

Climate-Proof Planning for an Urban Regeneration Strategy

Carmela Mariano¹

¹ Department of Planning, Design, Technology of Architecture, Sapienza University of Rome

Abstract

This paper deals with the issue of the relationship between climate change and the government's land management policies, investigating how urban planning regulation may provide responses to the need for planning and designing the coastal urban settings affected by flooding phenomena as a consequence of gradual sea-level rise (SLR).

In this frame of reference, comparison among the strategic planning experiences put into play in a variety of national and international settings suggests the urgency for policymakers to implement knowledge frameworks on planning instruments, in order to identify – as a prerequisite for defining site-specific design actions – the territorial settings affected by the phenomenon of flood risk.

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Keywords

sea level rise; climate-proof planning; urban regeneration; strategic planning

1. Introduction

The need to identify new references for a sustainable transformation of the territories affected by the risks and degenerative processes related to climate change (IPCC, 2013; UNISDR, 2015; UNFCCC, 2015; EEA, 2016), has solicited, therefore, in the last decades the scientific and disciplinary debate on the key role of urban and territorial planning, as well as on the urgency of an update of the planner's competences and of the instruments of territorial government in the elaboration of possible strategies of regeneration and resilience to climate change (Musco, 2008).

Strategies that imply, as we have seen, an overcoming of the traditionally sectoral approach on these issues, in favour of an integrated approach to urban complexity (Mariano, Marino, 2018) ascribable to the *Ecosystem Based Approach* (IUCN; 2020), as also advocated by the document *Guidelines for Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction* (Secretariat of the Convention on biological diversity, 2019) placing, in particular, emphasis on the need to define the elements of a knowledge process aimed at a spatial definition of the vulnerability of territories to climate change, with specific reference to the possible impacts on the landscape-environmental system, settlement-morphological, infrastructural and territorial endowments, and on the system of socio-economic relations.

Process capable of introducing and accompanying the construction of integrated strategies of climate-proof regeneration, in coherence with the objectives of the European Strategy on adaptation to climate change (EC, 2021), combining the emergency dimension with a perspective of design and transformation of the territory in a sustainable key, in which all the elements of the built environment adapt to the new balances with efficiency and high performance levels.

In the general framework of the research activities carried out by the author, this paper is part of the research conducted within the Department of Planning, Design, and Technology of Architecture (PDTA) at Sapienza University of Rome, with the university research work entitled “Strategie di rigenerazione urbana per territori climate proof. Strumenti e metodi per la valutazione della vulnerabilità e per l'individuazione di tattiche di resilienza degli ambiti urbani costieri soggetti a sea level rise” (“Urban regeneration strategies for climate-proof territories. Instruments and methods for assessing vulnerability and identifying tactics of coastal urban environments subject to sea-level rise”) (Principal investigator: Prof. Carmela Mariano). Dealing with the issue of the relationship between climate change and the government’s land management policies, the paper investigates how urban planning regulation may provide responses to the need for planning and designing the coastal urban settings affected by flooding phenomena as a consequence of gradual sea-level rise (SLR). Associated with other climate events like storm surges, this phenomenon doubtlessly represents one of the next challenges with which the “world risk society” (Beck, 2013) will have to grapple, both for the growing impact on cities and territories, and for the empirical evidence of the economic, social, and environmental damage it causes.

2. Literature review and objectives of the research

The global mean sea level (GMSL) is constantly rising, accelerating in recent decades due on the one hand to the shrinking ice caps of Greenland and Antarctica, and on the other to windier tropical cyclones and increasingly intense rains – all phenomena that may be blamed on the higher temperatures highlighted in the SR1,5 report (IPCC, 2018).

In a nutshell, the global forecasts on SLR at 2100 vary from 53 to 97 cm according to the IPCC (2013), and from 50 to 140 cm according to Rahmstorf (2007). In this scenario, a major impact will be seen along the coasts, causing widespread erosion. This impact on the territories’ morphological characteristics will probably trigger internal migration inside the coastal erosion, significantly increasing flood-related risk (Mariano, Marino, 2019a).

