



Increasing the Share of Green Areas: an Alternative Approach for Healthier Metropolitan Cities

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Abstract. Urban green areas create a healthy city where the natural environment and the built areas are interwoven. However, urban cities are facing stress between the high buildings with dense construction as a result of the rapid increase in urbanization, land value, and the decreasing of the proportion of green areas. Lacking green areas affects negatively on the development process in the environmental, social, and economic dimensions. The main aim of this study is to put an outline to increase the green area share in urban metropolitan cities as a holistic strategy for a healthier city. By Applying the concept of green roofs with top roof farming and green walls, it is possible to increase the green area share in metropolitan areas. In addition to enhancing the environmental problem, it can contribute to developing the urban food system and quality life. This study describes the significant role of urban green areas in cities based on sustainable aspects. The alternative ways of increasing the greenery in high-density urban cities are studied; some experiences in the world are described, and the situation in Cairo city is discussed.

Keywords: Quality life, urban farming, vertical gardens, green roofs, Cairo city, urban areas.

1. INTRODUCTION

Urban green areas are considered as green lungs and protective shield in the polluted and congested cities. Green areas provide a high range of biodiversity that could improve the quality of life and help to address many urban ills for city residents. However, the share of green areas per citizen is roughly equivalent to 0.33 square meters per individual (3.5 square feet), which is considered one of the lowest proportions in the world (Attia&Mahmoud,2009) (Figure1). This is because of the rapid increase in urbanization which is exceeded the need of people for green areas. In addition to lacking awareness of the importance of green areas in the development process, parks cannot be fulfilled with the very high land value in Cairo.

1.1. Research Problem:

Cairo city, which is similar to other cities in the developing countries, faces many problems. In addition to the challenges of rapid urbanization, there are many environmental problems such as all kinds of pollution (air, sound, visual), urban heat island effect and dense urbanization. The rapid urbanization creates not only environmental issues but also economic problems due to the high using of air conditioners for cooling. Additionally, there is a lack of food production and distribution, the food load with harmful toxic contaminants, and high food prices, which threatens human's health. Furthermore, there is a strong lacking of green area, and the percentage of greenery is extremely low (0.33 square meters per person) (Figure 1). Among all these problems stands out; a common denominator is increasing the share of green areas with alternative ways such as green roof, top roof gardens, or green

walls, which could help in the development process and raising the quality of life. However, the problem with the application of all these methods is lack awareness to choose appropriate and economic types for each case

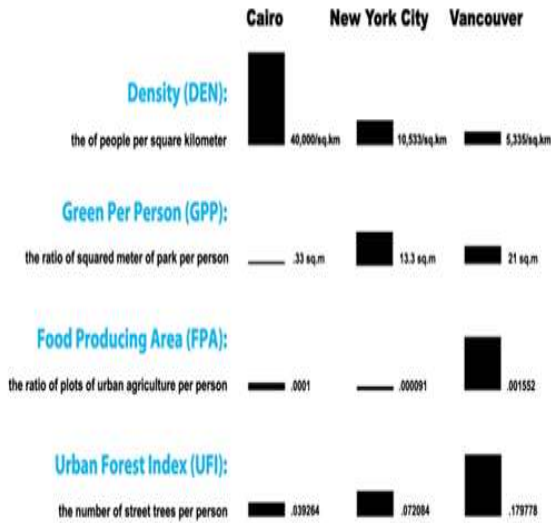


Fig 1, comparison of different greenery in different urban cities Source: Attia, S., Mahmoud, A., (2009)

1.2. Research objectives:

The main purpose of this research is to put an outline to increase the green area in urban metropolitan cities as a holistic strategy for a healthier city. It aims at shedding light on different dimensions of the benefits of the green area. Moreover, it could encourage residents, building users, urban planners, and architects to invest more in green areas application ideas, methods, and techniques such as green roofs, top-

roof farming, and green walls that can assist in increasing the percentage of green areas.

1.3. Research methodology:

The research methodology would firstly be reviewed by highlighting the importance of green areas on quality life and city development. The paper will be a qualitative study which shows the positive impacts of green area on the urban context and views the alternative ways of increasing the green areas instead of parks. Then, an analytical approach is shown by reviewing international and local applied strategies for metropolitan cities by applying. The result discusses the opportunities, limits, and challenges facing green roofs, green walls, and top-roof farming.

