Urban Adaptation to Climate Change in Athens, Greece

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Abstract

The Study area is located in Southeastern coastal Attica, extending along the coast, from the Southeast end of the Metropolitan area of Athens, to the southeastern edge of the Attican peninsula in the historical cape Sounion. The major environmental problems in the area emerge from the uncontrolled continuous construction of residences along the coastline, combined with the insufficiency of the sewer, water supply and waste management networks. The area is ruled by the major physical plan of the whole Attican prefecture. The Greek physical planning legislation places its development axes towards urban adaptation to climate change. This fact, along with the significance of the existence of a sandy coastline, next to the metropolitan area of a Mediterranean Capital, provides an opportunity to redefine elements of the structure of a modern metropolis. This study aims to designate the indispensable projects and infrastructure assessing their impact to the environment implementing I.C.T.s *(Information and communications technologies)*, and to develop a sustainable coastal tourism model. The qualitative homogeneity of the area's physical and anthropogenic environment constitutes a crucial factor, for the accessibility with the Great Temple of Poseidon in Sounion, in order to express continuity of the Greek history through time. A G.I.S. *(geographic information system)* environment finally is developed, containing all the appropriate digital layers for the above assessment.

Problem Determination

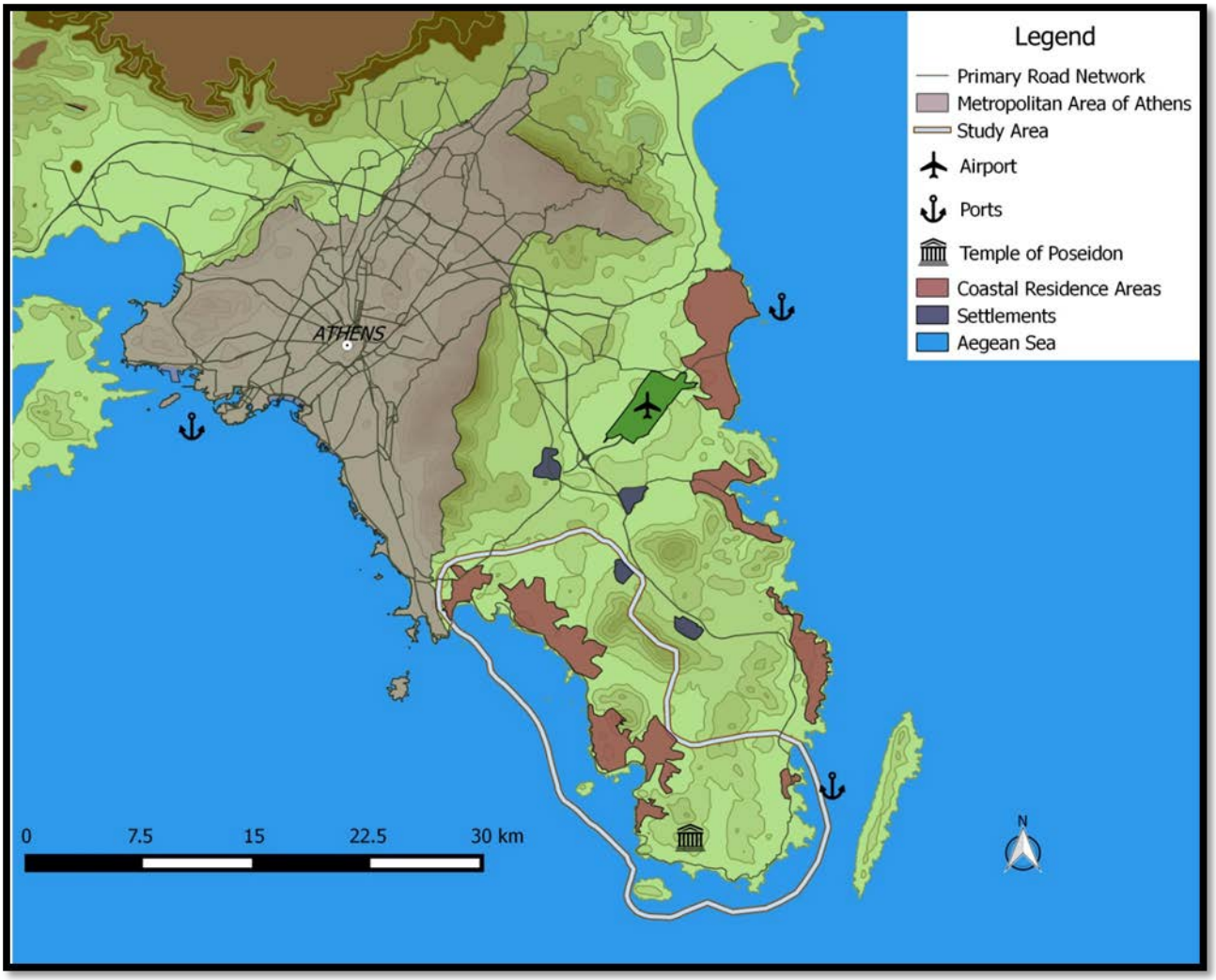
The spatial and urban problem of uncontrolled continuous construction of residences along the coastline has direct impacts on the environment. The area is not treated as a surrounding section of Athens and it operates parasitically because of the disconnected residential structure in relation to the country's capital. Furthermore, the existence of a National Park in the area makes the confrontation of the critical and extensive phenomenon of forest conflagration a top priority issue for the entire region. The comparative advantage of the region is the important historical and cultural heritage in conjunction with the natural beauty of the area.

