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The Assessment of Residents' Perception of Possible Benefits and Challenges of Home Vertical Gardens in Kigali, Rwanda

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Abstract: This paper aimed to provide a new insight into the application of home vertical gardens in Kigali, the capital of Rwanda, through a pre-assessment of the inhabitants' perceptions. There are several studies that indicated the awareness of the way residents think about the potential benefits and challenges of home gardens could make a considerable difference in designing and implementing these gardens. The Likert-scaled questionnaire (n = 558) was employed to evaluate how residents perceive vertical gardens, and what issues concern them most. The findings revealed that dwellers are almost familiar with the vertical garden concept and its possible effects on urban environments. The respondents mostly regarded vertical gardens as nice spots to socialize, relax, and interact with nature, and an opportunity for beautification, and recreation by growing ornamental and edible plants. However, they were rather apprehensive about some issues, more importantly, the extra expenses, the complicated operation and maintenance, and the type of structure installed on walls. In conclusion, small-scale and low-cost vertical gardens with lightweight structures and easy-to-use technologies are more likely to encourage householders to embrace home gardens. It is recommended that the vertical garden projects should be integrated into the urban green network strategy, leading to facilitating the processes of decision-making and financing.

Keywords: residents' perception; vertical gardens; climate; landscape; Kigali

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1. Introduction

While global warming, climate change, and urban resiliency are the key issues of urban life in recent years, several studies argued that even small green spaces such as kitchen gardens [1], living walls [2], roof gardens [3], vertical gardens [4], and green courtyards could positively affect the global issues at macro level [5]. As many parts of the world have encountered rapid urbanization and concerns about urban sustainability, it is thought that residents should be encouraged to take measures, like home (vertical) gardens, to mitigate environmental problems [6]. In addition, the psychological factors of home-based green spaces such as physical health [7], mental health [8], users' mood [9], positive memory about location [10], the relief of stress [11], sense of belonging [12], and aesthetic and beautification [13] are regarded as benefits of kitchen and vertical gardens on small scales.

Vertical gardens and living walls were discussed widely based on the application on facade, roof, and floor structures [14] to maximize the use of spaces for growing plants [15] with effects on food circulation [16], cooling of cities, and framing up in the cities [17]. From a wide perspective, not only the green aspects of landscape design include benefits for users [18,19] but also the buildings benefit from green spaces such as decreased temperatures, improved cooling, and reduced albedo effect [5,20]. In addition, some studies

listed other aspects of the benefits of green and natural elements on social interaction, well-being, and community quality [21,22]. For example, Miller [23] revealed that rich green areas could reduce the level of social disturbance and increase resiliency in unexpected situations in cities [24]. Nonetheless, a major part of the studies took place in developed countries [18,25].

While the major parts of the studies took place in the formal landscapes in recent years that were registered in terms of public spaces such as parks, open spaces, and natural resources [21], the evidence showed that informal and small green spaces such as vertical gardens, kitchen gardens, decorative plants, follower boxes [26], and native plants [27] include benefits for social interactions even in temporal forms [4]. As a piece of evidence, Tafahomi [18] highlighted that both private and public landscapes contribute to the urban temperature and cooling of the buildings in three different layers, including green spaces in courtyards, trees in liner forms alongside streets to provide shading for buildings, and the climber vines and shrubs to cover walls.

While the development of urban landscapes was recommended widely by urban development documents [28–30], the implementation and application in small scales, particularly households, faced challenges due to the absence of clear guidelines [18,31]. In fact, on the one hand, the development of urban landscapes failed due to the low level of knowledge about arboriculture to reduce the urban landscape into wood trees [32–34]. On the other hand, the small-scale gardens have been integrated into the ethno-botanical aspects of society [18] and socio-ecological interaction along the time [35], which resulted in gaps between inhabitants and natural environment [12] that have reduced gardens globally in a household scale. This problem of the application of landscape on a household scale was mentioned in terms of "cultural landscape" [36]. The cultural landscape reveals the level of interest and passion among inhabitants to apply, maintain, and even invest in home scale landscapes such as vertical gardens.

The problems of this research are elaborated in the way that inhabitants use gardens as a portion of the land on the ground, which, in congested areas, gardens are replaced with hardscapes such as parking and paved courtyards for daily activities. However, vertical garden concepts reduce dependency on the soil of the land and the portion of the plot for growing plants. Analyzing the opinions of inhabitants in cities through questionnaires and interviews has led both researchers and urban managers to deal with urban green spaces on different scales [25,37]. For this reason, exploring the ideas of the inhabitants about vertical gardens and their beliefs on this topic have been one of the trends in studies in many countries [38] due to the changing process of lived experience inhabitants and relationships between people, plants, and location [18]. Therefore, the research questions are formulated as:

What kinds of green spaces do the inhabitants prefer to use in vertical gardens?

What are the opinions of the inhabitants about the effects of vertical gardens on the city climate?

What are the inhabitants' concerns about the possible risks of implementing vertical gardens?

