

A Web-based DSS for Sustainability in Urban Green Zones

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Abstract. The utilization of urban green zones forms a major part of urban sustainability in the context of the improvement of quality of life of the citizens. Within the policy for sustainable management of urban green zones, the tools that are used effectively are new technologies such as web databases, web DSS, GIS and environmental impact prediction model. This paper presents the geodatabase, which was used as a background for the GIS and the ENVI-MET application in order to develop city microclimatic maps. Microclimatic maps will constitute a very important tool for the decision-making process in urban forest policy. The results will be presented as a spatial imaging system, through a software development for the GIS platform where the effects will be illustrated. The integrated web platform for the management of urban green zones constitutes an important step for the maintenance and improvement of quality of life in urban areas, the environmental sustainability, the environmental information dissemination, the improvement of urban planning and the web-DSS utilization for the integrated management of urban green zones.

Keywords: web-based DSS, sustainability, urban green zones, microclimatic maps, geodatabase.

1 Introduction

The utilization of urban green zones forms a major part of urban sustainability in the context of the improvement of quality of life of the citizens. Besides a greater tax base, preserving green zones, forests, river corridors, maintains the necessary biodiversity that enables this planet to function, creating oxygen, filtering carbon dioxide and other natural effluents; these processes are not only beneficial for quality of life they are critical for life itself (Kantartzis et al. 2007). Within the policy for sustainable management of urban green zones, the tools that are used effectively are new technologies such as web databases, GIS and environmental impact prediction model. Tasoulas and Andreopoulou (2012) indicate that Information and Communication Technology (ICT) is a discipline that can be adequately exploited in many scientific fields, aiming to help local authorities/administrative in decision-making process. This diffusion has already intruded in urban forestry management and administrators exploit software in order to make their management plans more virtual (Tasoulas et al 2013).

A database is a tool that local authorities/administrative can use to plan and standardize their practices for sustainability in urban green zones. Database is an essential Decision Support (DSS) tool while the web-based application simplifies the sustainable management of urban forest even more. A web-based DSS is a computerized system that delivers decision support information or decision support tools to a manager using a “thin-client” web browser (Engel et al. 2003). Due to the growing interest in the Web, there are many on-going efforts to develop and implement Web-based DSS in various areas (Bhargava et al. 2007), such as urban forest protection.

1.1 Background of the research

The present paper is part of the research program «URBAN: Integrated Framework of Management, Protection and Utilization of Urban and peri-Urban Forest» that deals with the study and recording of urban green zones. It is therefore an integrated research of the selected urban hedgerows in the four major Municipalities of Epirus Region during which the mapping of environmental impact is achieved combining the results of the contemporary research in the field of Urban Forestry, with the latest developments in the field of new ICTs.

The project aims to develop innovative quantitative and qualitative methods through the development of an innovative model to quantify the impact of “urban heat island” on the microclimate of the town considering the terrain type, the existence and the area of surface water, the kind, the exact location and the surface area of the island, the plant species and their special characteristics.

The tasks that will have been completed during the project implementation are the following: Studies on the field of natural environment, prediction microclimatic effects model, analysis of the Integrated Geoinformation System requirements, Integrated Geographic Information System development, data collection in the field

and insertion in the database, awareness website development, public dissemination of research results.

This paper presents the geodatabase, which was used as a background for the GIS and the ENVI-MET application in order to develop city microclimatic maps. Microclimatic maps will constitute a very important tool for the decision-making process in urban forest policy. The results will be presented as a spatial imaging system, through a software development for the GIS platform where the effects will be illustrated.

