Toward Improving Air Quality in Informal Areas in Egypt

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ABSTRACT

Many cities worldwide suffer from air pollution as a result of industries or human activities. Informal areas are highly vulnerable to environmental degradation, including air pollution. The research aims to determine suitable solutions that could be applied to improve air quality in informal areas. This can be achieved throughout using an analytical-qualitative approach, as the study starts with a theoretical part that presents the dimensions of the problem. The research focuses on two strategies that complement Egypt's current efforts and determine relevant urban factors. The theoretical part is followed by a Field study of an informal area in Giza that suffers from air pollution; this includes studies of the current situation and suggested solutions to improve air quality in the informal area. A questionnaire is done to evaluate the implementation feasibility of different solutions to improve air quality in the informal area, one is directed to urban planners, and the other to area residents. The results indicate that both planners and residents are accepting many of the suggested solutions to improve air quality in the studied area, whether by air filtration or circulation, and the differences in opinion was according to considerations including cost or changes in land use. The study concluded that the air quality can be improved in the informal areas that are polluted by using several strategies, mechanisms and treatments.

KEYWORDS:

Air Pollution, Urban design, urban environmental design, Urban upgrading.

الملخص:

تعاني العديد من المدن حول العالم من تلوث الهواء كنتاج للصناعات أو الأنشطة البشرية . تتعرض المناطق غير الرسمية بدرجة كبيرة للتدهور البيئي بما في ذلك تلوث الهواء. يهدف البحث إلى تحديد الحلول المناسبة التي يمكن تطبيقها لتحسين جودة الهواء في المناطق غير الرسمية، تم ذلك من خلال استخدام المنهج الاستقرائي التحليلي؛ حيث تبدأ الدراسة بجزء نظري يعرض أبعاد المشكلة والاستراتيجيات المختلفة لتحسين جودة الهواء، ثم يتم التركيز على استراتيجيتين تكملا الجهود الحالية للدولة ثم تحديد العناصر العمرانية ذات الصلة بهما، يتبع ذلك دراسة عملية لأحد المناطق غير الرسمية بمحافظة الجيزة والتي تعاني من تلوث الهواء. شملت الدراسة العملية تحديد الوضع الراهن واقتراحات تعديل أو اضافة بعض العناصر العمرانية بهدف تحسين جودة الهواء ثم تصميم استبيان لتقييم مدي امكانية تنفيذ تلك الاقتراحات من المخططين ومن القاطنين بالمنطقة، وتشير النتائج إلى أن كلا من المخططين والمقيمين يقبلون العديد من الحلول المقترحة لتحسين جودة الهواء في المنطقة المدروسة، سواء عن طريق ترشيح الهواء أو دورانه، واختلاف النقاط الخاصة فيما يتعلق بالتكلفة أو اجراء تعديل في إستخدامات الأراضي، وخلصت الدراسة إلى أنه يمكن تحسين نوعية الهواء في المناطق غير الرسمية الملوثة باستخدام العديد من الاستراتيجيات والآليات والمعالجات.

الكلمات المفتاحية:
تلوث الهواء ، التصميم الحضري ، التصميم البيئي الحضري، الارتقاء الحضري.

INTRODUCTION

Statistics show an increase in the number of patients with lung diseases due to air pollution in Egypt. The number of children with lower respiratory illness between 2010 and 2020 was eleven million, and people suffering from chronic pulmonary and cardiovascular disease will increase by 137 thousand (Bank 2013). Cairo has a poor dispersion factor (The dispersion factor expresses how fast the pollutants in the air are dispersed because of the weather conditions like temperature, rain, and the wind, as it makes a difference in the intensity of exposure to air pollution). Due to the low air quality, which is from factory emissions, burning of waste, natural causes such as dust and low rainfall, and high building with narrow streets, create a bowl effect. Based on the ISDF the initial estimations of unplanned areas pose to 60% of the total urban area, while the unsafe areas pose to 5% of the Greater Cairo Region. Air pollution is one of the main problems in informal areas (both unplanned and unsafe slums).

Research problem

Informal areas are one of the most vulnerable areas to air pollution due to their urban features, as deep ratio of urban spaces, the high density of coverage area, and unappropriated industrial activities cause inadequate ventilation, thus more density of pollutants in the area, so the residentials in these areas need solutions to improve air quality.

Research goal

The research aims to determine suitable solutions that could be applied to improve air quality in informal areas by enhancing air circulation and removing pollutants from the air.

Research limits

There are four strategies to improve air quality: The first strategy is to prevent release of pollutants and remove source of emission, the second is reducing emissions by minimizing the number of vehicles and improve traffic flow, the third is enhancing the Air Circulation, the fourth is to remove Pollutants from the air. (Abd_El_Aziz 2016)

The Egyptian Environmental Policy Program (E.E.P.P.) is the most used strategy to control factories and traffics emissions, but enhancing air circulation and removing pollutants from the air are not expansively used. These two strategies are considered complementary efforts at the local level. The urban designer could contribute to its activation, especially in informal areas already suffering from air pollution, which is considered part of its upgrading issues.