1.4. Research hypothesis:

The alternative ways, green roofs, urban agriculture, and green walls, are practical solutions to increase the share of green areas in high populations cities. Then, they help to solve other environmental, economic, social problems such as decreasing the rate of air pollution. Increasing green area share helps many aspects to develop and grow up.

2. The significant role of increasing the green area share on the development process:

Green areas have long and short terms benefits which are essential to the community and city (Figure 2 & 3).

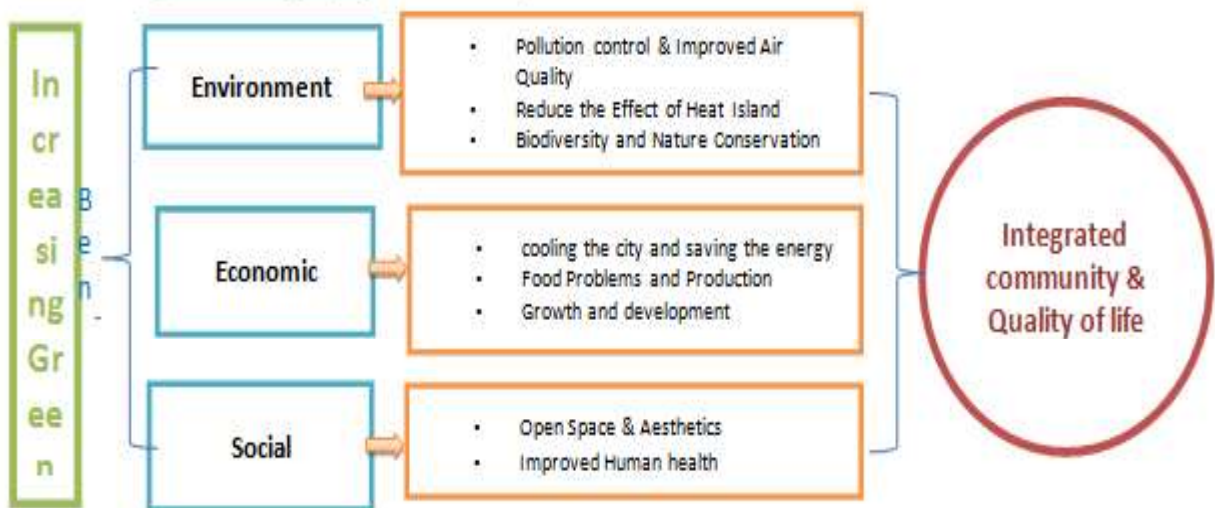


Fig (2), the benefits of increasing the green area on different aspects

Source: the researcher based on literature reviews

The Impact of Increasing the Share of Green Areas in Cities

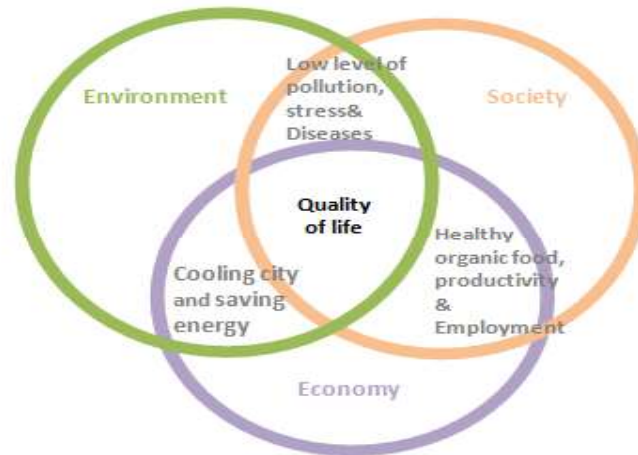


Fig (3), the benefits of increasing the green area on different aspects

Source: the researcher based on reviews literature

2.1. Environmental benefits:

2.1.1. Pollution control & Improved Air Quality:-

Cairo is ranked as one of the most polluted cities in the world, and residents live amongst the dust and smog, which threaten their health. Besides, Cairo's levels of air pollution, as reported by the WHO Global Ambient Air Quality Database, are approximately ten times the amount considered to be safe (Fahmy, 2018). Moreover, Cairo has had to suffer the dreaded "black cloud," which for over ten years has descended upon the city for a number of weeks, every autumn. Pollution in Cairo is expanding daily, impacting the lives of countless millions of people for whom a breath of clean air has become an unimaginable luxury (Attia & Amer, 2009).

