

# Residents' Perceptions towards the Application of Vertical Landscape in Cairo, Egypt

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**Abstract**—Vertical landscape is introduced in this study as an alternative innovative technology for urban sustainable developments for its diverse environmental, economic, and psycho-social advantages. The main aim is to investigate the social acceptance of vertical landscape in Cairo, Egypt. The study objectives were to explore the perceptions of residents concerning this certain phenomenon and their opinions about its implementation. Survey questionnaires were administrated to 60 male and female residents from the Greater Cairo area. Despite the various concerns expressed about the application of vertical landscape, there was a clear majority of approval about its suitability. This is quite encouraging for the prospect of vertical landscape implementation in Cairo, Egypt.

**Keywords**—Vertical landscape, green facades, social acceptance, sustainable urban development.

## I. INTRODUCTION

WITH the increased recognition of sustainability, different projects across the world involved vertical landscapes as a new innovation [3], [11]; it was considered as a viable strategy for urban development [10] towards evoking environmental, economic, and psycho-social significance [2], [7], [9], [13], [16]. This leads towards better sustainable urban environments [13]. However, it is not the case in Cairo, Egypt [4], [6]; Cairo needs to use alternative strategies for improving the balance between natural and built environments. This will help reduce the potential impacts of different risks such as global warming, climate change, energy consumption as well as pollution problems; all these potential issues directly affect residents' health and their quality of life [5], [14].

Vertical landscapes are the growing of plants to cover vertical structures, in which plants are attached directly to the building surface or indirectly on a designed structure attached to the building facade [13]. However, concerning damaging the outer surface of the building structure, direct greening is considered the most dangerous and not preferred system that affects the building envelope and can easily transfer moisture to the building surface. Accordingly, all technological projects and innovations in Europe and North America have used indirect vertical landscape systems [7] where the building will gain all potentials of the green areas on its surfaces, without any damage on the building envelope. Indirect vertical landscapes can be simple or complex according to the chosen system, it is generally consisting of two general classifications:

1- Green screens: are plants climbing on a special designed

structure. Roots of the plants could be down on earth or on the roof where plants descend from the top [16]. There are three types of green screens: Cable trellis system, wire-rope mesh system and modular trellis system [7], [12], [13], [16].

2- Living walls which consist of pre-vegetated panel or planted blankets that are fixed vertically on the building facade. Living walls allow for a great diversity and density of plant species and require more intensive maintenance than green screens [1], [7], [12], [15], [16]. Based upon research studies and literature reviews, there are three main systems that lay under living walls [7], [13], [16]: Panel system, container system and felt systems.



Fig. 1 Randomly selected buildings showing residents' intention in adding elevated planters and direct climbers on their facades, Heliopolis and New Cairo Areas, Cairo, Egypt

The aim of this study is to provide guidance for future efforts to promote and apply the vertical landscape strategy in Cairo city. The main objective of this study is to discuss the prior knowledge of residents towards vertical landscape phenomena, in addition, their perception and acceptance of the implementation, the potential concerns towards the application

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for their own point of view and the factors affecting the implementation in Cairo, Egypt.

Primary observations in Cairo neighborhoods showed preliminary evidence that some vertical landscape are part of Cairo residents' architectural patterns in an indirect way; some residents use direct climbers to the building surface and other use green screens especially cable system, and simple elevated planters (container system) were installed on balconies and façades of residential buildings (see Fig. 1). Yet their awareness and approval of vertical landscape different systems, and their social acceptance for it to develop in many directions is yet to be investigated.

Consequently, this paper is presenting an empirical research study that discusses vertical landscape perceptions among residents and their opinions towards their potential concerns. This is due to the importance of investigation the social acceptance of new techniques.

## II. METHODS

In terms of quantitative data analysis, descriptive statistics (using SPSS) were used to present the data through column graphs. A survey was used through analytical questions concerning perceptions and social acceptance of residents, sixty random residents volunteered to participate in the study. And in order to help them gain a general understanding of the phenomena, colored photographs were shown to them before running the questionnaires. The participants were asked to answer questions that aim to assess the social acceptance of VG Implementation, their common concerns toward the system and the main factors affecting VG in Cairo. The questionnaire was designed into two main parts. The first part (*the analytical survey*) assesses participants' prior knowledge towards vertical landscape, their perception towards implementing the application in Cairo and the common concerns toward its appropriation from their own point of view. The second part (*personal information*) was for setting the sample distribution. There was no interaction between participants; the questionnaire process was individually practiced.

