


The Landscape Urban Planning Approach for Improving Urban Air Quality, Case Study of Algiers, Algeria

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ABSTRACT

Gardens and urban parks are areas of great importance for the support of the urban ecosystem, in addition to their psychological and therapeutic values; they provide the urban environment with a large amount of oxygen. Trees produce oxygen through the operation of photosynthesis; one hectare of eucalyptus tree annually produces oxygen for 37 to 80 people, and absorbs 25, 000 kg of carbon dioxide for the same period of time. Wooded zone in urban areas significantly improve and purify the quality of the air that we breathe and make living environments healthier. A recent study carried out by the World Health Organization (WHO) revealed that the MENA region (Middle East and North Africa) is one of the most polluted in the world, air polluted by particulate matter smaller than 2.5µm (PM2.5). For the case of Algiers, measurements were taken during the first two months of the year 2023 by the station of the United States Embassy in Algiers, showed that daily average of 14 µm/m³ for particulate matter less than 2.5 µm/m³ and a daily average of 50 for the IQA, air quality index. According to the US EPA's NAAQS, any measurement above 12.0 µg/m³ (US AQI 50) may be hazardous to human health. Several factors of an exogenous and endogenous nature act directly on the quality of the air in large urban concentrations, CO₂ emissions, modes and nature of urban mobility, uncontrolled urban sprawl. High population densities, urban forms, morphology, the size of cities, which getting larger and larger, the choice of urbanization models, and the surface of wooded areas, all are, factors responsible for air quality. This study will be particularly interested in the contribution of gardens, parks and wooded areas in improving air quality, and consequently on the quality of the living environment in urban areas. In this respect, and to understand the situation, we take the city of Algiers as a case study. The field work will allow us to understand in a qualitative and quantitative way the contribution of the tree and the choice of tree species, understanding co-relation between landscape architecture decision and results obtained on the urban air quality, and try to research on how it would possible to improve air quality in urban areas by using trees new essence.

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1. Introduction

According to the 5th annual report on air quality in the world in 2022, there are only 5% of countries on the planet respecting the WHO guidelines on air pollution, Australia, Estonia, Finland, Greenland, Island and New Zealand. Conversely, the most polluted countries in 2022 in terms of fine particles 2.5 PM, are first Chad with 89.7 $\mu\text{m}/\text{m}^3$, which represents 17 times higher than the WHO annual average set at 5 $\mu\text{m}/\text{m}^3$, followed in second place by Iraq with 80.1 $\mu\text{m}/\text{m}^3$, 16 times the annual WHO recommendations . Pakistan comes in third position with 70.9 $\mu\text{m}/\text{m}^3$, Bahrain in 4th position with 66.6 $\mu\text{m}/\text{m}^3$, (Figure 1) in 5th position of the most polluted countries is Bangladesh with 65.8 $\mu\text{m}/\text{m}^3$, the report also indicates that 90% of the countries of the globe have exceeded the annual WHO PM2.5 guideline value of 5 $\mu\text{m}/\text{m}^3$.

Algeria is ranked in 58th place with a rate of 17.8 $\mu\text{m}/\text{m}^3$, air pollution in Algeria is mainly due to emissions from the combustion of fossil energy sources generated from industry, urban transport and even residential sector. The disparity of the results taken on the quality of the air, the values of NO₂, taken on different places of the capital Algiers, has pushed us to seek to understand the link which can exist between the space in question which is defined by a form and a precise spatial configuration and the value of NO₂ taken during a period of time, at this stage, the question that arises; Is there really a relationship between the quality of the air taken in public space and the physical components of the same space?

