



Received: 30/12/2021

Accepted: 30/10/2022

The Sustainable Micro-Landscape Urban Building Gardens: Case of Factory 4376, Sama Beirut and Tamlis–Tarik Jdideh

Rana El Khatib Abou Ghaida

Landscape department, Lebanese University, Lebanon
rana.ghayda@gmail.com

Micheline Wehbi*

mwsleiman@gmail.com

Nina Zeidan*

lebanon.nina.zeidan@gmail.com

Victoria Dawalibi*

dawalibi1@hotmail.com

*Associate Professor Landscape and Territory planning department, Faculty of Agronomy Lebanese University, Lebanon

Abstract

This paper tackles the sustainable micro-landscape urban building gardens, and aims to explore innovative planning and green design approaches, thus finding solutions to the depletion of green spaces in Beirut. This study is conducted on three buildings located within Beirut city, each having a different architectural typology. The first is Factory 4376 located in Sin EL Fil, the second is Sama Beirut located in Achrafieh, and the third Al Tamlis – Tarik Jdideh. Each building is either residential, commercial or both; and each is surrounded by different socio-economic neighborhoods. This study adopts a comparative methodology; it relies on detailed analysis of maps and aerial photographs, obtained from one of the local municipalities, as well as interviews with residents in the investigated areas, surveys, pictures, and similar case studies. Three solutions were suggested for the locations stated above:

- First solution: the implantation of a metallic structure on an old building that forms an extension to preexisting balconies.
- Second solution: the integration of the green sliding balconies on buildings with glass façades.
- Third solution: the integration of prefabricated modules to buildings with no balconies.

The paper concludes that green technologies, if integrated in the context of sustainability, can make a great difference, even if space is limited; hence overcoming the risk of losing greenery.

Keywords: Sustainable; Urban planning; Micro landscape; Green technologies; Losing greenery

Cite as: Abou Ghaida R.E., Wehbi M., Zeidan N., & Dawalibi V. (2022). “The Sustainable Micro-Landscape Urban Building Gardens: Case of Factory 4376, Sama Beirut and Tamlis–Tarik Jdideh”. *The Academic Network for Development Dialogue (ANDD) Paper Series, First Edition, 2022*. <https://doi.org/10.29117/andd.2022.017>

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تاريخ الاستلام: 2021/12/30

تاريخ القبول: 2022/10/30

حدائق المباني الحضرية ذات المناظر الطبيعية الدقيقة المستدامة: حالة المصنع 4376، وسما بيروت، وتمليس - طريق الجديدة

رنا الخطيب أبو غيدا

rana.ghayda@gmail.com

قسم المناظر الطبيعية وتخطيط الأراضي، كلية الزراعة، الجامعة اللبنانية، لبنان

ميشلين سليمان*

mwsleiman@gmail.com

نيننا زيدان*

lebanon.nina.zeidan@gmail.com

فيكتوريا دواليبي*

dawalibi1@hotmail.com

*أستاذ مشارك، قسم المناظر الطبيعية وتخطيط الأراضي، كلية الزراعة، الجامعة اللبنانية، لبنان

ملخص

تناول هذه الورقة موضوع المساحات الخضراء، وتهدف إلى استكشاف أساليب التخطيط المبتكرة والتصميم الأخضر، وبالتالي إيجاد حلول لاستنفاد المساحات الخضراء في بيروت. أجريت الدراسة على ثلاثة مبان داخل مدينة بيروت، لكل منها نمط معماري مختلف؛ الأول هو مصنع 4376 الواقع في سن الفيل، والثاني مبنى سما بيروت الواقع في الأشرافية، والثالث حي سكني في التمليس - طريق الجديدة. كل منها عبارة عن مبنى سكني أو تجاري أو كليهما؛ وكل محاط بأحياء اجتماعية واقتصادية مختلفة. وتعتمد هذه الورقة منهجية تركز على تحليل مفصل للخرائط والصور الجوية، التي تم الحصول عليها من البلديات المحلية، بالإضافة إلى مقابلات مع سكان المناطق في محل البحث؛ والمسوحات، والصور، ودراسات حالات مماثلة. تم اقتراح ثلاثة حلول للمواقع المذكورة، وهي:

– أولاً: إضافة هيكل معدني على مبنى قديم يشكل امتداداً للشرفات الموجودة مسبقاً.

– ثانياً: دمج الشرفات الخضراء المنزقة في المباني ذات الواجهات الزجاجية.

– ثالثاً: دمج الوحدات الجاهزة مع المباني الخالية من الشرفات.

وقد خلصت الورقة إلى أن التقنيات الخضراء، إذا أدمجت في سياق الاستدامة، يمكن أن تحدث فرقاً كبيراً، حتى لو كانت المساحة محدودة؛ وبالتالي تسمح التغلب على خطر فقدان الكلي للمساحات الخضراء.