So, the research focuses on applying these two strategies (enhancing the Air Circulation, remove Pollutants from the air) to improve air quality.

Informal areas are divided to: Unplanned areas and unsafe slum, dealing with unsafe areas may require a complete change in planning and rebuilding housing, that make planning to improve air quality becomes more flexible to be integrated in the new planning, but dealing with unplanned areas which their buildings in better condition makes the change for upgrading be

more sensitive, and residentials are part of upgrading process. So, the research focuses on unplanned areas that are polluted and not in unsafe areas category.

Research Methodology

The research used the descriptive and analytical methodology, the theoretical study presents every factor that has an effect on air circulation and filtration, then the field study uses analytical approach to determine the current situation of the chosen informal polluted area, which is helping in suggesting solutions to improve air quality in the informal area. Solutions may be different in the implementation feasibility, or residence acceptance, so two questionnaires are needed to know that, first questionnaire is directed to urban planners, and the second is to area residents.

The Theoretical Framework

The theoretical study contained two main points as the following

- Factors that affect in enhancing air circulation.
- Factors that are affected in removing pollutants from the air.

Enhancing Air Circulation

Urban spaces like streets, squares, and public spaces are considered air passes. Air circulation is affected by main factors: The spaces direction, the geometry of the spaces, the relationship of the urban spaces, and the barriers in the spaces (Nastaran January 2013) (محمود عبد اللطيف، عنتر عبد العال، عصام عبد العزيز، اماني ناجي يوليو ٢٠٠٥).

Space Direction Effect

The street direction determines the microclimatic situation; when the streets are parallel to the wind flow direction, they are less resistant to airflow; however, when streets are perpendicular, they are more resistant to airflow.

Although cold winds are not preferred for thermal comfort in residential areas, they are needed because of seasonal problems such as air pollution, so the parallel direction is preferred for main roads, and perpendicular orientation is preferred for other streets (Nastaran January 2013).

The wind blows in straight air movement, so the parallel and straight streets improve wind movement within urban areas; the opposite happens in the narrow and winding streets, as shown in **Fig.1.**

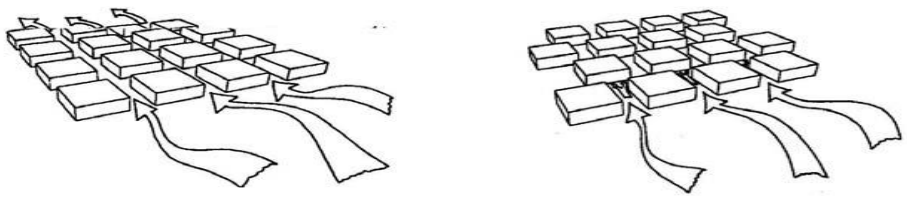


Fig. 1. The airflow inside the city, right in the case of parallel and straight streets, left in the case of narrow and winding streets (Nastaran January 2013).

The pollution concentration increases along the street canyon as the street is narrowed down than is in the case in parallel wind orientation, as shown in **Fig.2.**

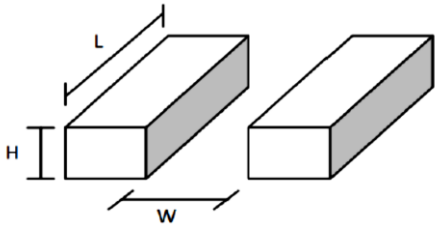
Fig.2. Air flow improves in straight and parallel streets, while moving slowly in narrow streets (Spirn 1986)

Spaces Geometry Effects:

The airflow in spaces is influenced by their geometric shape dictated by buildings. The spaces geometric shape factors are the distance between the buildings (w), the height of the buildings (h), and their length (L), as shown in **Fig.3.**

Kastner and Plate (1999) proved that in the case of (L/W=5 to 10), Pollutants concentration levels are relatively high in the long canyon, and therefore concentrations are concentrated at the ends of the street canyon (Kastner-Klein 199).

Giffoni's studies showed that if buildings with a height/width ratio are greater than 2, the first row of buildings converts the rising wind up and keep the rows of the next building of the first row under the wind; wind conditions change in the case of the wider streets. In wider streets, air can flow down and enter easily. The changing of H/W and L/W ratios cause a conversion that occurs from one system to another between the following systems: the wake interference regime- isolated roughness regime- the skimming regime (Nastaran January 2013) .



Aspect Ratio	Classification
H/W < 0.5	Avenue canyon
H/W = 1	Regular canyon
H/W > 2	Deep canyon
L/H < 3	Short canyon
L/H = 5	Medium canyon
L/H > 7	Long canyon

Fig. 3. Classification of canyons and their geometric shape according to buildings (Afiq W.M.Y.1,Azwadi C.S.N, Saqr,K.M. septemper 2012).

The isolated roughness regime happened between well-spaced buildings, as there is no interaction between leeward and windward flows, likewise to a wind flow around an isolated barrier.

