

## **URBAN FARMING AS SUSTAINABLE STRATEGY TO REVIVE INTERSTITIALS IN COMMUNITY HOUSING**

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### **Abstract**

The study aimed to investigate the preferences of urban residents to use interstitial housing spaces to encourage urban farming to reconnect people with nature while providing a healthier living. A quantitative approach using a survey questionnaire was used to investigate the preferences of urban residents in high-rise and terraced residential areas using private open spaces (interstitials) for urban farming. The study revealed that i) many urban residents do not use interstitial spaces for growing plants due to the lack of interest, space, time, and skills. ii) establishing requirements to promote and support urban farming with architectural intervention, such as providing adequate size and shading of the interstitial spaces, can promote urban farming among building residents. This study focused on the residential interstitial spaces, the balcony, front yard, and rear yard, where urban farming could benefit the household members; aesthetically, climatically, and psychologically. The findings can guide architects and urban residents on the critical role of interstitial spaces, and the interventions can support urban farming in promoting sustainability. This study concludes with possible interventions that can improve the effectiveness of the interstitial spaces, thus contributing toward a more sustainable space and living.

Keywords: Architectural intervention, Interstitial spaces, Residential building, Sustainable living, Urban farming.

## **1. Introduction**

It is estimated that by 2050 more than two-thirds of the world's population will live in cities, up from about 54 % today [1]. Urbanisation can create connected and cascading effects, as high population density fuels the need for massive development with housing that contributes to environmental degradation and social exclusion. Various typologies of houses are being developed rapidly to meet the urban population's needs. The people occupied not only the spaces within the building but also the spaces between them. These open spaces are referred to as interstitial spaces [2]. In urban planning, interstitial space invokes to portray the effect of urban sprawl and its future opportunities.

In contrast, Matos [3] explained that interstitial spaces appear as components of suburban growth with possible transformation with the intention of revitalisation. On a smaller scale, 'interstitial' depicts different sorts of forgotten, derelict, informal, or marginalised spaces such as rooftops, balconies, and courtyards that serve as settings for social contact [2]. Rojas [4] described interstitial spaces as delimited by buildings, walls, and other structures where architectonic functions can occur. Open or interstitial spaces can be categorised mainly into public and private open spaces.

The open spaces within and between residential buildings represent a valuable place where people spend time in contact with other people and nature near their homes. These open spaces between residential buildings impact the sustainable development of urban areas [5]. Key attributes of successful open space areas are spatial arrangement, accessibility, identified function, safety, the quantity and character of greenery, safety, and maintenance that influence the quality of the environment and residents' quality of life. The quality of the open spaces strongly influences the sustainability of urban fabrics because they can make a difference in ecological preservation, transportation patterns, and social aspects [6]. Rapid urbanisation has reduced vegetated areas, increased surface temperatures, and altered urban microclimates [7]. Due to the unprecedented growth of towns and cities, people have been more distant from nature. Farming was the centre, the social core of cities in the olden days. It was a social activity, cultivating, buying, and selling [8]. Private open space is a vital component of the residential layout, including balconies, front yards, rear yards, and communal areas. In this study, only private open spaces specific to residential buildings were considered.

### **1.1. Current unsustainable use of the interstitial spaces**

Numerous studies have argued that man modifies his environment from his needs and aims but is himself directly affected by the environment he lives in [9]. Over time, owing to modernisation and a fast-moving lifestyle, some housing spaces have been neglected, mainly interstitial spaces. Steele and Keys [10] explained that the problem of neglected interstitial spaces in housing results from human practice. This view is supported by Shaw and Hudson [11], who argue that unused spaces emerge from people's actions, damaging the quality of the whole space and experience [9]. The third millennium is transforming how users inhabit spaces [12]. People find it hard to use these places with the right furnishings that go well in these settings. Hence most interstitial spaces turn into neglected rooms for pigeons and ménage items [13].

Detail examination of interstitial spaces by Edwards [14] showed that in the contemporary world, exterior spaces are reduced to small balconies or yards and are rarely used because they do not offer any functional space. The proper conceptualisation of smaller exterior spaces results from the lack of space in cities due to the rising mass population. Hence, interstitial spaces' role is to express modernity or façade modulation rather than functionality. Furthermore, its poor spatial quality and inefficient connection to other house rooms make it an unutilised space for the resident. Thus, this has transformed the culture and pattern of residents but has damaged the quality of the spaces. The interstitials were once considered a sacred room for privacy and comfort. The domestic interstitial spaces constitute the outdoor living space recommended for micro-climate and social activities. It also offers an equilibrium between internal and external lifestyles and spaces. Despite all the advantages, the interstitials have been neglected and ignored in the modern movement of housing [14].