الكلمات المفتاحية: الاستدامة، التخطيط الحضري، المناظر الطبيعية الدقيقة، التقنيات الخضراء، فقدان المساحات الخضراء

للاقتباس: أبو غيدا، رنا الخطيب وسليمان، ميشلين وزيدان، نينا ودواليبي، فيكتوريا. (2022). "حدائق المباني الحضرية ذات المناظر الطبيعية الدقيقة المستدامة: حالة المصنع 4376، وسما بيروت، وتمليس - طريق الجديدة". سلسلة الأوراق البحثية للشبكة الأكاديمية للحوار التنموي - النسخة الأولى، 2022. <https://doi.org/10.29117/andd.2022.017>

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1. Introduction

A number of Arab countries witnessed demographic change due to war, crises and displacement. (Nations, 2015). This created many challenges due to the high population. The lack of greenery therefore affected climate and led to global warming, especially in large cities, causing sustainability to become a topic of concern (Glass Rook, 2018). “Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Schilling, 2018).

Some Arab countries are designing sustainable cities, an example of which would be Abu Dhabi (Sustainability, 2021). In the context of sustainability and urbanization, adding greenery and the optimal exploitation of empty spaces, such as integrating green balconies, play a major role in decreasing the effect of urbanization; hence making our cities more comfortable and environmentally healthier.

“Even though green balconies are seen more frequently in new construction projects, not a lot of research has yet been done on their impact. The trees on the green balconies are not only aesthetically pleasing but will also have an effect on the local microclimate” (Marugg, 2018).

Two case studies were chosen to help in developing a design that fits the case of Lebanon. In the first case study, the buildings had no balconies. A team from New Zealand initiated a new design (prefabricated module) that could be added to the building, forming a plant room. In the other case studies, it focused on transforming the buildings into vertical forests through cultivating the balconies, like in the case of Bosco Vertical (Giacomello, 2015).

2. Importance of Green Spaces

A study done by (Jansson, 2014) has shown that the presence of green spaces in cities holds many benefits for human health, longevity, as well as physical and mental wellbeing.

Green spaces have increased the quality/value of properties by improving their appearance aesthetically. They also hold ecological benefits that can help in minimizing the effects of noise and pollution, and protect from urban heat island effects.

2.1. Green architecture and integrated vegetation

Green architecture: A new concept that aims to convert the quality of living in cities into an eco-friendly environment, this concept led to the creation of green buildings designed from nontoxic materials. These buildings contribute to saving energy consumption up to 40%, increasing passive solar energy. They produce minimal harm to habitat, maximize the efficiency of space utilization, recycle the older buildings and conserve water sources by setting up specific systems like winter harvesting (Ragheb, 2016). “The term building integrated vegetation: can also be referred to as building greening systems. The five most common building integrated vegetation typologies” are shown in Figure 1 (Raji, 2015).

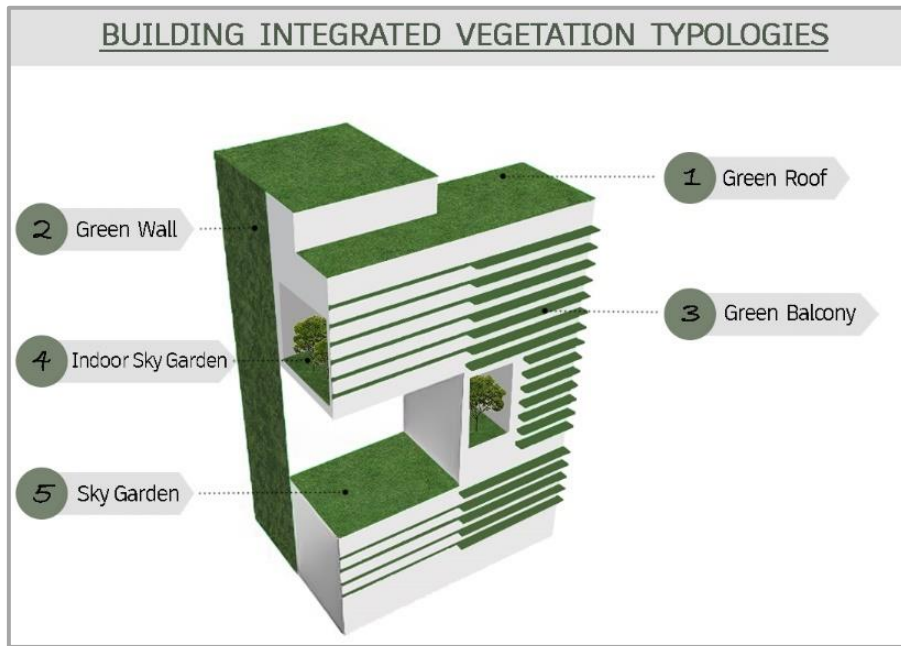


Fig. 1: The building integrated vegetation

Green roofs are considered as a new green technology that holds many advantages for a building, such as harvesting and retaining water, creation of a green habitat for some animals and insects, beautifying the building, and decreasing the urban heat island effects (Wang, 2020).

Green walls are known as vertical greenery. It is the cultivation of plants on building fronts. Compared to green roofs, green walls can cover more spaces within the built environment where high rises are the transcendent building fashion (Francis, 2014).



