

Chapter 2

Nexus Approach to Disaster Risk Reduction, Climate Adaptation and Ecosystems' Management: New Paths for a Sustainable and Resilient Urban Development

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Abstract The “nexus” approach has recently been widely interpreted as a groundbreaking vision for dealing with existing and emerging environmental challenges. Therefore, we will focus here on the potential for extending the nexus approach to some of the factors threatening the future development of urban areas and, namely, to individual and coupled hazards, climate change and environmental degradation. These factors are currently faced in different ways by individual institutions and policy developments that are still far apart, despite the fact they interplay and overlap at different levels and would require cross-sectoral strategies and measures to coalesce. This contribution will first explore the potential of the nexus approach to shed light on the complex interactions among natural, technological and na-tech risks, climate-related impacts and ecosystems' degradation. Then, the need to develop an integrated knowledge base for more effective interventions to drive cities towards a sustainable and resilient development will be discussed.

2.1 Introduction

The increasing frequency and severity of natural and human-induced disasters, often linked to extreme weather events, is causing considerable damage in Europe, especially in urban areas. The latter, characterized by an increasing density of people, goods and equipment, are often the result of development paths that have been largely geared to soil consumption and sealing, paying little or no attention to the issues of risk prevention and mitigation.

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We will explore in the following the complex linkages among ecosystems' degradation, climate change, risks and urban development, in order to provide hints for developing a cross-sectoral approach to these issues, emphasizing the key role of urban planning processes. According to this goal, the contribution is structured as follows:

- firstly, the interdependencies among urban development, ecosystems' degradation, climate change and natural, technological and climate-related risks will be analyzed;
- then, the main steps towards a better integration among the considered issues will be presented, focusing on the EU research projects as well as on the scientific and institutional debate;
- finally, the potential for applying the nexus approach to the challenges posed by the interdependencies between natural dynamics and human activities will be discussed.

2.2 Interdependencies Among Environmental Degradation, Climate Change, Risks and Urban Development

Urban population is increasing all over the world: Europe is one of the most urbanized countries in the world and, according to the 2014 World Urbanization Prospect, urban population is expected to further increase from 73 to 80 % by 2050. In the meantime, starting from the Nineties, “urban areas [in Europe] sprawled faster than population growth” (EEA 2013). According to the scenarios developed by the Espon Project, land consumption will continue to increase mainly in Western Europe, showing a slight decrease only in Eastern Europe (van Delden and Vanhout 2014). Housing and recreation services, economic and industrial activities, transport networks and infrastructure are widely recognized as the main responsible of land consumption phenomena. The loss of natural, semi-natural and agricultural areas mainly affects Peri-Urban areas placed around major cities or along infrastructure networks, with significant consequences, ranging from a fragmentation of natural habitats to the loss of biodiversity and reduction in food production. Moreover, the sprawl of urban settlements often results in more resource-intensive lifestyles, because of the increased transport and domestic energy needs. This can “further increase the burden on ecosystems” (EEA 2015).

The growth of urban population and the sprawling of urban land uses across Europe have relevant repercussions not only on the consistency and quality of

natural resources, but also on natural and man-made risk levels. The latter depend indeed, on the one hand, on the various hazard factors affecting Europe; on the other hand, on the vulnerability of the exposed areas and assets. Hazards themselves are often increased by human activities: for example, soil sealing phenomena—due to the sprawling of urban land uses—significantly affect the cycle of water resources and, combined with increasing human pressure, further worsen the precarious geo-environmental balance of the European territory. Available statistics on hazards and risks (Munich 2013) show an increase in the total number of disasters in the recent decades, with a significant percentage of hydrological, meteorological and climatological events (tropical storm, flooding, mass movement, drought, heat waves, etc.) in respect to geophysical events, showing an almost stable trend in the time span 1980–2013. The European Environmental Agency has clearly identified river flooding and wind related storms “as the most important natural hazards in the EU in terms of economic loss” (EEA 2012).

Furthermore, in the last decades numerous natural events have induced major damage to hazardous industrial facilities, increasing the number of so-called na-tech events: this trend is expected to continue in case of more frequent climate-related hazards.

