LIFE CLIVUT

Climate Value of Urban Trees

Layman's Report

The LIFE CLIVUT project - LIFE18 GIC/IT/001217 has received funding from the LIFE Programme of the European Union

GENERAL INFORMATION ABOUT THE PROJECT

Project Title: CLIVUT - Climate Of Urban Trees – co- funded by the LIFE Programme of the European Union under contract number: LIFE18 GIC/IT/001217

Project acronym: CLIVUT

Project Location: Italy, Greece and Portugal

Project Duration: 01 / 09 / 2019 - 31 / 08 / 2023

Total budget: € 2,337,069

EU contribution: € 1,277,137

Coordinating beneficiary: University of Perugia

The associated beneficiaries:
Instituto Superior de Gestao
Aristotele University of Thessaloniky
Municipality of Perugia
Municipality of Bologna
CESAR

Sector: Governance and Information

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INTRODUCTION

About the project

Large urban areas, in general, have a significant impact on the causes of climate change as they are the main emitters of greenhouse gases, producing up to 70 per cent of global anthropogenic greenhouse gas emissions, the largest source of which is related to fossil fuel consumption (Yue and Gao, 2018). At the same time, cities are significantly affected by the effects of climate change; therefore, they represent not only one of the problems, but also the main scope for mitigating the negative effects of climate change.

Urban climate change risks are bound to increase and will impact infrastructures, ecosystems, housing, the provision of goods and services, as well as the livelihoods and health of urban communities.

In urban areas, trees help mitigate the effects of heat islands by contributing to lowering urban temperatures in an important way.

Urban adaptation and mitigation therefore provide significant opportunities, with cities having a key role to play in addressing climate change (Carter, 2011). Different types of urban greenery have a positive effect on local climate, air quality, noise levels, and soil stability (Gill et al., 2007; Nowak and Dwyer, 2010; Carrus et al., 2015; Shashua-Bar and Hoffman, 2000). In these terms, the LIFE CLIVUT project 'Climate value of urban trees' (LIFE18 GIC/IT/001217) has been implemented in four cities in the Mediterranean area: Perugia and Bologna in Italy, Thessaloniki in Greece, and Cascais in Portugal.

Due to the current state of trees in an urban environment, the ecosystem contribution they generate in an area is different. We know that the tree stock in cities is often of a significant age and we often do not know the actual number and quantity of benefits they generate in the city. In this sense, knowing the tree stock that each city has in both public and private heritages becomes synonymous with the resilience of cities in the fight against climate change and the contribution they can make to this cause.

PROJECT OVERVIEW

The idea and the missionof the project

What is LIFE CLIVUT?

LIFE CLIVUT intends to develop knowledge and methodologies for the design and implementation of an Urban Green Strategy for Climate Change aimed at optimising the climatic and environmental services of "urban forests".

The overall objective of the project is to develop and implement the Urban Green Climate Change Strategy in medium-sized Mediterranean cities based on the shared planning and management of urban green and natural spaces by urban planners and citizens. The strategy, designed using an ecosystem-based approach, will:

- Improve the city's ecosystem adaptive capacity.
- Maximise the climate mitigation potential of urban green resources.
- Provide biodiversity and nature conservation benefits by improving people's safety, health and well-being.

The project involves several actions and uses methodologies inherent to 'Citizen Science' and participatory projects.

LIFE CLIVUT actions are addressed to:

- Those responsible for urban planning and green areas, aimed at providing knowledge and tools for the use of green areas in the city in the reduction of the effects of climate change on the urban ecosystem;
- Citizens, in order to increase their knowledge on the role of urban green areas, to encourage their participation in its management and to increase their interest in green investments, including private ones;
- Students at different school levels with the design and experimentation of original educational paths that increase knowledge of the problems linked to climate change, the role of green areas in mitigating their effects and that bring out more sustainable consumption behaviour;
- Businesses through the availability of a dedicated tool for accounting for the emissions generated by their activities and the participatory identification of a regulatory and incentive system that rewards their reduction and offsetting, including through new urban forests.

The tree species were mapped through a free web app designed ad-hoc, which can be used by all citizens “LIFE CLIVUT TREEDB”, hereafter Clivut-Treedb:

lifeclivut.treedb.eu

The main goal of the LIFE-CLIVUT project is to establish constructive collaborations with the municipality administrations for the development of a green asset strategy by devising best practices and recommendations for the management of urban green areas, with the final aim of mitigating the local effects of climate change.