Fig. 2: Green walls

3. Urban micro-landscape





Urban micro container gardening is a technique used to cultivate vegetables, herbs, roots and tubers in small spaces. These spaces might be balconies, small yards, patios, or rooftops in which we can use containers – anything from plastic-lined wooden crates, old car tires, plastic buckets, trashcans, and wooden pallets to purchased “nourishments” and polypropylene bags. Small-scale hydroponic

systems are another option as well as geaponics, growing plants in hanging containers with little to no soil, or aquaponics, which is growing plants (or fish) directly in water (Haberman, 2014).

This new technology is mainly integrated in balconies.

3.1. Types of Gardening in apartments

Table 1: The different types of gardening

Types of gardening	Image
<p style="text-align: center;">Growing plants in containers</p> <ul style="list-style-type: none"> There are different types of vegetables that can be cultivated in this type of gardening, such as carrots, tomatoes, radish, spinach, onions and beans 	 <p style="text-align: center;">Fig. 3: Planting in pots</p>
<p style="text-align: center;">Growing plants in baskets</p> <ul style="list-style-type: none"> Hanging baskets are ideal for vegetables, such as cherry tomatoes or strawberries 	 <p style="text-align: center;">Fig. 4: Gardening in baskets</p>
<p style="text-align: center;">Hydroponic system</p> <ul style="list-style-type: none"> Hydroponic gardening is a method used to grow plants without soil This method can be used to grow vegetables and flowers. It is a clean method 	 <p style="text-align: center;">Fig. 5: Hydroponic system</p>
<p style="text-align: center;">Aquaponics system</p> <ul style="list-style-type: none"> This type of gardening is a combination of hydroponic and aquaculture 	 <p style="text-align: center;">Fig. 6: Aquaponics system</p>

A balcony is considered as a platform that expels from the wall of a building. The presence of a balcony has been proven to improve natural ventilation on the indoor ambience as well as enhance the thermal comfort, and thus minimize the need for mechanical ventilation and energy consumption in buildings (Ribeiro, 2020).

“The value of this personal space is often not fully appreciated. Some studies suggest that residents in high-density developments are less susceptible to illness if they have a balcony or terrace garden” (Kennedy, 2015).

In the last decade, there has been an increase in the number of high-rise buildings. These newly

adopted architectural prototypes have changed the landscape identity of Beirut city, to name a few: Sama Beirut Building, Sky gate, 44 Tower, 4748, Les Domes de Sursock ... Check Figure 8 and 9 depicting the change caused due to urbanization.



Fig. 7: Achrafieh before urbanization



Fig. 8: Timeline map showing the gradual urbanization in Tarik Jdideh

Due to the widespread use of such buildings, it is difficult to implement greenery on them. We relied on the case study that was conducted in Milan (Giacomello, 2015) that established a design of vertical forests, with built-in Balconies (refer to Figure: 13). “The balconies are cantilevered 3,3 meters from the building facade and have to support trees ranging from 3 to 9 meters in height” (Marugg, 2018).

Many of the newly constructed high-rise buildings have either glass façade or lack balconies, so this led us to look for new studies that enable the engineers to add structures to the buildings capable of replacing balconies.

Balconies in this study were favored over other green technologies (green roofs and vertical walls etc.) due to their function (in and out) as an extension of the indoor living of each resident, providing the individual with more privacy.

4. Case Study 1: Prefabricated Garden Module

In modern apartments, there is a lack of space for gardening. A team from New Zealand has initiated a new design to solve this issue and add space for urban gardening. This space is called a plant room (Meinhold, 2010).

4.1. Case Study 2: The Bosco Verticale Projects

It consists of two towers located in Porte Nova district in Milan. They are characterized by the distribution of vegetation on the terraces and all facades. The target of the project is to increase biodiversity and help establish an urban ecosystem, in which vegetation will create a vertical ecosystem that can be inhabited by animals, insects and birds (Elena Giacomello, 2015).



Fig. 9: Bosco verticale upper part (Elena Giacomello, 2015).

5. Site Analysis

In this study three buildings located in an urban zone in Beirut city were selected. Beirut is the capital of Lebanon.

Sin El Fil is located in the north-eastern suburb of Beirut, its surface area is 2.5Km, and it's separated from Beirut by the River of Beirut (Fil, 2007). **Achrafieh** is one of the oldest districts in Beirut, located in the eastern part of the city. **Tarik Jdideh** is known throughout history as the area stretching from Makassed High School located in Horsh Beirut from the northern side, till the end of Sabra Street from the southern side. **Al Tamlis** is a neighborhood on the northern edge of Tarik Jdideh (Carta).