The air quality in downtown Cairo is more than 10 to 100 folds of acceptable world standards (Attia & Amer, 2009). Air pollutants could be directly reduced by urban greening when vegetation and greens trap dust and smoke particles. According to researchers, 85% of air pollution in a park can be filtered (Bolund & Sven., 1999). Moreover, urban green areas could reduce the level of noise in the streets that happened by the traffic and another source, which causes stressful and creates health problems.

2.1.2. Reduce the Effect of Heat Island in urban areas:

Urban heat island effect can increase urban temperatures by 5°C (Bolund & Sven, 1999). Using plants and vegetation can mitigate the

effect of urban heat island because of the material and characteristics of plants, provide shades, and reflect the sun's heat instead of absorbing it. The climate in hot regions, as the greater Cairo region, could be improved by vegetation and greens ground cover.

2.1.3. Biodiversity and Nature Conservation:

Urban green areas give to the cities with ecosystem benefits ranging from conservation of biodiversity to the regulation of urban climate. Urban areas are quite different in solar input, rainfall pattern and temperature, solar radiation, and relative humidity differ significantly as a result of the built environment (Heidt, & Neef, 2008). Thus, using plant species that adapted to the local environment condition with low maintenance is essential to achieve sustainability.

2.2. Economic Benefits:

2.2.1. Environmental Economic Benefit (cooling the city and saving the energy):

Green areas consider a natural way to make the city cooler, which helps in saving the energy used in cooling. Besides, plants improve air circulation, and they can increase evapotranspiration. Trees and vegetative growth provide shades and lower the temperatures, which reduce the use of air conditioning and help to minimize the high temperatures. For instance, a park of 1.2 km by 1.0 km can produce an air temperature between the park and the surrounding city that is detectable up to 4 km away (Heidt & Neef, 2008). According to a study in Chicago, the total energy

for heating and cooling by 5 to 10% is reduced by increasing trees cover on the city by 10% (Sorensen, Smit, Barzetti, & Williams, 1997).

2.2.2. Food Problems and Production:

There are two problematic issues with food production in Cairo. First, the quality of food is shallow according to the pollution and toxic contaminants that threaten health. Furthermore, high-quality food, which is called by (organic food) considered a luxury because they are luxurious, expensive, and limited. The other one is the quantity of food itself and food distribution. For example, in a recent couple of years, there was lacking some crops like sugar and potatoes.

Urban farming on the both of building (top roof farms or green walls) and urban level is considered an effective way that helps in food production. This system can provide healthy organic inexpensive products. Moreover, the cost of transportation of the food could be reduced to the minimum when providing fresh food for large communities in almost any climate (Attia & Amer, 2009).

2.2.3. Growth and Development:

Green areas in cities could attract foreign investments, which assisted rapid economic growth such as Singapore, Thailand, and Malaysia. In addition to the added value of beautification, they also support tourism significantly; for example, people go to the international parks and the natural green places in other cities as Beirut in Lebanon or Bali in Malaysia (Sorensen, Smit, Barzetti, & Williams, 1997).

The indicators indicate that the property values and financial returns for the land developer are increased between 5% and 15% by green areas depending on the type of project (Maas, Verheij, & Groenewegen, 2006).

2.3. Social benefits:

2.3.1. Enhancing Open Space, & Aesthetics:

Green areas have a significant role in enhancing the public open space, which is any open piece of land that undeveloped (has no buildings or other built structures) and accessible to the public, such as green spaces, schoolyards, streets, playgrounds, public seating areas, and public plazas. It is found that open spaces need many facilities to be comfortable for the citizen and users like greens

and trees. For example, the street needs trees to prevent it from UV radiations, reduce noise, and filter the air.

