

## Article

# Spatial Planning and Climate Adaptation: Challenges of Land Protection in a Peri-Urban Area of the Mediterranean City of Thessaloniki

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**Abstract:** The growing interest in climate change and related risks has triggered efforts to address both its causes and impact. Climate action is mainstreamed in various public policies in which spatial planning has a key role and operates as a coordinating framework as well as one that enables specific interventions. At the same time, land, an indispensable element of spatial planning, is gaining attention as a natural resource that is closely related to climate change. Increasing need for land protection raises the need for a renewed role of spatial planning of all types and levels. This paper examines issues of land protection related to climate change in a peri-urban area of the Thessaloniki metropolitan area in Greece and seeks to identify how the types of spatial planning contribute to land protection. It is argued that when viewing land protection from a climate adaptation perspective, a renewed relationship between the types and levels of spatial planning that demands emphasis be placed on their cooperation and the enabling of novel approaches such as nature-based solutions becomes apparent.



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**Keywords:** spatial planning; climate adaptation; land protection; Thessaloniki; nature-based solutions

## 1. Introduction

Over recent years, climate change has constituted a major challenge for public policy making, due to the need for urgent action [1,2] that aims to address both its causes and impact at the various levels, from global to local [3]. Spatial planning in particular is capable of playing a key role in addressing climate change. It can promote climate adaptation as a framework for the coordination of various activities over a specific territory and a mechanism for the implementation of adaptation measures on the ground. A first conceptualization of this relationship emerges from the forms of relationships existing between spatial planning and the environment from which the designation of environment as a risk is the one closest to climate change issues [4,5]. Despite the fact that natural risks such as flooding and forest fires have long concerned spatial planning even before the climate change agenda had come to the fore, they also pose challenges to spatial planning from the viewpoint of disaster prevention and climate adaptation and highlight the need to enable novel solutions through spatial planning.

The role of spatial planning in climate action has been widely acknowledged [5–7], and at the same time, challenges stemming from climate change affect the very nature of spatial planning, and thus call for a rethinking of its rationale and a renewal of its mechanisms and tools. This is true for the entire spectrum of spatial planning, from regulatory to strategic. Among the key elements of spatial planning that demonstrate the need for a renewed approach, land stands out since its role in climate change is indisputable. This in turn poses challenges to both land use planning and strategic spatial planning that require a reconsideration of their role and scope. It seems important that not only the instruments provided by spatial planning be utilized in the pursuit of climate adaptation and mitigation but also that novel tools be incorporated into spatial planning.

Land protection in metropolitan areas is highly appropriate for examining the above issues because land is a subject of key importance for both spatial planning and climate policies. Metropolitan areas enable all types of spatial plans and all forms of planning from strategic to regulatory, while the complexity of problems related to climate change in these areas is becoming urgent [8]. Metropolitan areas with similar climatic, geomorphological and socioeconomic characteristics face common challenges in terms of land protection, spatial planning, and climate adaptation. Mediterranean areas are characteristic in this respect, as they share similar experiences regarding climate change impacts and land management. A medium to high vulnerability to potential climate change impact is expected in these areas [9]. The following climate change impacts have been observed in and projected for 12 European transnational Mediterranean regions: an increase in air temperature, duration and intensity of heat waves, frequency and intensity of droughts, sea surface temperatures, and seawater acidification; a decrease in precipitation and water availability; and river run-offs together with a rise in sea level and loss of biodiversity in the marine ecosystems [10]. Urban agglomerations on the coastline are predominantly characterized as “hot spots” of potential climate change impact [9]. In these areas, land is subject to inefficient regulation and weak implementation of spatial planning that has led to an extensive change to the peri-urban space in the form of continuous urban sprawl and increasing land take [11]. Land use change in the coastal zones of Europe is considered to be an indicator to evaluate the future status of these areas, since land use constitutes a key driver for interaction between natural and anthropogenic processes. This relates to the increased vulnerability of coastal areas in Europe due to the increase of built-up areas [12].

This paper examines issues of land protection in the context of spatial planning from a climate adaptation perspective with a focus on a peri-urban area of Thessaloniki, a Mediterranean coastal city in Greece. By considering the role of land in the ecosystem approach, the paper seeks to identify how types of spatial planning contribute to land protection and the importance of novel solutions that are nature-based solutions in this case. The second part of the paper outlines theoretical considerations on land protection with respect to spatial planning. Based on these considerations, the third part sets the methodological framework by identifying three types of planning pertaining to climate adaptation. The fourth part examines a flood-prone area of the peri-urban area of Thessaloniki and how land protection is addressed by spatial planning. In the fifth part, the case study is discussed and concluding remarks are made.

## 2. Spatial Planning for Climate Adaptation and the Parameter of Land

The role of land as a natural resource has long been neglected, and the fact that it is a finite resource has been ignored. Recently, the significance of land has been accentuated by both the sustainability and climate change agendas [13]. Efforts towards minimizing land degradation involve two policy options: the sustainable management of land in order to slow down degradation, and an increase in the restoration rate of degraded land so that the two trends can converge to minimize land degradation [14]. Competition for land has led to the recognition of its scarcity, above all that of fertile land caused by land degradation and by increasing population with its consequent demand for food and energy especially in urban areas [15].

