DOCTORAL SCHOOL IN ENVIRONMENTAL ENGINEERING
Department of Civil and Environmental Engineering
University of Trento – Italy
XXIII cycle

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Improving the consideration of cumulative effects in Strategic Environmental Assessment of spatial plans.
A case study in the peri-urban region of Milan.

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Abstract

Most of the significant changes on the environment have resulted from individually minor but collectively significant human actions and decisions. This kind of consequences has been defined Cumulative Effects (CE) and their systematic consideration can be attributed to the scientific basis and institutional context of Environmental Assessment (EA) theory and practice. In particular, addressing CE in EA has been accepted to be more particularly important at strategic level, giving a great emphasis to higher tier assessment, namely Strategic Environmental Assessment (SEA), as the most appropriate level to effectively consider CE due to its broad scale and its focus on influencing future development (Sadler and Verheem, 1996; Cooper and Sheate, 2002; Fischer, 2002; Thérivel and Ross, 2007).

Within the European context, Strategic Environmental Assessment (SEA) Directive, concerning '*the integration of environmental considerations into plans and programmes*', explicitly solicit CE to be considered (*Annex I*) and spatial or land use plans are among the most important planning instruments required to be linked up with SEA by this Directive. Generally speaking, spatial plans aim to manage the present and the future use of land, resources and services to allow for sustainable and efficient pattern and future development, mainly acting at regional and local level. Therefore, the SEA of spatial plans can be defined as a decision support process aiming to address the potential environmental effects that can result from implementing the proposed plan, paying particular attention to anticipate cumulative and large-scale effects.

However, in spite of recognition amongst the scientific, regulatory and practitioner communities of the importance to adopt a strategic approach to appropriately deal with CE, it is worth noting that it seemed to be seldom the case as the treatment of CE results particularly disregarded in current SEA practice, suggesting that there is a gap between the theoretical emphasis given to SEA and SEA practice with respect to the consideration of CE. Additionally, referring to the spatial planning context, the challenge to capture those individually minor consequences on the environment relies on its hierarchical tiered system as local spatial plans often contribute to small insignificant changes, mainly not subjected to EIA, that could significantly affect regional environment. And this could cumulatively cause significant environmental changes at regional scale which are seldom considered by local level decisions since not significantly relevant at that scale (e.g. land take, air quality, biodiversity loss, etc.). In particular, these scale-lag consequences has been stated mostly noteworthy for highly urbanised regions, where environmental or ecological thresholds (e.g. air quality standards, land take, CO_2 emissions, etc.) tend to be more easily exceeded due to narrow, small and, apparently, insignificant land use changes (Antrop, 2004; MEA, 2005; EEA, 2006).

In the light of this, this dissertation aimed to propose and apply a methodological approach to improve the consideration of cumulative effects in SEA of spatial plans, by focusing on the Italian spatial planning system and urban regions.

This overall goal was reached by pursuing the following intermediate objectives:

1. to understand how SEA for spatial planning works in practice;
2. to explore how CE are currently treated in SEA of spatial plans;
3. to develop a methodological approach to improve the consideration of cumulative effects in SEA of spatial plans;
4. to apply the proposed approach to a case study, by empirically testing its applicability and discussing its limitations.

The first assumed that proposing a methodological approach to support SEA in treating CE required the achievement of a good knowledge on SEA and planning processes. To meet it a double-perspective was adopted, by moving forward from theoretical basis to empirical observations. Findings suggested a number of systemic and methodological constrains affecting SEA practice. Among the most important, the inadequate role of scoping in appropriately addressing relevant issues and in supporting the overall SEA process and methodology; as well as a scarce consideration and assessment of future alternatives and an unsatisfactory definition of monitoring plans.

The second investigated whether and how cumulative effects are currently considered by SEA practice in different international contexts, with particular reference to spatial plans at

local and regional level. To meet it, both an international expert survey and a systematic review of SEA reports were carried out. The results suggested that: CE were poorly and not thoroughly considered by international SEA practice, highlighting general and contextual barriers (e.g. legal requirements, availability of guidance, etc.). They further highlighted a lack of methodological approaches to: support the scoping of CE; orient the assessment towards the 'future'; and assess CE through a more evidence-based perspective, being the most frequent consideration of CE a qualitative description based on expert opinions. Conclusions mainly regarded the need to: better scope CE issues (VEC, '*other foreseeable future actions*', etc.); better handle the scale-lag effects (spatial crowding and time lag); better explore planning alternatives and future conditions; and improve the systematic treatment of uncertainty.

Basing on findings and shortcomings emerged from theoretical and empirical outcomes, a methodological proposal for improving the consideration of CE in SEA of spatial plans was developed in order to meet the third objective. By focusing on regional spatial plans, it consisted of four key tasks: the selection of VEC; the identification of relevant PPPs (other projects, plans, programmes and policies) contributing to cumulative changes on identified VEC; the definition of spatial planning alternatives and future conditions; and the assessment of CE on VEC through a core set of indicators.

Therefore, in order to achieve the last objective of the research its applicability was tested in a case study in the peri-urban region of Milan. The study area represents one of the most urbanised and industrialised part of Italy, with significant urban pressures on existing protected areas and remaining rural patches, which are playing an important role in maintaining the regional ecological network and provide for several important environmental services. Firstly, regional green infrastructure was selected as VEC; then, three relevant '*other foreseeable future actions*' were identified (i.e. highway transportation corridor, protected areas conservation plans, and rural policies). Subsequently, two main planning alternatives and future land use scenarios were developed and made spatially explicit, starting from a couple of regional land use maps. Then, the regional cumulative effects on VEC (e.g. habitat fragmentation, surface runoff, etc.) were assessed against a range of future conditions through a core set of indicators, mainly quantitative and spatially explicit, simulating relevant environmental processes, such as hydrological cycle, local surface temperature, ecological connectivity. They were all selected and computed starting from land cover data, allowing the combined effects to be quantified and land use scenarios to be compared. The results mainly showed that the method provided an applicable means to, firstly, transfer policies and decisions into maps, and then, predict their combined effects on selected VEC. Moreover, it can be straightforwardly included in SEA of regional

spatial plans in order to support more evidence-based and sustainable decision-making, and thereby, applied to other case studies, by appropriately tailoring the selection of indicators on relevant VECs. In addition, future developments of the proposed approach were suggested. Among the most important were: a better exploration of future conditions, including, for instance, those actions and decisions whose spatial explicitness is not directly detectable, but whose contribution to CE on VEC could be significant; and a systematic treatment of the uncertainty characterising assumptions and predictions.

Finally, being the proposed approach specifically tailored for the SEA of regional spatial plans, it would be particularly interesting to test its feasibility and effectiveness in a real-life spatial planning process, providing, at least, an indication of whether or not the developed method could have any discernable impact on the management of CE and, subsequently, on the environmental quality of the region in which the spatial plan would be applied.