When the H/W ratio increases, a wake interference regime happens; when the ratio increases more, the street canyon is isolated from the air in the urban pattern; thus, a steady circular vortex appears in the canyon; this vortex works on the skimming regime, which is more common in the urban distribution of buildings as shown in **Fig.4.**

Johansson studied the influence of street geometry in a case study in Morocco as real measurements in a time of about a year and a half. This study confirms that the wind speed in the deep canyon is slower and steadier throughout the year (Johansson 2006).

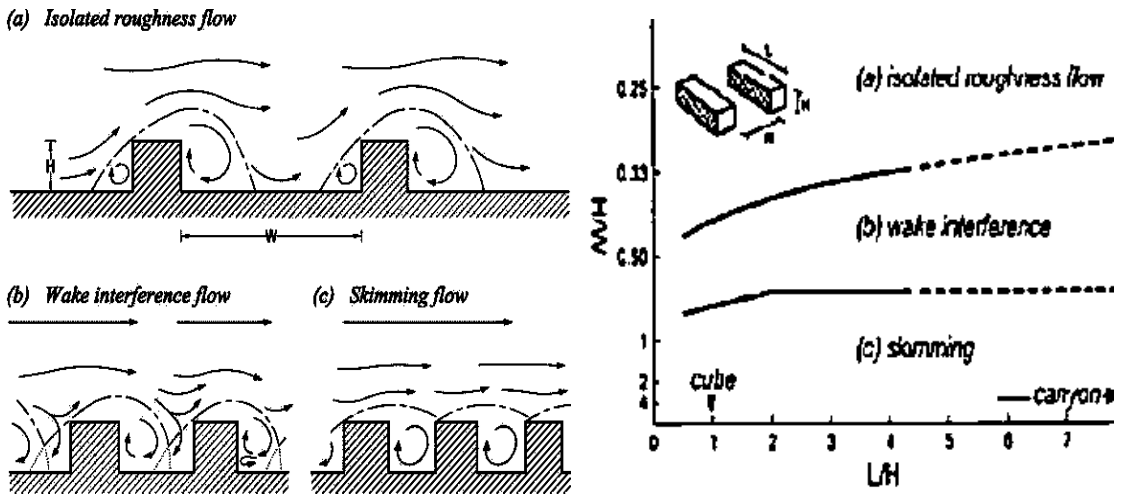


Fig. 4. Airflow regimes over an array of barriers (Nastaran January 2013).

Effect of wind speed on Pollutant Concentration

Wind speed also affects the side where Pollution is concentrated. Increasing wind speed oncoming perpendicular to a regular canyon will reduce the pollutant concentration inside the street canyon. Tsai and Chen's (2004) experiments show that if the wind speed is less than 1.0 m/s, the concentration of Pollution on the leeward side is 16-9% more than on the windward side; if the wind speed is between 2 and 4m/s, the percentage rises to 107-64% (Afiq W.M.Y.1,Azwadi C.S.N, Saqr,K.M. septemper 2012). **Figure 5** illustrates how Pollution concentrates on the leeward side.

Effect of Buildings' Heights:

The street lined with buildings of different heights or pervaded by open areas tends to have better air circulation than those lined with similar buildings of the height. **Fig.6** (Spirn 1986). Erell et al. (2011) have shown that step-up in heights on one side of the street affects wind flow, as shown in **Fig.7.**

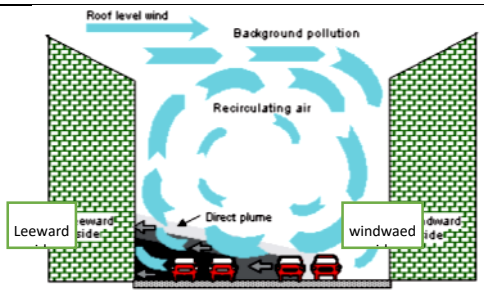


Fig. 5. The concentration of Pollution in a Street Canyon (University n.d.)..

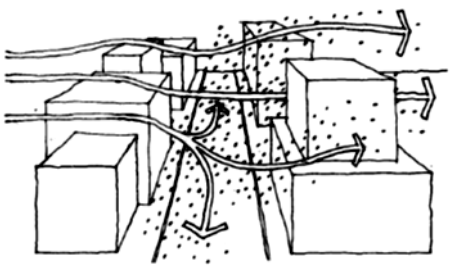


Fig. 6. Air Flow with Intersections of Streets and Buildings Height (Spirn 1986).