The close relationship between land and climate change is emphasized since “the way we use land drives climate change and climate change adds stress to land systems and so worsens existing risks to people and nature” [16]. Changes in the conditions of land that are caused either by land use change or by climate change affect climate at both global and regional levels. At the regional level especially, such changes can “reduce or accentuate warming and affect the intensity, frequency and duration of extreme events” [17] (p. 13). Land degradation usually appears in the form of land take, land fragmentation, and soil sealing. It has negative impacts on human and ecological systems and severely affects ecosystems and threatens ecosystem services [18,19]. Thus, the growing interest in combating land degradation has led to action in scientific and policy fields as is evident

in the actions of world organizations for combating climate change, such as the UN and the EU.

While land use and land cover change are key drivers of land degradation, the role of policies, plans, and regulations in land use, that is the role of spatial planning, only recently came to be emphasized [20]. For many years now, spatial planning has been “an enduring feature of most nations’ attempts to manage land use changes, the growth and contraction of cities, the renewal of infrastructure and the use of resources, balanced against individual and societal preferences within a democratic arena” and is subject to continuous transformations [21] (p. 6). The sustainability agenda has highlighted land-related challenges faced by spatial planning, as it was urban sprawl that led to the adoption of policies seeking to reduce land take such as the compact city model and land recycling practices.

The ecosystem approach based on ecosystem services (ES) brings land into the epicenter of the effort towards climate adaptation and disaster risk reduction. Through its direct effect on the spatial organization and allocation of human activities and relevant infrastructure, it affects land use change and leads to urban transformations, which in turn “affect ecosystems and the services they provide, thereby affecting human well-being. By adopting an ES-based approach to land use planning, development strategies can take into account ES provision” [22] (p. 2). Based on these considerations, Ronchi, Arcidiacono, and Pogliani propose a methodology for assessing ES in order to identify areas suitable for urban transformation and set sustainability criteria to achieve this [22].

Different forms of spatial planning contribute to managing land use [21]. Spatial planning addresses land-related issues either in a normative way through land use regulation, or in a strategic way, through the creation of a coordinating framework that provides policy guidelines for territorial development. The role of strategic spatial planning in climate adaptation strategies appears to be promising since in many countries spatial planning is not given much attention by climate adaptation strategies, but when it is, it is primarily an issue “of political willingness and capacity building” [23] (p. 27) that pertains mostly to strategic spatial planning. Strategic spatial plans provide frameworks for action instead of directly determining land management and the allocation of uses, which is the task of land use planning. Strategic plans usually refer to “(1) how much growth is expected and/or desired to fulfill the region’s need for economic development and housing, (2) where distinct types of urban development (e.g., dense housing, single family homes, mixed uses, industrial facilities) should unfold, and (3) which areas should be protected in order to assure the long-term persistence of natural and cultural assets” [20] (p. 33). Therefore, they support the pursuit of multiple purposes in changing local situations and facilitate discussions with citizens and other actors.

Spatial planning not only provides tools for applying climate change policies but also operates as a “democratic arena” that promotes negotiations and “place-based synergies” [24] (p. 16). It is suggested that both “flexibility and adjustability” as well as “robust and sound provisions” are needed due to the uncertainty characterizing climate change [25] (p. 35). Another suggestion is that whereas planning by law, that is by land use regulations, is indispensable, a combination of land use planning and strategic planning could be used in order to avoid the deficiencies of each [26]. When it comes to climate adaptation, regulatory planning (planning by law) can decrease flexibility and lead to “lock-in situations”, which are not easy to overcome when planning for climate adaptation is needed. Strategic spatial planning in the form of collaborative planning can contribute to a decrease in inflexibility in order to avoid “lock-in situations” [26].

Recently, the risk approach has highlighted the importance of land in relation to spatial planning, since provisions made by spatial planning for land use and land protection have to meet urgent challenges of disaster risk reduction. Climate change has brought us to the complex relationship between spatial planning and land. The role of ecosystems in climate adaptation and disaster risk reduction has highlighted the catalytic role of nature in this relationship and has led to the elaboration of nature-based solutions. This is, for instance,

the case of flood prevention, which led to the adoption of measures aimed at reducing soil sealing in the form of green infrastructure [27].