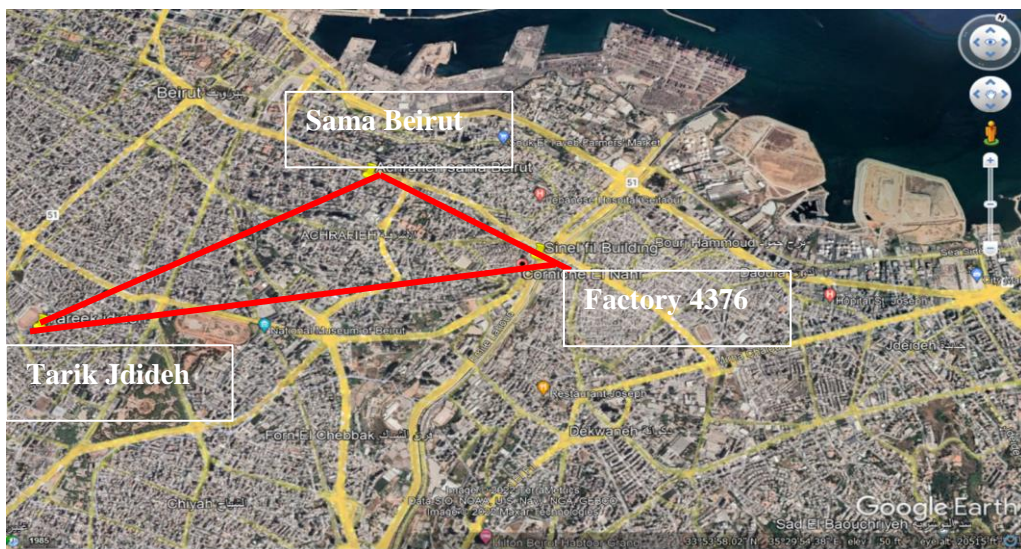








Fig. 10: Google map showing the location of the selected sites

Table 2: Showing the Analysis of the selected sites

<p>Description of the sites</p>	<ul style="list-style-type: none"> ● Factory 4376 building with no balconies in an industrial zone in Sin EL Fil ● Residential building ● Upper class neighborhood 	<ul style="list-style-type: none"> ● Sama Beirut is a residential, commercial and office tower located in Achrafieh Sodeco region. It is the tallest tower in Lebanon with a height of 195m (Beirut, 2014) ● Cosmopolitan neighborhood 	<ul style="list-style-type: none"> ● Al Tamlis Building has small apartments and balconies ● Al Tamlis is a suburb located in Tarik Jdideh ● Residential building ● Low socio-economic neighborhood
<p>Maps</p>	 <p>Fig. 11: Location of Sin EL Fil highlighted in red</p>	 <p>Fig. 12: Sama Beirut building</p>	 <p>Fig. 13: Location of Al-Tamlis in red</p>
<p>Photos</p>	 <p>Fig. 14: Factory 4376</p>	 <p>Fig. 15: Sama Beirut building</p>	 <p>Fig. 16: Tamlis-Tarikh Jdideh</p>
<p>Problematic of the site</p>	<p>Change of landscape character, previously it was a forest now it is considered as an industrial zone</p>	<p>The facade of this tower is made of glass, retention of heat in summer time leads to the elevation of the greenhouse effect</p>	<p>On the environment level: neglected public spaces, lack of greenery, traffic jams, change of the landscape character</p> <p>On the social level: unemployment, illegal practices due to poverty</p>
<p>Typology of the buildings</p>	<p>Predominantly residential, the neighborhood of Sin EL Fil has a few offices and commercial developments. Additionally, buildings are closely aligned to the streets with (5 to 6 floors). (Mezher, 1999)</p>	<p>Around 63% of the entirety of Achrafieh is considered residential and commercial while 25% of its surface is institutional, 18.24% is commercial, 7% is residential and 1% is for Leisure buildings with 5 to 8 floors in addition to many high-rise buildings (Bizri, 2013)</p>	<p>As underdeveloped buildings with small apartments, (between 60 and 110m²), these apartments either lack balconies or contain small ones with an area of 3 to 5m² (Nahnoo, 2016)</p>
<p>Economical Aspect</p>	<p>The economy of Sin EL Fil relies on the presence of industries, it includes 98 industries (industries, 2017)</p>	<p>Achrafieh has a service-oriented economy with main growth sectors (banking, tourism ...). It constitutes a prime location for investment and tourism (Bizri, 2013)</p>	<p>It is described as a ‘State’ of Destitution, Financial Reliance, and Social Hardships. Within the neighborhood, unemployment is rampant, as bunches of men linger on the roadsides while others ride their motorbike (Nahnoo, 2016)</p>




6. Methodology

The methodology used in this project is based on the comparative study between three different sites. The sites have different architectural typologies, as well as different social and economic status. In addition, each site is either residential or commercial.

Why a comparative method?

We have chosen a comparative method to show that our approach can be applied to different typologies.