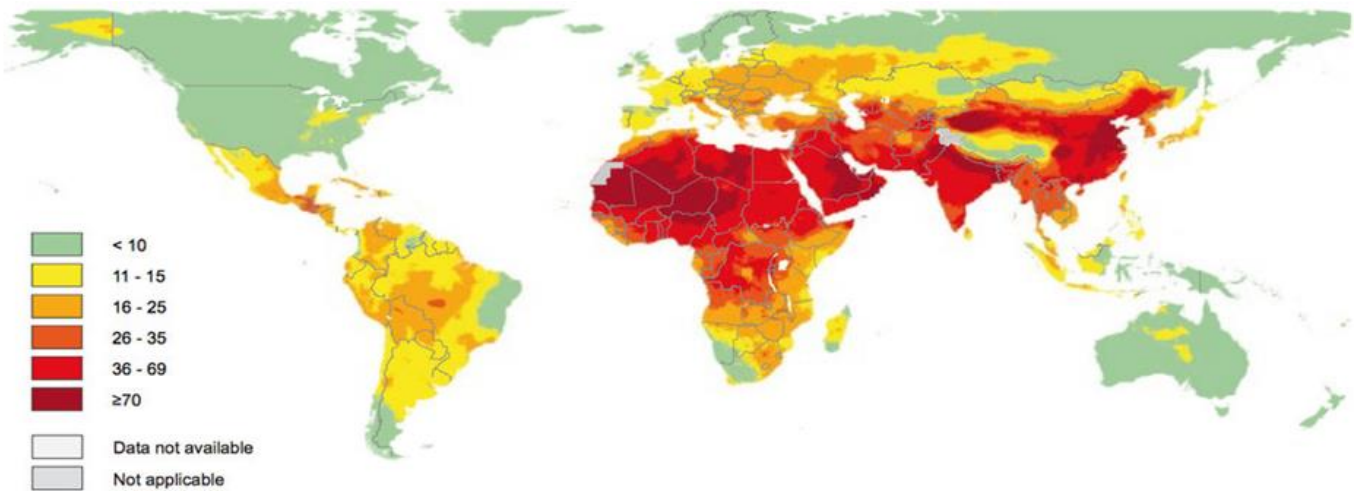


Figure 1. Particulate matters under 2.5, PM_{2.5} concentration, world map (WHO source 2023)

2. Context of study

The context of study concerns air quality assessment in several preselected site in Algiers, giving interest to study site, not areas not perimeters, is for the master reason that site contains a set of physical attributes that could be defined as the sum of relations existing between container, contents, immediate environment, external acting agents, and emerged reactions.

At that point of view, sites of study, concretely includes physical elements; that are man-made elements, as well as living elements, trees and plantations, mostly these physical contents are delimited by streets, the intersection of streets results up by an urban open space configuration, beyond streets, urban walls came to shape the urban open space.

Air quality assessment process concerns an area of 6 km distance, covering the main three municipality; Bab el Oued municipality, Algiers Centre and Belouezdad, all of them having an opening to the Algiers bay on the Mediterranean sea. Three group of distinct site were selected to proceed to air quality assessment, the first group concerns public gardens developed on slopping site, the second group concerns public gardens developed on flat site, and the third group concerns planted streets. The

common characteristics of the study sites, are mostly planted with Benjamin Fig trees, which are first introduced to Algeria in 1864 during the French colonial period. Benjamin Fig tree is native from south East Asia and is known by its good resistance to pollution, and don't need too much maintenance during its long life that can reach 300 years (Figure 2).

Land scape approach in improving the urban quality life, is a concept as old as human being existence, but the real innovation of the 19th century is the appearance and generalization of municipal parks made available to everyone In England, John Claudius Loudon, Scottish botanist was the first to plead in favour of the opening of public gardens, asserted as an "instrument of social reform" (Zeybekoglu Sadri, S., 2020).

During the 19th century the most important program of public parks integrated into an urban plan is French: it is the restructuring of Paris, launched by Napoleon III and orchestrated by Baron Haussmann

The objective is to "ventilate" the capital; it is a question of providing Parisians with fresh air and new leisure spaces by opening up spaces, in particular with the help of major thoroughfares and large public parks.

For the case of Algiers, the city possess many gardens, and got its first garden ; le Jardin d'essai, Test garden in 1832, few time after in 1833 garden Maringo actually named Jardin Sofia took place at the western limit of Bab el Oued, another garden was erected in 1864 in Bab el Oued on a slopping site open to the Mediterranean sea was named le Jardin de la Ferrierre actually Jardin Taleb Abderrahman, the square port said in front of the national Theatre was edified in 1853, years later and after city walls destruction on the eastern direction of the old city le Jardin plateau des Gliere (actually les jardins de la grande poste) was edified in 1889. The early awareness of the importance of gardens in improving urban quality is felt through the city fabric organization, and the position of gardens within the district to which it belongs.