For urban and peri-urban areas in particular, which are vulnerable to climate-induced risks such as heat waves, flooding, droughts, and forest fires, there is a need to utilize appropriate measures. Growing densification and artificialization of urban and peri-urban land, respectively, leads to loss or degradation of natural areas, and consequently to loss of biodiversity and ecosystem services [28]. Given the capability of blue and green areas to enhance ecosystems “as essential backbones to climate change mitigation and adaptation” and promote sustainability in general, specific terms are introduced and relevant tools utilized, for instance green infrastructure, with the aim to promote systemic solutions through ecosystem services, all of which are described under the heading of nature-based solutions (NBS) [28] (p. 2). According to a report by the EU Horizon Programme [29], nature-based solutions

“[ . . . ] are actions which are inspired by, supported by or copied from nature. Some involve using and enhancing existing natural solutions to challenges, while others are exploring more novel solutions, for example mimicking how non-human organisms and communities cope with environmental extremes. Nature-based solutions use the features and complex system processes of nature, such as its ability to store carbon and regulate water flow, in order to achieve desired outcomes, such as reduced disaster risk, improved human well-being and socially inclusive green growth. Maintaining and enhancing natural capital, therefore, is of crucial importance, as it forms the basis for implementing solutions. These nature-based solutions ideally are energy and resource-efficient, and resilient to change, but to be successful they must be adapted to local conditions”. [29] (p. 5)

NBS are also defined as “sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to build more resilient communities” [30] (p. 4). NBS have four key goals: enhancing sustainable urbanization, restoring degraded ecosystems, developing climate change adaptation and mitigation, and improving risk management and resilience [29].

On the basis of the scale of intervention, NBS can be divided into three categories: “watershed or landscape scale, neighborhood or site scale, [and] coastal areas” [30] (p. 5). Another categorization is based on the types of the ecosystems addressed by NBS, which are identified as follows: “Type 1: better use of natural/protected ecosystems (marine protected areas networks and fisheries). Type 2: NBS for sustainability and multifunctionality of managed ecosystems (innovative planning of agricultural landscapes). Type 3: design and management of new ecosystems (e.g., greening buildings, artificial ecosystems)” [31] (p. 245). These categorizations can serve as frameworks for identifying appropriate solutions for respective areas in the context of adaptation strategies.

NBS proceed from strategy to action as they combine visionary elements, above all inspiration from nature, with pragmatic ones, such as the realization of actions supported by nature. The need for a combination of regulatory with strategic elements in a systemic and holistic way is inherent in the way NBS are promoted. As noted in the guide for local communities by Federal Emergency Management Agency (FEMA) [30], “Planning and carrying out nature-based solutions requires an integrated approach that works across agencies and departments”. This is evident in the way it provides guidelines for incorporating nature-based solutions through community planning processes and programs in order to promote resilience. More particularly, for land use planning it is suggested that first the goals and principles should be set, which we can assume corresponds to strategic level planning. Then, depending on the type of nature-based solutions selected by the community, detailed guidelines can aim to “Establish riparian buffers and protect stream corridors; Direct development to previously developed areas and areas with existing infrastructure; Promote compact (e.g., mixed-use and transit-oriented) development; Reduce impervious cover; and Modify landscape requirements, including tree protection requirements”. In addition to land use planning, it is suggested that hazard mitigation planning incorporates

NBS not only into specific actions and projects but also in broad and long-term goals which can benefit from “education and outreach, and incentive-based programs” and the mainstreaming of NBS into various programs and policies [30] (pp. 14–15).

The methodology suggested by the EU Horizon report [29] for delivering evidence-based NBS makes a distinction between general policy objectives and specific interventions, by noting that separation of general objectives into specific interventions is the way to overcome the mismatch between policy and evidences. Such an approach resembles the way strategic spatial planning provides guidelines for detailed planning and its implementation. In turn, detailed evidence can be drawn from a pool of detailed solutions that can promote a common objective while their selection is based on local circumstances and characteristics [29].

### 3. Methodology

Evidently, from a climate adaptation perspective, land is the subject matter of many adaptation options that are enabled by spatial planning and that have recently taken the form of NBS. In terms of methodology, the choice is to identify how the different types of spatial planning involve and contribute to land protection from a climate adaptation perspective in both theory and practice. To do this, based on the above theoretical discussion about the role of spatial planning in land protection through a climate adaptation perspective and the contribution of NBS to this, it is essential to identify the types of plans involved.

Davoudi [6] (p. 5) suggests “key climate change policies”: (a) climate change mitigation through energy supply, (b) climate change mitigation through energy demand, and (c) climate change adaptation (in the cases of flood risk and heat waves), and also identifies three types of planning interventions for each of them, namely proactive planning, regulatory planning, and strategic coordination.

According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), three categories of adaptation options can be identified, namely structural/physical, social, and institutional. Among them land is addressed mostly within the context of the institutional options, and more specifically within the subcategory of laws and regulations, whereas the subcategory “government policies and programmes” includes many land-related adaptation options [32] (p. 845).

The way in which the types of spatial planning are involved in climate adaptation is evident in the options set by the European Climate Adaptation Platform [33]. From a sectoral perspective, the option “Adaptation of Flood Management Plans” recommends actions contributing to climate proofing that include “both adapting constructions to mitigate the risk of flooding in flood-prone areas and the modification of behavior to reduce risk of those living/working there”. From a land use planning perspective, the option “Adaptation of Integrated Land Use Planning” recommends land use measures such as “changing land use in a way that it positively affects the regional water balance” and “zoning, building codes, such as minimum floor heights and water proofing, as well as land use permits” to prevent exposure to risks. From the perspective of strategic planning, the option “Adaptation of integrated coastal management plans” is based on an integrated and ecosystem-based approach and at the same time “promotes a strategic (long-term viewing), integrated and adaptive approach to coastal zone planning and management” with a view to sustainable development of coastal areas [33].