2.3.2. Improved Human health:

Lack of green area has a negative impact on mental and psychological human health because people who live in urban areas have less opportunity to be physically active, which leads to an expansion in respiratory diseases such as asthma, COPD, and upper respiratory infections.

3. Alternative ways to increase green areas in urban:

Increasing of the population in cities, congested traffic, high land value, and housing shortage are considered significant issues and challenges faced by metropolitan crowded cities in their sustainable development and increasing the green areas through traditional ways such as parks. Therefore, Developers and specialists have to think for alternative methods, using roofs and walls of the buildings for green areas.

3.1. Green roofs:

Green roofs are an alternative to breathing space roofing, sustainable, and passive design structures of vegetation surfaces applied to a strong and water-resistant membrane of an appropriate conventional roof build-up in rainy climates. Urban green roofs can address the lack of green areas in many crowded cities. They provide the city with open space, improve the air quality and reduce the effect of the urban heat island. In European countries such as Germany, Green roofs are used in storm water management and drainage control, which can use or harvest rainfall from a green roof (Attia & Mahmoud, 2009).

Although green roofs provide all benefits, there are no green roofs in hot arid climates such as Arab cities. This is because the minimum annual precipitation rate for a green roof, based on European norms, should be more than 450-650mm. Therefore, it is difficult to cultivate a green roof in Cairo city (26mm) (Attia & Mahmoud, 2009). Using artificial irrigation makes the system lose the whole point of sustainability within water-scarce regions.

3.4. Urban agriculture:

Urban agriculture is a localized food system wherein the production, processing, distribution, access/consumption, and disposal/recycling of

food occur in and around the city (Smit, Ratta and Nasr, 1996). Urban agriculture has three types: backyard gardens, community gardens and commercial farms (Brown and carter, 2003). First, backyard gardens are land around homes or rooftops and balconies. Second, community gardens are a large piece of land or roof for several households. The production of both types of gardens is used for home residents.

The last one, urban commercial farms, are designed for-profit businesses in public areas managed by schools, hospitals, universities or charity bodies (hui. & SCM, 2011).

A multitude of benefits like providing the basis for better society and community interaction (community gardening), reducing the environmental impacts related to traditional food production and distribution, and improving access to fresh food (a significant problem in , neighborhoods) could be achieved by a green wall or top roof farm designed for urban agriculture.

3.2. Top roof farms

Roof farming has long been promoted as an economical and effective strategy for increasing investment opportunities through growing crops and enhancing the built environment. Top-roof






farms are designed for four main purposes: food production, active recreation, reusing wastes (compost, storm-water), and educational opportunities (Brown & Carter, 2003). Urban farming is an economical solution regarding the profit which can cover the cost of irrigation systems in a hot arid climate.

3.3. Vertical gardens “green walls”:

Another solution could help to increase the share of the green areas; vertical gardens started to take an essential place in recent years. The concept of using the building’s façade as an area that could be planted is very useful and appropriate for metropolitan areas. Green walls are an ancient one, with samples in architectural history getting back to the Babylonians – with the well-known Hanging Gardens of Babylon, one of the seven ancient wonders of the world.

Green walls or vertical greening with its types; Green facades and Green living walls can provide a cooling potential on the building surface; it decreases the energy consumption by increasing buildings thermal performance; decreases the urban heat island effect; increases the interior air quality; decreases the noise pollution (Lundholm, 2006). It improves habitat and biodiversity; it creates a healthy environment.