An interesting study titled “Mediterranean UNESCO World Heritage at risk from coastal flooding and erosion due to sea-level rise” (Reimann et al., 2018), calls attention to the UNESCO sites located in the coastal areas of the Mediterranean most exposed to flood risk caused by sea-level rise, emphasizing the risk of loss not only on a material level, but also in terms of the people’s cultural identity. This brings the consequent risk of losing the perception of certain landscapes that we may define as “sub limen” , from the Latin Sub Limen (“under the threshold, limit” – the etymological root of “subliminal”), which in this context refers to the limit of the coast, the physical limit between earth and sea that determines the landscape, the transition between the present and future landscapes of territories that are in actuality “suspended” because they are affected by a phenomenon of potential risk of loss¹.

The relevance and currency of the issue dealt with is emphasized by numerous international research institutions, including the European Environment Agency (EEA, 2016) which, in the report “Climate change, impacts and vulnerability in Europe 2016”, expresses the need for European countries to define strategies and plans for territorial adaptation on a national, regional, and local level in order to prevent and manage the risk linked to the climate crisis. The United Nations Office for Disaster Risk Reduction (UNISDR, 2015), in its document “Sendai Framework for Disaster Risk Reduction 2015-2030”, also enshrined the key role of territorial planning in reducing the vulnerability of territories, stressing on the one hand the inadequacy of the approaches and of the sectoral instruments put into play thus far to prevent and mitigate risks, and on the other the need for a transdisciplinary approach that goes beyond the specific points and purview of regulations.

Not least, The 2030 Agenda for Sustainable Development emphasizes the need to “make cities and human settlements inclusive, safe, resilient and sustainable” and urges the signatory states to “take urgent action to combat climate change and its impacts” (UN, 2015).

A study by ENEA, titled “Sea-level rise and potential drowning of the Italian coastal plains: Flooding risk scenarios for 2100,” (Antonioli et al, 2017), published in Quaternary Science Reviews, is an essential, prerequisite document

¹ The issue of “sublimen landscapes” is studied within the research “MEDWAYS Le vie del Mediterraneo”, international scientific cluster, National Academy of Lincei (resp. Mosè Ricci, University of Trento) in the contribution of the PDTA Department, Sapienza University of Rome “Landscapes of the SubLimen. Itinerary between the “suspended” territories of the Adriatic coast “by Carmela Mariano and Marsia Marino (2022 forthcoming).

for this research. In Europe, approximately 86 million people (19% of the population) live within 10 km of the coastline, and in the Mediterranean area this figure rises to 75%. This scenario was also determined by the rapid urbanization of the 1960s, which contributed towards what was in many cases an unplanned development of coastal settlements now exposed to serious flood risk (Sterr et al., 2003).

The areas at greatest risk are those in Turkey (Anzidei et al, 2011), the coastal area of the Northern Adriatic (Antonioli et al., 2007; Lambeck et al., 2011), the Aeolian Islands (Anzidei et al., 2016), the coasts of Central Italy (Aucelli et al, 2016) and eastern Morocco (Snoussi et al., 2008). As for Italy, the study by Lambeck et al. projected a sea-level rise in 2100 based on the IPCC 2007 report and Rahmstorf (2007), whose results show that, assuming a minimum rise of 18 cm and a maximum of 140 cm, 33 Italian coastal areas will be flooded by the projection date. For the Italian region being investigated (Northern Adriatic, Gulf of Taranto, and Sardinia), by the year 2100, a sea-level rise of 53-97 cm (IPCC, 2013 – RCP 8.5) and 140 cm (Rahmstorf, 2007) is hypothesized.

In addition to the social and environmental stressors that have long been acknowledged to affect urban areas, IPCC Reports have unequivocally identified cities as exposed and vulnerable to climate change, and liable to be subject to the projected impacts of sea level rise and of an increased frequency of extreme events, such as heatwaves and floods. At the same time, due to their high population density and concentration of human activities, cities are themselves major contributors to greenhouse gas emissions. It is therefore urgent that specific planning strategies are developed and implemented, jointly addressing both mitigation and adaptation targets, highlighting potential synergies, and resolving conflicts and trade-offs.