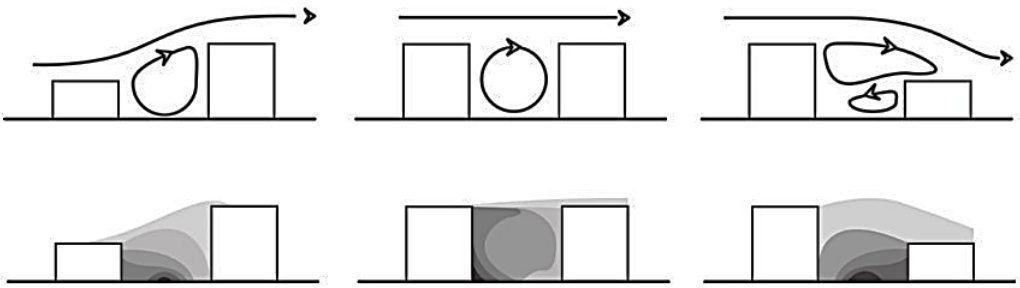


Fig. 7. Influence of Difference Buildings Height on The Wind Flow Around Buildings (Erell,E., Pearlmutter,D., Williams,T., 2011).

Effect of Shadows on Space Relationships

The design of shaded areas and other opening areas in the urban environment leads to variation in temperature, which helps air circulation (محمود عبد اللطيف، عنتر عبد العال، عصام عبد العزيز، اماني ناجي يوليو ٢٠٠٥).

Effect of Sea and Land Breezes

The Sea and Land Breezes are the wind that blows from sea to land during the day and at night. The highest temperature is found in the distance between buildings, then those at the cross point.

Effect of Special Treatments

Windcatcher is one of the unique treatments which spread in the designs of buildings in the Middle East and North Africa; wind towers and wind catchers are a good way for passive cooling and natural ventilation in buildings and, of course, designed according to the rates of speed and direction of wind and airflow rate.

Lup, Negin, and Leslie's (2017) Experiments showed that a wind catcher in the stratified orientation of the coming wind improves pedestrian-degree wind speed in the canyon by 2.5 times. If the windcatcher has closed sidewalls, it will improve maximum pedestrian-degree wind speed in canyons about four times. **Figure 8** shows two cases (a), (c) Windcatcher without sidewalls and its natural velocity quantity contours and three dimensional in canyon versus (b), (d) wind catcher with sidewalls and its natural velocity quantity contours and three dimensional in the canyon. (Lup Wai Chew , Negin Nazarian,Leslie Norford 2017).

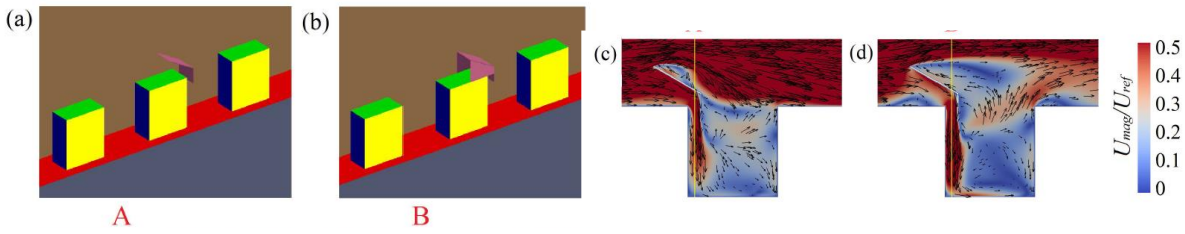


Fig. 8. Using Wind Catcher to Pedestrian-Level Wind Speed (Lup Wai Chew , Negin Nazarian,Leslie Norford 2017).

Remove Pollutants from The Air

Vegetation as a Wind Filters

Planting has a Great contribution to reducing the level of air pollution, the suspended particles settle on the leaves of the tree, and the plant absorbs some gases such as carbon dioxide, nitrous dioxide, etc. Wide trees in the vast streets are preferred, which act as a buffer between the source of Pollution and the population, but it is not preferred in narrow streets where trees obscure air traffic in the ratio (h/w) = one or less where separated leaves of pollutants from mixed air. Roofs and green walls can also be used in buildings where there is not enough space in the streets for afforestation.

Building Materials Absorption of Pollutants

Modern techniques in building materials are used to improve air quality. Such as incorporating a type of concrete that cleans the air through the sun by converting pollutants into a harmless building, such as a hospital facade in Mexico made of Tiles coated by (TiO2) coat. See Fig.9.

Reduce Dust Pollution (pm10, pm 2.5) Using Water Suppression

The use of water in the control of dust in the atmosphere of the oldest means used in this and can be used by several means, including fog, foam generation systems, and water sprays, see Fig. 10. These systems are differentiated according to their energy and water consumption rates.

Urban Innovations

Many innovations have appeared to clean the air; one of the effective ways is the smog tower. It provides fresh air in public spaces. It has been launched in many countries like China, Netherlands, and Poland. It is equipped with environment-friendly technology, cleans about 30.000 m3 / h, and uses a little green electricity. **Fig.11.**

Fig 9. Mexico City's Manuel Gea Gonzalez Hospital Has an Ornate Double Skin that Filters Air Pollution (www.google.com n.d.).

Fig 10 water sprays (www.google.com n.d.)

Fig 11 smog free tower Beijing , China (www.google.com n.d.)