## **1.2. Statement of the problem and aim of the study**

Due to the growth of towns and cities, people have been more distant from nature. Standardisation of homes and high-rise habitat started to grow at any size and shape, neglecting the residential interstitial spaces. Although urban farming and interstitial spaces have been debated for many years, most studies have focused on the urban scale in a separate field. This brings to the gap of this study: to investigate the preference of urban residents to use interstitial spaces (private open spaces) in housing to encourage urban farming. The study concludes with possible interventions that can improve the interstitial spaces' effectiveness and thus contribute toward a more sustainable space and living. The results can guide architects and urban residents on the critical role of the private open space in urban residential, and the interventions can support urban farming in promoting sustainability. Thus, the possible interventions to increase the sustainability of the interstitial spaces can benefit stakeholders socially and economically.

## **2. Possibility of Reviving the Interstitial Spaces (Private Open Spaces)**

Much research has proven that there are many advantages in reviving interstitial spaces. The following are some of the advantages.

### **2.1. Social and culture**

A detailed examination of the characteristic of interstitial space by Shaw and Hudson [11] shows that the interstitial represents socio-economic abandonment. The authors demonstrated that such spaces are social breathing spaces. They allowed activities to happen and question the limited notions within current discourses that conceive the relationship between public and private space. Shahlaei and Mohajeri [9] claimed that people need to be in connection with the outside to satisfy human physical and social life. Unfortunately, in third-world countries, mimicry of mode and modernisation intensively influence social change [15]. One must not look at the interstitial space as a 'neutral grid' but one in which cultural differences, historical meaning, and social practices are inscribed and actively made through everyday human practices [16]. The interstitial can be interpreted as a place for social, cultural, and environmental change. According to Yazdanpanah and Walker [17], the interstitial spaces is the place for collaboration, with collective and layering of activities for the user. The

author further explains that the space, once activated, can be used for regular communal entertainment while the nature of the space encourages social interaction.

## **2.2. Micro-climate**

Due to urban heat islands, more recent attention has focused on micro-climate. A few authors have reported the role of interstitial spaces in creating a comfortable micro-climate. Sthapak and Bandyopadhyay [18] argued that the interstitial space is generally referred to as a microclimate modifier that improves the comfort level of the surrounding environment. The space has a high potential to mitigate high temperature, channel breezes, and adjust the degree of humidity inside the house. The interstitial space serves as a social gathering place and a source of airflow and creates thermal comfort for the user [19]. Thus, the interstitial space is a cool air reservoir, mostly in hot climates. This helps to maintain a low temperature in the interstitial and surrounding rooms [18].

## **2.3. Temporal**

According to Das [20], the benefits of interstitial spaces are functional and enhance psychological well-being by taking a break or a pause. According to Piccinno and Lega [12], the interstitial space is a temporal element. This view is supported by Laffah [21], who argues that interstitial space is a domestic open space able to provide a pleasant environment for the inhabitant while meeting the need for serenity, a place of tranquillity, and pure pleasure to attempt to overcome the daily life condition by taking a break. Asadi et al. [15] posited that the interstitial space is designed for the user's comfort, where the user needs to stop for a short or long time before returning to the real world. The space provides an escape to the inhabitant where they can meditate and seek peace. Interstitial space creates physical or visual access between inside and outside or a place to relax. It is the focus of the house, providing a place to rest. With its transparency, the place offers a "pause moment." The interstitial is a semi-open, semi-closed room. This location can be more connected to the inside or the outside. More enclosure elements make it more reliant on the inside, while more openness exposes it to the outside.

## **3. Urban Farming as a Sustainable Strategy for Interstitial Space**

Urban farming seems new and exotic, but it has been the norm since the dawn of farming activity ten thousand years ago. Steel [8] shared the same thoughts that cities and farming co-evolved. Early human settlements surrounded productive farmland providing economic and social means. The front yards, intermediate courtyards and backyards were full of nature. Due to the industrial revolution and uncontrolled urban sprawl, farmland and farming activity were abandoned and relocated far from residential areas. Numerous studies have argued the effect of climate change and food security as separate topics [22]. The latter argues that structure, concrete, and asphalt transportation system, in conjunction with urban activities, have caused an increase in temperature compared to the surrounding rural areas. Urban farming is a potential strategy to reduce the urban heat island problems. The expansion of urban and indoor farming is necessary to respond to the ongoing climate change and build more resilient cities [22].