The urgency to face the challenges related to climate change in terms of mitigation, adaptation and possible transformation of sensitive territories affected by risks and degenerative processes has prompted in recent years a reflection on the responsibilities of policy makers in transposing these issues into urban agendas. More generally, this aspect has brought out the need to both update the skills of the urban planner and territorial governance tools, with the aim of developing possible regeneration and resilience strategies to climate change.

The objective of the research is to identify theoretical/methodological and operative references for trialling and innovating the content of urban planning regulation, with particular reference to the need, on the one hand, to expand the framework of knowledge of the possible impacts on the territory produced by climate change, and, on the other, to provide for adaptation strategies and site-specific actions aimed at resolving the risk.

For this reason, the research highlights the need to overcome land governance policies' traditionally sectoral approach to the issue of climate change, in favour of climate-proof planning, through lines of deeper analysis that adopt an experimental, integrated, multi-scalar, and iterative method, and that bring the work fully into the scientific and disciplinary debate.

3. Methodology

In the general framework of the research activities carried out by the author, the contribution gives back part of the results of a work of analysis and critical evaluation of some planning experiences carried out at national and European level, which allowed, through an inductive method, to identify two different approaches of the tools promoted by the Local Authorities and Territorial Agencies in a climate-proof perspective (Maragno et al, 2020).

A first approach refers to a strategic dimension, related to the supra-municipal planning level (metropolitan or regional area), which identifies the main strategies for adaptive and resilient cities to climate change.

A second one recalls a regulatory dimension, mainly referred to the municipal planning level, which highlights a gradual process of integration of the plan contents, both in terms of implementation of the cognitive framework of the vulnerability of the territories, with the preparation of management drawings that give the consistency of the areas affected by the risk phenomenon, differentiated by level of hazard and in relation to possible time horizons analysed (heat islands, floods, alluvial phenomena, subsidence, etc.); both in terms of identifying possible mitigation and adaptation project actions on "target" areas identified by the Plan, from which to identify quantitative and qualitative indicators/requirements/standards, referring to the measures adopted (Mariano et a, 2021).

In particular, the activity of analysis and critical analysis was based, on the one hand, on the study of dossiers and reports prepared by public administrations (PAs) and published on institutional websites, articles and scientific proceedings, and, on the other, on interviews and meetings with representatives of the PAs concerned.

In particular, the criterion for choosing the case studies, attributable to the two approaches, considers the prevalence of a strategic approach in the planning tools adopted in the Italian national context, instead the examples of the international context also highlight the presence of a experimental with the identification of specific actions and guidelines for climate adaptation.

In general, the plans were analyzed that in general terms deal with the issue of the response to climate change, regardless of the presence in the reference territory of a specific sea level rise risk problem. For this reason, among the plans of the Italian national context, the Strategic Plan of Milan is present, in addition to that of Milan and Venice, because it is configured as a recent example of strategic planning of a large area, the Metropolitan City (established in following Law 56/2014), which highlights a focus on new issues and new perspectives for action prompted by climate-change.

4. Case studies

The research activity concentrated on a comparative assessment of certain trials of strategic plans in italian national (Genoa, Milan, Venice) and international (Vejle, Rotterdam, New York) settings.

With reference to the examples of strategic planning in a national setting (referring to the metropolitan cities of Genoa, Venice, and Milan), general guidelines emerge with respect to the issue of the territory's adaptation to climate change. By priority, these are oriented towards implementing urban policies with a short-term (3 years) temporal horizon that does not meet the need to outline a structured medium- and long-term vision, in order to respond to the issues related to climate change. These guidelines are, in particular:

- sharing a common horizon and a multi-actor convergence upon an action strategy, while at the same time recognizing the various players' specific characteristics and autonomy;
- strengthening dialogue between the various levels of governance and between public and private players, involving stakeholders and citizens in close connection with the world of research and innovation;
- adopting a knowledge-based approach and fostering the integration of the various land governance instruments with a view to "downscaling" (Musco, Fregolent, 2014), as recommended by the Venice strategic plan (2018) that emphasizes the need to promote a coordinated management of the environmental Plans system, and by the Milan plan (2019) that highlights the need to join together the land governance instruments that, on various levels, deal with the environment;
- considering the adaptation actions' complementariness with the mitigation interventions alone;
- promoting forms of sustainable financing for urban projects aimed at reducing land consumption and at increasing urban and environmental quality (Milan, 2019);
- carrying out the regular monitoring and assessment of progress towards adaptation (Genoa, 2017).