Overall, it seems that three different types of planning can be identified when seeking to address climate adaptation, as shown in Table 1.



**Table 1.** Types of spatial planning for climate adaptation.

Source/Context	Type of Intervention		
Davoudi (2009) [6] (p.5)	“Proactive through plans, strategies, SPG [Supplementary Planning Guidance]; resource mobilization”	“Regulatory through development control”	“Strategic coordination through consultation/collaboration”
IPCC 5th Assessment Report [32]	Structural/physical	Institutional	Social
European Climate Adaptation Platform [33]	Sectoral (adaptation of flood management plans, adapting construction, modification of behavior)	Land use planning (changes in land use, zoning, building codes, building permits)	Strategic (integrated coastal management, stakeholders’ involvement, vertical and horizontal integration)

Source: [6,32,33] (own elaboration).

In addition to established types of spatial planning, instruments of spatial planning for high-risk areas include compulsory purchase, which is very costly, land development in the public interest following the purchase of land, and consensual relocation to safe areas where public land is available [34]. When it comes to policy implementation, there is a need for specific options enabled by spatial planning. As indicated in the ARMONIA research project [35] (pp. 37–38), spatial planning includes the following types of action for hazard mitigation: “Keeping areas free of development”, “Differentiated decisions on land use”, “Recommendations in legally binding land use or zoning plans”, and “Influence on hazard intensity and frequency (hazard potential) by spatial planning”, all of which involve decisions as to the use of land.

Greiving and Fleischhauer [23] identify strengths and weaknesses of spatial planning with regard to climate change adaptation. They distinguish 10 adaptation options and evaluate their performance as poor, fair, and good. Options concerning the adaptation of existing spatial structures and buildings, changes in land use (differentiation or relocation), and assessments (of exposure to extreme events or climate change impacts) appear to have poor or fair performance. On the other hand, the potential of spatial planning is considered good for “Identification of interaction between land uses and the changing climate”, “New guiding principles (such as ‘resilience’)”, “Avoiding non-adapted developments”, and “Keeping disaster-prone areas free of further development” (e.g., through zoning instruments) [23] (p. 33).

It can be argued that the nature-based approach can contribute to an improved performance of the various types and options of spatial planning for land protection from the perspective of climate adaptation and risk prevention. First, the ecosystem and nature-based approach can provide a common reference framework for the cooperation and coordination of the various plans. Second, NBS can attribute specific content to the various options and make it easier for planners to communicate these options and find ways to implement them. Options with fair performance can benefit most from the evidence-based approach enabled through the selection of the proper solutions from a pool of detailed solutions that promote the same objective (see for instance the above mentioned EU Horizon report [29]). Even options with poor performance might benefit from the nature-based approach, as in cases of difficulties arising due to established property rights, which are argued to need “incentives and good practices aiming at convincing the private landowners” [23]; such incentives and good practices can be found in NBS.

Based on the above recognition of the types of spatial planning involved in climate adaptation action for land protection as well as the role of NBS, we proceed to examine these in the case of a flood-prone area in the western peri-urban zone of Thessaloniki. The key assumption is that despite the lack of a climate adaptation strategy, the various types of plans, namely sectoral, strategic, and land use plans, provide options for land protection

capable of promoting climate adaptation, while NBS can contribute to a better performance of spatial plans towards land protection. Evidence is drawn from (i) the (non-ratified) draft of the revised Strategic Plan for the Thessaloniki metropolitan area [36]; (ii) the land use plan of the local municipality, a structure plan called General Town Plan (Geniko Poleodomiko Schedio—GPS in Greek) [37]; and (iii) the sectoral approach, which is the Flood Risk Management Plan (FRMP) for the relevant river basin [38].