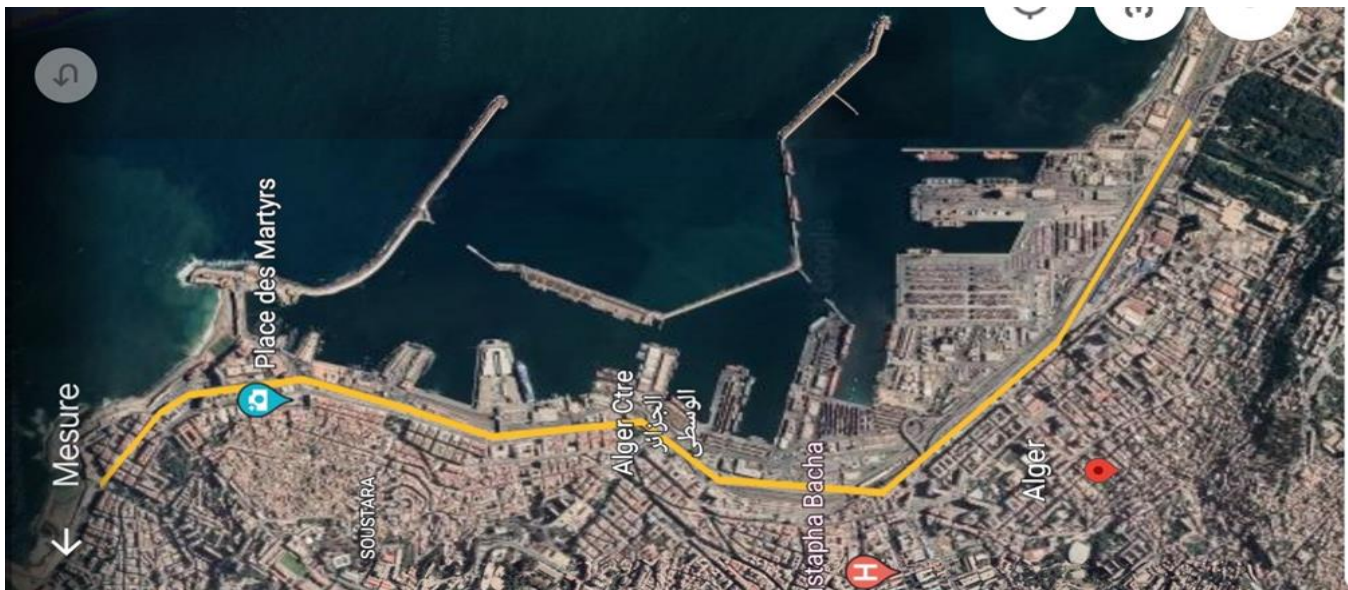


Figure 2. Context of study, 6 kilometre distance area on the Algiers bay

3. Research methodology

The methodology adopted for air quality assessment in urban open space is an hybrid methodology based on two level assessment processing, the first one is a descriptive method which consist on collecting information about physical attributes of the site case of study, the site of study which is

considered as an urban ecosystem in relation with the whole city fabric, in that perception the site of study is constituted of a set of contents, like physical elements and living elements, the sum of contents are framed by a container, which give a specific and a distinct form and configuration for the urban open space, the container which give form to the space, itself is surrounded, and resulted from the cross intersection of streets, the position of streets on the limit of urban open space let us to decide the space use and hierarchy, so then public urban space limits made by streets intersections can be considered as well as boundaries as well as means of transition. The public open space configuration is also made by urban walls; blocks of buildings, facades opened to the public open space case of study, in descriptive methods we interest also to the public space topography, whether is developed on slopping site or on flat one, to the orientation of the space, the sun exposure, and wind ventilation.

Collected data resulted from the descriptive method serve essentially to make decision about the position of points from which air quality, in particular NO₂ pollutants will be measured. These points or measurement station are identified on site according to a number of factor, 5 factor may have direct impact on the air quality on urban open space; the first one is the density of trees on studied area, the second criteria is the wind speed and the public space air ventilation, the third factor is the height of the surrounding buildings, the fourth one is the density of traffic in studied area, the fifth factor is the values of NO₂ pollutants, NO₂ values are quantitative indicators of pollution in a space. For instance the case of the garden of la Grande Poste, the garden is developed on slopping site, designed in sort of cascade, four platform shape the garden, the lower platform situated at 25 meters altitude, the second one at 39 meters, the platform at the middle is situated at 48 meters above the sea level, and it is reserved for the floral clock, and the superior platform is located at 56 meters., here 4 point of measurement were taken in correspondence to each one of the previously cited platform, and Intersection of streets passing by the garden.