TABLE I  
 SAMPLE DISTRIBUTION

		Number of Participants	Percentage of Participants
Age	Below 20	5	8
	From 21 to 29	30	48
	from 30 to 40	15	24
	Above 40	13	20
Education Level	School	1	2
	College degree	40	63
	Post graduate	18	29
	Other	4	6
Gender	Male	27	43
	Female	36	57

Snowballing sampling approach was used during the selection of participants [8]. The respondents included 60 residents with middle and high middle income with minimum

school degree. They varied according to age and gender distribution (43% males and 57% females). Some participants were of ages below 20 (= 5.80%), some were between 21 and 29 years old (= 30.48%), some were between 30 and 40 (= 15.24%) while others were above 40 years old (= 13.20%), as shown in Table I.

## III. RESULTS

### A. Prior Knowledge about Vertical Landscape

The purposes of these questions were to discover how many individuals are familiar or had prior knowledge of vertical greening. Such knowledge might impact what benefits and concerns they listed and whether they agreed with having a vertical landscape on building facades in general. This question would also provide insight on the importance of the educational benefits of vertical greening in Cairo.

TABLE II  
 RESIDENTS' PRIOR KNOWLEDGE TOWARD VERTICAL LANDSCAPE-FREQUENCY DISTRIBUTION

	Residents' Responses	Number of Participants	Percentage of Participants
Residents' Prior Knowledge	Yes	27	45%
	No	33	55%
	Total	60	100%

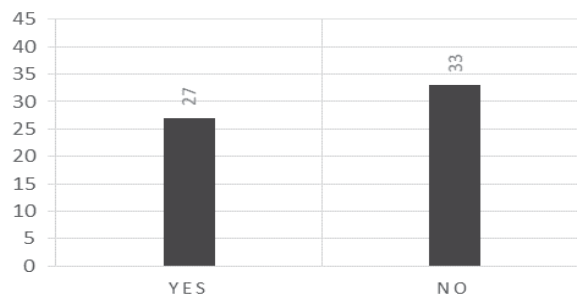


Fig. 2 Prior knowledge toward VGS- Frequency distribution

As shown in Table II and Fig. 2, more than half of population was not familiar with vertical landscape (= 33.55%). This clarifies the residents' relative lack of awareness concerning vertical landscape in Cairo.

### B. Preferences of Implementation of Vertical Landscape

The preferences of implementation of vertical landscape question were chosen to determine the overall opinion of residents on vertical landscape implementation. This question thus paralleled this study's overall objective of determining the feasibility of constructing vertical landscape in Cairo.

A relatively high percentage of residents (=39.65%) agreed with having vertical landscape on their own apartment buildings or houses. 10 of the respondents did not know (=10.17%) and 11 opposed of having vertical landscape (=11, 18%) (Table III and Fig. 2). Clearly then, the vast majority of residents are in support of implementing vertical landscape, lending strong weight to the argument that it could be installed. Moreover, Table IV reveals that there is a fairly consistent level

of agreements and disagreements with the opinions of having vertical landscape regardless of the familiarity (of agreed residents, 37% have prior knowledge and 28% do not), which are the majority of population concerning both sides of the table. This shows that residents' preferences to vertical landscape installation does not relate to their familiarity to the system.

