Climate change and green networks. Spatial planning provisions at the Greek metropolitan areas

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Abstract. Climate change has recently emerged in the scientific dialogue as an important environmental issue. Several policies from the global to the local level have been formulated to frame the actions and measures that will enhance the resilience of societies and space. The focus is on outlining goals, objectives, and strategies both for mitigating climate change impacts and for adapting to reduce its effects and ameliorate vulnerability. The Greek National Strategy for Adaptation to Climate Change (2016) includes certain adaptation measures that relate to the design, increase and integration of open / green spaces, and recognises spatial planning as a framework for the effective coordination of adaptation policies. This work focuses on the recording and evaluation of relevant policies that are formed at the metropolitan level in Greece, with emphasis on the organisation of green networks, as provided by strategic spatial planning. The study reveals that the effective contribution of spatial planning lies largely in the way it is utilised as a governance tool for policy coordination and management and the efficient integration of the planning system, from the national to the local level.

1. Introduction: addressing climate change issues through spatial planning

Climate change has emerged as a major environmental issue in recent decades and the relevant dialogue involves two possible approaches: (a) Adaptation means anticipating the extreme consequences of climate change and adjusting to the current and future effects of climate change by taking appropriate action to prevent or minimise the damage that can be caused; (b) Mitigation aims at tackling the causes and reducing and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere in order to prevent climate change [1]. These challenges create the umbrella for a range of policies relating more broadly to the environment and the impact of human activities on it [2]. EU countries have made specific commitments under the United Nations Framework Convention on Climate Change (UNFCCC) to reduce anthropogenic greenhouse gas emissions. The effort to deal with and adapt to the phenomenon now occupies various scales [3].

Cities could be major contributors of greenhouse gas emissions due to transportation models, the sprawling growth patterns, the way in which energy is used etc. On the other hand, climate change will have critical impacts on urban infrastructure and populations (heat waves, coastal flooding, storm surge, etc) shaping the need for adaptation policies at the local level [4]. However, better understanding of the territorial dimension is needed and related adaptation strategies at the European, national and regional levels should be developed [5]. National emission reduction strategies can be rather effective if economy-wide mitigation policies are complemented by urban policies [6]. At the
same time local action should be implemented in the context of broader frameworks, and supportive national and regional policies and incentives are required to ensure city-level initiatives [7]. The spatial challenge in formulating an adaptation strategy is to shift from a sectoral approach towards multifunctional thinking.

Spatial planning is recognised as a framework for the effective coordination of adaptation policies in order to ensure, in the long run, sustainable development prospects. Appropriate spatial and urban planning can offer solutions in order to address the complexity of the phenomenon and its multiple dimensions and thus reduce vulnerability to the expected impacts [8]. Spatial planning may acquire a crucial role for the implementation of adaptation policies through land use and land development while the contribution of green infrastructure (GI) is emphasised [9]. In Greece, the National Strategy for Adaptation to Climate Change was ratified with L. 4414/2016, aiming to contribute to strengthening the country's resilience to the effects of climate change. The adaptation actions include measures for the buildings and the design of open spaces but also the increase of the urban green with integration of unused areas and the redistribution / restoration of green spaces.

Organizing green spaces in networks may help in their functional integration in the urban environment. Green network as a term is often used interchangeably with GI [12], which is defined by defined by the European Commission as “a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services” [11]. Networking of green spaces, along with multifunctionality and connectivity, constitutes core feature of the GI concept which is in place to manage contemporary climate change challenges.

This paper concerns the examination of policies and strategies incorporated to address climate change issues, with emphasis on the organisation of green networks, providing an evaluation of the cohesion, integration level and effectiveness of the tools proposed by spatial planning. What is investigated is the strategic spatial planning for the two Greek metropolitan areas. In short, the methodology consists of the following steps: a) thorough study and indexing of policies and strategies included in the spatial plans for the two metropolitan areas, from mid ‘80s to mid 2010s, b) identification of policies, strategies and tools that relate either directly or indirectly to addressing climate issues change and on the other hand to the organization of green networks, c) comparative and critical presentation of the typology of directions and measures identified previously.