On the other hand, as to the analysis of strategic planning case studies in an international setting, alongside the content of a general nature and of urban policy, a markedly experimental approach emerges, more oriented towards identifying site-specific planning responses depending on the orographic and geomorphological characteristics of the territory (Todaro et al., 2009). This requires strategic approaches diversified depending on the cases and articulated in accordance with scenarios of a short, medium and long-term vision although some of the strategic plans are mainly oriented towards a long-term (Rotterdam) or medium-term (New York) vision.

The temporal horizons often referred to for medium- and long-term visions are 2050 and 2100, while through 2050, short-term strategies and good practices are outlined.

Each territory requires a site-specific approach. However, it is equally true that, on a strategic level, certain, recurring conditions can be found; this has made it possible to systematize the cases deemed, in this research's opinion, essential

for defining urban regeneration strategies in settings affected by the effect of sea-level rise, or considered at future risk of flooding – strategies that are such as to guarantee an urban planning development that is long-lasting and resilient over the long term.

Table 1. Comparative overview of the contents of strategic plans (by C. Mariano, 2021)

National setting	Strategies
Strategic plan of the metropolitan city of Genoa	climate-proof urban policies
Strategic plan of the metropolitan city of Milan	climate-proof urban policies
Strategic plan of the metropolitan city of Venice	climate-proof urban policies
International setting	
Vejle’s Resilient Strategy	climate-proof urban policies and design strategies for defense, adaptation and delocalization
Rotterdam Climate Change Adaptation Strategy	climate-proof urban policies and design strategies for defense, adaptation and delocalization
One NYC 2050. Building a strong and fair city	climate-proof urban policies and design strategies for defense, adaptation and delocalization

The Vejle’s Resilient Strategy (approved in 2013 and updated in 2019), promoted in the context of the 100 Resilient Cities partnership, takes into its corpus the three macrostrategies (defence, adaptation, delocalization), theorized in the research setting. It is articulated in four key strategies for a resilient urban development (Mariano, Marino, 2018), making reference to the content of a general nature already surveyed in the strategic plans analyzed in the national setting:

- “Co-creating city,” a slogan that refers to public/private collaboration for the performance of structural interventions, like the creation of an information and experimentation centre – the “Laboratory for climate change adaptation and flood control” – aimed at managing fjord flood risk;
- “Climate resilient city,” which makes reference to the repercussions of climate change on the city’s infrastructures, such as for example the port, the coastal area, communications infrastructure, the water system and the sewer system, and for which it calls for targeted actions aimed at increasing these systems’ resilience;
- “Socially resilient city,” which instead aims to increase social and economic cohesion thanks to the citizens’ active involvement from the decision-making to the realization phase; this is also done by promoting the dissemination of the strategies proposed through the drawing up of updated catalogues, in order to promote Vejle as a “pilot city,” an international model of urban resilience;
- “Smart city,” which promotes the introduction of digital technologies for managing the risks connected to climate change, but also relating to the daily management of traffic, modes of parking, and information on the climate and on tourism (Vejle Kommune, 2013).

However, beyond the content of a general or urban policy nature, the strategic plan defines the areas at flood risk and identifies priority settings for intervention, for which a vision, articulated in various temporal horizons – 2025, 2050, 2100 (Figure 1) – was outlined.

Articulated by temporal horizons, the site-specific actions relate to planning interventions included in the defence strategies, with works of environmental engineering, adaptation with nature-based solutions, and delocalization with the possibility of building resilient neighbourhoods (Vejle’s Resilient Strategy, 2013).