Regarding the research problems and questions, the main objective of this research was to discover the opinions of the inhabitants in Kigali about the potential benefits and challenges of home vertical gardens to improve green landscape, and therefore the quality of urban life. This was based on a systematic survey [18,25,37] to facilitate the implementation of urban landscape at micro level [25]. The city was originally located in a forest area with a tropical climate, however, rapid urbanization, new development, and unplanned settlements have gradually changed the forest into an urban fabric, and the hardscape in houses developed as a fashion [39]. To explore the research questions and objectives about vertical gardens and their effects on the quality of life in both households and urban areas, this research began with a literature review, followed with designing questionnaire, and analyzing the collected data to highlight the findings, discussion, conclusion, and recommendations.

2. Vertical Gardens and Opinions of Inhabitants

From an ontological perspective, gardens were the first attempt of inhabitants to bring the forest into order for fruit production [1,40] as a primitive aspect of horticulture. Tzoulas [41] highlighted kitchen gardens, courtyards, and house greenery as a significant part of the urban green infrastructure to contribute the climate stabilization of cities. While the classification did not present any specific scale or quality, it can be assumed that all categorical gardens in houses could be part of the urban ecosystem to create urban green infrastructure [38] that supports the ecosystem and biodiversity in cities [42].

Vertical gardens in the field of landscape design are classified into two general categories, including vertical gardens and living walls [43,44]. The vertical gardens include specific structures such as flower boxes, roof gardens, and green terraces that can be used as containers for the plants to keep them independent from the ground for growing [2,45,46]. The living walls refer to the vine's structure with a direct connection to the ground for nutrition. The plants on the living walls could be hosted by the walls directly or indirectly through supportive structures such as fences, wires, and scaffolders [47]. Loh [48] showed some examples of the application of both living walls and vertical gardens in indoor and outdoor spaces through panel, flat, and container systems. Nonetheless, the living walls with the climber vines are common to observe in urban areas due to the low maintenance costs. In addition, the study highlighted the application of living walls in Kigali based on the covering fences and walls for more privacy and a reference point for the area of the land [39].

The living wall could extend and expand over the walls, fences, and buildings due to the stems of plants and connection to the ground based on the growing system of the climber plants [18]. However, the growth of plants in vertical gardens is limited to the size of the containers due to the specification of soils, water, and plants. Despite the limitations of applying vertical gardens in homes due to the structure, maintenance, and the size of growth, a variety of vertical garden concepts could be observed in the household scales due to the culture and context [4]. The report highlighted that the landscape in different locations is constructed based on the cultural factors among inhabitants over time [49]. This transformation of the urban landscape referred to the socio-economic aspects in developing countries to modify the spaces for the new generations [39]. Through this process, people change the urban elements and functions to adapt the urban environment to their needs [50].

There are differentiations between the vertical garden concept in terms of household scale for self-consumption and urban farming concerning urban agriculture and food production through industrialization and commercial activities [4,17]. Urban farming refers to the new technology conceptualized to answer food production in urban metropolitan areas through the construction of multistory buildings for mechanized farming on large scales [16,17]. While the urban farming concept attempts to solve the food shortage, climate change, and water systems in urban areas, green walls and vertical gardens support food production for self-consumption, beautification, the creation of hangout spots, and increasing interaction with nature on a small scale [18,28,51].

The studies revealed the clusters of benefits for vertical gardens and green spaces in urban areas. For example, there is a set of studies on individuals that focused on the benefits to humans and users such as the improvement of mental and physical health and overall well-being [7,9,11,52]. The second cluster referred to the beautification, sense of place, connection to the location, and cultural values [12,19,25,26,37,53]. The third cluster is concerned with climate change, urban environment, and urbanization levels [21,25,30,54–56]. The fourth cluster mentioned the food support system through urban gardening and farming [4,14,17]. In addition, another group of studies preferred to classify the benefits of urban green into environmental, economic, and social [57], which are more dimensional categories than thematic ones.

To achieve the benefits, the residents' awareness of home vertical gardens is of a great importance. Filor [58] argued that a developed landscape could represent the concerns of

inhabitants about the landscape. However, people might perceive landscapes in various ways, so there are differences and even gaps in the official recommendations and applications in urban environments [59]. These gaps could result in passivity among dwellers in regard to developing landscapes [18], which would reveal a contradiction between socio-culture and built environment policies, and actions [60]. Nonetheless, Barker [61] stated that culture includes a wide range of meanings, even contradictive ones. Culture is under reconstruction based on the daily activities of inhabitants [62]. For this reason, a new terminology of culture refers to the "mapping of meanings" [61], p. 87. It refers to the perspective of the user to interpret and apply vertical gardens. For example, Coupaye [12] highlighted that users make assumptions about the patterns of vertical gardens due to the behaviors of plants. Moreover, the study mentioned that the level of anthropological relationships between users and plants on a small scale, like home gardens, was higher than it was in urban farms. In this regard, many factors influence the opinions of users to select plants for planning, cultivation, and application in vertical gardens due to social, cultural, and anthropological aspects depending on time and location [12]. This background constructed symbolic meanings for plants in different cultures due to lived experiences based on beliefs and customs [40] and even mythology [63].

However, there are concerns about possible challenges, cost-benefit considerations, and motivations to implement home gardening such as vertical gardens [64]. Despite the increasing value of properties with green spaces [65,66], some issues are considered to discourage dwellers to develop home vertical gardens, such as knowledge, costs, and maintenance [25]. For example, Zahir [67] discussed that limited knowledge of practical issues, particularly the technical aspects of implementation, deters residents from the application of vertical gardens [68]. Another study in Cyprus indicated that economic and technological complications posed barriers in relation to embracing the concept of home vertical gardens by inhabitants [69].