Table (1) Green wall benefits source: author

| Benefits of Green System | Description | |
|-----------------------------------|--|---|
| Environmental | <ul style="list-style-type: none"> - Improving air quality. -Ameliorate heat island effect. -Reduce carbon dioxide. - Control stormwater run-off. -Noise reduction act as a noise barrier. -reduce the heat urban island effect. |  |
| Building Energy | <ul style="list-style-type: none"> -Lower heat absorption. -Lower indoors temperature. -Reduce the energy used for cooling. |  |
| Aesthetics | <ul style="list-style-type: none"> -Give an impression of beauty. -Possible to create living art. |  |
| Psychological & Health | <ul style="list-style-type: none"> -Relaxing and soothing. -Provide a substantial & spiritual connection to nature. -Reduce symptoms of discomfort. |  |
| Economic | <ul style="list-style-type: none"> -Increase usable & amenity space. -Increase the green coverage ratio. -Increase property value. -The green environment translates into higher employee efficiency. -Branding opportunity. |  |

4. INTERNATIONAL & LOCAL PRACTICES

4.1. Paris allows anyone to plant an urban garden:

Paris city encourages their dwellers to plant the city through growing plants on top roofs, on walls, in boxes, in streets, under trees, or on fences. In 2016, the government passed a new law that allows anyone to plant within the city's limits. Greens could be cultivated in front of homes, companies or offices. This increasing of green areas is necessary to counteract the effects of the urban heat island as a result of the climate change effects facing the city, enhance the quality of life for city dwellers and boost the beauty of the city (Figure 4). Wherefore, dwellers can grow plants such as flowers, vegetables or fruits to get products that can use or buy them and increase their incomes or cover the overhead of planting. Moreover, landscape architects and gardeners must use sustainable ways in plating, avoiding pesticides and promoting biodiversity in the city. Thus, the main goal is creating 100 hectares of living walls and green roofs by 2020, where agriculture shall constitute one-third of this greenery (Cooke, 2016).



Fig (4) using alternative gardens (living walls in Paris, France) Source: Cooke, L., 2016

4.2. Singapore:

Singapore has a holistic approach to encourage other stakeholders and developers to invest in green structure in their developments as well as the community and green their buildings, either the ground or the upper levels, as top-roof and terraces to improve the quality and quantity of urban green areas. Singapore's green areas could double by 2030. The government has a target to increase of 200 Hectares of the rooftop of greenery and make the city more attractive and more productive urban biodiversity by the urban landscape. The developers use to green the buildings such as community pavilions and ground garden. The scheme also encourages new greening trends like top roof farms, communal gardens and solar panels, (Figure 5). According to a URA (Urban Redevelopment Authority) statement, the main aim of increasing green areas by landscaping on walls and roofs does not only beautify buildings but also cool the ambient temperature and provide visual relief to passers-by.

Developers of mechanical and electrical equipment are required because of using rooftop areas for greenery. However, the URA would grant gross floor area exemptions that could represent significant cost savings for developers and building owners Singapore (Wong, w., 2017).



Fig (5) an overview of the landscape for urban areas

Source: Wong, w., 2017

4.3. The strategy of increasing the green areas in Barcelona:

Barcelona, which is one of the most densely populated cities in Europe, needs to become a greener city as a result of environmental problems such as air pollution, heat, and climate changes. According to the Commissioner for Ecology, Frederic Ximeno, Barcelona has 7 square meters of greenery per citizen; however, the World Health Organization recommends between 15 and 20 square meters per person.

The program to boost green areas in the city plans a series of processes to achieve the main goal of increasing greenery by 1 square meter per citizen by 2030, in other words, for Barcelona to have 165 hectares of green areas (Redacció, 2017).

4.4. CASE STUDIES IN CAIRO:

In the urban context, Green areas are a complex and problematic issue, as a result of lacking sufficient areas of green spaces in Cairo city. However, there is a huge need for transforming green areas into livable and attractive places to achieve the creation of sustainable clean communities (Kafafy, N. ,2010). Many initiatives, NGOs and private enterprises have a significant role in emerging with interest in encouraging residents to increase urban agriculture on different scales and increasing environmental awareness in Cairo.

4.4.1. Schaduf in Cairo:

Founded in 2010, the main idea was to “create green spaces.” The aim is providing inspired urban green solutions that elevate the quality of life through social and environmental change. The main products include roof gardens, vertical gardens, and top-roof farms. First, the roof gardens or green roofs are just creating a green space in homes for any purpose, and this type is suitable for villas and compounds. Second, different types of ornamental plants could be grown by vertical gardens “Green walls” for decorative purposes or heat insulation, and this is for companies and branding regarding the high cost because of the irrigation system and maintenance. The last one, top roof farms are for underprivileged areas because they have an income from growing different types of herbs and crops. However, creating top roof farms need to have enough information about the plant selection with the environmental conditions and trained people to know how to farm with hydroponic and raised beds. Unfortunately, it is found problems with the property legal papers to have microfinance in privileged areas. The contraction also has several barriers, such as low-quality waterproofing systems and the weight of the farming system, (Figure.6) .



