An Estimation of Oxygen Release from Green Surfaces in Durres City

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Abstract: - Due to urbanization trend in Durres city, distance between city inhabitants and nature is increasing. Urban greenery is one of the methods to bridge this gap between people and nature.

The study results were performed with the cooperation of EPER Center, professors and students of Durres "Aleksander Moisiu" University. It was focused in the estimation of O_2 release from green surfaces at different areas of Durres city. The results achieved were carried out by field visits, the use of the GIS method and calculations performed based on various standard manuals.

According to the results, it was concluded that the total amount of O_2 release from green surfaces was 64420 kg/year or 64.4 t /year. It was also calculated that the available green surface for a resident in Durres city is only 1.05 m^2 out of required 9 m^2 per capita.

Based on the needs of the population and the EU standards, this study suggests that the amount of O_2 release should be $1.49 \cdot 10^8$ kg/year or $1.49. 5 \cdot 10^5$ t/year. The needed costs to be invested to achieve this O_2 amount, is about 47 .65 billion ALL.

Finally, it can be concluded that the low number of trees in Durres city, requires urgent provisions to improve air, and life quality of Durres citizens.

Key-Words: - Oxygen release, Public green surface, Lost green surface, Air quality

1 Introduction

The transformation of natural and agricultural lands into urban areas is increasing every year. It is estimated that 66% of the world's population will live in cities by 2050, compared to 30% in 1950 [1]. In those areas, humans, animals, and plants coexist together. Dense buildings, heavy traffic, construction works with deep excavation, and the common use of concrete and glass materials leads to the degradation of the environment in relation to plant growth [2].

Urban vegetation, particularly trees, provides numerous benefits that can improve environmental quality and human health in and around urban areas. These benefits include improvements in air and water quality, building energy conservation, cooler air temperatures, reductions in ultraviolet radiation, and many other environmental and social benefits [3, 4].

According to statistics, people spend 80%-90% of their time indoors, so indoor air quality, whether at home or in the office, has a significant impact on people's quality of life, health status and work efficiency. [5]

Vegetation absorbs CO_2 through the processes of photosynthesis, releases O_2 into the air, and consequently helps to mitigate urban air pollution [6, 7].
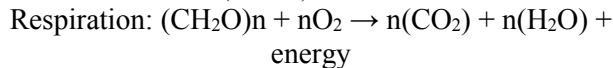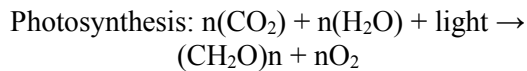
Increasing energy consumption, soil sealing and the high competition for surface between green and grey infrastructure in densifying urban areas may lead locally to a lack of urban greening [8] and the loss of biodiversity. Climate change will potentially lead to a decline of quality of life in cities [9].

Planting trees remains one of the cheapest, most effective means of drawing excess CO_2 from the atmosphere [10].

A single mature tree can absorb carbon dioxide at a rate of 48 lbs./year and release enough oxygen back into the atmosphere to support 2 human beings [11]. Trees remove gaseous air pollution primarily by uptake through the leaves, though some gases are removed by the plant surface. Trees also remove pollution by intercepting airborne particles. Many of

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the particles that are intercepted are eventually resuspended back to the atmosphere, washed off by rain, or dropped to the ground with leaf and twig fall [12].

Net oxygen production by trees is based on the amount of oxygen produced during photosynthesis minus the amount of oxygen consumed during plant respiration [13, 14]:

$$\text{Photosynthesis: } n(CO_2) + n(H_2O) + \text{light} \rightarrow (CH_2O)n + nO_2$$
$$\text{Respiration: } (CH_2O)n + nO_2 \rightarrow n(CO_2) + n(H_2O) + \text{energy}$$

The purpose of this paper is to:
- evaluate the state of green surfaces and the amount of O_2 release in Durres City;
- recommend measures to be taken for improving air quality

2 Materials and Methods
The object of the monitoring methodology used in this paper is the accurate inventory of urban greenery, the assessment of its condition and the creation of a digital platform to assist the dynamic / alternative environmental monitoring process.

Vegetation and urban ecosystem, through their services, are indicators for air quality monitoring according to European standards (EU directives 008/50 / EC and 2004/107 / EC).

The basic service that was evaluated through measurements, digitalization and analysis was the amount of O_2 emitted from green surfaces.

The main component of the methodology was the creation of the urban tree database in GIS (similar to the i-Tree platform) realized through field visits and consultations with specialists in the field. Elements identified in the field included: type, diameter of wood (via a strip meter), height of trees (by comparing the floors of nearby buildings or urban lighting poles), tree cavity - measured as the product of their two dimensions.