Figure 1. Settings at flood risk starting from 2030; areas above 2 metres in elevation are in yellow. Source: Stormflodsstrategi. Stormflodsbeskyttelse der gror med byen (2019).

The Rotterdam Climate Change Adaptation Strategy (2013) identifies four general strategies for the city’s adaptation to the flooding phenomenon:

- Reinforcing and constantly updating the defence system against floods, storm surges, and sea-level rise, to protect settled areas);
- Adapting the urban space to flood impacts;
- Promoting an integrated planning in favour of a resilient urban development;
- Promoting working opportunities in the field of adaptation to climate change, thus strengthening the economy, improving quality of life, and protecting biodiversity.



Figure 2. Settings at flood risk, forecast at 2100, indicating the infrastructure at risk. Source: Rotterdam Climate Change Adaptation Strategy (2013).

In this case as well, the plan defines certain settings at flood risk in 2100, emphasizing the main infrastructures affected by possible flooding (Figure 2). For these infrastructures, a vision is set out that, despite the prevalence of the defensive strategy approach, articulates three strategies for a resilient metamorphosis of the public spaces exposed to risk:

- “sponge”: water plazas, infiltration zones, and green spaces;
- “protection”: dams and coastal protection;
- “control” of flood events: evacuation routes, water-resistant buildings, and floating structures (Rotterdam Climate initiative climate proof, 2013).

The *One NYC 2050. Building a strong and fair city* (2019) Strategic Plan, drawn up as part of the 100 Resilient Cities and Mayor’s Office of Resiliency project, considers the City of New York to be one of the metropolitan areas most affected by flooding phenomena caused or aggravated by sea-level rise, as took place on the occasion of Hurricane Sandy (2014).

The plan, which anticipates the municipal administration’s vision at 2050, is structured in eight general goals articulated into thirty specific initiatives.

In particular, as regards the specific initiatives of goal no. 6 “A livable climate,” we find:

- Achieve carbon neutrality and 100 percent clean electricity;
- Strengthen communities, buildings, infrastructure, and the waterfront to be more resilient;
- Create economic opportunities for all New Yorkers through climate action;
- Fight for climate accountability and justice.

As with other international examples, the Plan identifies some settings for which, while not setting the exact perimeter of the areas at flood risk, it shows the areas currently subject to flooding, and that will continue to be so in the future; areas not currently affected by flooding but that will be so in the future (2020, 2050, and 2080); and areas that are not – and that are estimated not to be – affected by flooding phenomena. (Figure 3).

The *One NYC 2050 Strategic Plan* outlines a medium-term vision and has 2050 as its temporal horizon of reference.

Of the plan’s thirty specific initiatives articulating the eight goals, initiative 21 “Strengthen communities, buildings, infrastructure, and the waterfront to be more resilient” defines certain strategic lines referring specifically to urban adaptation to the phenomenon of sea-level rise:

- Mitigation of risk, which calls for the implementation of projects to protect vulnerable coastal areas in Lower Manhattan, Red Hook, the Rockaways, Jamaica Bay, the East Shore of Staten Island and other risk areas; an initiative to strengthen sewer infrastructure in order to deal with possible flood events is planned;
- “Climate-smart” adaptation, which calls for building awareness among property owners in the floodplain on climate change issues, in order to incentivize ordinary and extraordinary maintenance on their properties so as to make the building stock resilient to possible flood events (subsidies for this are provided); promoting and supporting non-profit organizations providing assistance to citizens residing in risk areas; and increasing the percentage of public greenery and green infrastructures;
- Integration of policies and instruments of land governance, which will involve updating building codes and zoning on a local level in support of the planned adaptation initiatives (One NY2050, 2019).