In summary, vertical garden concepts and ideas are a reaction to the limited land in the houses due to the congestion and density in the urban areas that need to be advertised and celebrated. Benefits of the vertical gardens include psychological aspects (relaxation, view of green spaces, and places to sit), health qualities (mental, physical, and interpersonal), visual qualities (aesthetics and beautifulness), food production (fruits, vegetables, and herbs), environmental qualities (air quality, cooling, and biodiversity). On the opposite side, there are some concerns about vertical gardens, especially the concept of vertical gardens (living walls versus vertical gardens), technical issues (structure, construction, maintenance), and budget (cost of construction and maintenance). Table 1 presents the detailed aspects of vertical gardens. To discover the level of awareness and concerns of the inhabitants in Kigali city, the research methodology is discussed in the following section.

Table 1. The key criteria for the vertical garden concepts.

Concepts	Topics	Examples	References
Purpose-based	Psychological aspects	Relaxation View of the green Place to sit	[5,7–11,18–20,23,24,31,37,53,59–62,70]
	Health	Mental health Physical health Interpersonal health	[5,7,9–11,18–20,37,52,70–73]
	Aesthetics and cultural aspects	Beautification Greenery and nice spot	[1,2,5,7,8,10,13,18,21,22,33,34,36,38,40–42,49,51,58,63,70,74,75]
	Food	Fruits Vegetables Herbs	[1,4–7,10,12,15,18,26,27,31,37,39,49]

Table 1. *Cont.*

Concepts	Topics	Examples	References
General effects	Environment	Green spaces Biodiversity Urban development	[4–6,10,12,16,18,21,22,26–28,30,31,37,39,41,42,44,45,48,50,55,56,70,75–77]
	Climate	Air Temperature Humidity	[3,5,16,18,21,22,28–30,41,43–45,54]
	Landscape	Landscape Gardens	[1,2,4,6,14,27,35,36,39,43,46–48,65–69]
challenges	Technical	Construction Maintenance	[1–3,6,8,12,14,17,32,35,42,43,46,47,51,57,64,65]
	Concerns	Perception about risks	[6,12,14,17,32,35,42,43,46,47,51,57,64,65]
Technology and cost	Structure and Technology	Structure Technology	[1–3,6,8,12,14,17,32,35,42,43,46,47,51,57,64,65]
	Budget	Cost of construction Maintenance	[2,6,14,17,32,35,37,64–66]
Knowledge	Learning	Interest to know Cultural background	[7,9,14,18,21,22,25,30,70,73]

3. Materials and Methods

3.1. Methodology

Questionnaires were applied widely to discover the common understanding, level of satisfaction, and general opinions of users [78,79], such as green infrastructure in cities [80,81] and vertical gardens and living walls [25,38,68]. A major part of the questionnaires applied the Likert scale [82,83] as a tool for analyzing the user's perception in social research [84,85].

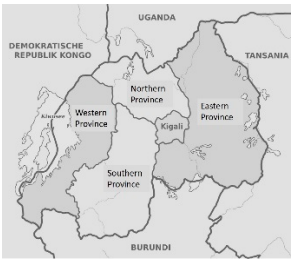
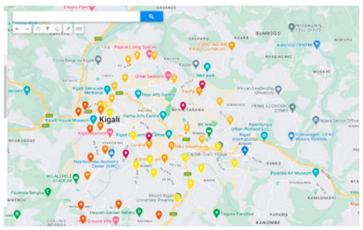
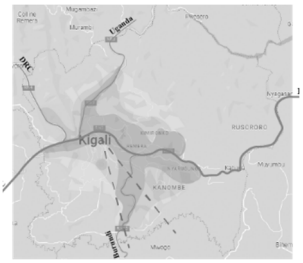
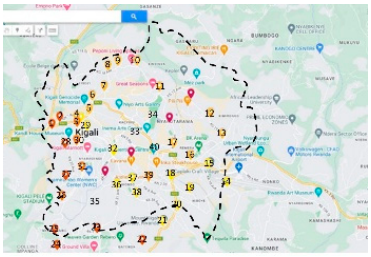
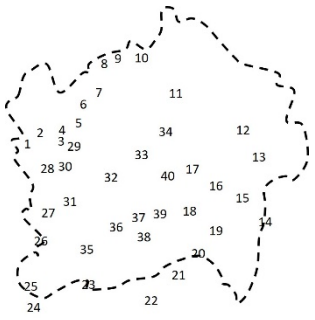
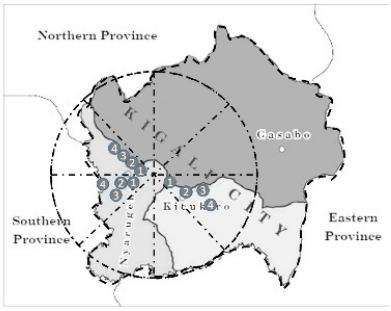
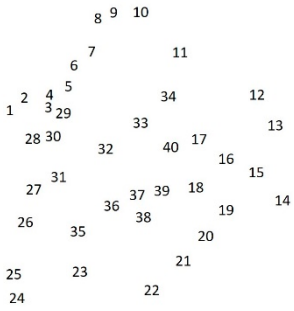
The Likert questionnaire has been applied widely by research to discover perceptions of people about topics, products, lifestyles [79,82], and landscape design [25,86]. The simple arrangement of questions, weights of values, similarity of the structure, and the speed of filling up the questionnaire were mentioned as the key advantages of applying the Likert scales in the research [11,81,82]. In addition, analyzing the results in the Likert scales included some level of interpretation [87,88], particularly in landscape research [89–91].