4. Descriptive methodology

Descriptive methodology is operated to gather quantitative information about the sites case of study, at this stage of assessment process we need to establish a list of criteria that allow us to well understand the correlation between the space component and space's attributes. for this purpose, 5 criteria are taken in consideration, the first criteria is related to the shape and the space dimension, the second criteria focus on space case of study limits interpreted in term of length and width, the third criteria is about the quality and quantity of plantation, the fourth criteria is related to the surrounding buildings; elevation, the fifth criteria is about the space orientation solar orientation, and sun exposure duration.

The descriptive methodology is exercised on three group of preselected sites, the first group concerns gardens developed on flat site Jardin d'essai and Port Said square are taken as case of study. The second group is constituted of la Grande poste garden and Taleb Abderrahman garden, both of them developed on slopping site.

The third group contains Hassiba Street and Didouche Street (Figure 4). The two street are heavily planted with Ficus Benjamin trees.

4.1. Le jardin d'essai

It was on December 30, 1832 that General Antoine Avisard, acting Governor General, signed the decree creating the trial garden at a place called El Hamma to the east of Algiers. Its first vocation was to be a model farm, but also a testing ground for the cultivation of useful plants and thus provide for public plantations.

In 1837, its area was increased from 5 to 18 hectares and sanitation and construction works were ordered. Thus, the Jardin d'Essai gradually began to take shape under the leadership of Auguste Hardy, appointed director in 1842 "an almost square surface, three main axes which crossed the garden from north to south (allée des Platanes created in 1845, the Allée des Dragonniers and the Allée des

Bambous created in 1847 and the Allée des Ficus created in 1864) and thus delimited the large sectors (the French garden, the English garden, the nursery, the greenhouses).

The acclimatization garden will integrate the municipality of Algiers. In 1914, the Hamma became a public garden intended for walking, but the State remained the owner. From 1913 to 1946, the General Government of Algeria which manages the garden, begins work of reorganization and restoration. Also become a place of vacation and walk, works of embellishment are undertaken in 1914 by the architects Régnier and Guion, winners of a competition to whom we owe the perspective of the French garden which extends from the National Museum of Fine Arts (created in 1930) to Hassiba Ben Bouali street over an area of 07 hectares.

The garden during its long history has gone through times of degradation and abundance, the garden closes due to rehabilitation work between 2001 and 2009. Reopened in May 2009, it now houses the premises of the National Research Institute agronomy of Algeria (Figure 3).

The garden in its current state covers an area of 32 hectares, bounded from the north by Belouezdad street for a distance of 570 meters, on the south side by Hassiba Benbouali street for a distance of 590 meters, to the east is bounded by the August 20, 1955 stadium and a residential group, to the east is limited by the national library and the Sofitel hotel. The garden at its creation had more than 6000 species of trees, today there are only 2700 trees in good condition, despite the great loss of several hundred trees, the garden remains one of the privileged places recognized by its quality of air.

4.2. Square Port Said

The square most probably was created in the same period as the national theatre in 1853, the square is of a square shape covers an area of 5000 square meters, occupying the north side of the TNA. The square housed benches, chairs and birds appreciated by all those who tasted the charm of gossip.

You could see a population of regulars, engaged in endless conversations under the evergreen trees, the square is planted with Ficus, Magnolias, Palms, and Bamboos.

The square is bordered from the east and west by Haussmann-style buildings with a template of 4 levels, forming urban walls 20 meters high, its position on a platform at an altitude of 20 meters high. Compared to the level of the sea, its fully cleared north facade and open to the Mediterranean, have made it one of the most privileged places for outdoor socialization activities.

During its history the square has undergone transformations in the use and in the quality of the elements which constitute them, today the square is only with 27% of its green cover, of what it was at the time of origin.

4.3. Hassiba Ben Bouali street

Hassiba Benbouali street was created in 1864 to give birth to the lower Mustapha district, it connects the garden of the large post office on the west side and the May 1 crossroads on the east side over a distance of 1180 meters, with its 18 meters wide Hassiba street has a 10-meter floor, offering traffic in 2 lines in the direction of going and a line for the return, sidewalks planted with Ficus on both sides reaching 4 meters wide, along Hassiba Street there are 472 Ficus trees planted at an interval of 5 meters.