The city's transformation of underused, neglected, or deserted spaces could coordinate green infrastructure. These spaces could potentially reduce carbon waste,

provide energy through renewable resources, and feed urban residents through small-scale farming. Although urban farming will never replace rural agriculture supply in terms of volume, it does present opportunities to produce remote energy and food production while achieving climate-friendly agriculture by sequestering carbon and reducing emissions produced by buildings [23]. Chiesura [24] argued that such vegetation is fundamental to human well-being, therefore it is an essential aspect of liveability. Due to the scarcity of farming land in cities, there are opportunities to encourage farming through design and development to preserve ecological habitats [23]. Hence, urban farming represents potential in the urban fabric. In addition, compared to the plantation of trees only, urban farming provides benefits to urban residents with access to fresh food and healthy living [25].

### **3.1. Social cohesion**

Social cohesion refers to the once dynamic sense of connection with others, and the presence of vegetation can significantly encourage positive social interaction that cultivates social cohesion [26]. Vegetation strengthens a neighbourhood's social cohesion by providing a place for gathering and activities [27]. A study by Arnberger and Eder [28] analysed the correlation between nature and community engagement and found that residents have a higher level of community attachment due to a higher quality of life. This community affiliation is a way to foster community spirit. As a result, community involvement is critical. It promotes people's development of various possibilities, such as the growth of urban farming. Thus, social interaction seems to be strengthened by the presence of vegetation close to or within a residential area [27].

### **3.2. Aesthetics**

As a user experience a place, their primary sensory interaction with that place is visual; these resources are essential components of the quality of life [21]. The aesthetic dimension is related to the positive visual image of the garden and its relation to buildings. The residential interstitial spaces provide visual relief from urbanised areas and scenic views. Inhabitants are also affected by their immediate visual surroundings. Local aesthetics, typically found on a neighbourhood level, comprise the city's urban visual character. Hence, nature could play a significant role in improving the aesthetic and unique quality of interstitial spaces. Nature not only improves the microclimate but also creates a pleasant environment [14]. Aside from its ecological and economic importance, biodiversity has always been aesthetically pleasing. A study based on Ulrich's conceptual perspective [29] suggested that aesthetic performance is central to thoughts, conscious experiences, and behaviours. The results indicate a strong tendency to prefer nature over urban sceneries.

### **3.3. Micro-climate modification**

Vegetation can play an essential role in the microclimate of buildings. A study by Maleki [30] indicated that vegetation could reduce the temperature by 5 °C. Vegetation modifies microclimates by reducing temperature through evapotranspiration. Buyadi et al. [7] studied the vegetation growth effect on reducing the surface temperature in Malaysia. They reported that vegetation significantly decreased the outdoor temperature of a residential area by 1.32 °C. A similar study by Huat et al. [31] investigated vegetation's role in reducing the temperature in hot

outdoor urban spaces. The study concluded a drop of 2 to 5 °C in the presence of vegetation compared to a hard surface area, while Wong and Cheng [32] reported a variation of 4.01 °C between a hard surface and a well-planted area. The authors indicated a strong relationship between thermal comfort and vegetation. A Malaysian study by Mari et al. [1] revealed that a front yard covered with vegetation had significantly lowered the outdoor temperature by 3.3 °C compared to a non-vegetated front yard due to vegetation shading and evapotranspiration.

#### **4. Research Methodology**

The study employed a quantitative approach using a designed survey. The study started with a review of the literature on interstitial spaces in housing and the potential for revitalisation. This was followed by the development of a questionnaire survey in order to generalise the results to a specific population [33].

##### **4.1. Study sample**

The sample for this study comes from two major (2) types of community housing typology in Klang Valley, high-rise residential buildings (HR) and terraced houses (TH), to offer a variety of perspectives. Klang Valley is a developing city with an abundance of residential development. There are various uses of interstitial spaces in high-rise residences (HR) and terrace houses (TH) in this city. Furthermore, these community housing typologies include at least one (1) type of interstitial space, such as a balcony, front yard, backyard, or a combination of these. A total of 142 respondents participated in the study.

##### **4.2. Typology of interstitial spaces (private open spaces)**

The study investigated three types of interstitial spaces that are commonly found in residential buildings in the local context.

###### **4.2.1. The rear yard**

The rear yard, in general, is a more private area within which some outdoor domestic activities can be accommodated. Rear yards are particularly important private areas of open space. The purpose of this is to ensure that people can enjoy everyday outdoor domestic activities within the privacy of their garden. It supports the creation of residential spaces that are landscape dominated, bringing with it ecological, climatic, and aesthetic advantages. The existence of private open space brought significant advantages to the community. Miller [34] argued that the lack of contact with nature in the urban environment leads to a severe lack of human experience.