3.2. Conceptual Framework for Research Design

To evaluate the opinions of the inhabitants about the vertical gardens, a Likert questionnaire in five scales was designed to discover how inhabitants reacted to the questions. The questionnaire was designed to ask the opinions of the users and inhabitants in the city about the application of vertical gardens in their homes to discover their level of concern and knowledge [12,58]. The questionnaire was designed in four main sections. First, there were some introductory questions, including age, gender, education, and occupations of the respondents [78]. Second, two questions were asked to know the respondents' general knowledge about vertical gardens and whether they had applied some forms of home vertical gardens [79]. Third, it was the main body of the questionnaire, arranged in five clusters to discover how participants perceive the purposes of creating vertical gardens [14,39,58,59], the possible challenges/risks for householders [25,67,68], the main effects of vertical gardens on urban environments [21,25,30,54–56], the common interests of residents to learn more about vertical gardens [4,14,57–59], and the preferences or concerns about the technology [2,4,46,47] and costs [64,69] of vertical gardens [25,67,68]. Fourth, as the last part, an open question was put to receive any suggestions and recommendations.

Table 2 presents the locations of the survey across the city.

Table 2. The mapping process of the selected locations to survey.

Description	Map	Description	Map
Adapted Rwanda map		Points on the map	
Development process of the city		Highlighted points on the map and boundary of the city	
Kigali city districts		Inhabitants points and the boundary of the city	
Method: to select critical points for questionnaire in each district of the city		Just points of the questionnaire survey on the city	

3.3. Research Process

The locations of the survey were selected according to boundaries of cells, districts, and main roads in Kigali city (Table 2) to carry out interviews and to fill out the questionnaires. A group of researchers was trained for the survey during three days. The process of training encompassed four aspects: 1. how to approach the respondents, 2. how to start the questioning, 3. how to show the pictures of the vertical gardens to respondents, and 4. how to fill in the questionnaires.

The hard copies of the questionnaires were distributed to conduct a survey of residents in Kigali. Although it was supposed that the survey team would fill out the questionnaires within 11 days, the survey took them around two months. The selection of the respondents was randomly based on the respondents' interest in the research. Therefore, there were some cases that the requests of the survey team were either refused or faced with demand

for compensation by the passersby. The survey team attempted to maintain the gender balance among the respondents, however, this concern was not fully addressed.

In each location, the survey team filled up between 10 and 15 questionnaires, based on an attempt to keep the gender balance in the survey. In total, 558 questionnaires were completed across districts in Kigali. To increase the level of knowledge about vertical gardens among respondents [58,59] some images of living walls and vertical gardens were shared on the cellphones of the survey team members to show the participants (Table 3 shows some of those photos).

Table 3. Images to help the respondents recognize vertical gardens and living walls.

Images for the Application of Vertical Gardens in Kigali	Images for Application of Living Walls in Kigali
	
	

4. Results

To collect a sample of the inhabitants, living in Kigali city, 40 spots were chosen across the city. There was no limitation on gender and age. The sample consisted of 600 residents, however, the completed questionnaires for analysis were 558. The survey took place between December 2022 and January 2023 to discover the opinions of the inhabitants in Kigali city about home vertical gardens. It was after the rainy season, so the survey team had the opportunity to meet participants in public spaces. The fact is that the survey was carried out outdoors. The collected data were analyzed through SPSS version 26, and arranged in two parts, namely general information and the perception of participants of vertical gardens.

4.1. Information of Participants

This section shows the general information of the respondents, including gender, age, education, and occupation. According to the Table 4, females made up a larger proportion of the participants (just over 60%).

Table 4. Gender.

Title	Frequency	Percent	Valid Percent	Cumulative Percent
Male	222	39.8	39.8	39.8
Female	336	60.2	60.2	100.0
Total	558	100.0	100.0	

Most of the respondents were middle-aged between 29 and 42 years old, and had primary/secondary school education. A third of them had higher education backgrounds (Table 5).

Table 5. The level of education.

Title	Frequency	Percent	Valid Percent	Cumulative Percent
Illiterates	8	1.4	1.4	1.4
Primary School	81	14.5	14.5	15.9
Secondary School	142	25.4	25.4	41.4
High School	136	24.4	24.4	65.8
College	40	7.2	7.2	72.9
University	151	27.1	27.1	100.0
Total	558	100.0	100.0	

The respondents introduced themselves under different titles of occupation. The major group was involved in local business (38.9 percent), and around 20% of participants were workers that formed the second largest group (Table 6).

Table 6. The occupations of the respondents.