2. Results: Climate change and green networks in the Greek metropolitan areas

2.1. Metropolitan Spatial Planning in Greece

Athens is the capital of Greece and the leading centre in terms of population, economy and culture. The first Athens Master Plan (AMP), known as the Regulatory (or Strategic) Plan of Athens, was enacted in 1985 with the ambitious target to curb urban sprawl, reduce social disparities and enhance environmental protection. The Plan incorporated the enactment of the Organisation of the Master Plan and Environmental Protection of Athens (namely "Organisation of Athens"/O.R.S.A.), who was responsible for monitoring the implementation of the AMP. The Plan was updated a few times after its approval by the Greek Parliament and many of its goals remains relevant. However, it was rapidly bypassed by the development policy of the 90s, the development of major infrastructure projects such as the new airport at Spata area and the 2004 Olympic games projects that entailed major transformations of the urban area and were not sufficiently programmed and spatially integrated [12]. A new AMP was enacted in 2014 (L.4277/2014). The main objectives applied are (a) balanced economic development and strengthening of the international role of Athens, (b) sustainable spatial development, effective protection of the environment and cultural heritage and adaptation to climate change, and (c) improvement of the quality of life by balancing the distribution of resources and benefits of development [13].

Thessaloniki is the second economic, industrial, commercial and political centre in Greece. The Thessaloniki Master Plan (TMP) was issued in 1985 (L. 1561), incorporating, as in the case of Athens,
the enactment of the "Organisation of Thessaloniki" (OR.THE.). In 2006 there was an effort to draft and adopt a "new" Master Plan, covering a significantly wider area which was considered functionally connected to the metropolitan area. After its re-drafting in 2012, it went through several consultation processes and finally it was not adopted, while in 2014 both O.R.S.A. and OR.THE. were abolished and their jurisdictions were transferred to the Ministry of Environment, leaving a significant gap in the two metropolitan areas’ governance. According to the recently issued L. 4759/2020 for the "modernisation of urban and regional planning legislation", the Regional Spatial Planning Framework (RSPF) of Central Macedonia should include a special Annex for the strategic planning of the Metropolitan Area of Thessaloniki. Nevertheless, such an Annex was not incorporated in the RSPF which was issued in 2020. In any case, after the above developments, the current strategic directions for the spatial development at the metropolitan level derive from the RSPF.

2.2. Climate change policies in metropolitan spatial planning

The challenges of climate change were not directly mentioned nor adequately addressed under the provisions of the two MPs of 1985 (Table 1), given that climate change has only recently emerged as an important environmental issue in the scientific dialogue and planning policy and practice. Nevertheless, they include certain policies / objectives that are indirectly related to climate change issues. Some policy directions of the AMP 1985 correspond to priorities for adaptation (prevention of natural disasters such as flooding) and mitigation (eg. strengthening the public transport system). The plan also includes an environmental program with provisions for the protection of the landscape, forests, wetlands, agricultural land, coasts and the natural environment in general, as well as the protection of historical and cultural heritage, the reduction of air and soil pollution as well as of nuisance. Similarly, protecting Thessaloniki from natural disasters, and taking the necessary measures for flood protection and equipping it with the necessary technical infrastructure works, constitutes one of the objectives set for the wider area of Thessaloniki’s future development in the TMP 1985.

Since the early 2010s, the spatial plans for the two metropolitan areas implicitly consider climate change issues and incorporate relevant provisions in several sectoral policies. In the case of Athens, the challenges of climate change are among the critical issues addressed by the new AMP (2014), especially in combination with the risk of natural disasters. The relevant objectives are mentioned at Article 5 and direct reference to climate change is made at Article 18 titled “Protection of the natural space and biodiversity and adaptation to climate change”. The article includes management policies and tools, such as special programs for the forest land and the mountain areas, directions for the conservation of agricultural land, the protection of sensitive wetland and coastal ecosystems and green spaces of various levels (Table 1). Moreover, mitigation policies are incorporated (e.g. sustainable mobility, compact city model, protection of natural and cultural resources etc), while, in relation to adaptation, the basic choice considers the directions and actions for managing green spaces and creating a green network. In order to monitor and evaluate the implementation of the AMP, the operation of an environmental, spatial and socio-economic observatory based on related indicators is provided. However it has not been organised yet.