Table 3: Showing the methodology of the study

Methods used in the project	
<p>Case studies: Two case studies were chosen to help in developing a design that fits the case of Lebanon. In the first case study of the buildings with no balconies, a team from New Zealand initiated a new design (prefabricated module) that can be added to the building forming a plant room (Meinhold, 2010). In the other case study, the buildings would be transformed into vertical forests through cultivating the balconies like in the case of Bosco verticale (Elena Giacomello, 2015).</p>	
<p>Collection of Data</p> <p>Maps of the sites from the municipalities. See the figures in the right-side column. The maps are edited by the author to show the actual state of each site</p>	 <p>Fig. 17: Figures showing the actual state of the sites</p>
<p>Site visits (taking pictures of the sites and conducting interviews). Collecting more information about the history of the site and the impact of urbanization on different aspects. Check the figures in the right-side column</p>	 <p>Fig. 18: Photos showing the selected sites</p>
<p>Google maps to determine the location of each site and the green spaces that are still present and compare with previous photos to show the impact of urbanization on the depletion of green spaces. Check the figure on the right showing the depletion of green spaces</p>	 <p>Fig. 19: Google maps time line showing the urbanization of tarik el jdideh</p>
<p>A survey was only carried out in one site (Tamlis)</p> <p>It was done on a sample of 60 people</p> <p>The aim of the survey was to analyze the impact of urbanization, and the absence of green space on people</p> <p>To determine the different usages of balconies</p> <p>To see what type of plantations people prefer in this area</p> <p>Due to lack of accessibility to the buildings of Sama Beirut and Factory 437, surveys were not done for these selected sites</p> <p>Interviews were held with architects and designers from the Order of Engineers and Architects in Lebanon</p> <p>To see the impact of such new architectural typologies on the ecosystem and the landscape character</p>	