The urban walls vary from one sequence to another, at the beginning of the Hassiba urban axis the heights of the buildings on either side, near the garden of the large post office, easily reach 20 meters high, the equivalent of 4 level, the urban walls on the sequence of Mauritania Square rise to 24 meters, on the side of the agha the templates rise to 4 levels with a fifth level set back, the same template is maintained until the crossroads of first May.

The relief of Hassiba Street is of a very low slope, the altitude is 15 meters at the level of the garden of the great post office, and reaches 23 meters at the level of May 1st.

4.4. Didouche Mourad street

Rue Didouche was created in 1907, as an extension of rue Larbi Ben Mhidi (formerly rue d'Isly), giving birth to the district of Mustapha superior, and shortly after to the districts located at the heights of the capital. The Didouche axis extends over a distance of 1220 meters and a width of 20 meters. In its physical configuration, the axis consists of a central roadway with a width of 12 meters and sidewalks on either side with a dimension of 4 meters wide for each. The alignment of 488 Ficus benjamana trees provides shade and protects walkers along the shopping street.

The urban walls of rue Didouche are made up of buildings largely in the Haussmann style, some examples belonging to the art nouveau style, and art deco, built between 1900 and 1930. The size of the buildings reaches 20 meters high, the equivalent of five level with a last floor set back (Figure 4).



Figure 3. View of Jardin d'essai garden



Figure 4. View of Didouche Mourad Street

4.5. La Grande Poste Garden

The law on development, embellishment, and extension plans is made applicable to Algeria by the decree of January 5, 1922. Algiers was endowed with its plan in 1931; it was thus one of the first cities of the French Empire to have them. You should know, on this subject, that the French colonies, especially Morocco (with Marshal LYAUTEY), the Middle east and to a much lesser degree Algeria, have set up a Laboratory for innovative methods of urban planning in plan. The main protagonists of the French school of town planning exercised their expertise in these colonies, like Prost and Danger in Algiers, for the establishment of the town plan.

In 1898, the decision to demolish the Isly gate was taken. The gate being on the place of the current main post office, in 1900 the gardens of the Glières plateau took place of the old rampart and the gate of Isly. The garden is designed in steps opening a beautiful panorama over the port of Algiers and the Mediterranean Sea. The garden is largely planted with ficus trees. Built on a slope, this flower garden offers a very beautiful view of the bay of 'Alger. In its upper part (facing its second entrance overlooking the rue du Dr Saâdane, Ex-Berthezène), a large monument has been erected. On November 11, 1928, Le Pavois, commonly known as 'Le Monument aux Morts', a work created by Paul Landowski and Charles Bigonet, in memory of the Algerians and French who died during the First World War (14-18) was inaugurated (Figure 5).

In 1978, on the eve of the African Games, M'hamed Issiakhem was asked to revamp this stele reminiscent of the French colonial period. The famous visual artist locked the Pavois in a concrete sarcophagus. He adorns the facade of this monument with a sculpture: two raised fists, breaking the chains of the colonial yoke. The Garden covers an area of 11421 square meters, develops in steps opening on the north side on the bay of Algiers, the garden is composed of 4 platforms constituting 4

thematic gardens, the first thematic garden is located at an altitude of 25 meter, exclusively used as a space for relaxing and reading newspapers and also used as a transition space for pedestrians.

The second garden is located at an altitude of 39 meters; a grade part of the surface of this garden is taken to provide the exits of the Algiers metro. The third garden is at an altitude of 48 meters; it is a fenced garden, richly planted with several varieties of plantation and houses the floral clock and the stele of freedom.

The fourth garden is located at 56 meters high, is a space planted mainly with ficus, the garden at the top has about 120 trees for the most part Ficus.

4.6. Taleb Abderahmane Garden

During the visit of Napoleon III in 1861, Princess Eugenie deplored the lack of shade under the omnipresent sun. It is true that the city of Algiers counts in everything and for everything only the Marengo gardens, ex-garden of the condemned built by 300 military convicts under the command of Colonel MARENGO and the TEST garden entrusted to the good care of the English botanist, HARDY. In 1865, during his second visit to Algeria, the Emperor decided to open from the casbah a large strip of greenery that would descend from the Vallée ramp to the sea on the site of the artillery arsenal.