The "new" TMP (2012) contained a separate article (Article 63) titled "Preventing and mitigating the effects of climate change". The proposed objectives include (a) the prevention and reduction of gas emissions; (b) the timely and effective preparation for tackling climate change impacts; (c) the contribution to the objectives of the National Action Plan. These objectives should be integrated into land use planning and urban greenery management processes. Climate change issues are considered in several sectoral policies / strategies for the development of the metropolitan area (Table 1), while there are provisions for the implementation of targeted programs and measures (regulations, financial or tax incentives, information and awareness actions, specific urban or environmental rules etc) to reduce greenhouse gas emissions. Meanwhile, the “prevention and mitigation of the effects of climate change” constitutes the first thematic section of environmental policies promoted through the Environmental Protection Program (EPP). There are also provisions for developing a monitoring and evaluation system of the plan, which includes indicators referring to air pollution and climate change.
To achieve the goal of “protection of the quality of the atmosphere and the population from the
exhibition to noise, radiation and airborne allergens” (Article 64), adaptation measures are taken,
which include among others the residents’ information through real - time access to air quality data
from a unified monitoring network.

Table 1. Climate change policies in metropolitan spatial planning.

| Climate change considerations | Athens AMP ’14 | Thessaloniki TMP ’12 | RSPF |
|-------------------------------|---------------|----------------------|------|
| Concrete policies for climate change | □ ■ ■ | □ ■ ■ | ■ |
| Prevention and mitigation | □ ■ ■ | ■ ■ ■* | ■ |
| Contribution / relation to the national action plan | ■ | ■ ■* | ■ |
| Integration into / relation to land use planning | ■ ■ | ■ ■ | ■ |
| Adaptation | ■ | □ | ■ |
| Prevention and adaptation | □ ■ | ■ ■* | ■ |
| Sectoral policies / strategies | ■ ■ ■ | ■ ■ ■* | ■ |
| Natural resources | ■ ■ | ■ ■ | ■ |
| Cultural resources / heritage | ■ | ■ | ■ |
| Sustainable mobility / public transportation | ■ | ■ | ■ |
| Energy | □ | ■ | ■ |
| Technological hazards / accidents | ■ | ■ | ■ |
| Natural disasters | ■ | ■ | ■ |
| Coastal zone management | ■ | ■ | □* |
| Urban forests management | ■ | □ | ■ |
| Agricultural land protection | ■ | □ | ■ |
| “Compact city” policy | ■ | □ | □ |
| Management of rainwater networks of watercourses | □ | ■ | ■ |
| Tools / programs / measures | ■ | ■ | ■ |
| Regulations | ■ | ■ | ■ |
| Financial / tax incentives | ■ | ■ | ■ |
| Information actions | ■ | ■ | ■ |
| Urban / environmental codes / terms / directions | ■ | ■ | ■ |
| Additional researches / studies | ■ | ■ | ■ |
| Monitoring and evaluation system of indicators | □ | ■ | ■ |
| Monitoring the quality of the atmosphere | □ | ■ | ■ |
| Directions for action plans | ■ | ■ | ■ |
| Related Programs | ■ | ■ | ■ |
| Monitoring mechanism | □ | ■ | ■ |

■ explicitly / directly
□ implicitly / indirectly
* directions referring to the wider area of RSPF, not specifically to the Thessaloniki Metropolitan area

A few years later, the drafting of the RSPF of Central Macedonia considered certain challenges that
the Region is facing regarding the adaptation to climate change impacts: a) the probable increase of
fire events, b) the intensity of water use in combination with the reduction of rainfall and
desertification, and c) erosion and loss of productive soils as a result of sea level rising. Climate
change issues are incorporated in the provisions for several “Development Spatial Units” as well as
different areas with special physiognomy: metropolitan, mountainous, coastal. At the metropolitan
area, climate change is considered a field requiring a coordinated approach involving the cooperation
of many municipalities. “Prevention and adaptation to climate change” is directly referred to the “Key
priorities for the protection, preservation and enhancement of natural and cultural heritage” (Article
10), promoting the implementation of best practices to increase energy efficiency and RES integration
As for the directions for the lower-level spatial planning, the Local Spatial Plans should include
special sections on adaptation to climate change. What is worth to note is that Article 16 which
concerns “Directions for the Thessaloniki Metropolitan area” makes no reference to climate change
issues, apart from the connection to the policy for green spaces.
2.3. Policies and strategies for the organisation of green networks

