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An Analysis of Carbon Sequestration from Green Surfaces in Durres City

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Abstract: *In recent years the urban population in Durres city has grown exponentially, leading to an increase of CO_2 and consequently contributing on a large scale to climate change. Urban trees are basic to sequester CO_2 emissions as they incorporate carbon in their biomass. The amount of $C0_2$ sequestration from green surfaces in Durres city was $50.13 \cdot 10^6$ kg/year instead of $116.35 \cdot 10^6$ kg/year that it should be. Increasing the amount of green vegetation, the energy that can be stored will be $3.7 \cdot 10^5$ MWh compared with the actual value of 162,48 MWh. Consequently, water carrying capacity will be 2321 times more than the amount of water needed to maintain the present public green spaces. These data can be used to help assess the actual and potential role of green trees in reducing atmospheric CO_2, a dominant greenhouse gas. This study was conducted under the project "Green lungs for our cities - Alternative and comprehensive platform for monitoring air quality, noise pollution and urban greenery to affect policies at the local level". Measurements were performed with the cooperation of Eper Center, professors and students of "Aleksander Moisiu" University.*

1. INTRODUCTION

Global warming is a phenomenon of rising earth temperatures due to the production of Greenhouse Gases (GHG) and one of them is CO_2 (Azaria et al., 2018). Poor air quality occurs when pollutants reach high enough concentrations to affect the environment and/or human health. Urban outdoor air pollution is a more specific term referring to the ambient air pollution experienced by populations living in urban areas, typically in or around cities (Guerrero, 2014). Industry (steel and chemical industries, power plants), agriculture, waste incineration, combustion of fossil fuels and road traffic are the important local sources (Celik et al., 2005).

Carbon dioxide is one of three greenhouse gases that are receiving increasing attention. CO_2, methane (CH_4) and nitrous oxide (N_2O) are believed to trap heat in the atmosphere the same way glass does in a greenhouse. The accumulation of these gases in the atmosphere is likely to cause climate changes (USDA, 2000).

According to Heede (2014), 80% of global carbon emissions are caused by urban human activities. Human activities such as fuel combustion during vehicular transportation, power generation emit large quantities of carbon dioxide to the environment. Moreover, construction operations and other industrial operations have also been recognized as major carbon emission

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sources. Thus, global researchers have been significantly focused on investigating methods to reduce carbon emissions (Mesthrige & Samarasinghalage, 2019).

Carbon sequestration is the process through which atmospheric carbon is captured and stored for the long term. The process slows the atmospheric accumulation of greenhouse gases released by such activities as burning fossil fuels. Plants can play an important role in this process (https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/carbon-sequestration).

When a tree dies and the wood is allowed to decompose or is burned, most of the stored carbon goes back to the atmosphere, though some of the carbon can be retained in the park soils. Through their growth process, trees can sequester significant amounts of carbon in their biomass (Nowak & Heisler, 2010).

The absorption of atmospheric carbon dioxide by tree leaves is accomplished through photosynthesis, the primary biosynthetic pathway in which CO_2 and water (H_2O) are used to produce carbohydrates and return oxygen (O_2) to the atmosphere. Through the process of respiration, these carbohydrates are metabolized to provide the plant with the energy needed for its growth and functioning (Fares et al., 2017).

2. MATERIALS AND METHODS

The method followed by monitoring green trees was based on these steps.

1. Before going out on the field to gather relevant information, the most important stage in the process of creating tables with relevant fields for which there is interest in getting information.
2. Field monitoring: Outlining in ArcMap or Google Maps the monitoring area and printing maps as material that should have each working group at the time of field trip, along with other materials: clothing with project logo, folders, pens, excel spreadsheets, measuring devices, cameras (photography of vegetation and various problematic situations), maps, etc.
3. The process of obtaining field information, completing excel spreadsheets and related notes during monitoring. Completing the table by specifying: The name of the area where it is being performed monitoring, an ordinal number for each plant, tree type, diameter measurement, age up to the infiltrating surface attribute. Other fields are filled in by calculations in excel or ArcMap.
4. This phase closes the field monitoring process and the start of work on its disposal data in digital formats, in excel spreadsheets, or ArcMap.
5. The penultimate stage after completing the attributes for each monitoring is related to the product final: MAPS. Cartographic layout is one of the main products of the whole process because it is the best presentation of the state of the terrain with appropriate information. The maps are of different themes depending on the parameters that are monitored and relevant calculations.
6. The final stage in the GIS data submission process is data conversion in a readable format for submitting all monitoring on the online platform.