There were 5 steps followed for this study:

a) Division of study areas with clear boundaries and area between 7-20 ha per study region. The areas were named according to main neighborhoods or streets.

b) Detailed inventory and digitalization of the vegetation area (identification of each tree, medium and high shrubs, as well as green areas and gardens).

c) Specific measurements like trunk diameter, cavity surface, type of vegetation, ordinal nomenclature, estimated height, approximate age, condition of

vegetation, trunk cover, condition of cover, green area.

Through these data, the use of "Tree age calculator" and "Tree benefit calculator" were then identified the age of the tree and was calculated the amount of oxygen (kg/year) that it was released in environment.

d)Identification of infrastructural and environmental problems.

This methodology followed has a high degree of accuracy compared to other alternative methods such as orthophoto in geoportal [15].

3 Results and Discussion
Monitoring of urban green surfaces in Durres city was carried out in three areas, zone A (commercial zone), zone B (industrial zone), zone C (residential zone) as shown in the following map (Map 1), during the period January 2019 - February 2021.

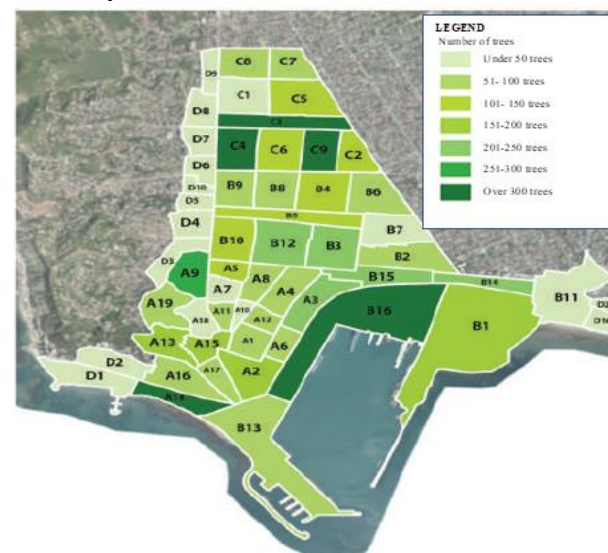Each of them was divided into subzones and in total was composed of 44 subzones.

Fig. 1: Number of trees for each subzone

Area A includes the "Volga" area, the "trade road", the "Egnatia" road, the "Court" road, the "Museum of the Martyrs", and part of the amphitheater. There were identified 2292 trees in this area.

Zone B includes "Adria" street from the train station to Dajlani bridge, the road from the sports palace to "Niko Dovana" stadium, "Glaukia" street to the big industrial market, "Aleksander Goga" street to the Durres police directorate. There were identified 2333 trees in this area.

Zone C includes the area of "Niko Dovana" stadium, , Durres regional hospital, the area of the swamp, the park near "Vaso Pasha" Street and surroundings. There were identified 1775 trees in this area.

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From the monitoring and calculations of each urban tree of Durres city, $64.4 \cdot 10^3$ kg of oxygen were released.

In the three monitored areas of Durres city were identified $212.3 \cdot 10^3$ m² of existing green surfaces and $66.1 \cdot 10^3$ m² lost as well as 6400 urban trees, which were mainly of Tilia Cordata, chestnut, palm, maple, poplar, oak, pine, plane, Ligustrum lucidum etc. Each of them had a diameter (from 10 to 15 cm) and a certain age (up to 100 years).

The table below shows a summary of urban greenery monitoring (tab 1).

Table 1. Summary table of urban greenery monitoring

Public green surface (m²)	Total number of trees	Total O₂ released (kg/year)
$212.3 \cdot 10^3$	6400	$64.42 \cdot 10^3$

The maps of each area with green surfaces are presented below (map 2, map 3, map 4).

Fig. 2: Green surfaces of A zone

Fig. 3: Green surfaces of B zone

Fig. 4: Green surfaces of C zone

As we see from Table 1, the total amount of O_2 released per year from green surfaces is $64.42 \cdot 10^3$ kg or 64.42 t.

Based on [16] a human breathes about 740 kg of oxygen per year. If we rely on Durres city population (202 000 inhabitants) [17] we can calculate the amount of O_2 needed for this population which is about $1.49.5 \cdot 10^8$ kg/year or $1.49 \cdot 10^5$ t/year.

Comparing the amount of O_2 released by actual green surfaces and what is standard, it is far from meeting these standards.

It is estimated that for the amount of O_2 released actually in Durres city the cost goes somewhere around 20.5 million ALL.

To improve air quality in Durres city, local authorities have to increase green surfaces. Based on population size the cost to be invested is about 47 .65 billion ALL.

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Based at the results, the total public green surface in Durres city is 212 300 m^2 or 21.23 ha. The lost green surface due to urbanization is 66 100 m^2 or 6.61 ha.

According to the World Health Organization (WHO), every city is recommended to provide a minimum of 9 square meters of urban green surface for each person [18, 19] provided that it should be accessible [20], safe [21] and functional [22]. WHO also suggest that an ideal amount of urban green surface can be generously provided as much as 50 square meters per person [18].