Table 2 shows the main results of the research as regards the policies and strategies for the organisation of green networks. It becomes obvious that green policy constitutes a concrete policy in all MPs (’85 and 00s) but not in the RSPF of Central Macedonia. Green spaces networking, although not constituting a concrete policy in all plans (eg. TMP ’85), emerges as an important principle in the pursuit of several objectives and sectoral policies.

Table 2. Policies and strategies for the organisation of green networks.

| Tools / programs / measures                             | Athens AMP '85 | Athens AMP '14 | Athens TMP '85 | Athens TMP '12 | Thessaloniki RSPF |
|--------------------------------------------------------|----------------|----------------|----------------|----------------|-------------------|
| Urban or / and suburban green as a concrete policy     | ■              | ■              | ■              | ■              |                   |
| Green spaces networking                               | ■              | ■              | ■              | ■              | ■                 |
| Specific programs / action plans                      |                |                | ■              | ■              | ■                 |
| Strategic operational plans for the green areas       |                |                | ■              | ■              | ■                 |
| Pilot interventions                                    |                |                | ■              | ■              | ■                 |
| Monitoring and evaluation system of indicators         |                |                | ■              | ■              | ■                 |
| Physical design and reconstruction of green / open spaces |                |                | ■              | ■              | ■                 |
| The green policy as a policy to tackle climate change | ■              | ■              | ■              | ■              |                   |

The main objectives of AMP 1985 include the protection of the environment which is connected with the quality of life. The specialisation of the main objectives refers to the “ecological reconstruction”, the promotion and protection of historical sites, the landscape, the mountain areas, urban forests and the coastline. The role of green spaces is determined indirectly within the objectives for the promotion of the historical physiognomy of Athens and the upgrading of its central area. In the context of the "reconstruction of the neighbourhood" a pedestrian network is formed.

The AMP 2014 includes two basic pillars concerning open spaces: (a) their networking and (b) the effective management of their qualitative and quantitative upgrading. The directions and measures included serve all three objectives of the new AMP. More specifically the networking of the cultural attractions and the natural environment contributes to the international touristic attractiveness of the capital (Article 4), while facilitating the ‘compact city’ policy and its residential needs (Article 5.2). The creation of a green network is an environmental protection effort (Article 17), targeting at improving microclimatic conditions (Article 5), while through local level interventions it will improve the residents’ life quality (Article 6). The directions for Urban Development include (Art.12) horizontal actions such as (a) the effective management and maintenance of the public space and (b) the equal supplementary reinforcement of public, green and open spaces in order to balance spatial inequalities and social exclusion, thus making obvious the urban/environmental and social dimensions.

According to the Article 19, the networking of green spaces is a basic structural element for the urban space renovation including: (a) The formation of a “green arrow” by the mountains of Western and Northern Attica and (b) A green net including the connection of Ymittos-Penteli, the connection of central Athens with Parnitha Ymittos and Egaleo and local green Nets. A series of focused actions restricting building ratio and change of land use is legislated so as to protect the mountainous lands (Article 18, 4b). The directions for the ‘green arrow’ utilisation regard especially the “special plans of mountainous areas protection”. The urban tissue is linked with the mountainous areas through green boulevards, sidewalk and recreational facilities. The green network is formed by integrating existing natural areas, but also new green spaces with the appropriate interventions, such as additional plantings or even land use changes. The network includes not only green spaces but also archeological sites, monuments, special landscapes, sensitive areas, important water streams, coastline areas, metropolitan parks and sports sites. Also, open spaces of public or private buildings are functionally included. For the implementation of the green network, directions towards the local planning level are foreseen, as well as the configuration of a new tool for the management of the public space.
The local plans should record, evaluate and protect the areas of the natural environment that can be elements of the network by connecting them on metropolitan, municipal and neighbourhood level. In this direction, specific urban planning tools are suggested (e.g. application of Article 16 of L. 2508/1997 about securing public spaces in old city plans). A new tool concerning "Green Network Planning Studies" is suggested as part of "integrated programs for the recovery and management of public space". Their target is to regulate and manage the urban open space with the aim of the functional integration of public and private green areas. In relation to the "programs" no further details are specified by the AMP.

