laws;
- Estimation of the Potential Nuisance Impacts (PNI) according for each homogeneous area of the territory according to S, EL and SL.
- Definitions of common strategies to solve or mitigate nuisances impacts and protect quiet and healthy areas according to the potential PNI.

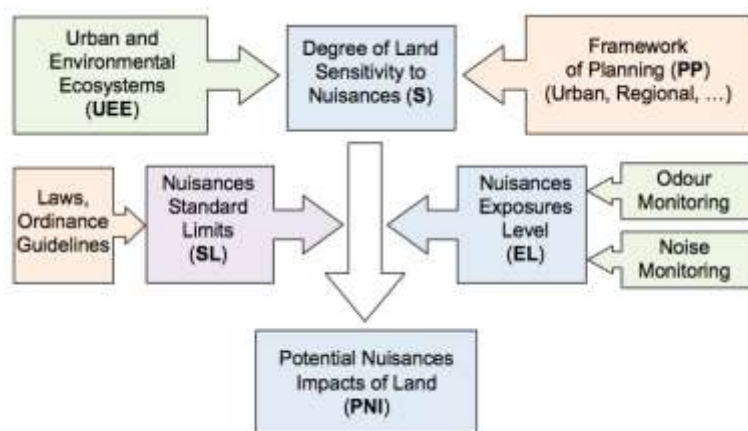


Figure 1. Framework for the definition of the Nuisance Action Plan.

Degree of Land Sensitivity to Nuisances (S) is function of the Urban and Environmental Ecosystems (UEE) according to the indicators reported in Table 2.

Table 2. Criteria and indicators for the assessment of the degree of Land Sensitivity to Nuisances (S).

Criteria	Indicator	Class	Score	
Strategic level	LU	Land use destination or class of locations	Residential	30
			City Centre	20
			Commercial	15
			Agricultural	10
			Industrial	5
Abundance of Receptors	Rc	Number of citizens	High	30
			Medium	20
			Low	10
	Rb	Sensitive building (<i>schools, hospitals, Cemetery, etc.</i>)	Presence	10
			Absence	0
Re	Sensitive environmental location (<i>preserved area, National or regional park, protected ecosystem, etc.</i>)	Presence	10	
		Absence	0	
Environmental Pressures	Pn	Noise impacting sources	Presence of relevant sources (<i>Airport, Rail, Highways, Industry, et similar</i>)	0
			Absence of relevant sources	10
	Po	Odour impacting sources	Presence of relevant sources (<i>Wastewater Treatment Plant, Landfill, Industry, et similar</i>)	0
			Absence of relevant sources	10

Degree of Land Sensitivity to Nuisances (S) will be expressed in percentages according to the following equation:

$$S(\%) = (LU + Rc + Rb + Re + Pn + Po) / 100$$

Each indicator assume in relation of its class a score according to the assessment matrix reported in the Table 2. To take into account the overall framework of planning (PP), the degree of Land Sensitivity to Nuisances is calculated in current scenario (S_0) and compared with the planned scenario (S_p).

For the estimation of Potential Nuisance Impacts (PNI) is necessary define Nuisances Standard Limits (SL). If noise limits are easily to identify according to the National standards and laws, in contrast, odour acceptability levels are not universally defined and regulations are generally still lacking. On this point several studies are trying to standardize odour impact limits and European Union is ready for a standardization, then

the definition of Nuisances Standard Limits (SL) will be immediate.

5. Conclusions

Noise Action Plan is well defined Europe and in literature there are several tolls for its sustainable implementation. In contrast odour emissions that often cause significative and negative impacts don't have a defined planning. On other way noise annoyance and odour annoyance have the same target receptors and that could be managed under the same Action Plan. The framework of a Nuisance Action Plan was proposed as prosecutable solution based on the degree of land sensitivity to nuisances. Nuisance acceptability levels are then definable according to the sensitivity of the locations.

Further studies and efforts by the Authorities are needed to define odour limits. Factors related to vibrations and visual perception of the landscape can further contribute to control total sensorial annoyance in the land planning.

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