If we refer to Durres city population (202 000 inhabitants) and actual green surface (212 300 m^2) we can calculate that to a resident in Durres city is offered only 1.05 m^2 of green surface out of 9 m^2 that it should be according to WHO standards.

The comparative tables below shows cities in the world and the amount of green surface per square meter per capita. (Table 2, 3).

Table 2. Top 15 cities in the world and amount of green surface per person [23]

#	City	Country	% of Green Space	Square Metres of Green Space Per Person
1	Auckland	New Zealand	33.59	288.89
2	Gothenburg	Sweden	26.65	221.18
3	Bratislava	Slovakia	24.68	200.37
4	Bern	Switzerland	25.54	102.70
5	Riga	Latvia	18.02	85.60
6	Sydney	Australia	5.48	77.45
7	Reykjavik	Iceland	3.37	75.59
8	Tallinn	Estonia	16.73	65.10
9	Helsinki	Finland	21.38	61.48
10	Madrid	Spain	31.12	59.53
11	Marseille	France	19.47	55.37
12	Berlin	Germany	21.09	54.17
13	Zurich	Switzerland	22.97	53.98
14	Prague	Czech Republic	12.60	48.96
15	Stockholm	Sweden	20.56	46.97

Table 3. The adoption of urban green space standards in several cities [24]

	Cities	Size	Population	m^2/person
1.	Greater London	4 hectares	1000 residents	40
2.	Edinburgh	2.9 hectares	1000 residents	29
3.	Cambridge	4.6 hectares	1000 residents	46
4.	Washington	3.8 hectares	1000 residents	38
5.	Minneapolis	2 hectares	1000 residents	20
6.	Los Angeles	4.85 hectares	1000 residents	48.5
7.	Kansas City	3.64 hectares	1000 residents	36.4
8.	Bristol	1.0 hectares	1000 residents	10
9.	India	0.8 hectares	1000 residents	8
10.	Pakistan	0.52 hectares	1000 residents	5.2

In comparison with the most cities and required standards, it is obvious that the existing green surfaces in Durres city are far from the standards.

3 Conclusions

Urban greenery contributes to the improvement of air quality and the reduction of noise pollution by: absorbing gaseous pollutants (NO_2, SO_2, O_3) through the leaf surfaces; capture PM10 particles (dust, pollen, smoke); release oxygen through the process of photosynthesis; enabling the creation of shadows, which reduce air temperatures; standing as anti-noise barriers to noise.

Based on the results achieved in this paper we can conclude that:

- The amount of O_2 released per year from green surfaces in Durres city actually is calculated to be 64420 kg or 64.42 t;

- The amount of 0_2 released needed for this population (by standards) is nearly $1.49 \cdot 10^8$ kg or $1.49 \cdot 10^5$ t (O_2/year). The cost to be spent for this investment goes somewhere to 47 .65 billion ALL;

- For a resident in Durres city is available only 1.05 m^2 of green surface from 9 m^2 that it should be;

- The main factors that may have influenced the loss of green areas are the occasional and indiscriminate constructions in the city of Durres;

- Durres municipality is working to regenerate existing green surfaces by replacing them with young trees. These trees produce less oxygen than older ones. As a result, we have less oxygen released to meet vital needs

This study had some limitations. Due to the situation created by the 2019 devastating earthquake, followed by the Covid -19 pandemic, it was not possible to proceed and survey wider areas. For this reason, few aim that in the future we will monitor

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the entire green area of the city of Durres in order to have a clearer picture of the entire area of Durres region.

4 Recommendations

Based on the results of this study the authors recommend as follows:

- Establishment of a green belt in the hills around Durres city to prevent urban sprawl, to expand current green surfaces and to connect the existing ones.
- Rehabilitation of existing parks (park at the amphitheater of Durres, villa of Zog, Currila) with plants resistant to microclimatic conditions of Durres city and with a significant impact on improving ecosystem services, such as: maple, oak, maple, plum, etc.
- Creation of green corridors within the city, based on the existing path that connects the area of Durres amphitheater with the port area.
- Creation of a new park in Kallm, 3 km north of city center center, as part of the general local plan for the increasement of green areas in Durres Municipality.
- Establishment of a tree and flower nursery in the Durres Municipality in long-term cooperation with existing private nurseries, so that they adapt to the climate of Durres to guarantee longevity over the years.
- Rehabilitation and construction of green pockets in public areas within the residential blocks in district 15, and 18 of Durres city and later in the entire Durres Municipality area.
- Expansion of green surfaces in existing areas as well as in new neighborhoods that are being consolidated.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)
Migena Nako, Elvis Cela, Abdulla Diku have collected data in the field, their processing and construction of data in the GIS platform
Osman Metalla, Marsida Klemo, Azem Hysa have interpreted and evaluated the data