This collaboration will help public administrations improve the knowledge of their urban green assets and enhance the climatic and ecosystem functions of green areas. An urban green asset management system was built with data recorded through plant survey (including those collected by citizen science initiatives) on the dendrometric characteristics of existing and future urban trees, about their environmental and climate performances, as well as with the best management practices to enhance their ecosystem services.

The web app Clivut-Treedb was developed ad-hoc to enable both urban planners and citizens to improve their awareness about urban climate effects. It is based on plant data libraries (dendrometric information) for the main Mediterranean tree species that can be found in the project areas. This web tool will be used for the implementation of green assets strategies and highlight their environmental benefit, climatic effect and socio-economic impact.

Moreover, citizens and students will be involved in monitoring private urban green areas, and will receive climate-oriented and ecosystem-based guidelines to enable climate resilient areas. Lastly, the use of the web app Clivut-Treedb will allow entrepreneurs to account for their emission and identify compensation measures bringing their activities towards the goal of zero emissions.

Tree shading and evapotranspiration effects contribute to mitigating summer temperatures by decreasing air temperatures up to 7 degrees in the Mediterranean area (Cao et al. 2010). This leads to a reduced energy demand for building cooling systems, which indirectly impacts air quality, greenhouse gas emissions, and global warming (Shashua-Bar and Hoffman 2000).

Finally, urban trees contribute to the reduction of air pollution by absorbing particulate matter (David J. Nowak, Crane, and Stevens 2006; David J. Nowak and Dwyer 2010; David J. Nowak et al. 2013;
Massetti et al. 2019).

Vegetation acts as an "air natural conditioner", tempering the thermal extremes that characterise the urban heat island **(Shashua-Bar and Hoffman 2000).**

OUR RESULTS

Results and goals of the project

- **An increase in the use of public green areas and the related impact on health -** The LIFE CLIVUT project through dissemination activities has made citizens living in the 4 pilot and transfer cities more aware of the role and ecosystem benefits of urban green space.
- **A willingness to pay for new green spaces and trees in one's city -** Investments in urban greenery help mitigate climate change and city resilience in the face of the increasingly frequent extreme phenomena that our cities face.
- **Growing interest/attention to environmental and climate matters -** The project noticed a growing interest in the 4 project targets (public administrators, citizens, students, and entrepreneurs) towards climate change also through the expression of concern about their future. Nevertheless, it was mentioned that urban greening with its mitigation and adaptation functions is a largely interesting solution that can be an active way tackle the climate crisis.
- **Change in management of green areas -** The public administrations in the cities involved in the project are changing how they manage public green areas to improve CO_2 storage and make trees more resilient to climate change. With the spread of new diseases or pathogens, and it has become necessary to increase biodiversity by changing the choice of species by first checking the planting conditions and then the best species best suited to those locations.

These changes will save greatly on the mortality of planted species, and improve management practices of existing trees by intervening in a more rational and indicated way than the old methodologies, also using tools with low environmental impact.

The collected data was then processed through SimaPro software (software dedicated to environmental analysis) to determine the value of climate-altering emissions for urban greenery.

Because the climate footprint is a partial environmental indicator, that is, it considers only the interactions of the plant life stages from nursery to death along urban boulevards or parks with the climate, leaving out other types of environmental impacts (e.g., ozone depletion potential), the models developed allowed for an assessment of the impact of green management on urban living.

Through the analysis over the three years of the project, it was possible to develop a model indicating which are the best techniques for green management in the urban environment through guidance on which machines to use for both planting and maintenance and care technics in the urban environment.

This allowed the results to be evaluated through the calculation of carbon footprint.

1) Carbon sequestration:

Through the urban green census, it was thus possible to identify which species performed best in urban settings. This inventory made it possible to account for the actual amounts of CO_2 sequestered by trees, and to assess what the increase in sequestration might have been if new trees were planted in turn and how they may have absorbed CO_2 over time.

We evaluated each species located in the 4 pilot cities their numbers and age verifying that over time the uptake tends to decrease and therefore it is necessary to plan for tree planting in a scaled manner.

2) Monitoring of urban green and citizen engagement:

The monitoring of urban greenery was also brought forward with the help of citizens that provided the actual idea of the value of the green assets of the 4 project cities.

The involvement of citizens and students was one of the key points of the project because it enhanced the relationship between citizens and greenery and disseminated knowledge and new skills while also going so far as to dispel some misconceptions derived from the lack of information on certain matters.