7. Concept of the Design

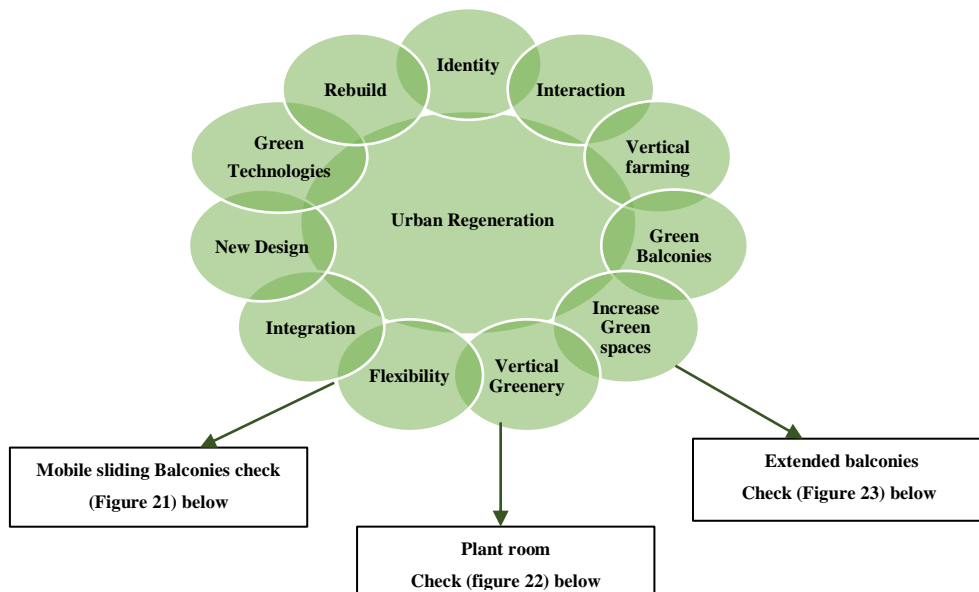


Fig. 20: Diagram showing the main factors that led to the concept

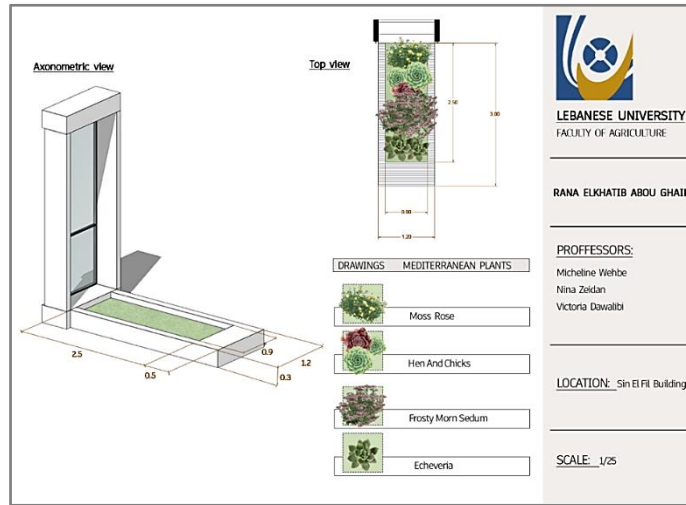


Fig. 21: Sliding Balconies

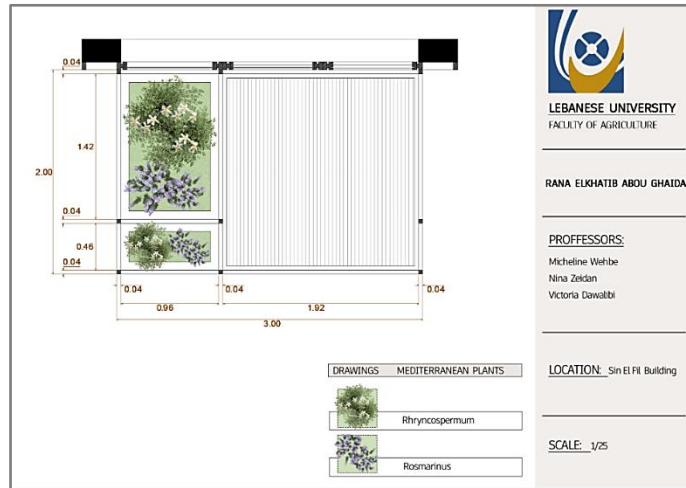


Fig. 22: Plant room

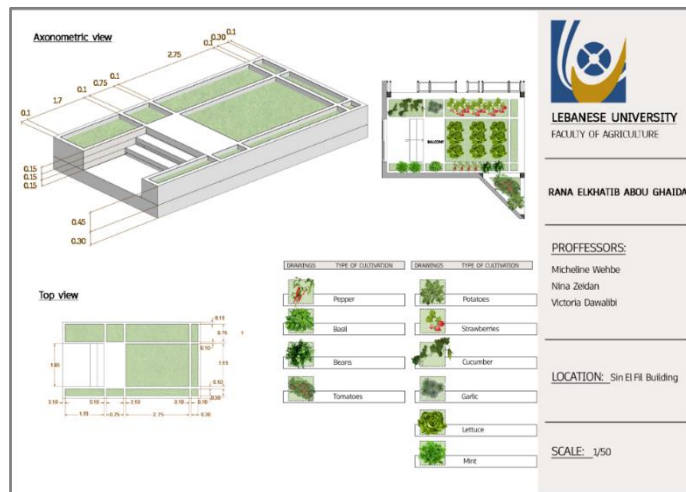


Fig. 23: Extended balconies

8. Intervention

Based on the surveys that were carried, and the analysis of the socio-economical level of each neighborhood. We came up with three solutions.

The survey was done in Tamlis-Tarik Jdideh on field and in paper form. There were (60 respondents) that answered 20 questions, regarding the impact of depletion of green spaces.

Results of the survey:

1. Social Level: The residents of Tamlis lack the knowledge regarding the importance of greenery. The population lives in an open neighborhood, where everyone knows each other.
2. Economic level: Most of the population residing in Tamlis are either unemployed or own low wage trade.
3. Typology: The buildings are underdeveloped with small apartments of area (between 60 and 110m²), these apartments lack balconies or contain balconies of area (3-5m²).

On the other sites, interviews were held with professional architects to analyze the problems of the newly adopted buildings and to see the possibility of implementing new designs. In this study, we wanted to introduce new type of green technologies that are mainly dependent on the presence of balconies. Due to the fact that some buildings in Lebanon have no balconies; the solution was to add plant rooms and to meet the sustainable measures in terms of material used, types of vegetation and their impact on environment, society and economy.

9. Actual State of the Three Sites



Fig 24: Showing actual state of Sin El fil



Fig. 25: Showing actual state of Sodeco Square- Achrafieh

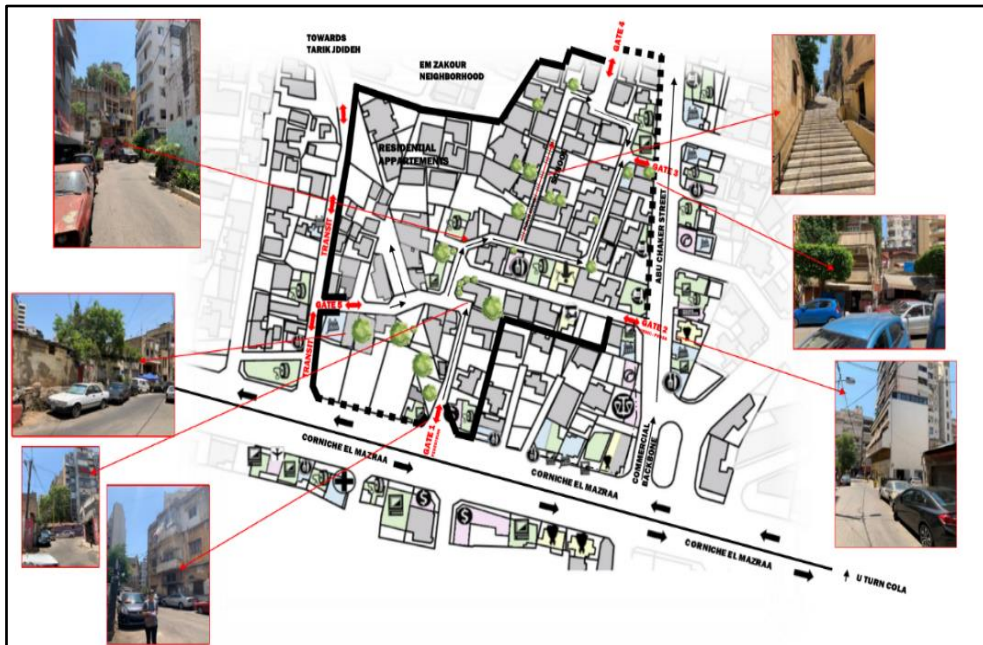




Fig. 26: Showing the Actual state of Tamlis Tarik Jdideh

9.1. Factory 4376 Building

For the first site, we suggested a module made of iron structure. This module was designed by Mediterranean vegetation; check Table 4, in order to retrieve the feeling of the village and reduce the impact of urbanization in appearance.