Title	Frequency	Percent	Valid Percent	Cumulative Percent
unemployed	54	9.7	9.7	9.7
Labor	113	20.3	20.3	29.9
Farmer	37	6.6	6.6	36.6
Gardener	13	2.3	2.3	38.9
Business, retail, sales-	217	38.9	38.9	77.8
Public Services-Clerk	47	8.4	8.4	86.2
Transport	21	3.8	3.8	90.0
Housework	5	0.9	0.9	90.9
Higher Job	51	9.1	9.1	100.0
Total	558	100.0	100.0	

In addition, a total of 336 respondents (68.6 percent) were almost familiar with the concept of vertical gardens, while 175 respondents (31.4 percent) had no idea about it. However, only 112 respondents (20.1 percent) had used home gardens, and 446 respondents (79.9 percent) stated that they did not apply vertical gardens in their homes.

4.2. Opinions of the Respondents

The questionnaire was developed in five sections, including potential benefits, possible challenges, urban effects, interests of the respondents, and technological concerns. The following parts represent the participants' perception of each cluster of questions.

The respondents answered homogenously to the first cluster of questions. They generally agreed with the landscape and beautification of their homes. In contrast, the question about medical plants was responsible for the lowest figure. The respondents were happy with the possibility of developing fruit and vegetables at home (Figure 1 and Table 7).

The respondents answered to the first cluster of questions in a similar way. They generally agreed with having a beautiful landscape at their homes. However, the lowest figure was associated with the medical plants for vertical gardens. Respondents were also happy with planting fruit and vegetables at their home gardens (Figure 1 and Table 7).

With regard to the possible challenges of applying home vertical gardens, the respondents opined a difference between the physical aspects and a dramatic increase in garden insects and animals. According to Figure 2, the level of the agreement in the physical factors was higher than others (Figure 2 and Table 8).

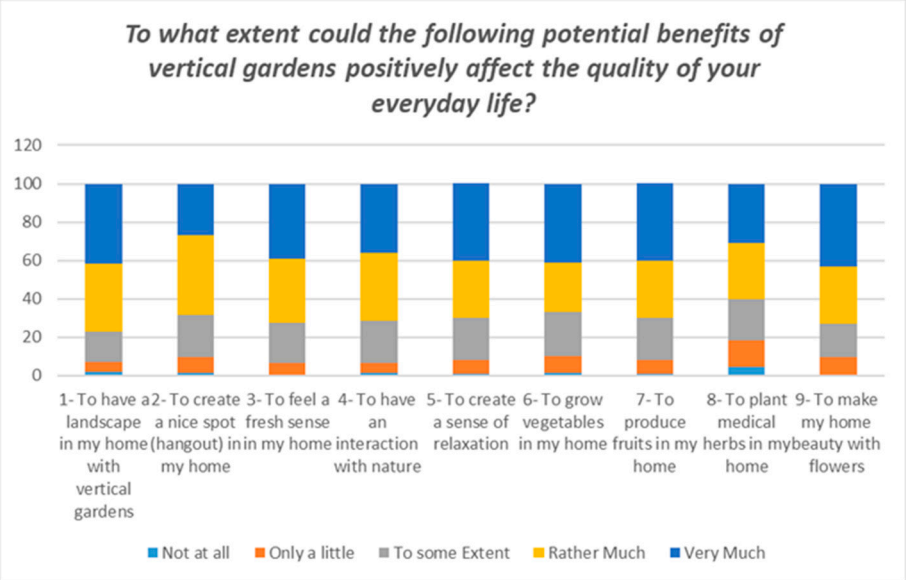


Figure 1. Potential benefit of vertical gardens in homes.

Table 7. Potential benefit of vertical gardens in homes.

Title of Questions	N	Sum	Mean	Std. Deviation	Variance
1—To have a landscape with vertical gardens in my home	558	2289.00	4.1022	0.96916	0.939
2—To create a nice spot (hangout) in my home	558	2140.00	3.8351	0.96699	0.935
3—To feel a fresh scent in my home	558	2259.00	4.0484	0.93380	0.872
4—To have an interaction with nature	558	2231.00	3.9982	0.95218	0.907
5—To create a sense of relaxation	558	2191.00	3.9265	1.02744	1.056
6—To grow vegetables in my home	558	2213.00	3.9659	1.05534	1.114
7—To produce fruits in my home	558	2239.00	4.0125	1.00351	1.007
8—To plant medical herbs in my home	558	2056.00	3.6846	1.17307	1.376
9—To make my home beautiful with flowers	558	2265.00	4.0591	1.00184	1.004

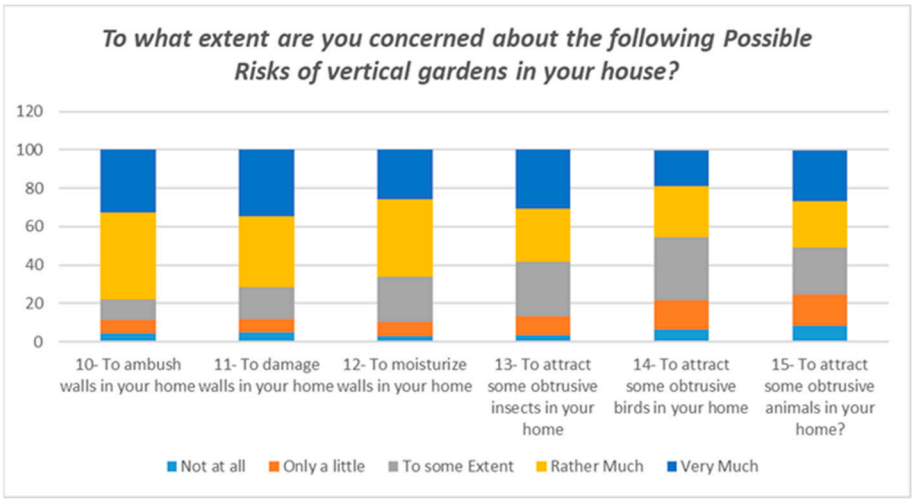


Figure 2. Possible risks for vertical gardens.