Another aspect to be remarked refers to the impacts of the heterogeneous hazard factors on natural and rural ecosystems. Despite the lack of detailed information and devoted databases on the impacts of natural, technological and na-tech hazards on these ecosystems, some types of natural hazards (e.g. climate-related phenomena as droughts or fires) may significantly affect natural resources, whilst technological and na-tech hazards always represent a serious threat to both natural and rural ecosystems.

Nowadays scholars largely agree that climate change is closely related to the growth of urban population, to the consequent conversion of natural and rural areas into urban land uses and to urban lifestyles. The expected growth of urban population will further increase energy consumptions and, if current lifestyles will remain substantially unchanged, the GHG emissions. Climate-related phenomena will increase current risk levels, “exacerbate existing environmental problems (...) and pose additional challenges to providing sustainable water and sanitation” (EEA 2015).

In Fig. 2.1 the complex interactions among human activities and natural dynamics are represented, shedding light on the inadequacy of the still prevailing sectoral approaches to environmental degradation, risks and climate change and the need, in order to reverse current trends, of innovative approaches capable to modify current urban development patterns through revised spatial and land use planning processes.

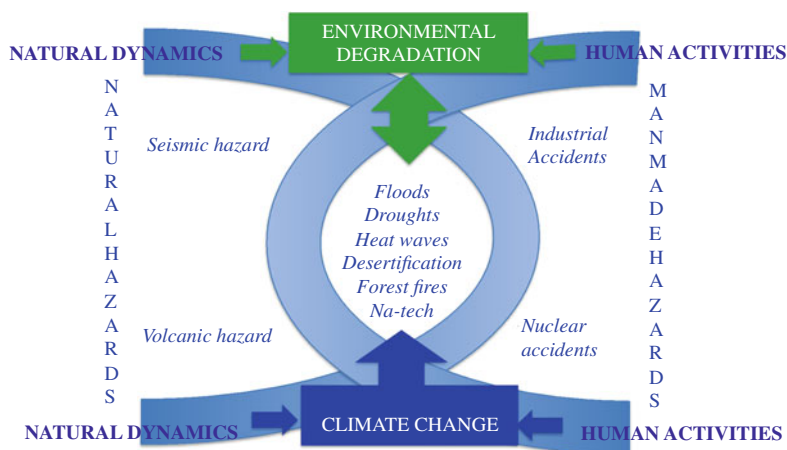


Fig. 2.1 The complex interdependencies among human activities and natural dynamics

2.3 Efforts Towards Integrated Approaches

In the face of the negative “loop” that characterizes interactions among human activities and natural dynamics, the recent debate on Sustainable Development Goals has been largely focused on the need for better integrating development goals and environmental sustainability, emphasizing that the “integration is not only possible, but necessary” (Boltz et al. 2013).

Moreover, in the last decade large room has been devoted to the concept of “mainstreaming”, interpreted as the informed inclusion of significant environmental concerns into decision-making processes at different levels. Various steps have been undertaken in the last decades in order to better integrate:

- environmental issues into land use planning processes;
- risk issues into land use planning;
- climate concerns into urban development policies.

The integration of environmental issues into land use planning processes has received large attention starting from the Nineties and the main outcome is related to the widespread application of the Strategic Environmental Assessment (SEA), introduced by the EU Directive 2001/42/EC. The SEA has significantly improved land use planning process, by ensuring the consideration of environmental, social and economic sustainability issues along the different steps of the land use planning process (Galderisi and Profice 2012).

However, the SEAs so far developed across Europe are largely focused on the impacts of land use planning choices on consistency and quality of environmental resources (water, soils, air, etc.), neglecting the multiple interrelationships between land use planning choices and alteration of the natural environment on risks, climate change and climate-related hazards.

Instead the key role of land use planning tools to minimize natural hazards related risks has been acknowledged in literature (Burby 1998; Walker et al. 2011) and steps forward have been taken in the last two decades at the European level.