#### 4. Climate Adaptation and Spatial Planning for Thessaloniki

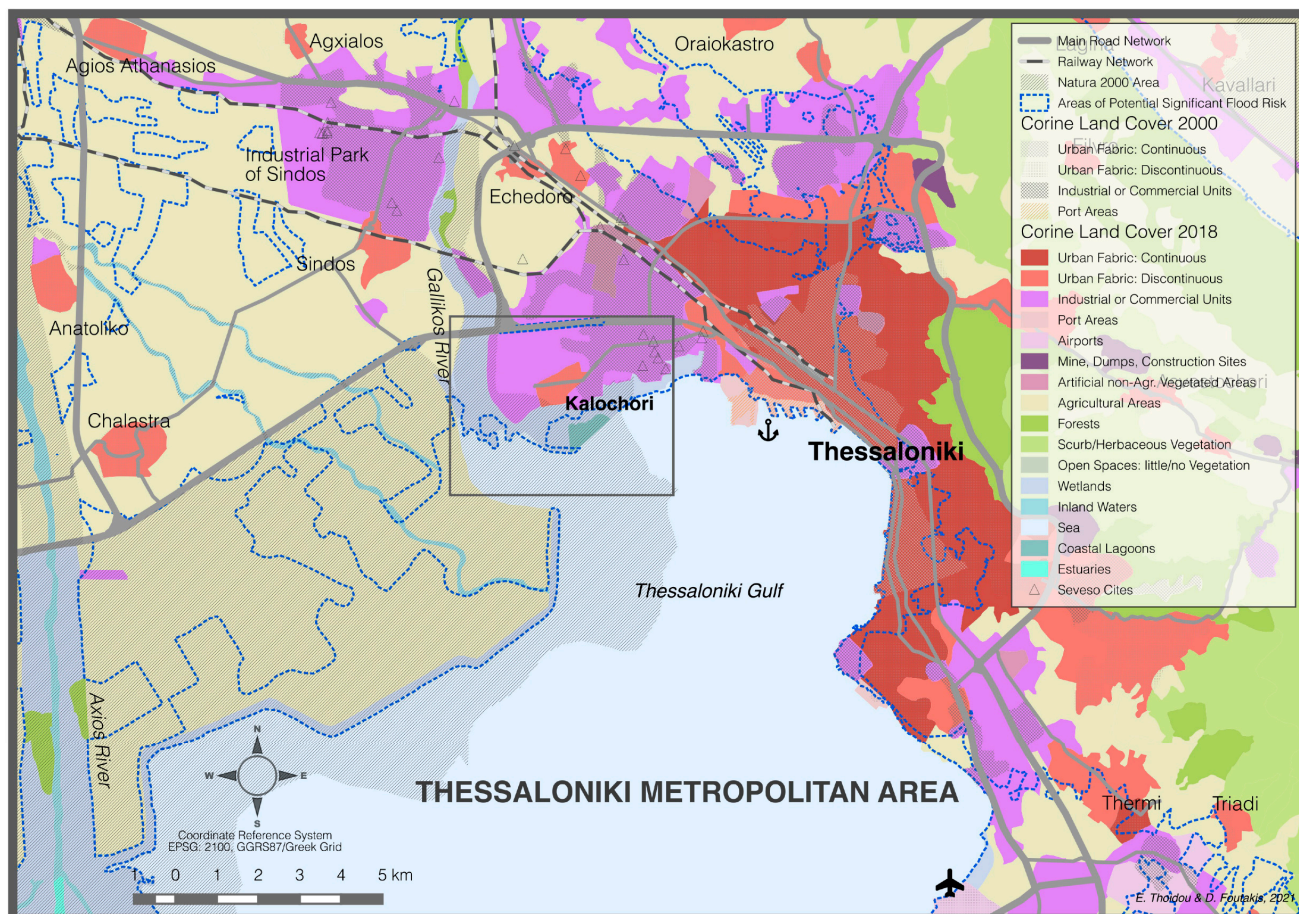
Thessaloniki is the second largest metropolitan area in Greece, with about 1.1 million inhabitants (2011). It is a coastal city located in the Thermaikos Gulf, with a Delta of three major rivers and a broad plain to the northwest comprising the River Basin of Central Macedonia. It is a gateway city with the majority of its transportation and wholesale trade activities located in its central and northwestern part. It is a significant industrial pole, featuring organized industrial sites, with widespread industrial activity located in the northwest. Service sector activities are located in the central and southern part of the metropolitan area, which has been characterized by pressing urban sprawl trends, most heavily in the 1990s. Economic crisis has seriously hit the metropolitan area [39] thus triggering the need for a resilient approach to spatial planning [40].

The regional unit of Thessaloniki (NUTS III level) to which the metropolitan area belongs falls under the Mediterranean region typology of the ESPON Climate Project, combining characteristics of both a metropolitan and a coastal area [9]. According to the ESPON Climate project, Thessaloniki is included in the group of those areas in Europe with the highest “aggregate potential impact of climate change”, and at the same time has a low “overall capacity to adapt to climate change” [9] (pp. 19–21). In terms of land take, a significant increase has occurred during recent decades due to urban sprawl and extensive out-of-plan building. Land cover by artificial surfaces in Greece rose from 2.9% of total land surface in 2009 to 3.4% in 2015, which corresponds to an increase of 17.3% [13]. Evidence for land development pressures can be drawn from data on soil sealing. In 2015 the northwestern coastal zone of Thessaloniki, where the study area is situated, performed high soil sealing, which was the result of a trend towards increase, as the “average annual increase of sealing” (2006–2015) ranged between 0.1% and 0.2% [41]. According to the ESPON project “Sustainable Urbanization and land use Practices in European Regions” (SUPER) [42], in the 2000–2018 period, the daily rate of urbanization for the regional unit of Thessaloniki was in the class of 10,000–20,000 m<sup>2</sup> (the second highest class at the EU level). The increase of urban fabric area is higher than that of population (with a ratio over 1.75, which corresponds to the highest class) [42].