Table 4: Represents the plants used in Sin El Fil building

Type of Plant	Image
Romarin	 <p data-bbox="927 479 1114 510">Fig. 27: Romarain</p>
Rinchospermum	 <p data-bbox="896 725 1144 757">Fig. 28: Rinchospermum</p>

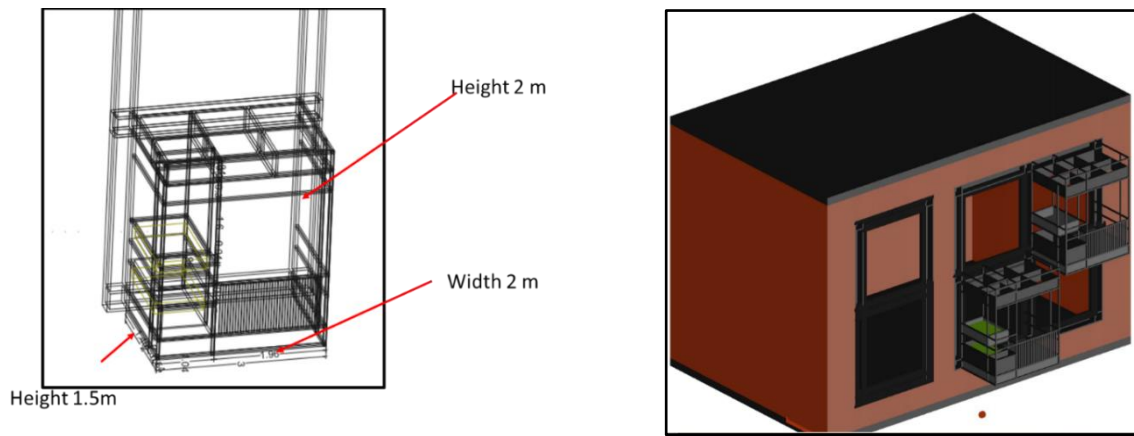


Fig. 29: The design of the module



Fig. 30: Factory 4376 Building Before intervention






Fig. 31: Factory 4376 Building after intervention

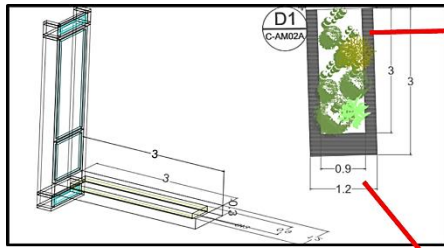
9.2. Sama Beirut Achrafieh

The second selection was a modern high-rise building made of glass facade with no balconies, the solution that was suggested in the first site (ironic module) cannot be used in this type of building. So, we recommended installing sliding balconies that can be used as an indoor and outdoor design, with succulent plantations; see Table 5, that need minimal care and have an urban appearance.

This intervention will be mainly done on one facade of the building to offer the best sun and ventilation conditions for the vegetables to grow. It will also reduce the effect of heat retention in such types and add life to the building

Table 5: Shows the plants selected for Sama Beirut building

Type of Plant	
Moss Rose	 <p>Fig. 32: Moss rose</p>
Echeveria	 <p>Fig. 33: Echeveria</p>
Frosty morn (sedum)	 <p>Fig. 34: Frosty morn</p>



Sliding metallic structure with aluminum pots, cultivated with succulents that grow (maximum 50cm in height) and need minimal requirements, they can overstand dry weather and low water consumption.

Width 0.9 m

Fig. 35: Module of the design case Sama Beirut

Table 6: Sustainable Materials used in the three sites




Materials	
Fiberglass pots	 <p>Fig. 36: Fiberglass pot source</p>
Aluminum pots	 <p>Fig. 37: Aluminum pots</p>
Metallic structure	 <p>Fig. 38: Metallic structure</p>



Fig. 39: Sama Beirut before intervention



Fig. 40: Sama Beirut after intervention

9.3. Tamlis-Tarik el Jdideh

We have chosen a building located in al- Tamlis (Tamlis is a suburb in Tarik Jdideh), Tarik Jdideh. Tarik Jdideh previously had a different landscape; it was known for its agricultural character, after urbanization this has changed drastically.

The selection of this building was mainly to show that our intervention could be applied to any building type.



Fig. 41: Showing the building in Tamlis











Fig. 42: Showing Selected building in Tamlis

At the environmental level: adding greenery and limiting the risk of degradation of green spaces.
 At the social level: finding specific types of plantations that suit the social profile of the area.

After the survey that was carried out in the field, it showed that people lack the knowledge of the risk of urbanization, and the new techniques that are used in cultivation and that they are interested in cultivation of vegetables, fruits and herbs (See Figure 45).