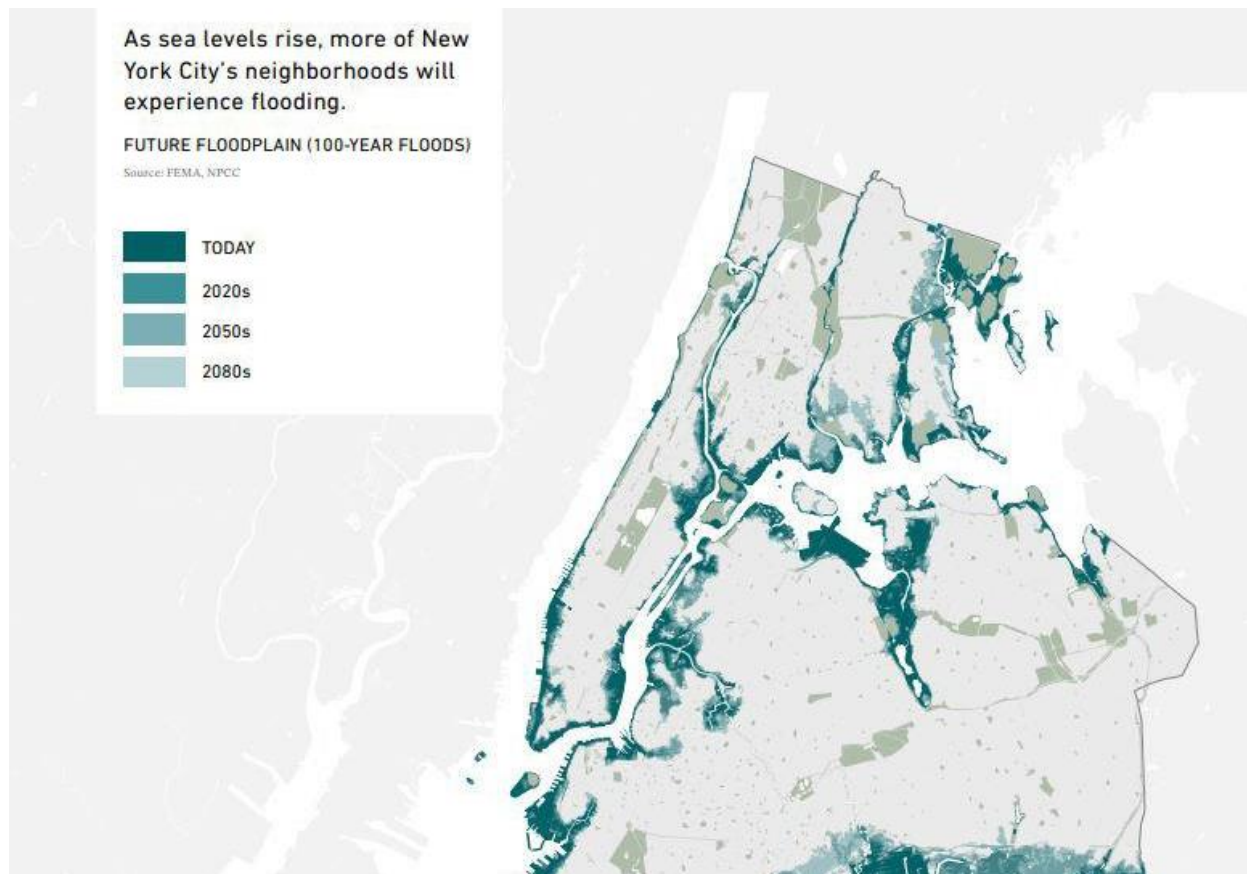


Figure 3. Areas at flood risk from the present to 2080. Source: One NYC 2050. Building a strong and fair city.

5. Results and Discussion

These research experiences, show the search for a transcultural continuity of objectives and actions, in the dual strategic and regulatory form of plans, and take on and operationally decline crucial issues at the heart of EU policies for sustainable development (Europe 2020 Strategy) and climate change, for the improvement of territorial connectivity and the harmonisation of ecological, landscape and cultural values (EU, 2011), the promotion of city efficiency in a smart and green perspective, concretely pursuing an integration between urban planning and ecology.

