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# CLIMATE CHANGE MITIGATION AND ADAPTATION FOR URBAN AND RURAL LANDSCAPES

**Abstract**
Spatial development processes and climate change are the main processes that lead to an increased level of risk for urban and rural landscapes. In particular, hydro-meteorological extreme events are increasing in frequency and intensity, generating dramatic negative impacts on ecosystems and increasing the hazards of other risks, such as fires, sea-level rise and biodiversity loss.
Moreover, climate change can alter the value system, which local communities traditionally use to interact with landscape. However, the need to face climate change can also push researchers, local authorities and policy makers to find and test, both at the urban and wider scale, sustainable solutions that can transform the relation between landscape and its community and make them more resilient.
This section presents studies and researches investigating how to ensure the reduction of risk by climate change with the landscape preservation and promotion.

**Keywords:** climate change, mitigation, adaptation, landscape enhancement

**Striking a balance between the contrast to climate change related risk and landscape value enhancement**

Climate Change is acknowledged as one of the defining issues of the 2000s [1] and the methods to contrast its dramatic effects on urban and rural areas are one of the most investigated topics in the fields of urban planning, architecture and civil engineering in recent years. The constantly increasing climate change related phenomena, such as storms, droughts, heat waves, afflict the territory and its functional subsystems at different scales, ranging from the public health to rural productivity, including urban settlements and infrastructures efficiency.
According to the "The Lancet", one of the most eminent medical journal, Climate Change could become the greatest threat of the 21st century for public health [2], [3], since the increase in the intensity of climatic extreme events, such as heat waves, contributes to the worsening of cardiovascular and respiratory diseases, especially among the elderly, and endanger water and food supply [4], [5].
Moreover, the presently available models, considering current greenhouse gas emissions, estimate a potential sea level rise by between 0,6 and 1,8 meters by 2100. In some parts of the world, such as some nations bordering the Indian Ocean, this phenomenon could force millions of people to abandon the place where they live in. As well as the above-mentioned heat waves increase, a higher temperature will accelerate the water cycle leading to more floods and droughts and heavily impacting on world agricultural production, especially in places where water scarcity is a critical problem [6].
In this described risk scenario, cities are the elements having the highest exposure due to the density of population, dwellings, and economic activities. Furthermore, climate change can also have catastrophic impacts on infrastructure, worsening the access to basic urban services and, therefore, the quality of life in cities.
Landscapes, both urban and rural, as conceived by European Landscape Convention [7], are not immune to climate change effects, since they alters the value system through which local communities traditionally read and perceived landscape.
However, despite Climate change is the main cause of rapidly changing landscape scenarios (e.g. ever more intense coastal flooding have been eroding the Italian coast line for a total amount of 35 $km^2$), it can also produce positive implications, since adaptation and mitigation strategies to be implemented in order to face its impacts could become drivers of relevant transformations. As a matter of facts, the solution to face climate-related risk that researchers, local authorities and policy makers have been trying to find and test in recent times will significantly modify – and in some cases has already modified – urban and rural landscape and its perception.
For instance, at the territorial scale, climate-sensitive management of agriculture (e.g. by shifting to crops with higher carbon storage potential or reducing forest clearing for agricultural expansion) can contribute to not only to a relevant reduction of atmospheric concentrations of CO2, but also to support natural landscape conservation policies.
Furthermore, some mitigation strategies at the urban scale to limit greenhouse gases emissions, such as the implementation of sustainable mobility-oriented traffic policies are able to transform the landscape-community relation. Road policies and management (e.g. restricted traffic areas, bike lanes, etc.) can create a sense of landscape and increase visual landscape perception, in addition to the functional benefits of a more efficient traffic circulation [8], [9].
Moreover, in recent times, the adoption of climate-sensitive design principles within urban regeneration intervention is becoming increasingly common. It is no coincidence that urban regeneration is considered, among urban policies, the most suitable tool to implement efficient strategies to face Climate Change: ranging from low-carbon urban environment creation through land uses rearrangement, to real estate requalification as a result of buildings retrofitting or their replacement with new ones with better energy performance, including the enhancement of vegetated and permeable spaces provision within densely urbanized tissues [10], [11], [12]. Moreover, in recent years, urban regeneration projects provided the opportunity to implement the ecosystem-based approach, theorized in the 1990s by Grumbine and configured as an integrated resource management strategy towards the sustainable use of the resources themselves [13], [14]. Researchers and policy-makers have identified in the ecosystem-based approach a criterion for introducing sustainable and economically viable solutions in government decisions in order, on the one hand, to face and solve urban problems such as water and urban run-off management, air quality and temperature control and, on the other, to deal with cross-cutting issues such as the defence and promotion of biodiversity, public health, social justice, economic development. Given the multiplicity and heterogeneity of the targets addressed by these solutions, recent studies and researches preferred to adopt, instead of ecosystem-based approach, the name nature-based solution (NBS), defined by the European Commission as «inspired solutions and assisted by nature, economically convenient, which simultaneously provide environmental, social and economic benefits and which help to 'build' resilience» [15]. The NBS concept combines the ecosystem-based approach, which includes ecosystem services, green and blue infrastructures, environmental engineering interventions and the low-impact development approach, with the economic and social benefits of systemic solutions capable of producing technical, regulatory, social, financial innovations and ensuring the efficient use of resources [16].
Among Climate Change adaptation strategies, nature-based solutions adoption and ecosystem services supply will produce relevant transformation in urban and rural landscapes in the next years, and their implementation will require integrated and multidisciplinary methodological approaches able to develop multi-target projects aiming at infrastructural efficiency, risk prevention and mitigation, urban spaces quality enhancement and landscape valorisation.

This section aims to investigate if a positive reconciliation between safety enhancement and risk reduction with the landscape preservation and promotion is possible and which is the way to pave, in order to achieve it.
It is evident that, to gain these results, it is necessary to analyse practical examples regarding landscapes that have been tangibly modified by climate change, the social and economic impacts produced and the actions implemented to tackle them.
Furthermore, special attention is paid to assessment methods and tools capable of measuring ecosystem services in different landscape settings to understand the added value of NBSs to landscape quality.
In addition, it is relevant to observe how the application of proper cost-benefit analyses to urban context having peculiar landscape values, such as historic urban landscapes, could support public administrations decisions in the choice of the most sustainable structural and non-structural mitigation measures for Climate Change related risks, not only from an environmental and social perspective, but also from a financial and economic one.
Finally, particular consideration is given to methodological design or urban planning approaches based on NBSs, green and blue infrastructures and ecosystem services, aiming at striking a balance between facing Climate change and its effects and landscape value enhancement.

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