He draws up the plans himself, which will also be used to ventilate the Plateau des Glières. This gap of light will pass through the Place du Général Farre, the only artery wide enough to accommodate the five gardens planned by the architect, Mr. Valentin. The only problem, and it is a major one, is that an old Jewish cemetery dating from the Ottoman era, where the remains of the Jewish victims rest, occupies part of the square. In 1880, after a very difficult politico-religious conflict with the Jewish community, the authorities moved the cemetery to the nearby suburb of Saint-Eugène. Only the koubah of the two saints RASHBAZ and RIBACH, place of pilgrimage and devotion, located on the mount of Sidi EL KETTANI poses a problem.

The Arab workers give up breaking the tomb, which resists any enterprise of demolition. In desperation, the authorities transfer the mausoleum to its entity. Then nothing stands in the way of the company. At first, we are content to plan the land to plant rows of trees in the middle of it at the end of the 18th century, thus responding to the expectations of Empress Eugénie. In the 1930s, the gardens took on their final appearance, to the delight of children and their mothers.

Boulevard Général Farre is renamed in favor of Boulevard Guillemin. The five squares adopt this surname as well as the college, which dominates them and borders them from the top of its string of stairs. These rest and play areas are a delight for the inhabitants of the neighborhood. After Independence in 1962, like many places the garden was renamed Taleb Abderrahmane garden, in memory of the martyrdom of the revolution, the young physicist scientist Taleb Abderrahman.

The stepped garden covers an area of 12, 300 square meters, and opens towards the Mediterranean Sea, forming 5 garden terraces, starting from the level of 20 meters above sea level arriving at 42 meters in its upper part. The garden is planted with 129 trees, several species of shrub trees, and decorative plantations. Ficus Benjamina trees, date palms, Japanese banana trees, pruned junipers, massively populate the garden, this landscape composition forms a microclimate and a place of relaxation for residents on hot days (Figure 6).

The buildings on the east and west side of the garden rise to 5 levels, on the south side a residential group of 12 levels dominates the upper part of the garden. The garden during its long life has seen several maintenance and renovation works, the garden today regains its brilliance and its landscape value.



Figure 5. View of la Grande poste garden



Figure 6. View of Taleb Abderrahmane garden

5. Results discussion

The second stage of work consists on evaluating the rate of NO₂ (dioxide of nitrogen) and CO (monoxide of carbon) the two pollutants directly responsible of the increase of PM_{2.5} and PM₁₀ particular matter in the air, for this reason three group of site were chosen to be made under test, NO₂ and CO were taken during a period of 3 weeks in April, from Friday the 04 April to 30 April 2023, for the present paper we have presented the most significant values taken from 07 April to 11 April 2023

5.1. Jardin d'essai garden assessment results

The first group consists of the Jardin d'essai garden and the square of Port Said, for the case of Jardin d'essai 4 points were taken in consideration to evaluate NO₂ and CO values, point A is situated at 9 meter of altitude, the point B situated at 13 meter altitude, point C is situated at 22 meter altitude, the point D is the situated at the limit of the hill on the south direction.

In Jardin d'essai garden, we notice that the values of NO₂ and CO taken the 08 and 09 April are largely superior to WHO guideline, these values are directly impacted by the wind speed and air ventilation, the plantation density 57% at point D, and building prospect act negatively on the NO₂ and CO values.

On the 11 April we notice that NO₂ and CO rates are quite responsible, are respectively 5.17, 6.07 at the point A, the two values got increased due to the wind speed at that day, around 20.4 km/h, the plantation density act positively in decreasing NO₂ AND CO values. Building prospect acts on the rate of NO₂ and CO, when buildings are very close each other, pollutants matter concentration stand longer in the area than when the prospect is flexible and large.

Values of NO₂ and CO recorded in square Port Said were very close to WHO guidelines, for example NO₂ values range between 3.79 to 14.48 and CO values range between 4.21 to 7.6, so the high values in NO₂ and CO are directly related to air ventilation, wind speed and to the surrounding building layout (Table 1).