TABLE III  
RESIDENTS' PREFERENCES TOWARDS VERTICAL LANDSCAPE IMPLEMENTATION- FREQUENCY DISTRIBUTION

Residents' Responses	Number of Participants	Percentage of Participants
Yes	39	65 %
I don't Know	10	17 %
No	11	18 %
Total	60	100

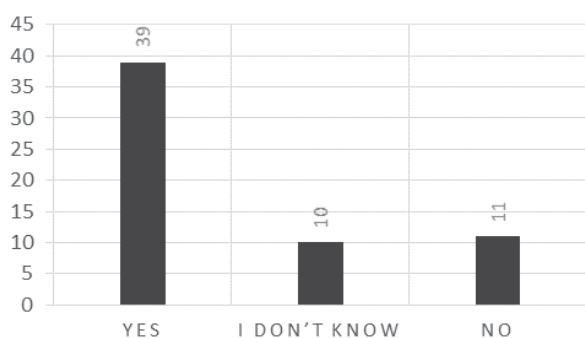


Fig. 3 Preferences towards VGS implementation- Frequency distribution

TABLE VI  
RESIDENTS' PRIOR KNOWLEDGE IN RELATION WITH PREFERENCES OF IMPLEMENTATION- FREQUENCY DISTRIBUTION

Prior Knowledge		Yes	Don't know	No	Total
		Yes	37 %	3 %	5 %
No	28 %	13 %	13 %	55 %	
Total	65 %	17 %	18 %	100 %	

### C. Response to Concerns and Issues towards Vertical Greening

Residents' were asked to state their concerns towards vertical landscape installation, no choices were given in order to avoid biasing the respondent's answers. Results revealed that although residents' majority was in favor of vertical greening acceptance as a potential solution for a better Cairo, yet there were many concerns toward the appropriation.

Results showed that the main concerns were about the "needed maintenance" "presence of insects", "installation costs" and "irrigation". Other concerns were stated as "the lack of technical understanding", "plant selections and orientation", "falling of leaves", "soil stabilization" and "impact on building envelope". These answers reflect residents' worries about the application of vertical landscape in Cairo, Egypt from the technical and economic aspects. Results were related to the results of prior knowledge and preferences of implementation through cross tabulation. This was to explore a deeper

understanding to residents' concerns towards vertical landscape.

TABLE V  
RESIDENTS' PRIOR KNOWLEDGE ABOUT VG IN RELATION TO CONCERNS- PERCENTAGE DISTRIBUTION OF TOTAL CONCERNS

Concerns	Prior knowledge		Total
	yes	no	
Needed maintenance	13 %	16 %	28 %
Presence of Insects	7 %	11 %	18 %
Installation costs	6 %	8 %	14 %
Irrigation	6 %	8 %	14 %
Presence of dirt	4 %	4 %	9 %
Lack of technical understanding	1 %	4 %	5 %
Plant selection	1 %	4 %	5 %
Public approval	1 %	4 %	5 %
Orientation of vertical landscape	3 %	1 %	4 %
Falling of leaves in autumn	1 %	1 %	1 %
Soil stabilization	0 %	1 %	1 %
Impact on building envelope	0 %	1 %	1 %
Total	45 %	55 %	100

Results demonstrate (as shown in Table V) that most of respondents who had concerns with insects, irrigation, installation cost and other issues had no prior familiarity of vertical landscape. The only concern found to be relatively high among those who had prior knowledge was the *maintenance and presence of insects*. These respondents may have had prior contact with a vertical landscape where they noticed the continuous care needed. Also, it was shown that the majority of those who had these concerns (especially who had concerns with insects, irrigation, maintenance, selection and survival of plants and costs) agreed with having vertical landscape, as shown in Table VI. This clarifies residents' majority agreement of vertical landscape implementation yet they have concerns regarding the application. Results also in Table VI reveals that the majority of concerns were from residents who have not had prior knowledge of vertical landscape.

TABLE VI  
RESIDENTS' PREFERENCES OF IMPLEMENTATION IN RELATION WITH OPINION TOWARDS VERTICAL LANDSCAPE CONCERNS- PERCENTAGE DISTRIBUTION OF TOTAL CONCERNS

Concerns	Preferences of implementing VGS			Total
	yes	Don't know	no	
Needed maintenance	17 %	6 %	5 %	28 %
Presence of Insects	9 %	3 %	6 %	18 %
Installation costs	11 %	2 %	2 %	15 %
Irrigation	9 %	2 %	1 %	11 %
Presence of dirt	4 %	1 %	3 %	9 %
Lack of technical understanding	3 %	1 %	1 %	5 %
Plant selection	3 %	0 %	0 %	4 %
Public approval	4 %	1 %	0 %	4 %
Orientation of vertical landscape	4 %	0 %	0 %	4 %
Falling of leaves in autumn	1 %	0 %	0 %	1 %
Soil stabilization	1 %	0 %	0 %	1 %
Impact on building envelope	0 %	1 %	0 %	1 %
Total	65 %	17 %	18 %	100