2 Paper Preparation

The database contents include geographical entities, vectors and descriptive information concerning the integrated recording information about the urban green zones of selected islands (the so called ENVI islands) in 4 cities of Epirus region, Arta, Ioannina, Preveza and Igoumenitsa. Functional and technical requirements analysis was carried out in order to constitute part of the digitized Geodatabase platform. The information recorded is about the area, the existence of surface water, the type, the exact location of the islands, the plant species and their special characteristics, such as: botanical and common name, tree height, height were canopy begins, canopy height, canopy diameter, diameter breast height, perimeter breast height, tree health, tree stability. The information recorded about the tree damages are the following: limited growth space, sidewalk elevation, stump decay, trunk twist, splits on tree trunks, vandalism, damages caused by pruning, drying, broken branches, asymmetric canopies, tassels caused by pruning, insects, yeasts, liquid outflow, ivy-pests. The manipulations for the restoration of the damaged trees can be: removal, monitoring, scheduled tree pruning, manipulations for tree injuries, none. The data of polygons that will be collected in public areas, will concern the shrubs, the herbaceous plants, the surfaces covered with water stones etc, the trees that cannot be mapped individually.

In addition, the orthophotomaps of National Cadastre and Mapping Agency and of Google were used as a background for the digitization tasks of urban green zones through photo-interpretation. Aiming at the dissemination of the environmental information, the optimization of urban planning with regard to sustainability and the database utilization for integrated management of urban forest, the database is available on the web within the Integrated Geo-Information Platform System through the research program URBAN (<http://urbantreemanagement.teiep.gr>). The platform allows the database utilization for the city microclimatic map development for the quantification of green zones effects on the city microclimate aiming to take the appropriate measures within a rational policy for the management of urban green infrastructure in the interests of quality of life of urban network and population.

In Figure 1, the main interface of the Scenario Map is presented. In this step, the user has to select which one of the four municipalities is interested in.

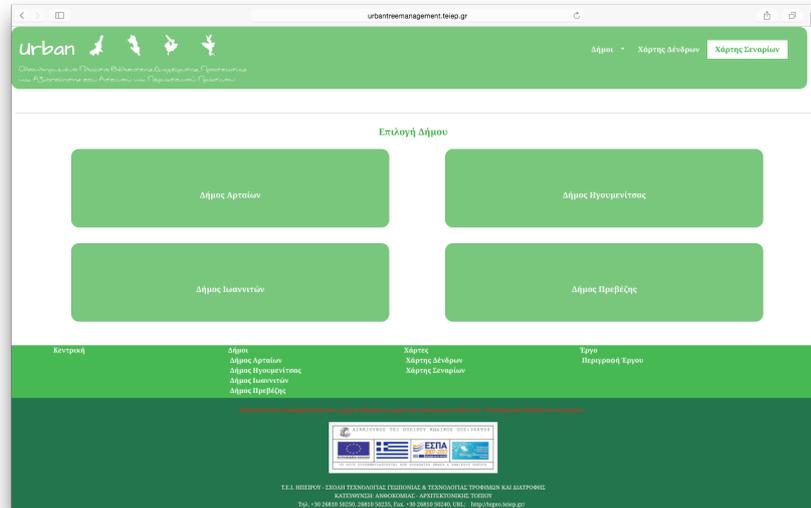


Fig. 1. The main interface of the Scenario Map

Then, the user selects the scenario and the index that will be illustrated by the microclimatic map. There are two possible scenarios: a typical summer day and a typical hot day. The provided indexes are the following:

- Discomfort Index (DI): expresses the human discomfort because of the air temperature and humidity
- Predicted Mean Vote (PMV): expresses the mean response of a larger group of people according to the human thermal comfort sensation
- Predicted Percentage Dissatisfied (PPD): expresses the predicted percentage (%) of people who are thermally dissatisfied in a place
- Sky View Factor (SVF): expresses the solid angle of sky view from land surface
- Air Temperature (T2m): expresses the air temperature (oC) at 2m height above the ground
- Surface Temperature (Ts): expresses the surface temperature (oC)

In Figure 2, the microclimatic map regarding the air temperature of a typical summer day in Preveza city. By locating the mouse cursor on a point of the microclimatic map, further information about the selected index value is presented.