3. RESULTS AND DISCUSSION

The results obtained in this paper are part of the project *"Green lungs for our cities - Alternative and comprehensive platform for monitoring air quality, noise pollution and urban greenery to affect policies at the local level"*. This project was realized in collaboration with *"Environmen-*

tal Center for Protection, Education and Rehabilitation" together with *"Aleksander Moisiu" University* students and professors for a period of approximately two years.

From data in Table 1, we may see conclude that the total number of trees evidenced is 6.400. From calculations, these trees release $64.42 \cdot 10^3$ kg/year O_2 and sequester $50.13 \cdot 10^3$ kg/year CO_2. Secondly,based on sciencefocus.com (https://www.sciencefocus.com/planet-earth/how-many-trees-does-it-take-to-produce-oxygen-for-one-person) a human breathes about 740 kg/year of O_2. If we apply this to Durres city population (202.000 inhabitants) (https://sq.wikipedia.org/wiki/Durr%C3%ABsi) the amount of O_2 that is needed referring to standards is $1.49 \cdot 10^8$ kg/ year. In this case, CO_2 sequestration should be $1.16 \cdot 10^8$ kg/year CO_2. Thirdly, the cost to sequester $50.13 \cdot 10^3$ kg/year CO_2 is $4.216 \cdot 10^5$ ALL whereas for $1.16 \cdot 10^8$ kg/year CO_2 the cost needed is $9.78 \cdot 10^8$ ALL.

Table 1. Number of trees, O_2 release, CO_2 sequestration and costs (in different areas of Durres city)

Area	**No. trees**	**O_2 release (kg/year)**	**CO_2 sequestration (kg/year)**	**CO_2 sequestration cost (ALL)**
Commercial (urban)	2292	13 400	31 000	44 612
Industrial	2333	25 220	9 450	185 001
Residential (suburban)	1775	25 800	9 680	191 987
Total	**6400**	**64 420**	**50 130**	**421 600**

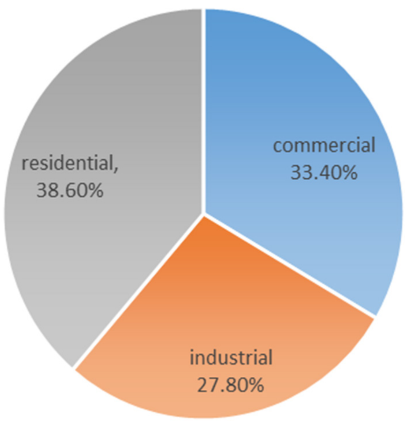
Source: Authors calculations

The total amount of energy conserved for 50 130 kg/year CO2 sequestration is 162.48 MWh (Table 1 and Table 2). The cost for this energy is 1.55 · 106 ALL. The energy conservation based on the number of inhabitants and standards should be 3.7 · 105 MWh and the cost to be invested for this amount is $3.5 \cdot 10^9$ ALL. Energy conservation (in %) by carbon dioxide sequestration is given in Graph 1.