#### D. Opinions about Forces and Criteria Affecting Vertical Landscape

The purpose of this question was to identify residents' opinions towards the most affecting factors of vertical landscape installation in Cairo. Residents were asked to arrange three factors: 1) Economic cost, 2) aesthetic qualities and 3) maintenance and care (where 1 is the most affecting factor and 3 is the least).

TABLE VII  
 RESIDENTS' OPINIONS ABOUT FORCES AND CRITERIA AFFECTING VERTICAL LANDSCAPE IN CAIRO, EGYPT – MEAN RATINGS

Forces and Criteria	Mean Ratings
Maintenance and Care	2.05
Beauty and attractiveness	2.00
Economic Cost	1.95

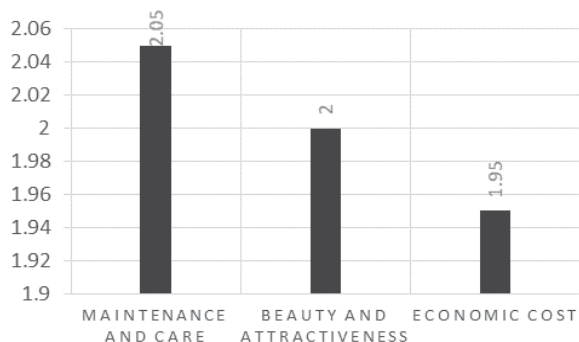


Fig. 4 Opinions about forces and criteria affecting VG – Mean Ratings

The survey results (as shown in Table VII and Fig. 4) showed that the most important factor (Mean ratings= 2.05), second was “the beauty and attractiveness” (Mean ratings= 2.00) and least was the economic cost (Mean ratings= 1.94). This also reflects residents' concerns towards vertical landscape maintenance, in addition to the importance of its aesthetic quality for the application in Cairo, Egypt.

#### IV. CONCLUSION

Findings of this paper clarified that the vast majority of residents were in support of Vertical landscape, lending strong weight to the argument that it could be installed. However, they have concerns regarding the application.

Result also showed that the majority of concerns were from residents who have not had prior knowledge of Vertical landscape, and most of those respondents had concerns with insects, Irrigation, maintenance, cost and other issues. The main concern found to be higher among those who had prior knowledge was the maintenance. These respondents may have had prior contact with a vertical landscape where they noticed the continuous care was needed. Moreover, results showed that residents' majority who agreed with having Vertical landscape are of nearly equal percentages to those who have prior knowledge of Vertical landscape. The higher majority of residents who disagreed or weren't sure concerning Vertical landscape implementation had no prior knowledge of vertical landscape.

Findings revealed that residents' acceptance to vertical landscape is related to their familiarity of the system which encourages a public awareness concerning vertical landscape in Cairo, this is to improve the Social acceptance by Proposing Education Awareness Programs.

Since the majority of concerns were mainly over the maintenance and installation of vertical landscape on building surfaces in Cairo. Therefore, it is essential to put in mind all aspects of installation concerning the appropriation in Cairo. Accordingly, various options are recommended in terms of maintenance as presenting set of guidelines to help explain the process of installation and installments, the economic feasibility, and maintenance issues and care programs, as well as presenting lists of possible suppliers and installers that could be contacted for application in the area. in addition to encouraging an agreement with companies or institutes that aim for achieving sustainability to commit to the maintenance of plants and the entire vertical landscape installation on buildings. This could help to alleviate some of these concerns.

This study showed residents' majority agreement of vertical landscape appropriation, despite their concerns. This suggests that, for most participants, the perceived potentials of Vertical landscape could outweigh the concerns about its implementation. These findings support the applicability of vertical landscape in Cairo, Egypt, which will consequently lead to a better sustainable environment in Cairo, Egypt with multiple environmental, economic, and psycho-social benefits for a better quality of life for residents.

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