Problem Elucidation

The population density of the city of Athens increases exponentially the amount and density of air pollutant emissions and environmental nuisances that the atmosphere in Attica peninsula, receives. Therefore, all non industrial areas, surrounding the city, have to contribute, to the decongestion of the air pollution phenomenon [1]. In addition, the coastal element that defines the Greek

geomorphology has to be protected and promoted for environmental, aesthetical and touristic reasons, especially when it is located in the critical, near region of the capital city.

Mapping



Map 1: The Greater Study Region and Elements of Importance.

Important Information and Primary Decisions

Athens is a coastal city, populated by almost 4 million citizens [2]. It is also one of the earliest if not the oldest continuously habited Capital city in the world [3]. These significant comparative advantages come in fundamental contrast with the aforementioned problems. Therefore, the policy followed by this study is dominated by this simple rule: **Upgrading something is a first step in saving it.** This tactic can be easily applied to the confrontation of climate change, not because upgraded areas get magically saved, but because those who have the means to save them will then have a reason to do so. All the above facts, along with the course of the current economic crisis in Greece, constitute and form the axes for the development of a planning process that shape the final alternative scenarios [4].

Scenarios

Each of the three alternative scenarios follows a fundamental axis, oriented to the adaptation of the economic and environmental needs of the greater region. The emphasis of each scenario is given to:

- **Agricultural and processing sector.**
- **The financial profit maximization by touristic sector growth.**
- **The mild Combination of the above.**

All Scenarios include the anticipated compensatory works and are significantly influenced by the current economic crisis in Greece.

Scenario 1: Promotion and Development of Primary Production Sector

The dominant objective and simultaneously steering axis of this scenario is the interface of the rural and touristic sector. It is also of paramount importance, the balanced relationship/connection between financial development and protection of the natural and human environment under the light of viable and sustainable prosperity [5]. Given the need of the development of the agricultural sector, the study area could be converted into an environmentally sound, organized agricultural region. It would have many important comparative advantages, like the short distance from the country's capital trade center and the main export gateways, such as the ports of Piraeus and Lavrio, and the International Airport of El. Venizelos. In conclusion, when the development of the primary sector is in agreement and harmonized with the viability of the environment, the region can maintain its touristic character, giving an alternative choice, such as agro tourism [6].

Scenario 2: Formula1 Circuit & Infrastructure Support

This scenario is referred to an integrated construction project of Formula 1 circuit and supported infrastructure in order to achieve the best possible increase in financial profits. This proposal arises from the large disposable, abandoned public land of the salt works in the area of Anavyssos, which is according to the specifications of the respective federation. Also it is important to construct high standard hotel units and to improve the road network, towards a better service to the visitors. The entire design implementation is made according to the national and European environmental legislation. The main purpose is the development of a comprehensive, environmentally decent, viable and sustainable solution.

Scenario 3: Sustainable Environmental Planning through Tertiary and Primary Sector Combination Development.

This scenario aims to develop, a touristic linear plan along the coastline, and a recovery plan for the environmental variables of the entire region. It arises from the necessity of both financial and environmental progress that the whole Attican peninsular lacks [7]. Therefore, a trisection of the main transportation network is suggested, inserting a cycle lane and a sea-bus route, to the

monopoly of the current road network. Furthermore, infrastructure planning will be made, in order to upgrade the cultural and physical heritage, such as the Temple of Poseidon and the gulf of Old Fokaia. On the other hand, an agricultural association is recommended to be formed for the reuse of part of the abandoned lowland of the area. As for the above environmental recovery, a full reforestation will take place, in order not only to recover, but also to extend the National Park of Sounion. All touristic oriented actions and promotion will be coordinated by an Association, founded exclusively for this purpose.