The reference area is situated at the northwest coast of Thessaloniki around Kalochori, a settlement of about 5000 inhabitants, belonging to the Echedoros municipal unit and located on the eastern part of the Axios River Delta (Figure 1). The Delta area is “a system of river estuaries, marshes, lagoons and salt flats” and a biotope of high value, listed in the NATURA 2000 network of European ecological regions, and is protected by the Ramsar International Convention on wetlands. Its largest part is a National Park, with the Kalochori Lagoon constituting the eastern part of the park. Human interventions and engineering works over the years involving its water resources have shaped today’s picture [43].

This area of Thessaloniki is of particular importance in terms of water resources. From the 1930s onwards, a series of major drainage and flood control infrastructure projects and land improvements were constructed in the wider area, which secured land for the development of the settlement of Kalochori as well as other areas. Furthermore, agricultural land was secured in the pre- and post-war periods by the same means. However, the overexploitation of water resources along with increasing pressures on land resulting from human activities has caused severe environmental problems such as land subsidence [44,45]. As noted in the study on the Preliminary Flood Risk Assessment for Greece, this coastal area is protected by coastal dikes owing to the risk of seawater inflow under specific

circumstances [46]. According to the Study by the Bank of Greece on “Environmental and Economic Impact of Climate Change in Greece”, the whole Delta area is among the country’s “low-lying coastal areas” that are highly vulnerable to sea level rise [47] (p. 100).



**Figure 1.** Thessaloniki metropolitan area: northwestern and central coastal zone.

The area’s location to the northwest of the metropolitan area in close proximity to the major transportation hub around the port, together with the fact that the main national road axis runs along the northern edge of the area, has triggered land use and land cover changes. Of particular significance regarding this matter is the 1970s establishment of the planned industrial park in the north of the wider area, which is the largest in the country with a size of about 970 hectares. A huge transformation from agricultural land to artificial land for industrial and commercial uses has been witnessed in the last two decades, as is evident in the CORINE land cover maps of the years 2000 and 2018 [48] (Figure 1). This has led to an increasing degradation of the area’s natural environment, while the built environment is not without problems, such as the persistent lack of green spaces [49,50].

Among the increasing problems of land development and land protection in the area, the expansion of out-of-plan building activity, mainly for industrial and warehouse uses that have formed an informal (unplanned) industrial park, is becoming a serious issue, which urgently needs to be addressed. Despite their favorable location close to the transportation hub of the city, enterprises located there face serious problems due to the area’s characteristics and unregulated land development, such as drainage and flooding problems and a lack of technical infrastructure. This raises the issue of how construction activity can be brought under control bearing in mind climate change-related risks. This has been a challenging issue, primarily in the context of the specification of the GPS of the municipal unit, and more particularly, concerning the preparation of the Town Planning



Study (Poleodomiki Meleti—PM in Greek), which is a detailed local planning instrument required for the extension of the settlement of Kalochori. More recently, the development of the informal industrial park was designated as an issue of priority for the metropolitan area, and the elaboration of a Special Spatial Plan to regulate and upgrade the whole land development was officially announced in 2019, which has yet to be initiated. At the same time, a number of installations and industrial sites that fall within the Seveso Directive are located in the wider area of the municipal unit [51]. This is a challenging issue especially for areas with pre-existing residential and industrial development where it is difficult to ensure the necessary distances between vulnerable areas and hazardous sites.

Concerning sectoral policies contributing to climate adaptation, flood risk management is representative as it is closely linked to land management and spatial planning [52,53]. Flood risk management in Greece follows the EU Flood Directive. According to the Preliminary Flood Risk Assessment for the River Basin of Central Macedonia to which Thessaloniki belongs, the lowlands of the Thessaloniki conurbation as well as those of a stream at the southeastern part, the lowlands of Gallikos River (where the reference area is situated), and three major rivers (the Delta) in the northwest are included in the Areas of Potential Significant Flood Risk (APSFR) [46]. The reference area is part of the area of flood risk GR10RAK0008 for which two potential causes of flooding are identified, namely river flooding and sea level rise [54]. Accordingly, this area is addressed by the Flood Risk Management Plan (FRMP), which is drawn up for all zones at risk in the River Basin (with a medium likelihood of flooding—at least a 1 in 100-year event). These plans are to include measures to reduce the probability of flooding and its potential consequences [55].

Overall, measures provided by the FRMP focus on prevention, protection and preparedness. At this early stage, the majority of the measures are horizontal; however, the following measures that relate to the reference area can be identified: control and maintenance of coastal dikes in Kalochori; preparation of a master plan for the flooding area of the Gallikos river; and incorporation of protective measures against pollution caused by flooding into emergency plans for large-scale technological risks. It is worth mentioning that despite the fact that the relevant EU framework makes provisions for types of action involving land use planning and green infrastructure [27], such measures are not directly mentioned in the FRMP.