Table 8. Possible risks for vertical gardens.

Title of Questions	N	Sum	Mean	Std. Deviation	Variance
10—To cover walls in your home	558	2202.00	3.9462	1.05537	1.114
11—To damage walls in your home	558	2172.00	3.8925	1.10617	1.224
12—To moisturize walls in your home	558	2113.00	3.7867	1.00593	1.012
13—To attract some obtrusive insects in your home	558	2078.00	3.7240	1.10450	1.220
14—To attract some obtrusive birds in your home	558	1874.00	3.3584	1.14506	1.311
15—To attract some obtrusive animals in your home	558	1922.00	3.4444	1.26674	1.605

The participants emphasized the probability of damage to external walls of their buildings. Additionally, they were little concerned about garden insects, small animals, and birds.

The respondents' views about the effects of vertical gardens on urban areas were almost similar. They agreed with the positive impacts, such as reduced temperature, improved landscape, and beautification of the city. (Figure 3 and Table 9).

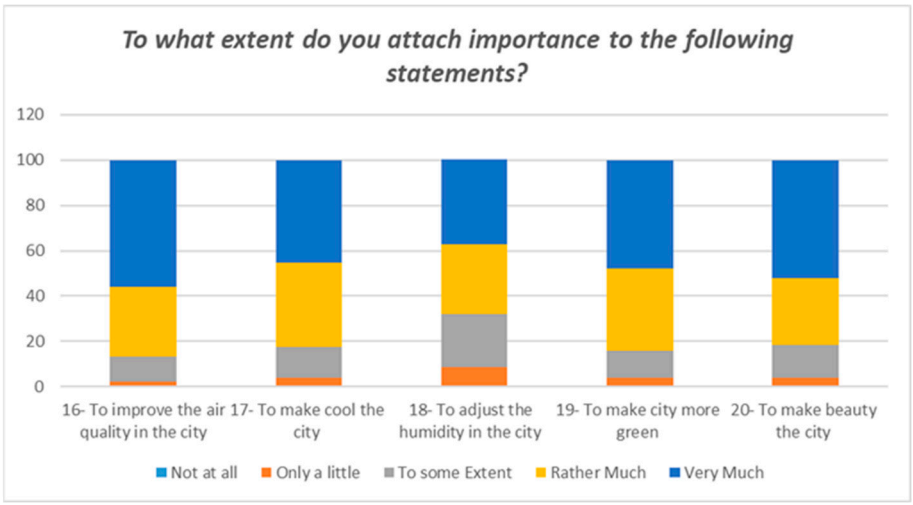


Figure 3. Urban climate and vertical gardens.

Table 9. Urban climate and vertical gardens.

Title of Questions	N	Sum	Mean	Std. Deviation	Variance
16—To improve the air quality in the city	558	2458.00	4.4050	0.77258	0.597
17—To make the city cooler	558	2363.00	4.2348	0.83703	0.701
18—To adjust the humidity in the city	558	2213.00	3.9659	0.98312	0.967
19—To make city more green	558	2390.00	4.2832	0.82080	0.674
20—To make the city more beautiful	558	2397.00	4.2957	0.86235	0.744
16—To improve the air quality in the city	558	2458.00	4.4050	0.77258	0.597

The respondents had common sense about the positive impacts of home vertical gardens on the climate. This section of responses had more similarity among residents with a lower rate of variances and standard deviation. They were interested in learning more about vertical gardens in practice than by educational work. This is why the figure for participating in workshops and receiving catalogs was lower than other options (Figure 4 and Table 10).

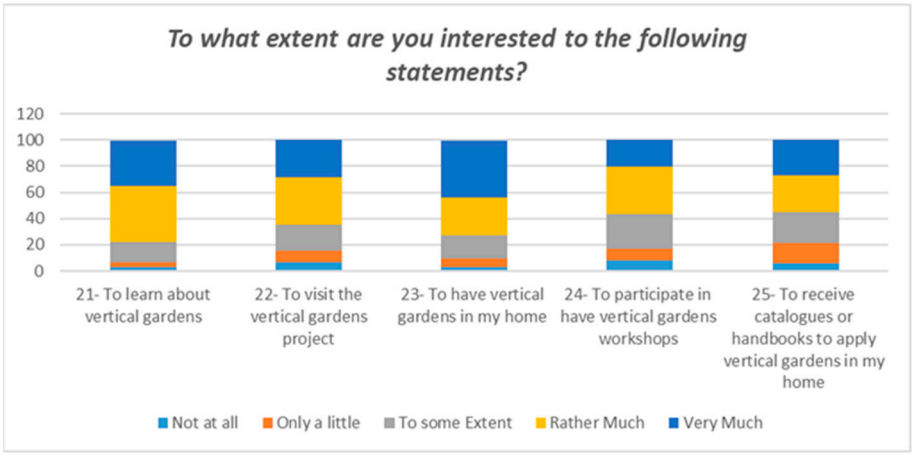


Figure 4. The respondents' interest in vertical gardens.