Methodological Approach

The methodological approach followed, was bisected to impact assessment and to comparative evaluation of the three scenarios. For each scenario the main impacts of planning interventions in both natural and human environment are recorded and analyzed considering the area of interest. According to this recording, the impact tables by Leopold were created for each scenario, which consist of columns, representing the respective interventions and lines, representing the variables, which are examined. In addition, the method of multicriteria analysis MCDA (MultiCriteria Decision Analysis) was applied, considering all the quantitative and qualitative variables, which have to be taken into account for the decision progress [8]. More specifically, the REGIME method was implemented, evaluating projects and policies of regional planning [9]. For this application's first step, it is necessary to determine the criteria that have been assessed. The standardization of the importance-weights of the criteria, which express the relative significance of the criteria under the study planning-problem, is the next critical step of the method. Finally, based on the procedure of analysis, the two above mentioned methods conclude in the optimal alternative-scenario that is considered the most appropriate.

Multicriteria Analysis Results

The results of the Regime analysis are presented in the following diagram.

Diagram 1: ***Hierarchy of the Scenarios expected efficiency.***

The most efficient scenario is Scenario 3: Sustainable Environmental Planning through Tertiary and Primary Sector Combination Development, probably due to its polymerous nature and to the small levels of environmental interference.

The Shortlisted Plan

The shortlisted scenario has the necessary characteristics to be a flexible and useful pedestal for a sufficient, environmental and growth plan, in the coastal area of Eastern Attica. Therefore, an extensive reforestation in the current bushy parts of the area would not only decongest the levels of air pollutants of Athens, but it would also potentially be an example of a Metropolitan green arsenal pointed towards the upcoming threat of climate change in the Mediterranean.

The not so coincidental coexistence of global warming and rapidly developing technologies, determines the necessary quality levels and acceleration of the preliminary planning. The unprecedented reduction, of the erstwhile cost of planning, and the access to information that was never before imagined, makes I.C.T.s the go-to tool of projecting and depicting the qualitative and quantitative future of the natural and anthropogenic variables. Eventually, environmental planning next to a massive metropolitan area is not an axis of growth, but an axis of sustaining and improving the conditions, that the human race prefers, in order to prosper. Consequently, it can just potentially predetermine the qualitative nature of the production sectors development. This observation comes as a necessity of facing the current economic crisis in Greece, in a responsible and polyfunctional way.

A long term sustainability plan often provides the opportunity of an indirect environmental upgrade [10]. In the present case, the promotion of the historical events, and natural beauty that the area possesses, can rapidly increase the quality levels of future interference and the perceived levels of spatial importance of the region. The upgrade of the provided services, in the great Temple of Poseidon, using new technologies (virtual reality) and audiovisual means, can effectively demonstrate Sounion's direct connection, to the Mythical, Homeric and Historic times. This act, can display a modernization in the touristic model that Greece systematically provides, but can also make the sacredness and significance of the region, perceived.

The same method applies to the extensive 40 km of sandy certified clean seashore of the area [10]. This resource, unique in Europe consists of hundreds of size varied beaches, the majority of which is not used, thus congesting the pollution in the larger gulfs of the area. *Prima facie*, promoting the inconspicuous beaches would foresee their direct pollution, but the increased touristic demand for quality and multidisciplinarity, combined with the existence of a functional plan that does not handle individually the processes of development, suggests the exact opposite. Of course, tourists and visitors cannot do nothing but harm a natural resource, but their satisfaction is inextricably connected with the motivation for further environmental planning by the state and the investors.

As for the aforementioned agricultural development, the main aim is to develop eco friendly units that produce certified PDO-PGI-TSG products that agree with the corresponding National and

European legislation [12]. The lowland of the area was considered too precious to crop during the critical ninth decade of the twentieth century. Thus, it was considered a potential residential area, but only the coastal region kindled the interest of the contractors. Today the 10 km to the north region of Mesogeia produces large amounts of certified agricultural products**.** The extension of these activities to the South is suggested, and a connection with the tertiary production sector of the area is sought. Also, the Hellenic Centre for Marine Research (H.C.M.R.) in Anavyssos, can provide expertise for the expansion of the agricultural development to the marine area. Mollusks and Shellfish plantations are recommended in order to emphasize the character of the local cuisine and to further certify the bathing water quality. Finally the planned cycle lane and the sea-bus route will effectively complete the upgrade and the era of devaluation of the area.

Conclusion

Climate change is a multidimensional, hard to predict, continuous phenomenon. In the present case, it will someday threat the city of Athens. The most effective way to face that threat is to make people deeply appreciate the vital conditions that the earth so generously provides.

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