Past EU research projects—such as the “Applied Multi Risk Mapping of Natural Hazards for Impact Assessment (ARMONIA)” funded under the VI FP—have produced frameworks to guide planners in analyzing different risk components in order to assess the compatibility of alternative land uses with existing hazards and risks (Galderisi and Menoni 2007). Most of the hints provided by the Armonia Project have been embedded in the working paper on “Risk Assessment and Mapping Guidelines for Disaster Management”, issued by the EU in 2010, that represents a significant progress towards an effective multi-risk analysis. The Guidelines point at the need for involving multiple stakeholders in risk assessment processes and ensuring extensive public information on the process and outcomes of risk assessment.

Recently a growing attention has been paid to climate change and many scholars have emphasized the need for a climate sensitive land use planning, addressed to reduce GHG emissions and adapting cities to climate-related impacts (Davoudi et al. 2009; Wilson and Piper 2010). Nevertheless, so far most of the initiatives addressed to counterbalance climate change have been carried out through sectoral plans, implemented on a voluntary base by Local Authorities and only few cities have started an effective path to integrate climate issues into ordinary urban planning processes.

Efforts have been also addressed to promote a better integration between climate policies and risk reduction strategies (EFDRR 2013; Kelman et al. 2015). Nevertheless, so far an effective integration between these areas seems far from being reached, neither in theory nor in practice.

Finally, it is worth mentioning the increasing number of studies addressed at exploring the potential of ecosystem-based measures for improving cities’ response to natural and climate-related hazards and enhancing climate mitigation (Naumann et al. 2011; Estrella et al. 2013). In recent years, also the European Commission (EU 2015) has been devoting larger room to the development of nature-based solutions in order to address a variety of societal challenges, ranging from a more sustainable urban development to the recovery of degraded ecosystems, up to climate change adaptation and risk reduction.

Although the need for integrating the different areas of concern related to sustainability—comprising risks and climate change—is nowadays largely shared in institutional documents as well as in scientific literature, and some steps towards this goal have been undertaken, current knowledge as well as responsibilities and practices are still very fragmented. The main barriers to the development of an integrated approach are related on the one hand to the persisting difficulty to disseminate available knowledge out of the boundaries of the different scientific communities and even more to transfer research knowledge to practitioners and policy makers; on the other, to the current organizational structure of local governments. The latter are indeed often arranged into silos (GIZ and ICLEI 2014) and each of them, based on a single sector approach, is in charge of a specific issue: risk

reduction, water management, energy, transport. Such a structure does not encourage the required cross-sectoral approaches and strategies to address the complex challenges that cities have to deal with. Climate mitigation and adaptation, for example, are still mainly pursued through sectoral tools, scarcely related both to the existing DRR strategies as well as to land use planning choices and the potential of the SEA for evaluating the impact of land use planning choices on risk levels and climate change is still undervalued.

2.4 Potential of a Nexus Approach

The “nexus” approach is currently interpreted as a groundbreaking vision for dealing with emerging environmental challenges. Nevertheless, the actual difference between the emerging nexus approach and the holistic approach, largely debated since the Eighties, has to be firstly discussed. According to Hussey et al. (2015) a holistic approach “demands integrated or whole system research and policy approaches that may extend beyond our capacities, including too many variables and imperatives”. On the other hand, the Nexus approach allows us to reduce the focus on some specific sectors and, in so doing, it might be more manageable and thus, more effective in guiding practices. The Nexus concept was firstly used in the early Eighties referring to the interdependencies between natural resources. Then, it was focused on the relationships between food and energy recognizing the “implicit water-resource dimension of the nexus between energy and agriculture” (Scott et al. 2015). Recently the Nexus approach has been further extended, by embracing the linkages among environment, health and well-being, and some attempts to provide ideas and tools for operationalizing such an approach are currently available (GIZ and ICLEI 2014). Also the Global Sustainable Development Report issued in 2015 highlights the interconnections among specific goals and suggests the adoption of a nexus approach to jointly analyze some issues for specific policy purposes.