As far as strategic spatial planning is concerned, the need to address climate change impact is among the key objectives of the draft of the revised strategic plan for Thessaloniki [56] and is further specified by land protection and land development priorities and recommendations (Table 2). Mitigation options receive primary attention and are better linked with implementation measures (transportation, renewables, greenhouse emissions, and so on), while adaptation options are more abstract. Land protection is clearly addressed by recommendations made for risk prevention, specifically flood prevention. While floods represent the greatest risk stemming from the coastal character of the area, forest fires are also included among the hazards identified in the plan regarding other parts of the metropolitan area. Overall, a complex relationship is evident in the plan, in that flood risk should be taken into account in land development, while land use planning could be utilized as a means of preventing flooding, especially in areas lying outside the town plan. Moreover, recommendations concern not only traditional planning tools but also new guiding principles, such as reducing soil sealing and promoting the compact city model, which is indicative of the fact that various options pertaining to NBS have been included in the strategic planning framework.

Regarding the role of detailed land use planning, various types of land use regulation already apply to the area. Additionally, various regulatory plans for the area have been elaborated or announced without having been ratified, which illustrates the difficulty in addressing complex problems of land development and land protection.

Since the early 1990s, land use development in a wide part of the area surrounding the adjacent river has been brought under control by means of a presidential decree for “the establishment of protection zones as well as of building regulations and restrictions”

(1994). A large part of the wider area of the Axios River Delta has been incorporated in environmental protection schemes (NATURA 2000 network, RAMSAR Convention, and National Park) while the renewal of the legislative framework for the National Park is expected.

**Table 2.** Draft of the revised Strategic Plan for Thessaloniki: provisions related to climate change.

Organization of economic activities, transportation and networks
Combating natural and technological hazards and accidents - Specialized measures for disaster prevention, protection, and recovery (against earthquakes, industrial accidents, floods and forest fires) - Using the instruments of urban, regional, and environmental planning [ ... ] Decision making on future land uses, buildings and infrastructure should take into account flood risks
Environmental policies
Climate change mitigation and adaptation - Prevention of greenhouse emissions [ ... ] Preparation of climate change adaptation [ ... ] Contribution to national targets [ ... ] - Climate mitigation measures [ ... ] - Climate adaptation measures: Projects to improve the microclimate in urban areas [ ... ], projects to prevent coastal erosion, projects to improve management of natural resources [ ... ], dissemination of information [ ... ] and public awareness raising, measures/incentives to integrate/avoid specific practices in various activities (agriculture, livestock, industry)
Environmental protection infrastructure
Protection against flooding: precautionary and anti-flood measures especially through spatial planning and control of out-of-plan location of various activities [ ... ] control of soil sealing through urban planning on the basis of the compact city model and the directions towards increasing green space
Integrated coastal zone management
- Integrated management of the complex biological, geophysical, aesthetic, social, cultural and economic assets in order to ensure sustainability - Guidelines for the Western coastal zone of Thessaloniki: Environmental upgrade and organization of the seafront from Kalochori to the port. Restoration of the Kalochori Lagoon and promotion of National Park protection
Implementation
Action Plans Combating climate change, biodiversity conservation, integrated coastal zone management, protection and preservation of water and soil resources, improvement of environmental protection infrastructure, integrated risk management, security and protection

Source: [36] (pp. 56, 63–64, 74–75, 79–81, 85) (own elaboration).

The General Town Plan (GPS) of the Echedoros municipal unit in which the settlement of Kalochori belongs [37] incorporated existing regulations and designated special protection areas and limited development zones. In order to regulate informal land development, the GPS made provisions for an extension of the town plan, in which potential risks should be estimated and land suitability should be secured according to planning legislation. This entailed the preparation of the Town Planning Study, which in general specifies the GPS of a particular district of a municipality. To proceed with this study, besides the geological survey, which is provided by law to indicate the limits of permitted land development, a special survey on flood risk was carried out, as requested by the relevant ministry, for the purpose of defining the flood zone of the adjacent Gallikos River [44]. Following this, studies that are more specific were requested by the ministry before resuming the process of land use planning and before an extension of the town plan could be approved, which has yet to take place.

Furthermore, the GPS recommended the drafting of a study to search for a viable solution to the problem of technological risks in spatial, environmental, and socioeconomic terms. It also suggested measures to further control the development of Seveso sites. Thus, a double faceted problem of risk prevention becomes evident in the area. The experience of incorporating the technological risk dimension into the land use planning of the municipal

unit (GPS) [37] has been indicative of the limitations imposed on particular adaptation options due to existing spatial structures that represent established land uses and property rights. On the other hand, raising concerns over flood risk at the stage of specifying the GPS that is the preparation of the Town Planning Study could contribute to the avoidance of “non-adapted development” with regard to land protection [23]. It seems that strategic objectives and provisions for combating climate change have influenced land use planning for the examined area on issues of flood protection and risk prevention. This is not just an obligatory response; rather, it can be thought of as representing awareness raised in the context of the strategic planning process, which confirms that “spatial planning has to consider all spatially relevant natural (and in fact also technological) hazards” [57].