Through the activities of the LIFE CLIVUT project so many people have been involved on issues related to the benefits of urban greenery, the economic value of trees in the city of the environmental benefits of good tree management. Materials have been disseminated to increase citizens' awareness of the possibilities of local governments to manage greenery, and public-private partnerships have been developed to manage greenery according to the best techniques derived from the analyses conducted
during the LIFE CLIVUT project.

3) The developed model:

The developed Clivut-Treedb is a user-friendly platform for collecting green asset data that non-expert citizens can use, thanks to a function to identify tree species in an easier mode with the inclusion of an open source platform derived by a citizen science project for automatic plant identification (PlantNet).

From an IT point of view, the system resides on a central server, currently located at the Department of Engineering of the University of Perugia. An Apache web platform has been set up on this server to allow access via the web to the applications and database in the system. The central core consists of a spatial database (PostgreSQL and its PostGIS extension) on which the spatial data relating to the census sites are managed and the environmental information (particulate) from the regional environmental agencies is made available.

The application component is developed using open source software both for the GIS component (which is a founding element of the system), represented by GeoServer, OpenLayers and PostGIS, and for the strictly application component, developed in JavaScript and Php, through which the various models for measuring and predicting the environmental behaviour of the census trees are processed.

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All the functions can be accessed through a common browser and a normal Internet connection, requiring no installation on the devices used, thus being independent from technological platform used and the type of connection (landline or mobile network) and can therefore also be used on the move.

To access the system, it is sufficient to request access authorization, and so, in addition to the possibility of consulting data, the registered user is able to manage data related to areas of personal interest independently and confidentially.

Through the Clivut-Treedb, different sets of "dendrometric" data were collected in a geo-localized way for each tree present in the
studied areas at different
ages (growing stage).

Mathematical models (based on international scientific literature) were selected to calculate the following ecosystem parameters: CO_2 sequestration, particulate (PM10) absorption, shadow effect, biodiversity increase.

4) Economic evaluation:

We know that a tree is an important element not only in the rural setting, but especially within the urban mosaic. Because of the many ecosystem services it freely returns to the ecosystem, a tree can really make a difference in the urban context.

Consider, for example, the positive effect on psychophysical well-being, their social and recreational value, but also the historical value of trees as symbols of a past era or a particular event. It is not coincidental that the presence of tree species in the vicinity of homes and buildings helps to increase their value.

Therefore, the economic value of a tree has long been discussed. While it is relatively simple to assign a value to species that populate forests and orchards, it is not so easy for trees placed in urban settings, precisely because of the many variables involved.

In any case, it should always be kept in mind that the value of a tree in the city depends on several factors, for example, its characteristics, the context in which it is located, and the cost/benefit ratio over time.

To date, there are several estimation methods, developed by expert arborists around the world and published in international journals. Among the best known methods:

- **Swiss -** Estimates value by starting with a base price to the tree, and considering its size, location, aesthetic value and health condition; then applies a reduction index if the tree is damaged;
- **American -** Assigns a starting unit value based on replacement cost and then taking into consideration species, health condition and location;
- **Australian -** The evaluation follows the methods of the American method, but also considering plant life expectancy, location and health status;
- **English -** Designed to provide public agencies with a professional method of estimating the economic value of a tree.

However, none of these methods take into account the economic value of the tree for its climate and environmental performance and this is precisely one of the goals of the LIFE CLIVUT project.

THE FUTURE

Likely future scenarios

The results obtained will also be compared with possible climate change scenarios in urban settings, thus using CO_2 storage prediction tools and thus refining or identifying the best management techniques to mitigate the effects of climate change through urban greenery.

The web app developed as principal objective of the LIFE CLIVUT project (Life clivut treedb) will be a valuable support for local administrators and citizens, and for entrepreneurs to enhance their greenery and better account for the climate impact on trees in the city, as well as the benefits they provide in the different urban areas.

Environmental benefits accounted for under the LIFE CLIVUT project also include not only the use of new trees in the city but also green roofs and other methods of making urban greenery that can mitigate the impact of heavy rainfall resulting from climate change, as well as developing new and suitable green areas to accommodate all segments of the population including students, with various aggregative green proposals, for example, coworking areas where social interaction can be developed, or play areas with permeable spaces between the green and playground equipment.

Several opportunities for urban greenery development can better combine management and design by recreating those infrastructures between the green the grey and the blue, hence, also improving constructive sustainability through permeable materials that counteract heat absorption, which thus improve albedo, or that can bring together multiple needs to improve usage.

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More information at:
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