Therefore, the complex linkages among environmental degradation, climate change, risks and urban development, briefly discussed in the previous paragraph, suggest the adoption of a nexus approach as a key for integrating current EU and cities’ policies, assigning a key role to land use planning. The adoption of the nexus approach might in fact allow us:

- a more effective transfer of the theoretical and technical knowledge developed in each area of concern;
- an improvement of existing knowledge, currently too fragmented for effectively informing integrated policies on different scales, by better focusing on interactions and feedbacks among the different sectors;
- a shift from policies addressed to improve the capacity of urban systems in the face of individual issues or threats, towards policies focused on the adaptive capacities of urban systems in the face of multiple and interconnected factors.

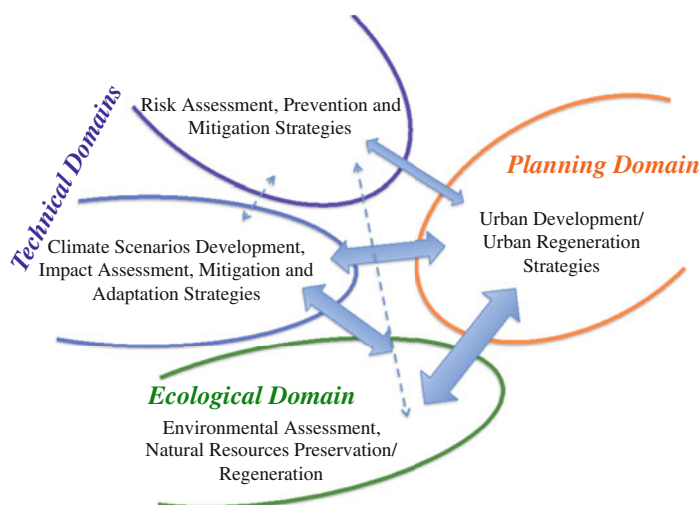


Fig. 2.2 The existing links among different domains (the *thickness* of the *arrows* indicates the greater or lesser interconnection between the considered domains; the *dashed lines* indicate the weakest links)

In respect to the first point, the adoption of a nexus approach might favor the building up of a common ground among different domains, too often separated in higher education programs as well as in research and in professional practice (Fig. 2.2). Nowadays, whilst environmental concerns are fairly included into planners' baggage and a growing attention is devoted to climate change issues as well as to the key role of natural ecosystems in counterbalancing climate impacts, persisting difficulties can be detected in transferring the significant body of knowledge on risks into land use planning and in promoting an effective sharing of existing knowledge between the fields of Disaster Risk Reduction and Climate Change Adaptation. Hence, a relevant effort should be invested into better integrating theoretical and technical knowledge developed on risk issues, and often confined into a very sectoral domain, into urban planners' education and training. The building up of a "safety culture" among planners is crucial, indeed, to effectively progress towards risk informed decision-making processes aimed at urban development.

Moreover, despite the role of natural ecosystems is nowadays acknowledged as a key element to counterbalance both natural and climate-related hazards, ecology does not make part of the educational curricula of experts in risk prevention and mitigation, nor ecologists are involved by the latter in working groups.

The weak link between these fields of competence has a twofold consequence: on the one hand, the impacts of natural and climate-related hazards on natural resources are often undervalued or neglected; on the other hand, ecosystem management is rarely considered as part of the portfolio of solutions to Disaster Risk Reduction.

Furthermore, even though green measures are nowadays widely interpreted as a key tool to counterbalance climate change, they represent only a first step towards an ecology-based urban development. A quite radical change in current pattern of resources' consumption in cities would be required, and, above all, the triggering of "comprehensive political, financial and technological strategies for an environmentally enhancing, restorative relationship between cities and the ecosystems from which they draw resources for their sustenance" (Woo et al. 2014).

The adoption of a nexus approach should be also addressed to strengthen the link between risk and climate change scientific communities.

Even though the dialogue between these two communities has been encouraged in the more recent years, barriers persist that hinder the development of a common language and the fruitful transfer of concepts, methods and results from one community to the other.