## 5. Discussion and Concluding Remarks

The reference area is representative of how complex pressures on land coexist with conflicting land uses and potential risks, thus highlighting the need for land protection from a climate adaptation perspective, which is enabled by all types of plans for the wider area. The strict environmental protection framework, above all the schemes of environmental protection of the Delta area as well as the decree on land use control of the Gallikos River wider area, most likely provides means for land protection. Moreover, from a climate adaptation standpoint, land protection needs to be seen through a dynamic perspective, which questions the emphasis usually placed on land development. For instance, in the reference area it seems that land development, which in the past was enabled by large-scale public infrastructure for land improvements and which has long been the basis of residential, agricultural, and in recent years, industrial, commercial, and transportation development, has been put into a new context requiring renewed planning perspectives that directly incorporate the risk dimension. A parallel can be drawn between this view and the argument that structural measures to confront natural hazards can stimulate development; however, there is a need for “more attention to be paid to limiting development in areas at risk from natural hazards” [58]. Noteworthy is an innovative approach to land development provided by NBS, the so-called “low impact development”, which is a “strategy for managing storm water at the source with decentralized micro-scale control measures” [59].

Overall, the issues discussed in this paper concern the role of spatial planning in land protection from a climate adaptation perspective that raises challenges for novel solutions. For this purpose, three types of plans were identified, namely sectoral, strategic, and detailed land use planning. Evidence was drawn from their examination in a coastal peri-urban area of Thessaloniki.

Climate adaptation strategy in Greece is in its preliminary stages and has started to be implemented through various policies, including spatial planning [60]. As can be verified from the flood risk studies and mapping within the context of implementation of the EU Flood Directive, to date emphasis has been placed on sectoral policies related to climate change, such as those for flood prevention and disaster risk reduction in general. At the same time, spatial planning places emphasis on environmental protection in the context of sustainable development and the prevention of various risks. Strategic spatial planning for the metropolitan areas is progressively incorporating the risk dimension into strategic goals and priorities. On the other hand, land use planning that already makes specific provision for securing settlements against geological hazards has recently started to refer to climate change and related risks. Despite this, the explicit linking of climate adaptation measures to land use planning has not yet been widely established [60]. Recently, the resilient cities' strategies have contributed to the recognition of the problem, but full incorporation of ecosystem-based solutions and green infrastructure is still missing [61].

Over the last few years, there has been increasing recognition of the role of spatial planning in land protection and disaster risk reduction at the country level, which was influenced by the dramatic experience of a disastrous fire [62] and disastrous flooding in the metropolitan area of Athens in 2018 and 2017 respectively. The question then arises

as to how land protection measures can be incorporated within the context of spatial planning from a climate adaptation perspective, especially in areas with pre-existing land development. It seems that the risk approach to climate change that enables land protection is gradually being developed within the context of sectoral planning, as in the case of flood prevention, and strategic spatial planning. In addition to this, as the examination of the study area has shown, the strategic planning process appears to be quite influential in the incorporation of the risk approach into land use planning. An encouraging point that has emerged from this case is that awareness of land protection is raised when concern about climate change increases. Overall, to achieve land protection through spatial planning from a climate adaptation perspective, a twofold challenge emerges.

Firstly, there is a need for an integrated approach to land, which demands that the risk approach to climate change be incorporated into all spatial planning types and levels so that evidence from the various types can be exploited. From the viewpoint of climate change, a renewed relationship between land use planning and strategic spatial planning is revealed when it comes to land protection that requires an enhanced role of both with an emphasis on their cooperation. Besides this, the flood management plan might benefit from specifying its measures for land use planning and green infrastructure. This resamples the nexus approach “towards policies focused on the adaptive capacities of urban systems in the face of multiple and interconnected factors” [63] (p. 16). In cases where strategic spatial planning has been neglected in particular, which is usual in conditions of crisis such as those in Thessaloniki, challenges of adaptation in all types of spatial planning as well as their collaboration emerge.

Secondly, there is a need to transform general concerns into specific land development and land protection options so that they can be pursued by land use planning. As confirmed in the study area, when it comes to established spatial structures little can be done by regulatory planning to facilitate adaptation to risks. However, it should be taken into account that land use planning has the potential to keep “disaster prone areas free of further development mostly through zoning instruments”, pursue “avoiding non-adapted developments”, and above all, promote the adaptation of existing spatial structures (settlements, infrastructures, and buildings) [23] (p. 33). To this end, an evidence-based approach such as the ecosystem approach promoted by NBS can be influential. For instance, as derives from the area’s characteristics, all the three abovementioned types of the ecosystem approach [31] are present. A “better use of natural/protected ecosystems” can be applied at the Kalochori lagoon. “NBS for sustainability and multifunctionality of managed ecosystems” can be applied at the river riparian zone, and “design and management of new ecosystems” can be applied in the built environment and the informal industrial park with regard to urban planning strategies.

It can be assumed that the complex issues faced by spatial planning, especially in Mediterranean coastal cities that are vulnerable to potential climate change impact, can benefit from evidence-based approaches that provide novel solutions. The challenge from a climate adaptation perspective is not only to apply individual NBS, but ecosystem-based solutions to be systematically integrated into spatial planning policies so that land resilience to various threats as well as overall planning resilience can be promoted.

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