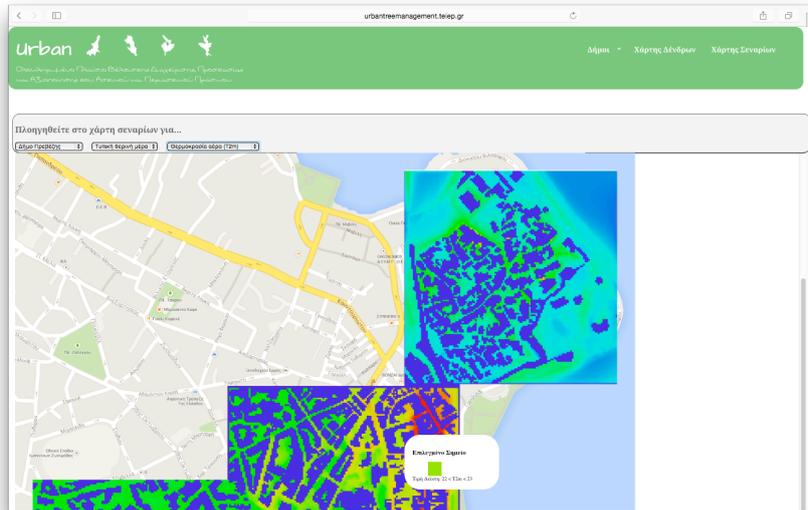


Fig. 2. Microclimatic map regarding the air temperature of a typical summer day in Preveza city

In Figure 3, the microclimatic map regarding the discomfort index of a typical hot day in Ioannina city.

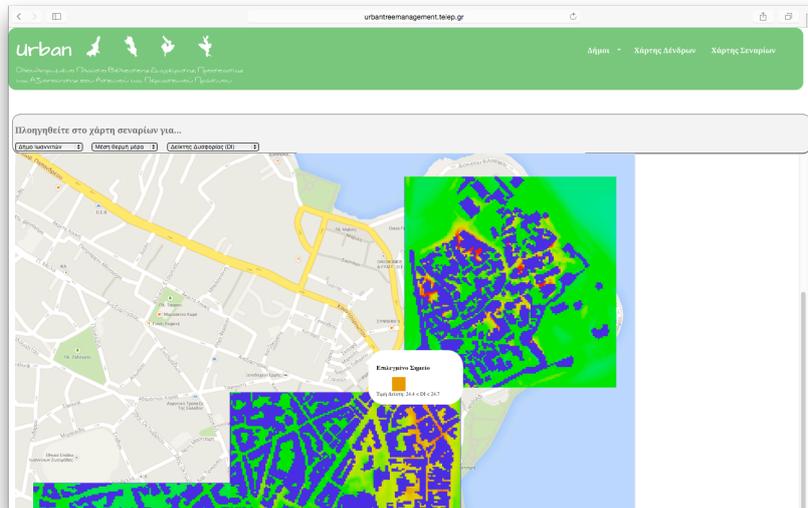


Fig. 3. Microclimatic map regarding the discomfort index of a typical hot day in Ioannina city

The integrated web platform for the management of urban green zones constitutes an important step for the maintenance and improvement of quality of life in urban areas, the environmental information dissemination, the improvement of urban planning and the web-DSS utilization for the integrated management of urban green zones. The web-DSS gives prominence to the “Sustainable Development” of urban areas as the fundamental principle for the citizens.

The purposes of the research proposal are summarized in the following axes:

1. Expansion of the experience of the involved research teams in the scientific field related to the optimum control of shade, temperature, the minimization of the “urban heat island” effect and
2. Sustainable development enhancement through the design and implementation of policies by leading citizens and organizations to the optimal use of urban resources (water supplies, optimizing the characteristics of urban and peri-urban green zones, etc).

The web-DSS interface is developed in the Greek language because it constitutes part of a research program of TEI of Epirus called “URBAN: Integrated Framework of Management, Protection and Utilization of Urban and peri-Urban Forest”. A future extend of the web-DSS could be the creation of multiple versions of the interface in other languages aiming to form a useful tool for managers abroad. However, adjustments should have to be made in the original code of the DSS whenever it is required, because every type of forest ecosystem is characterized by different needs.

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