The Field Study Frame Work

The field study uses the analytical-qualitative approach, based on analysis informal of the chosen area, which has recorded data about air problems from air quality monitoring stations, and has the common characteristic with other informal areas, then analysis of the quality air problems in the studied area. According to theoretical part and the case study characteristic solutions which are suggested to increase air circulation and filtration, but the extent to which

they can be implemented and the expected efficiency vary from one solution to another, and to know that; Two questionnaires are designed. The first questionnaire is directed to specialists in planning to find out three points:

- The implementation feasibility
- The expected efficiency
- The main current obstacles or requirements.

The second questionnaire is directed to residents, as they are stockholder and community participation in improving urbanism. The questionnaire is designed to discover:

- People awareness of the air pollution in the area
- The ambit of people's acceptance of every suggested solution
- Possibilities for voluntary participation

Case Study Overview

The old city of Giza is one of the informal areas exposed to severe air pollution rates; air pollutant monitoring stations in Giza square monitor the main types of air pollutants, including PM10, CO, and SO2. (Amira,N., Zakey,A., Soltan,A., Wahab,M. 2018). **Table 1** Shows the data of gaseous pollutants (PM10), (C.O.), (SO2) that were monitored from a monitoring station in Giza square, which is affiliated with Egyptian Environmental Affairs Agency (E.E.A.A.) stations. **Table 2** shows that July is the highest ventilation rates, while November is the lowest.

Table 1. The Frequency of Exceedance of Pollutions (Amira,N., Zakey,A., Soltan,A., Wahab,M. 2018).

Site	**SO2**		**CO**		**PM10**		N: for SO2, NO2, and PM10 is the number of days exceeding the permissible limits, and for C.O. is the number of 8-hour averages exceeding the permissible limits
Giza	N *	%	N	%	N	%	
square	6.0	0.5	361	9.9	457	35.7	

Table 2. Ventilation Index **(**VI**)** (Amira,N., Zakey,A., Soltan,A., Wahab,M. 2018).

Time	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Ventilation index	11.0	10.5	12.1	12.7	21.7	53.2	53.2	51.6	41.9	13.7	9.7	7.4
0-33 auper ventilation/ 34-54 medium ventilation / 55-100 better ventilation												

Study of the Intimate Area

The intimated area is under Giza square directly. There are bus stations and a parking lot, in addition to heavy traffic of vehicles in the square. Wind rose shows that Giza square is considered the gate of northern air blow, as shown in Fig.12 and Fig.13. This area is an old unplanned nucleus, and a gradual replacement of housing happened. **Fig.14**.shows photos of some buildings in the studied area.

Fig.12. The study Area (www.google.com n.d.) .

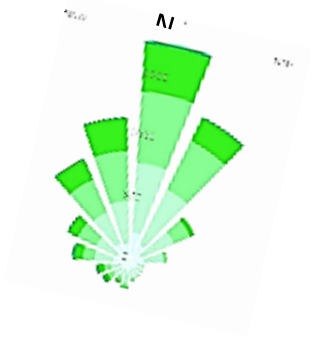


Fig .13. The wind rose of Giza (service n.d.)

Fig.14. Photos of Some Buildings in Study area by the Researchers

The Present Situation

The study of the present situation of the area included two parts. First, the study of urban factors' effect on air circulation or on air filtration (factors which mentioned in previous theatrical part), **table 3** and **figur15** show the Present Situation of every factor.

Second is the study of building uses, ages, conditions, and movement of vehicles in this area as shown in **table 4** and **figur15**.

Table 3. The Present Situation of affected urban factors on air circulation and filtration.

Urban factors affect air circulation	**Spaces direction**	By comparing street direction with wind rose, it appeared that vertical streets are parallel to the prevailing wind direction, the horizontal streets take the perpendicular direction of the Nile shore, but these streets do not connect directly to the Nile shore. Buildings are different in height; it is almost increasing in height when they become closer to the Nile shore.
	Spaces profile	The buildings' heights are between 12 meters and 36 meters, the width of the street is almost the same. It is 6 meters, so the (H/W) ratio is between 2 and 6. From surveying map fig.15, it is clear that about 78% of buildings' height are between 12 to15 meter height, 20% are more than 15 meters high, 2% is open land.
	Spaces relationships	Streets have not regulated relationships, a low percentage of the open areas about 2% as shown in fig.15.
	Spaces details	There is no bridge edge barrier in Giza square, helping in dispersing air pollution from cars. People use local squares as a market, so they put shades. The streets in the area are paved.
Urban factors affect air filtration	**Plant landscape filters**	Few plants in Giza square and the streets of the study area. Few numbers of Residents put plants on their balcony.
	Use special treatments	There is no special coating or construction material to filter the air in the area of studying or in Giza square.
	Water Suppressions	Water Sprinkles are used to irrigate the football yard behind Giza square. People use Water Sprinkles as an old method of controlling fugitive dust.
	Artificial purifiers	There are no artificial purifiers

Table 4. The Present Situation of Buildings and Movement of Vehicles

Buildings use	94% of building is mixed -use buildings, 3% is residential, 1% is commercial. 2% is open land.
Buildings ages	There is just one historical building in the study area, and the other buildings are recent.
Building's condition	Most Housings are built with concrete; fewer old ones are built with mud or bricks.
Movement of vehicles	A light Movement of vehicles in the area, there are no cars parking lots, Cars Park on the streets.