Fig (6) Example of Using green wall in a gift shop in Zamalek,

Green roof in CIBbank

Source: Schaduf, 2019

4.4.2. Shagarah initiative (Plant It) :

It is an initiative of Shagarah, which means “plant it” in the Arabic language developed by a petroleum engineer. The initiative has coordinated vegetables and fruit trees planting on public spaces as streets and schools. Moreover, the initiative has encouraged the implantation of top roofs and balcony farms. The main aim of this initiative is food production in the streets, and it has particular importance in a county as Egypt facing an increasingly drastic food shortage. According to the world food program, 16 percent of Egyptians have “poor access to food.” Moreover, Shagrah brought a verdant green hue to Cairo’s bleak, sand-swept cityscape, getting

trees growing wherever possible: by roadsides, from balconies, on rooftops. It is installed in a hydroponic garden on top of the employer's petroleum tanker. This initiative has already done the following:

- Planted 25,000 fruitful trees in Egypt.
- Supported 1,000 new rooftop gardens
- Run 100 community events about urban agriculture.

This initiative has targets for securing a long-term sustainable future for the project. It has a goal to plant 100,000 trees in the ground by 2020, along with 10,000 new balcony gardens. Beyond that, Shagrha is aiming to ring in 2030 by having planted a total of one million trees (Organic Food and Agriculture, 2018).

5. CONCLUSION

Green areas are a basic essential need for citizens because of their direct and indirect benefits. The study showed that the significant advantages of increasing the plants are: being economical support, helping to clean the environment and city, and enhancing the quality of life. In crowded metropolitan cities such as Cairo, with hard social, environmental and economic situation, the alternative ways are becoming necessary due to the very low percentage of green areas, however, the minimum percentage could not be achieved through the traditional ways such as planting empty areas and providing more green areas among the urban setting of these areas according to different challenges as the increasing land value.

Therefore, green roof, rooftop gardens, and green walls could be a suitable practical solution to solve all of the environmental and social problems and fit the economic situation, and the budget depends on the needs and kind of project.

Table (2) the differences between Green roofs, green walls, and top-roof farming

Source: Author

| | Green roofs | Green walls | Top-roof farming |
|------------------------------|--|---|---|
| Definition | Planting directly on the waterproof membrane of the roof | Planting with different systems on the walls (indoors and outdoors) | Planting in containers on a roof |
| Types | <ul style="list-style-type: none"> • Intensive • Extensive | <ul style="list-style-type: none"> • Green walls • Green Facades | <ul style="list-style-type: none"> • Hydroponic • Aquaponic |
| Irrigation | Rain in rainy climates | Irrigation systems | Hydroponics and irrigation systems |
| Cost per meter square | 1300-1450 Egp/m ² | 2800-3400 Egp/m ² | 15000 Egp for 200 seedlings for 8 m *2 m |
| Main purpose | Social & Environmental purposes | Aesthetic & Branding Environmental purposes | Food production |
| Maintenance | High | Very high | Medium |
| Kind of buildings | Hospitals, villas & governmental buildings | Shops, banks, & Malls | Houses, schools & Universities. |
| Disadvantages | <ul style="list-style-type: none"> • Lack of awareness | <ul style="list-style-type: none"> • High cost • High maintenance | <ul style="list-style-type: none"> • Narrow Plant selection |

In Cairo, there are legal, environmental, and social problems which faced green areas development on both of building and urban scale. From these problems the following:

- Lacking awareness of green area and sustainability.
- Financial issues about selecting a suitable system for the wall or roof, then the expenses exceed the income.
- Plant selection limited depends on climate factors.
- Legal and political issues.

Although it is found many challenges and disadvantages in the greater Cairo region to increase the green area share, they could be opportunities. The following table will be discussed.