Table 10. The respondents' interest in vertical gardens.

Title of Questions	N	Sum	Mean	Std. Deviation	Variance
21—To learn about vertical gardens	558	2251.00	4.0341	0.96096	0.923
22—To visit the vertical gardens project	558	2069.00	3.7079	1.17070	1.371
23—To have vertical gardens in my home	558	2255.00	4.0412	1.06693	1.138
24—To participate in have vertical gardens workshops	558	1966.00	3.5233	1.15044	1.324
25—To receive catalogs or handbooks on applying vertical gardens in my home	558	1981.00	3.5502	1.20151	1.444

The cost reduction and easy-to-use maintenance were the most significant factors in the technical part from the respondents' perspective (Figure 5 and Table 11).

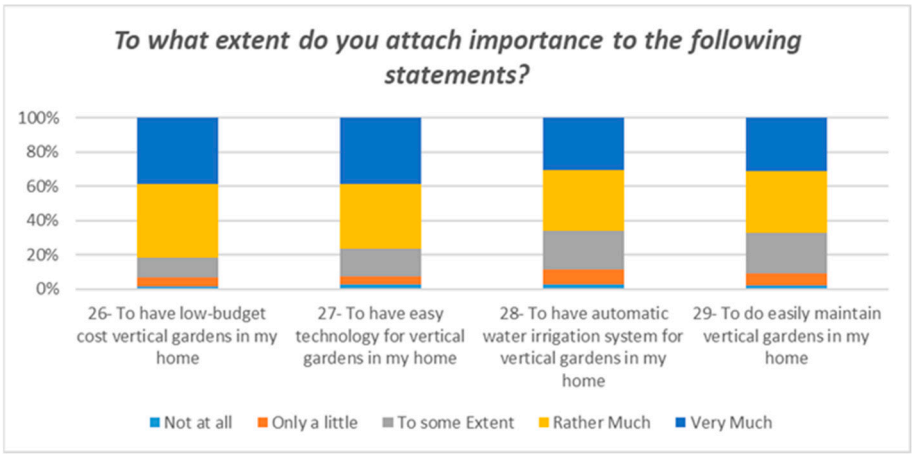


Figure 5. The technical aspect of the vertical gardens from the inhabitants' point of view.

Table 11. The technical aspect of the vertical gardens from the inhabitants' point of view.

Title of Questions	N	Sum	Mean	Std. Deviation	Variance
26—To have low-cost vertical gardens in my home	558	2296.00	4.1147	0.92118	0.849
27—To have easy technology for vertical gardens in my home	558	2262.00	4.0538	0.98315	0.967
28—To have automatic water irrigation system for vertical gardens in my home	558	2136.00	3.8280	1.04433	1.091
29—To easily maintain vertical gardens in my home	558	2161.00	3.8728	1.00266	1.005

5. Discussion

As the vertical gardens and living walls are globally growing in popularity, local governments tend to raise awareness of these concepts. The participants in Kigali, therefore, were familiar with the idea of vertical gardens, and interested in visible practices. This could play an important role in facilitating further actions [58,59]. Some residents of and African cities, including Kigali, have already implemented home vertical gardens and living walls, showing home gardens are paid attention by householders [38]. This level of awareness contradicted the results of the transitional process of changing gardens in Kigali [39]. People were interested in decorative and beatification and fresh sense in their homes, revealing a high level of attention to green elements [54], landscaping [39], well-being [19], and mental health [21].

Application of the vertical gardens on a home scale included a variety of decorative aspects that were discussed by earlier studies [12,19,25,26,37,53]. In a similar result, the respondents were more interested in decorative plants in terms of aesthetics and beautification through landscaping [12,25,26] than kitchen gardens and edible plants as part of small-scale urban farming systems [4,17]. This result supported the theories on changing the process of productive gardens to decorative gardens in Kigali [39]. Despite the interest in fruit vertical gardens, the respondents revealed that the application of vertical gardens needs to be simple, beautiful, and decorative as discussed by [4,14] to support the requirements of the inhabitants in which the level of the selection of herbs as a component for vertical gardens was low. In spite of poverty in some parts of African cities, inhabitants had concerns about environmental and social qualities [25,57,76,90–92].

The quality of people' daily life was discussed by a number of studies [4,51,60,68,76]. Similar qualities were emphasized such as a sense of relaxation, creating a nice spot, interaction with nature, and making the home beautiful through landscaping. Reference was made to the psychological effects of the vertical gardens [7,9,52] that mentioned previous results, based on mental health [8], positive mood [9], good memory about the place [10], and a sense of belonging among users [12]. Urban life conditions have led users to pay more attention to psychological qualities [7,9,52] than food support systems and urban farming [14,17]. These qualities in the urban environment support both the physical [7,19] and mental health [9,52] of the inhabitants on a small scale. The connection between the small-scale health quality and larger scale in urban areas was discussed widely by studies [20,71–73].