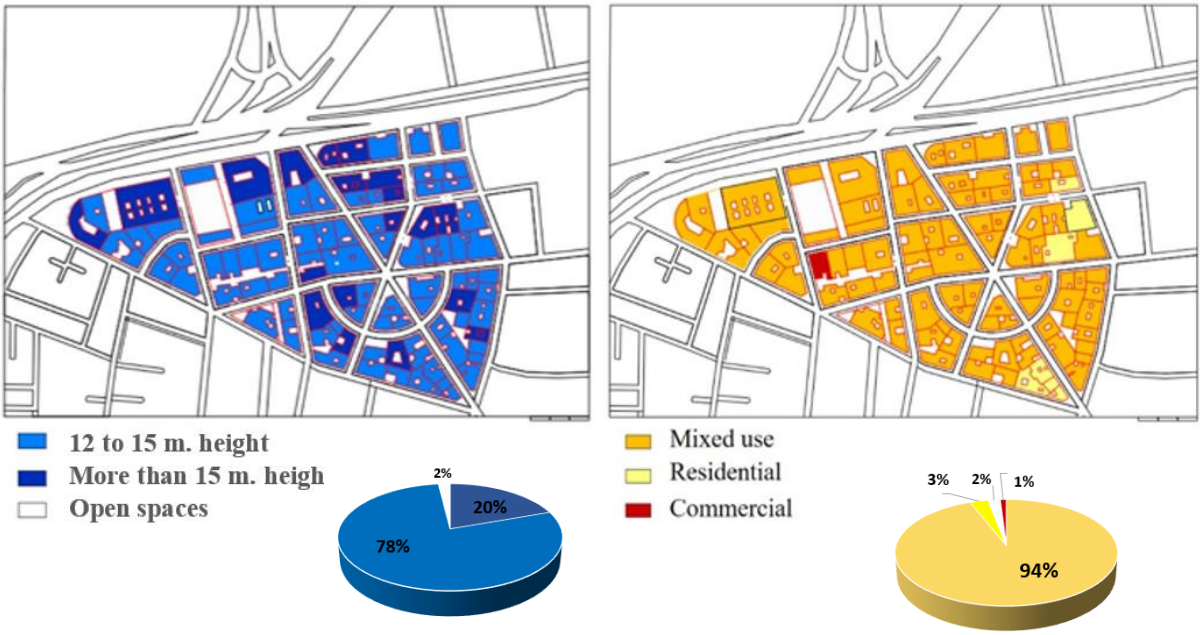


Fig. 15. Surveying maps, right: Buildings height, left: Land Use, (Source: Authors, 2022)

Area Analysis

The study area has strengths and opportunities that could help put solutions. A S.W.O.T analysis is made for the intimate area to determine that as shown in **table 5**

Table 5. Area Analysis. (Source: the researchers)

Strengths	Weakness	Opportunity	Threats
- Light traffic passing through the area. - Most Housing Skeleton is built with reinforced concrete, and it is in good conation. - Streets are paved.	- Heavy traffic in the square is considered a source of Pollution. - The difficulty of modifying urban blocks. - Unsuitable uses inside the area like workshops.	- The direction of the main streets is parallel to the wind movement, although it is narrow. - The breeze of land and sea comes from the Nile River beside the area.	- There is gradually replacement from low rise blocks to high rise blocks. - Some blocks are in bad condition; they are built with mud or bricks.
Special characteristics of the area.	Common characteristics with other informal areas.	Special characteristics of the area.	Common characteristics with other informal areas.

Results

This research is shedding lights on informal area and its air quality problems, the site maps show that the planning of the area combines radial and orthogonal, but in an irregular manner, and 94% of the land usages in the study site are mixed, while the heights of the buildings range from 12 to 36 meter with the scarcity of open spaces and squares.

It has the problem of replacing the low buildings by with high buildings, this which causes increasing in (H/W) ratio and poor circulation, the lack of green areas and the presence of

workshops and food shops causes smoke which is difficult to get rid of due to an increase in (H/W) ratio and poor circulation; the lack of green areas and the presence of workshops and food shops causes smoke, which is challenging to get rid of to poor air circulation.

The area also has special unique conditions: heavy traffic in Giza square, which causes air pollution and this area also, is near to the Nile, which has sea and land breeze.
From the previous theoretical part, many ideas could appear to solve air pollution in the area. Solutions contains the urban factors' effect on air circulation and the urban factors effect on air filtration. **Table 7** shows the suggested solutions to improve area air quality, and table 8 shows the results of first questionnaire which is directed to urban planners.

Table 7. The **suggested** solutions to improve area air quality.