Table (3) the challenges and opportunities of increasing the green areas in Cairo city Source: The author

| Challenges | Opportunities |
|--|--|
| No empty land “ High Density.” | Many of rooftops for private and public buildings are existing |
| High population | People need to work and invest |
| The environment is dry and sunny | Use plant selection from Egyptian flora |
| Low incomes and hard economic conditions | Developing the economic for the individual, companies, and the city. |
| Lack of knowledge and awareness | Elevate the confidence for people by learning how to farm because plants are living organism like a baby when he grows up. |

Planting the city with different kinds of vegetables and fruits or any greenery could change lots of things. Many measurable qualitative and quantitative benefits could be achieved from increasing green area share through green walls, green roofs, and urban agriculture. However, no greenery implementation can be created without knowledge of the different factors affecting the creating and designing. Climate situation, constructional, economic, and legal are the most effective factors at all.

6. References

- [1] Anon, (2018), “*Organic Food and Agriculture*,” (online) available at: <https://www.theswitchers.eu/en/switchers/fruit-trees-egyptian-agriculture-project/> (Accessed 21 may 2019)
- [2] Attia, S. & Mahmoud A., (2009). "Green Roofs in Cairo: A Holistic Approach for Healthy Productive Cities", In *Conference Proceeding on Greening Rooftops for Sustainable Communities*, June 3-5, 2009, Atlanta, USA.
- [3] Bolund P, Sven H.,(1999), *Ecological services in urban areas*, Elsevier Sciences: Ecological Economics, Vol. 29,pp. 293-301
- [4] Brown, K. H. and Carter, A., (2003), *Urban Agriculture and Community Food Security in the United States: Farming from the City Center to the Urban Fringe*, North American Urban Agriculture Committee, Community Food Security Coalition (CFSC), Venice, CA. (available at www.foodsecurity.org)
- [5] Cooke, L., (2016), “**Paris allows anyone to plant an urban garden**”, (online) available at: <https://inhabitat.com/paris-allows-anyone-to-plant-an-urban-garden-anywhere/?variation=a> (Accessed 21 may 2019)
- [6] Fahmy ,k., (2018), “Is Cairo the world’s most polluted city? ‘No’ says the government, ‘probably’ say its suffering residents”, (online) available at <http://www.arabnews.com/node/1368046/middle-east> (Accessed 21 may 2019)
- [7] Heidt, V. and Neef, M., (2008) “Benefits of Urban Space for Improving Urban Climate,” *Ecology, Planning and Management of Urban Forests: International Perspective*.
- [8] Kafafy, N. ,(2010). *The dynamics of urban green space in an arid city; the case of CairoEgypt*, Cardiff: Cardiff University - PhD Study.
- [9] Lundholm,J., (2006) “Green roofs and facades : a habitat template approach . *Urb Habitats*; 4:87-101
- [10] Maas J. , Verheij R., & Groenewegen P.,(2006),*Green space, urbanity, and health: How strong is the relation?*,*Epidemiology & Community Health*, 60(7):587-92
- [11] Redacció, (2017), “More greenery for a healthier city”, (online) available at: https://www.barcelona.cat/infobarcelona/en/more-greenery-for-a-healthier-city_508531.html (Accessed 2019)
- [12] Schaduf, 2019, Cow Gift Shof, <https://schaduf.com/schaduf-projects/cow-gift-shop/> (Accessed 2019)
- [13] Smit, J., Ratta, A. and Nasr, J., (1996), *Urban Agriculture: Food, Jobs and Sustainable Cities*, United Nations Development Programme (UNDP), Habitat II Series, NewYork.
- [14] Sorensen M., Smit J., Barzetti V. and Williams J., (1997), “Good Practices for Urban Greening,” *Inter-American Development Bank*. <http://www.iadb.org/sds/doc/ENV109KKeipiE.pdf>.
- [15] Wong,w., (2017), “**More urban farms, rooftop gardens in Singapore with enhanced greenery scheme**”, (online) available at: <https://www.channelnewsasia.com/news/singapore/more-urban-farms-rooftop-gardens-in-singapore-with-enhanced-9389944>, (Accessed 21 may 2019)