In respect to the second point, the adoption of a Nexus approach may significantly improve current knowledge. Current fragmentation of knowledge, often within the same disciplinary domain too, and persisting gaps in knowledge regarding interactions and feedbacks among elements and systems are the main barriers towards an effective understanding of the complex interdependencies among human activities and natural dynamics (Hoff 2011).

On the opposite, mutual learning and mutual knowledge generation across different domains might allow us to combine different ways of knowing and different actors who bring different types of expertise, driving existing knowledge beyond the sectoral/technical boundaries towards a systemic-oriented knowledge (Williams and Hardison 2013).

Current segmentation of knowledge is also mirrored in a fragmentation of competencies, responsibilities and operational tools at the professional and governmental levels that would significantly benefit from the nexus approach. The latter may induce a shift from "silo" approaches to the management of ecosystems, individual risks and climate change towards a more integrated and comprehensive management of the links between natural and human systems' dynamics. This is not a trivial challenge, since it requires first of all a cultural change, capable of bridging the different domains and, in so doing, to support the development of integrated strategies to the heterogeneous, although closely related, threats currently affecting cities. Secondly, it requires a significant organizational change that represents the third challenge implied by the adoption of the Nexus approach: separate institutional bodies in fact, which do not coordinate their activities, currently manage the different domains. A stronger cooperation/coordination among different sectors of local governments as well as among public and private stakeholders to tackle the interconnected challenges at stake is a prerequisite for promoting cross-sectoral strategies and initiatives. In this line, some European cities are building up resilience-oriented partnerships between different public actors/sectors and between private and public organisations addressed to better manage cross-sectoral projects, overcoming current segmentation of responsibilities and tasks. For example, the London Resilience Partnership, established in 2002, provides a mechanism for multi-agency cooperation to deal with large-scale emergencies (flooding, volcanic ash, Olympic games,

etc.). Similarly, the Barcelona Resilience Group, a public-private association established in 2008, is in charge of coordinating different sectors of local government, private operators, infrastructure owners, and other administrations to drive cross-sectoral projects for reducing urban vulnerability and guaranteeing the operational continuity of the city's services in case of hazardous events.

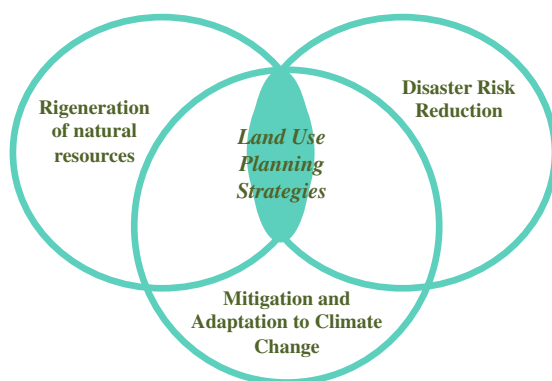
Finally, the key role that land use planning processes could play for making the adoption of a Nexus approach effective and capable to drive cities towards a sustainable and resilient development has to be emphasized. Urban planning processes should already ground on a systemic approach, allowing them to:

- collect and integrate different knowledge and information (arising from different disciplinary fields, developed at different geographical scales and referred to different temporal spans);
- take into account the complex interactions among different elements and systems (from the physical to the social, economic, environmental systems and their components);
- assess pros and cons of alternative land use choices, taking into account their immediate and future impacts on different resources as well as on different scales;
- prioritize strategies and goals by framing heterogeneous and sometimes conflicting goals as well as different stakeholders into a comprehensive vision.

Thus, urban planning processes might play a key role for overcoming “silo” approaches to the management of ecosystems, individual risks, climate change, favoring the application of a Nexus approach (Fig. 2.3).

To this aim, current methods and tools that currently characterize urban planning should also change. On the one hand, planners' culture and education should include the development of knowledge and skills on risks, climate change and ecology; on the other, roles and forms of urban planning tools should be re-designed as “frames” into which negotiate and reconcile competing and often conflicting objectives (Estrella et al. 2013), through “informed” and participated decision-making processes.

Fig. 2.3 The nexus for a sustainable and resilient urban development



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