Urban factors		**Intervention**
Urban factors affect air circulation	**Spaces direction**	Open corridor for passing more breeze of the sea comes from the Nile as there are buildings that block continuity of airflow.
	Spaces profile	Stop replacing low rise buildings with high ones.
	Spaces relationships	Replace unsuitable activities on the ground floor (like workshops) and making them open and green places.
	Spaces details	Adding wind catcher to increase wind velocity in streets.
Urban factors affect air filtration	**Plant landscape filters**	Increasing plants in the surrounding spaces (Giza square, Nile shore).
		Increasing trees and shrubs in streets.
		Roof gardens, green faces on private buildings, which have a good construction.
	Barriers	Adding barriers on the sides of bridges to Disperses pollution coming from cars.
	Purifiers	Adding purifiers in Giza square
	Water Suppression	Adding water suppression

Table 8. The mean value of the planner's expectations

Intervention	**Impact on air pollution**	**Implementation Feasibility**	**Main current Obstacles/ Requirements**
Open corridor for passing more breeze of the sea comes from the Nile as there are buildings that block continuity of airflow.	High	Hard	Demolition of some buildings
Stop replacing low rise buildings with high ones.	High	High	Continuity of inspection

Unloading unsuitable activities on the ground floor (like workshops) and making them open and green places.	High	Medium	-Compensation costs - Maintenance and management
Adding wind catcher to increase wind velocity in streets.	Medium	Medium	Open spaces for building wind catchers are limited
Increasing plants in the surrounding spaces which air entering from them to the area (Giza square, Nile shore).	Medium	High	-No Obstacles
Increasing trees and shrubs in streets	Medium	Medium	Narrow sidewalks
Roof gardens, green faces on the private building which has good construction.	High	Medium	-Fund difficulties -needed prompting
Building coating	Medium	High	
Adding barriers on the sides of bridges to Disperses pollution coming from cars.	Medium	Medium	Bridge narrow sides.
Adding purifiers in Giza square	High	High	finance difficulties
Adding water suppression	Medium	High	-Limited open spaces -Fund difficulties

The second questionnaire was directed to 44 resident families; their answer was as the following:

A- All people answered that they are suffering from air pollution in the area, and it is connected with lung diseases that they are suffering from.

B- The ambit of people's acceptance of suggested solutions varies between the four choices (easy, medium, hard, and unacceptable). **Fig. 16.**

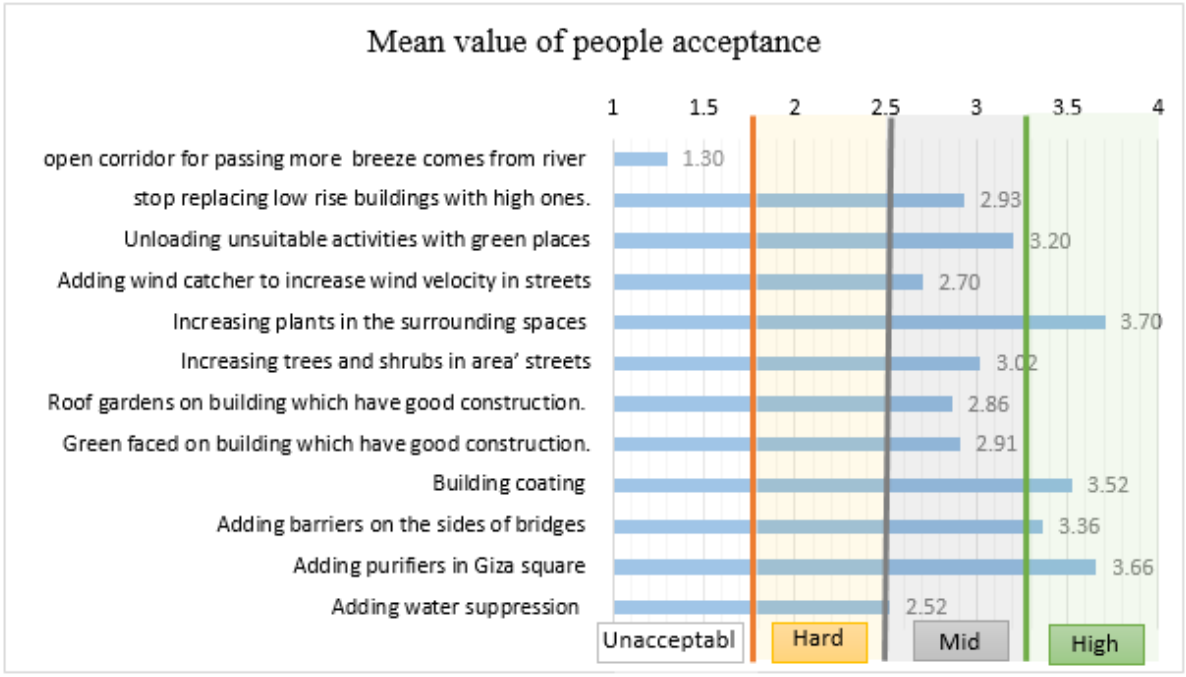


Fig. 16. Mean Value of People Acceptance to Suggestion Solutions.