The finding was in the same alignment with other studies' results, showing the positive effects of the small vertical gardens on urban sustainability [54], green infrastructure [41], climate [21], pollution [55], urban beautification [12,25,26], and green aspects of urban design [5,51]. This similarity demonstrated the common knowledge among the general public about the global problems that were discussed by [25,26,40,58]. The ecosystem concerns [93,94], the green aspect of development [28–30], landscape design through small projects [5,41,70] were highlighted by the inhabitants in the whole city, and some keywords such as landscape [12,58], beatification [8,63,94,95], and air qualities in the city are no longer jargon words for the dwellers but rather point to beliefs [12], understanding [62], and actions [21,54].

However, the technical aspects of the implementation of vertical gardens were highlighted by earlier studies [58,70] which also were part of the concerns of the respondents about the implementation of vertical gardens and relationships with the living spaces. In detail, some factors such as visibility [21], transparency [18], and safety [57] were indicated by the users as factors to cover up the walls. On the opposite, biodiversity quality [76] was part of the quality of life for the inhabitants who were open-minded regarding the biodiversity of the vertical gardens [6,62] in their homes, particularly for birds and small animals [74,76,77]. The contextual effects of lived experience in tropical climates have adapted the inhabitants to the local biodiversity [12,18,25]. In other words, to be open to biodiversity refers to the social and cultural aspects in terms of beliefs and costumes [40,61,63].

Home-based small gardens [28–31] are considered to be in alignment with the enhanced quality of urban climate and environment, mainly presented in masterplans [21,25,30,54–56]. These projects could be also connected with a range of measures to tackle environmental problems, such as ecosystem issues [70], climate change [25], urban resiliency [20], and urban equity. On the other hand, it makes a positive contribution to raising the residents' awareness of socio-ecological interventions [35], livable neighborhoods [72], and the relationship between environmental qualities and inhabitants' health [9].

6. Conclusions

It is argued that vertical gardens, living walls, landscape design, and environmental issues have recently received more attention in developing countries. As international lessons continue to proliferate around the world, most respondents in Kigali were familiar with the importance of green infrastructure and relevant concepts like home-based vertical gardens and their possible effects as well.

There is a collective concern about the possible impacts of climate change among policymakers, practitioners, and inhabitants in Kigali. In this way, the participants associated home vertical gardens with efforts to mitigate climate change on a larger scale. Moreover, a range of advantages, including having a nice quiet spot, interacting with nature, and recreation by growing ornamental plants and edible vegetables at home, are key reasons for the application of home vertical gardens from the residents' perspective in Kigali. The results demonstrate that the inhabitants attach more importance to decoration, beauty, and landscape in gardens in comparison to food production.

The possibility of access to the walls and installed structures for the observation and maintenance of climbing plants is seen as a significant issue that designers should assure residents who would like to have a vertical garden at their houses. Another issue that might disturb householders is a group of plants that would attract insects and little animals. There are key considerations to make home vertical garden concepts more feasible in Kigali. This research indicates that small-sized, on-budget vertical gardens in which easy-to-use technologies are applied will be more likely to be embraced by householders.

7. Recommendations

It is recommended that the low-cost home gardens, designed with lightweight structures and user-friendly technology have priority over other factors in Kigali. Using local and affordable material and equipment would encourage inhabitants to have home gardens. Furthermore, if householders cope with (re) planting, watering, weeding, trimming plants, and other jobs relating to garden improvements, the issue of operation and maintenance of vertical gardens would be less of a concern.

Learning more about the typology of houses and residents' preferences for garden plants will enable designers to prepare appropriate guidelines, and small-sized prototypes in Kigali. This is an effective way to bring stakeholders together to find out much more innovative alternatives and receive helpful feedback on the performance of vertical gardens.

Apart from the perception of residents, it is necessary for municipal authorities to integrate development of vertical gardens into urban green network policies. To obtain an integrated approach to development of green spaces could support the shared goals and the allocation of financial resources more efficiently. Moreover, it will be a good idea for the local government to arrange public events in order to introduce green development projects and raise the citizens' awareness of the positive implications of green actions on their living environment.

8. Further Research

To conduct further research into the feasibility of home gardens in Kigali would support urban sustainability-promoting strategies, as well as the citizens' involvement in creating livable neighborhoods. In this way, we suggest several studies as listed below:

Typology of home gardens in Kigali: the ways of the inhabitants apply kitchen gardens, vertical gardens, or living walls might be examined. Analyzing the typology, and forms of the gardens could contribute to making recommendations for improving the green infrastructure in the city.

Mapping the physical form of the houses and walls in the city: learning about the size of the houses and walls will help the researchers and designers to design prototypes of vertical gardens, leading to developing real-world projects. To study the typology of the houses will also support preparation of handbooks to represent various types of vertical gardens in proportion to the size, height, and orientation.

Spatial mapping of home gardens in the city: locate potential gardens through GIS could illustrate the priority spots that need updating policies, practices, and research to develop vertical garden concepts.

A discovery about the inhabitants' personal preference for the garden plant species: the preferences of the residents for the plants such as the color, scent, shape, and size could help designers to draw up guidelines on the use of preferred plants in home gardens.

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