With reference to the analysis of the Strategic Planning case studies in the international context, the research highlighted the presence, alongside the contents properly referred to the construction of a general vision of mitigation and adaptation strategy, of a markedly more experimental approach oriented towards also identifying site-specific project responses articulated according to short, medium and long-term vision scenarios. For these horizons, certain prevalent action strategies are outlined that are placed within the strategies of ecological urban regeneration. Within them, they articulate general guidelines for climate-proof urban policies and objectives and actions that may be placed in three design macrostrategies identified after the analysis: defence, adaptation, and delocalization (Mariano, Marino, 2019b).

The three prevalent approaches refer respectively to the need to defend the territory by means of environmental engineering works; to the appropriateness of increasing the urban structure's resilience to flooding phenomena in those areas for which defense works should prove insufficient; and to the appropriateness of delocalizing activities and settlements present in the areas exposed to greater risk, to others that are geomorphologically safer.

The defense strategy identifies (short-term) actions for the mitigation of and protection from the risk phenomenon, relying on hydraulic engineering works able to attenuate the extreme event's impacts on the territory.

Adaptation actions and strategies represent a complementary approach to mitigation. This approach implies the population's ability to continue living their habitat while making adjustments that can reduce flood impact to a minimum; and it involves practices of urban regeneration of compromised territories (Boateng, 2008) – practices that

can effect urban development with a view to sustainability and resilience (Salata, Giaimo, 2016), also by relying on the adoption of nature-based solutions (NbS) as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” or solutions inspired to the *Ecosystem-based Approach* (EbA) that involve a wide range of ecosystem management activities to increase the resilience and reduce the vulnerability of people and the environment to climate change (IUCN, 2020).

The third macrostrategy that has been conceived refers to the need to rethink the urban planning development of the settled coastal strips with a view to their ecological regeneration. This raises the need for new, flexible urban models capable of responding to heightened usership on existing services, while guaranteeing the population’s access (Bukvic, 2015; Bates, 2002; Mele et al., 2016; Davenport et al., 2016), to the point of outlining certain potential scenarios for the long-term relocation of the stricken population, possibly to be adopted as part of a regional relocation strategy for “climate crisis migrants” (Brent et al., 2015).

6. Conclusions

The comparative analysis of the strategic planning experiences conducted in an international setting, with particular reference to the content referring to climate-proof planning, underscores the “strategic role of knowledge” (Talia, 2020) in identifying – as a prerequisite for defining site-specific design actions – the territorial settings affected by the flood risk phenomenon as a consequence of sea-level rise.

Developing this knowledge framework allows policymakers and planners to interpret the content of the areas affected by the risk phenomenon, differentiated by level of danger and in relation to any temporal horizons analyzed for the medium and long term; and to provide for a possible adoption of indications relating to the detailed intervention categories aimed at resolving the risk within the planning instruments, with particular reference to the scale of local urban planning.

In this sense, it is emphasized, in the Italian national setting, how urgent it is to support and incentivize the building of complete and comprehensive databases, and to expand the framework of deliverables for more in-depth knowledge of the territory, aided by geographic information systems (GIS) and relying on the tools and methods of remote sensing and climate modelling aimed at the preliminary construction of vulnerability and risk maps of coastal urban settings, and at the consequent implementation of the planning instruments’ territorial knowledge frameworks. The purpose is to guide the definition of intervention macrostrategies and the choice among the actions of defence, adaptation, and relocation for the territories affected by the risk phenomenon (Mariano et al., 2021).

Monitoring of actions is a very important aspect of a successful adaptation plan, as is the case for any spatial planning tool.

The main difficulty in monitoring urban adaptation to climate change arises, in fact, when trying to measure (in quantitative terms through indicators) the effects of an action defined by the plan and its contribution to increasing the resilience of the area targeted by that action.

In this sense, the need is highlighted for a constant updating of the cognitive framework of the territory, through innovative elaborations and databases able to manage and share environmental, climatic, urban and economic information and a periodical evaluation of the results obtained through the implementation of strategies and site-specific climate-proof actions, which allows, in relation to new instances and monitoring results, to start a constant process of updating and adjustment of the Plan.

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