C- People accept to share in solving as the following: 39% could share by effort, 25% could share by money, and 36% do not want to share.

Discussion

There are many ways to solve air pollution in informal areas. These ways are integrated to achieve better air filtration and circulation.

According to the results of the questionnaire form the planners, some solutions are expected to be highly effective, they are opening corridors for air movement, unloading unsuitable activities (like workshops), making them open places, adding purifiers in Giza square, green façade, roof garden but at the same time, they have special requirements.

By comparing planners and people's answers, it had been observed that they have the same evaluation for the possibility of applying the solutions, except for four points, which are: Open corridors for passing more breeze, stop replacing low rise buildings with high ones, adding barriers on the sides of bridges to disperses pollution coming from cars, Adding water sprays.

These differences may appear because planners put many dimensions in their minds like funds and low; on the other side, people put property preservation first, and their acceptance is not related to afford funds. **Fig. 17.**

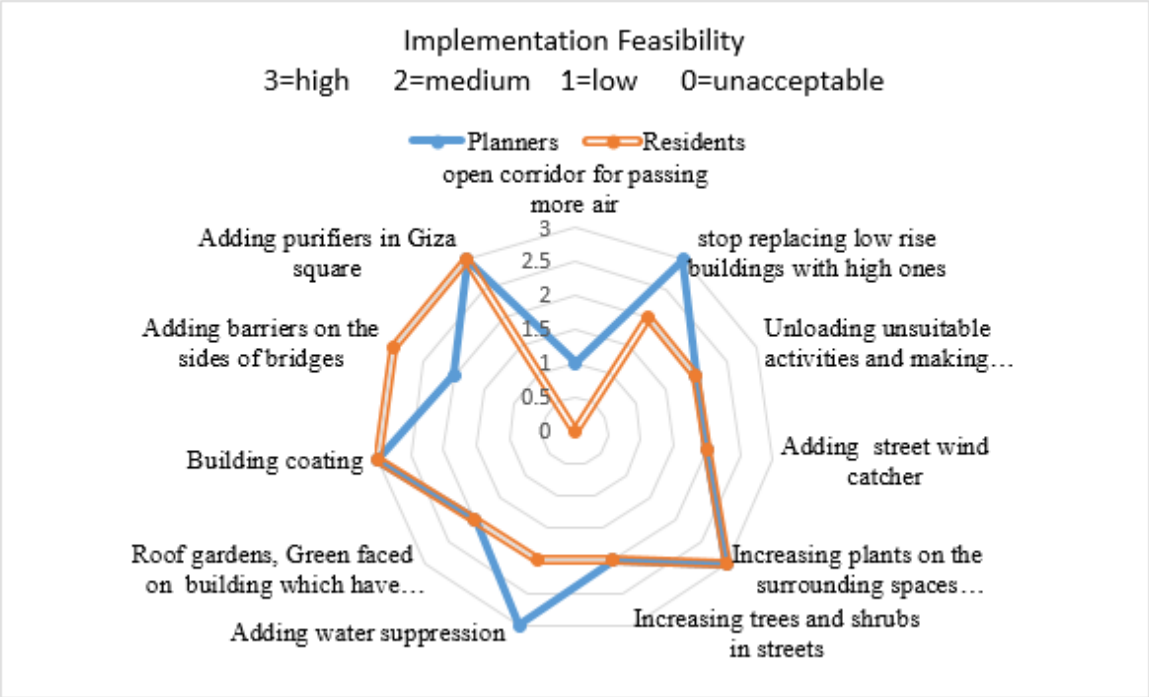


Fig. 17 Possibility to implement different solutions to improve air quality in the informal area

As much of the direct impact of air pollution on resident's health, there is a wide willingness to participate in projects to improve air quality, whether with money or effort.

Conclusion

The current efforts, whether from the government or from stakeholders and researchers, about finding solutions to the problems of the environment, pollution and global warming to preserve the planet and ensure its sustainability for future generations is one of the most important

considerations of this era, and therefore the importance of the research is to discover many solutions to solve air pollution.

The conclusion of this study can be summarized in the following points:

1) Informal areas have characteristics that make them more than other areas in the confinement of air pollution, so the research focuses on achieving two complementary strategies with the governorates and determining related urban factors.

2) Filtering air before inter the area by plants, use innovation for filtration are part of the solution; the other is making good circulation by open corridors for filtered air, using street wind catchers, unloading unsuitable activities on the ground floor (like workshops), and making them open and green places, increasing plants in suitable places, monitor building heights not to increase and block air circulation.

3) Expected Solutions are varied in strength from one case to another as some places may carry different characteristics; as in the case study, it has the proximity to the Nile, making it possible to benefit from the breeze of land and sea.

4) Many solutions are expected to be effective and applied with the help of the residents.

5) Modern technologies present solutions that do not need significant changes in urban content, such as pollution-absorbed materials, smog-free towers, and water suppression.

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