Table 1. Air quality assessment at Jardin d'essai garden

	07/04 W: NW					08/04 W: NE					09/04 W: NW				
	NO2	CO	WS	GC	Prct	NO2	CO2	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	4.38	7.2	10.8	89	0.05	8.28	7.5	11	89	0.05	8.28	11.3	11.1	89	0.05
B	4.44	7.1	10.8	89	0.05	8.37	7.2	11	89	0.05	8.37	11.2	11.1	89	0.05
C	4.51	7.2	10.8	89	0.05	8.5	7.6	11	89	0.05	8.5	11.3	11.1	89	0.05
D	4.54	6.8	10.8	57	0.28	8.54	7.1	11	57	0.28	8.54	10.9	11.1	57	0.28

	10/04 W: NE					11/04 W: NW				
	NO2	CO	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	8.68	8.4	18.5	89	0.05	5.17	6.07	20.4	89	0.05
B	8.78	8.3	18.5	89	0.05	5.23	6.08	20.4	89	0.05
C	8.94	8.4	18.5	89	0.05	5.28	6.1	20.4	89	0.05
D	8.99	8.1	18.5	57	0.28	5.33	6.12	20.4	57	0.28

5.2. La Grande poste garden assessment results

for the case of la grande poste garden, 4 points were chosen to proceed to NO₂ and CO assessment, the four points are respectively located in the 4 platforms constituting the garden; the point A is located at the garden's first platform at 25 meter altitude, the point B is located at the garden's second platform at 39 meter altitude, the point C is located at the floral garden at 48 meter altitude, the point D is located at the platform at 56 meter altitude.

NO₂ and CO values recorded during the 5th day assessment, show that the plantation density has a positive impact on NO₂ and CO results; that means the more there are trees and plantations the less NO₂ and CO is. The building prospect at the upper part of the garden is 0.36, that means there are more open urban space than built forms, such urban configuration strongly helps air ventilation, so then NO₂ and CO values go down (Table 2).

Table 2. Air quality assessment at la grande poste garden

	07/04 W: NW					08/04 W: NE					09/04 W: NW				
	NO2	CO	WS	GC	Prct	NO2	CO2	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	3.98	5.4	10.8	72	0.4	14.92	7.9	11	72	0.4	7.58	5.8	11.1	72	0.4
B	3.98	5.41	10.8	72	0.4	14.92	7.8	11	72	0.4	7.57	5.7	11.1	72	0.4
C	3.97	5.2	10.8	85	0.4	14.93	7.6	11	85	0.4	7.55	5.6	11.1	85	0.4
D	3.96	5.1	10.8	85	0.36	14.87	7.4	11	85	0.36	7.59	5.3	11.1	85	0.36

	10/04 W: NE					11/04 W: NW				
	NO2	CO	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	7.71	4.8	18.5	72	0.4	4.56	5.03	20.4	72	0.4
B	7.70	4.6	18.5	72	0.4	4.55	5.01	20.4	72	0.4
C	7.68	4.6	18.5	85	0.4	4.53	4.94	20.4	85	0.4
D	7.65	4.4	18.5	85	0.36	4.50	4.81	20.4	85	0.36

5.3. Hassiba Benbouali street assessment result

The case of Hassiba street, 4 points as well were selected to proceed to air quality assessment, the point A is located at the beginning of the axe at the cross section with la grande poste garden, the point B is located at 350 meter distance from the point A, at the node point of Mauritania place, the point C is located at the intersection of Hassiba street with Victor Hugo street, the point D is located at the 1 st May node.

Two main outstanding values were recorded at Hassiba street, on the 8TH of April at the point D at 1 st May node, we recorded the value of 15.49 for NO2 and 10.6 for CO, point D is a node point which is crossed by large traffic along the day, that explain the high values recorded at the point D.

Low values are recorded on the 11th of April at the point D, the 11th of April was Tuesday, a working day, values were taken at 4 pm, even though obtained results show that the rate of NO2 and CO was largely lower than the others day, this is because of the wind direction which was north west and the wind speed 20.4 km/h, that helped the ventilation of the area (table 3).