-Plant Selection

Table 7: Illustrating the vegetables and fruits used in Al-Tamlis project

Plant type	Latin name	Type of Cultivation	Season	Image
Tomato	<i>Lycopersicon esculentum</i>	Straw Bale/ container gardening	July August September October	
Cucumber	<i>Cucumis</i>	Cultivation of cucumber on a thrill	June July August September October	
Potatoes	<i>Solanum tuberosum</i>	Straw bale gardening	July August September October	
Strawberries	<i>Fragaria x ananassa</i>	Straw Bale/ container gardening	June July August	
Mint	<i>Mentha herb</i>	Container gardening		
Peppers	<i>Capsicum annum</i>	Straw Bale/ container gardening	June July August September October	
Lettuce	<i>Lactuca</i>	Straw Bale/ container gardening	June July August September October	
Garlic	<i>Allium sativum</i>	Straw Bale/ container gardening	July August September October	
Basil	<i>Ocimum basilicum</i>	Straw Bale/ container gardening	Annual Herb	
Beans	<i>Phaseolu vulgaris</i>	Straw Bale/ container gardening	June July August September October	

The buildings in this area were mainly old that need restructuring, so we suggested installing balcony extensions that are made of iron, that can strengthen the buildings' foundations and provide a space for cultivation, also improving the aesthetic appearance of buildings.



Fig. 42: Photo showing Al-Tamlis building before intervention



Fig. 43: Photo showing Al-Tamlis building after intervention



Fig. 44: Photo showing Al-Tamlis building after intervention

10. Potential Benefits of Green Balconies

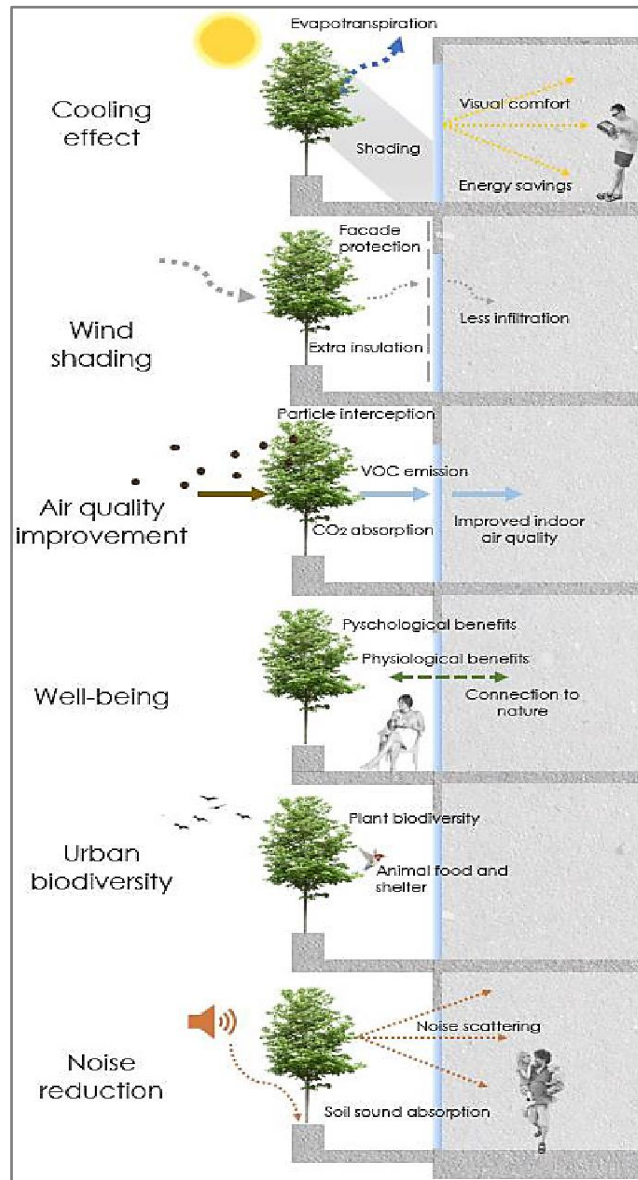


Fig. 45: Potential Benefits of Green Balconies (Marugg, 2018).

11. Conclusion

In this study, a new concept has been proposed relying on the interaction between economic, environmental and societal factors, aiming to help in increasing green spaces, to overcome the depletion of greenery in Beirut. The paper showed that these technologies could be implemented in buildings of different architectural typologies and socio-economic backgrounds. Three designs (Sama Beirut, sliding balconies), (Sin EL Fil clipped modules) and (Al Tamlis, extended balconies), were illustrated to provide practical solutions but some limitations were foreseen.

These limitations are mainly related to the cost of design, the architectural typology of some buildings, lack of awareness of the importance of this new concept, and the selection of suitable vegetation.

In conclusion, challenges might emerge while planning a healthy and comfortable environment in the context of sustainability.

Cities are affected by heat intensity, air pollution and traffic noise. Green balconies have the potential of addressing these problems by improving the local microclimate and creating a healthier living environment.

Acknowledgments:

We thank, Dr. Joseph B. Majdalani and the Architect Haifa El Arab for their advices, feedback and support.

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