Table 2. The quantity of energy conservation (by carbon dioxide sequestration) in different areas of Durres city and the costs

Area	**Energy conservation (MWh)**	**Cost (ALL)**
Commercial (urban)	54.40	$5.25 \cdot 10^5$
Industrial	45.27	$4.30 \cdot 10^5$
Residential (suburban)	62.81	$5.96 \cdot 10^5$
Total	**162,48**	**$1.55 \cdot 10^6$**

Source: Authors calculations



Graph 1. Energy conservation (in %) by carbon dioxide sequestration

Source: Authors calculations

From data in Table 3, we may add that the water carrying capacity for 6400 trees ($50.13 \cdot 10^3$ kg/year CO_2) is 35462.3 m^3/year. The cost for this amount is $172 \cdot 10^5$ ALL. For $1.16 \cdot 10^8$ kg/year CO_2 sequestration,the water carrying capacity should be $82.3 \cdot 10^6$ m^3/year. The cost for this investment is $3.9 \cdot 10^{10}$ ALL.

Table 3. The amount of water carrying capacity
(by green vegetation) in different areas of Durres city and the costs

Area	Water carrying capacity (m^3/year)	Cost (ALL)
Commercial (urban)	2687	$1.07 \cdot 10^5$
Industrial	16442.3	$3.17 \cdot 10^4$
Residential (suburban)	16333	$3.30 \cdot 10^4$
Total	**35462.3**	$\mathbf{1.72 \cdot 10^5}$

Source: Authors calculations

4. CONCLUSION

Based on the above results it is concluded that:

- Based on the standards (9m^2 of green space for each person) and the number of inhabitants in Durres city it should be sequestered $1.16 \cdot 10^8$ kg CO_2/year. The actual sequestration is 2321 times less of this value. The cost to be spent for this investment goes somewhere to $9.78 \cdot 10^8$ *ALL*. The needs for water carrying capacity and its cost should be respectively $82.3 \cdot 10^6$ m^3/year and $3.9 \cdot 10^{10}$ *ALL*.
- The energy conservation from CO_2 sequestration should be $3.7 \cdot 10^5$ MWh and the cost to be invested for this amount is $3.5 \cdot 10^9$ *ALL* ;
- Planting trees remains one of the cheapest, most effective means of drawing excess CO_2 from the atmosphere;
- Trees lower air temperatures by transpiring water and shading surfaces. They can reduce building energy use and cooling costs.

REFERENCES

Azaria, L., Wibowo, A., Putut, I., Shidiq, A., & Rokhmatuloh (2018): Carbon Sequestration Capability Analysis of Urban Green Space Using Geospatial Data. E3S Web of Conferences 73, 0 3009 DOI: 10.1051/e3sconf/20187303009;

Celik, A., Kartal, A., Akdogan, A., & Kaska, Y. (2005): Determining the heavy metal pollution in Denizli (Turkey) by using Robinio pseudo-acacia L. Environmental International, 31 (1), 105-112

Fares, S., Paoletti, E., Calfapietra, C., Mikkelsen, T. N., Samson, R., & Thiec, D. L. (2017): Carbon Sequestration by Urban Trees. DOI: 10.1007/978-3-319-50280-9_4, In book: The Urban Forest (pp. 31-39)

Guerrero, C.C (2014): Urban trees and atmospheric pollutants in big cities: Effects in Madrid (thesis doctoral) available online on http://oa.upm.es/32872/1/CARLOS_CALDERON_GUERRERO.pdf

Heede, R. (2014): Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010. Clim. Chang. 2014, 122, pp. 229–241;

Mesthrige J. W & Samarasinghalage Th. I. (2019): Global Research on Carbon Emissions: A Scientometric Review, Sustainability, 11, 3972; DOI: 10.3390/su11143972;

Nowak D. J, Heisler, G. M. (2010): Air quality effects of urban trees and parks, Research Series Monograph. Ashburn, VA: National Recreation and Parks Association.

USDA. 2000. "Growing Carbon: A New Crop that Helps Agricultural Producers and the Climate Too" Washington, D.C.: U.S. Department of Agriculture

https://sq.wikipedia.org/wiki/Durr%C3%ABsi

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/carbon-sequestration

https://www.sciencefocus.com/planet-earth/how-many-trees-does-it-take-to-produce-oxygen-for-one-person