Table 3. Air quality assessment at Hassiba Street

	07/04					08/04					09/04				
	W:		NW			W:		NE			W:		NW		
	NO2	CO	WS	GC	Prct	NO2	CO2	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	3.98	3.29	10.8	50	0.4	14.9	10.34	11	50	0.4	7.58	8.09	11.1	50	0.4
B	4.06	3.31	10.8	33	1.11	15.11	10.37	11	33	1.11	7.72	8.1	11.1	33	1.11
C	4.15	3.5	10.8	33	1.11	15.32	10.41	11	33	1.11	7.89	8.12	11.1	33	1.11
D	4.24	3.56	10.8	0	0.33	15.49	10.6	11	0	0.33	8.06	8.21	11.1	0	0.33

	10/04					11/04				
	W:		NE			W:		NW		
	NO2	CO	WS	GC	Prct	NO2	CO	WS	GC	Prct
A	7.72	8.01	18.5	50	0.4	4.57	6.03	20.4	50	0.4
B	7.88	8.06	18.5	33	1.11	4.62	6.05	20.4	33	1.11
C	8.1	8.09	18.5	33	1.11	4.71	6.07	20.4	33	1.11
D	8.3	8.11	18.5	0	0.33	4.83	6.09	20.4	0	0.33

Legend:

- NO2:** dioxide of nitrogen, unit $\mu\text{m}/\text{m}^3$
- CO:** monoxide of carbon, unit mg/m^3
- WS:** wind speed, unit Km/hour
- GC:** green covert, percentage
- Prct:** building prospect

6. Recommendation and conclusion

The contribution of vegetation on air quality improvement is an undeniable fact. However, trees are able to absorb only 7% to 27% of pollutants. The results obtained from the evaluation of air quality operated on the six study areas; show that the urban forms, the layout of the building blocks, the ventilation, and the circulation of the air are also factors that act directly on the duration of concentration of pollutants in an urban space.

Trees are living element that a large part in purifying the air we breathe and affect positively the concentration of air pollutants, directly by removing pollutants or avoiding emissions and secondary pollutant formation in the atmosphere.

We have also found that urban spaces developed on sloping land are less polluted than those on flat land, the orientation of the space in question and its exposure to the sun play an important role in the elimination of pollutants, spaces having clear urban openings present a considerably better air quality. Streets of 18 to 20 meters wide with urban walls 20 meters high forms a sort of narrow canals that retain pollutants longer than larger urban spaces. It is however advisable to design streets no less than 32 meters wide with a planted solid ground, it is imperatively important to choose trees with a high CO₂ absorption capacity, such as eucalyptus, ficus and bamboo. The promotion of means of soft mobility and the reduction of the use of fossil energy is an action strongly recommended in order to be able to go towards the reduction of harmful pollutants.

Landscape and greening of urban city is an approach that provide socio-economic and environmental benefits, garden and plated areas are not any more just a place for distraction but presents an urban entities fully fledged highly useful for the urban health.

References

- Binder, C. R., Wyss, R., Massaro, E. (2020). Sustainability assessment of urban systems, Cambridge university press 2020, 239-241. <https://doi.org/10.1017/9781108574334>
- Burik, S., Smid.R., Weber, R. (2022). Comparative philosophy and method; contemporary practice and future possibilities, Bloomsbury publishing. <https://doi.org/10.5040/97813501555053-005>
- Deakin, M., Mitchell, G., Nijkamp, P., Vreeker, R. (2007). Sustainable urban development volume 2, The environmental assessment methods, Routledge, 234-238.
- Fried, R. C., Rabinovitz, F. F. (1980). Compararative urbanism politics, Contemporary comparative politics series ; Joseph Lapalombara.
- Ewing, R., Park, K. (2020). Advanced quantitative research methods for urban planners, Routledge, 77-78. <https://doi.org/10.4324/9780429325038>
- González Castillo, O. F., Antonucci, V., Mendieta Márquez, E., Juárez Nájera, M., Cedeño Valdiviezo, A., Osorno Castro, M. (2022). Urban Resilience: Methodologies, Tools and Evaluation, Resilient cities, rethinking urban transformation, 89-106. <https://doi.org/10.1007/978-3-031-07586-5>
- Myers, G. (2020). Rethinking urbanism lesson from postcolonialism and global south, Bristol university press. <https://doi.org/10.51952/9781529204469.can001>
- Pannerai, P., Depaule, J.C., Demorgon, M. (1999). Analyse urbaine [Urban analysis], Prantese edition, eupalinos collection.
- Robinson, J. (2022). Comparative urbanism: tactics for global urban studies, IJURR studies in urban and social changes, Book series. <https://doi.org/10.1002/9781119697589>
- Zeybekoglu Sadri, S. (2020). City, Urban Transformation and the Right to the City, Journal of contemporary urban affairs Vol.4 No. 1, 1-10. <https://doi.org/10.25034/ijcua.2020.v4n1-1>