In the case of Thessaloniki, green networking does not constitute a concrete policy for the metropolis’ development in the TMP '85. Nevertheless, the promotion and protection of historical elements, the ecological reconstruction, the restoration of the relationship of the city with the Thermaikos Gulf, and the protection and promotion of the mountains, the landscapes of natural beauty and the coasts, emerges as one of the main objectives for the wider area of Thessaloniki. In order to highlight the physiognomy of the city, the creation of a unified network of pedestrian, free and historical spaces in combination with the creation of parking spaces is foreseen. Similarly, for the reconstruction of the neighbourhood, a single network of pedestrian flow, green, free spaces as well as areas of social equipment is pursued. Additionally, a system of large leisure, sports and cultural functions is created that serve the entire area of the city: suburban forest, military camps within the urban fabric, coastal zone.

The “new” TMP (2012) developed a concrete framework for organizing the urban and suburban green. The strategic objectives in this field include, among others: a) the provision of sufficient spaces and networks of urban and suburban green in all urban centres of the TMP’s wider reference area, their equal spatial distribution and their accessibility assurance, (b) the interconnection of green spaces and the creation of green, ecological, paths, c) the connection of green spaces with leisure and cultural functions, (d) the integration of natural hydrological elements or other ecological elements of urban and suburban space in the green network. Groves and forest areas, archaeological sites and monuments, landscapes, streams, coasts and coastal urban fronts, culture and sports areas, and former military camps, may be parts of the green network. The TMP pursues a unified urban policy for the metropolitan level which is formed around the following main axes: a) urban reconstruction, b) urban transport, c) urban and suburban green, d) planning, promotion and use of cultural and historical resources. Programs, interventions and action plans can be drafted by axis or in combination.

As for the proposed tools, the monitoring and evaluation system of the TMP in the part regarding the EPP, includes indicators that refer to urban and suburban green. With the cooperation of OR.THE. and the municipalities, strategic and operational plans are prepared for all urban centres of the wider area in order to create and upgrade the urban and suburban green infrastructures. An interesting direction to be specified during the elaboration and implementation of urban plans is the design of transitional zones around streams passing through or located outside the settlements, in a way to ensure, on the one hand, their hydraulic capacity and, on the other, their function as ecological corridors connecting green spaces.

Lastly, ensuring the functionality of ecological corridors within urban areas (mainly streams), constitutes one of the directions set for the biodiversity preservation in the RSPF. At the metropolitan level, individual urban planning interventions (of renewal or reconstruction) are promoted to create a zone of green spaces and soft recreation between the north side of the urban core and the airport area (outside the city boundaries), in the general context of coastal strategic planning. Priority is given on the promotion and integration, into the urban and suburban environment, of historical and cultural elements and monuments, preferably in combination with the design of free (existing and new, such as former military camps) and green spaces. Unified physical design and reconstruction of open / green spaces is promoted along with their connection with the nearby environmental protection areas. In this context, individual interventions concern a) the institutionalisation, protection and management of the suburban forest Seyh-Su and b) the environmental remediation and enhancement of all streams, as
elements of urban ecology. In general, implementing a green policy is referred to as a priority policy to tackle climate change and urban heat island effect.

3. Discussion and conclusions
In the recent spatial plans for both cases examined here, climate change mitigation and adaptation strategies run across several sectors including the natural and cultural resources, the energy networks and the coastal zone management. The MPs of the 2010s make extensive reference to climate change issues, while the RSPF of Central Macedonia lacks specifications for the metropolitan area, and the main body of strategies and directions covers its wider area of reference (Region). One notable remark is that, despite the effort to align with the contemporary challenges of climate change and the relevant European goals and national action plans, it seems that the related terms (adaptation, prevention, mitigation) in some cases remain vague, they are used inexpertly, requiring further elaboration and specification as regards the relevant provisions and measures.

Green policy constitutes a concrete policy in all MPs since 1985, but again not in the RSPF of Central Macedonia. At the same time, green spaces networking is incorporated as an important principle in all examined plans, running through several sectoral policies. What is worth to note, having been one of the main research questions of this work, is that the implementation of a green policy emerges as a priority to tackle climate change in the AMP and the RSPF. This entails the need for a coordinated approach to spatial planning, from the regional to the metropolitan / urban and local level. The AMP proposes a comprehensive framework of goals and directions for the management of green space, seeking for the cooperation between co-competent authorities and assigning the green maintenance to the Municipalities. Having identified important issues, the plan provides a toolbox to address them, forming guidelines for the underlying level of planning and a framework for the promotion of actions and specific projects aimed at developing an expanded green network at regional level. The relevant provisions may be ambitious based on the use of regular tools with limited application until today and with no reference to new / specialised tools that would be useful e.g. in relation to urban regeneration, utilisation of private space - connection with the public, tools of land policy etc.

Similarly, the RSPF advances the coordinated physical design and reconstruction of free / green spaces within the metropolitan area and their connection with the suburban environmentally protected areas. It sets directions referring to the design of air, water and green passages, as well as the creation of a complete and protected system of green public spaces, through which to ensure natural continuity between the surrounding areas of ecological value, the mountainous suburban areas and the coastal belt. Contrary to the AMP, it lacks specified implementation tools and studies. It seems that relevant specifications for the metropolitan level which were present in the TMP 2012 were not properly -and in detail- incorporated in the RSPF (being a different scale plan), highlighting the necessity of either a new strategic plan for the metropolitan area or for a detailed and comprehensive “Annex” to support the RSPF, as it is expected based on L. 4759/2020 (see Section 1). This is also related to the absence of a governance structure for the metropolitan area, after the abolishment of O.R.S.A. and OR.THE. The two organisations had important responsibilities for the implementation of planning (e.g. prepare researches and studies, cooperate with the municipalities, prepare Action Plans etc). Questions arise regarding whether such tasks are still at the fore in the Ministry’s policy. The formation of appropriate governance structures, along with the involvement of civil society at all levels, are a prerequisite for the overall success of efforts to tackle and adapt to climate change.

The effective contribution of spatial planning lies largely in (a) the way it is utilised as a governance tool for policy coordination and management, (b) the integration of spatial and environmental planning policies, with the systematic activation of appropriate tools for implementation and (c) the efficient integration of the planning system, from the national to the regional / metropolitan / local level. In more detail, the study reveals that the effective contribution of metropolitan spatial planning lies largely in the way it is utilised as a governance tool for policy coordination and management. Contemporary challenges require the promotion of integrated spatial
and environmental planning policies, with the systematic activation of new tools (e.g. monitoring and evaluation system, "integrated programs for the management of public space", land policy tools etc.). In both cases examined, climate change strategies and green networking are integrated into the existing spatial plans, and specific measures are provided. However, their actual implementation will occur during the elaboration of the local urban planning requiring effective coordination mechanisms. According to the L. 4759/2020, the lower-level plans (namely Local Urban Plans), which are mainly statutory, define the model of spatial organisation and development, land uses, building codes and restrictions, but also measures to adapt to climate change, measures to support emergency events and manage the consequences of natural and technological disasters and other risks. The specifications for the elaboration of these plans (August 2021) include such issues but remain generic. Judging from past experiences, the understanding of the relevant concepts and their effective adaptation and incorporation into an urban plan should not be considered an easy task for both the planning practitioners and the administration bodies that will supervise or approve the plans [14]. This leads to the need for specialised / targeted instructions and technical specifications as well as training the involved actors, to meet the requirements in both theoretical knowledge and planning practices.

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