###### **4.2.2. The front garden**

The front garden is generally a more open area that often contains paths and off-street parking. These areas provide a private space for residents to play, relax, communicate, and enjoy natural elements such as trees and vegetation, which make the atmosphere more attractive. They can also define the borders between dwellings and the separation between neighbouring houses. Allowing the penetration of sunlight and fresh air is another environmental function of open space.

### 4.2.3. The balcony

Balconies are one of the major architectural features in tropical climates. They are assumed to be architectural features for aesthetic yet practical buildings. The balconies are used for private outdoor activity while potentially benefitting the indoor airflow. The balcony served different possible activities by enlarging the living space without a garden. In many apartments, balconies are partly recessed to provide sunshine and shade. The balcony was originally based on the ground floor in the garden. However, it was later introduced on the upper floors of buildings forming part of the architecture. It is used to connect house owners to the outside world [35].

### 4.3. Instruments of the study

The questionnaire survey contained demographic inquiry, check box questions, questions on a 5-point Likert-style scale in which the number “5” indicated the highest response and “1” indicated the lowest response, and questions in a frequency Likert-style scale from “Very Frequently” to “Never”. In general, the instrument contains three (3) sections, A, B, and C. Section A of the instrument contains seven (7) demographic questions designed to ascertain the variety between participants in the study. Section B of this study focuses on the current use of interstitial housing spaces, which include courtyards, balconies, front yards, backyards, or a combination of these spaces. Section C of the instrument used in this study focuses on the influences of using interstitial housing spaces for urban farming.

## 5. Findings

The results indicated that almost 80% of respondents rarely use the balcony. Almost 50% use the front yard or backyard, while 95% of the respondents neglect the courtyard. The results show that the balcony is more likely to be ignored compared to the front yard and backyard (as shown in Table 1).

**Table 1. Frequency usage of interstitial spaces in housing.**

		N	Percentage (%)
<b>Balcony</b>	Never	14	14
	Rarely	30	30
	Occasionally	38	37
	Frequently	10	10
	Very Frequently	9	9
	Total	101	100
<b>Front yard and backyard</b>	Never	5	7
	Rarely	13	18
	Occasionally	19	27
	Frequently	24	34
	Very Frequently	10	14
	Total	71	100

Despite the reported findings, occupants rarely used interstitial space. Almost 46% of the residents rated it as very important, and 34% rated it as important, indicating that 80% of the participants acknowledged the importance of interstitial space. In comparison, only 20% undervalues interstitial space (as shown in Table 2).

**Table 1. Importance of interstitial spaces in housing.**

		N	Percentage (%)
<b>The interstitial spaces</b>	Not Important	1	0.7
	Slightly Important	5	3.5
	Moderately Important	23	16.2
	Important	48	33.8
	Very Important	65	45.8
	Total	142	100.0

However, findings show that most respondents do not use the interstitial space for its intended use. The results show that only 34 % of the respondents currently use the interstitial space to grow plants. In comparison, 36% use the interstitial space for storage or laundry, and 30% leave the space empty without performing any activity. More than half (66%) of the respondents undervalued the interstitial space, and only about 1/3 of respondents use interstitial space to plant vegetation (as shown in Table 3).

**Table 2. Current usage of interstitial spaces in housing.**

Variables	N	Percentage (%)
Storage/laundry	52	36.6
Not using	42	29.6
Growing edible/nonedible plants	48	34.0
Total	142	100.0

Most of the respondents, 66% (as shown in Table 3), reported that they do not use interstitial space to grow vegetation. The findings revealed that the main reasons why the residents do not use the interstitial space to plant vegetation are lack of time (OT), lack of space (LSP), and lack of interest (LI). Lack of skills (LS) and ownership of the house (OS) were scored lowest (as shown in Table 4).

The lack of time for gardening or vegetation planting was scored highest ( $M=4.66$ ,  $SD=4.274$ ). This was followed by a lack of space and time with scores of  $M=3.74$  ( $SD=1.026$ ) and  $M=3.62$  ( $SD=0.917$ ), respectively. The result shows that the respondents believed that more time and a larger space would interest them to do gardening. This finding conquered Laffah's [21] study.

**Table 4. Factors that discourage the use of interstitial spaces for growing plants.**

Factors	Mean	Std. Deviation
<b>OS</b> I do not own the place	2.74	0.866
<b>LS</b> Lack of skills	2.83	1.023
<b>LI</b> Lack of interest	3.62	0.917
<b>LSP</b> Lack of space	3.74	1.026
<b>LT</b> Lack of time	4.66	4.274

The findings (as shown in Table 5) revealed that non-gardeners believe there are benefits in planting edible vegetation. They can access fresh food (FF), improve micro-climate (IMC) or better thermal environment and add aesthetic (IA) values.



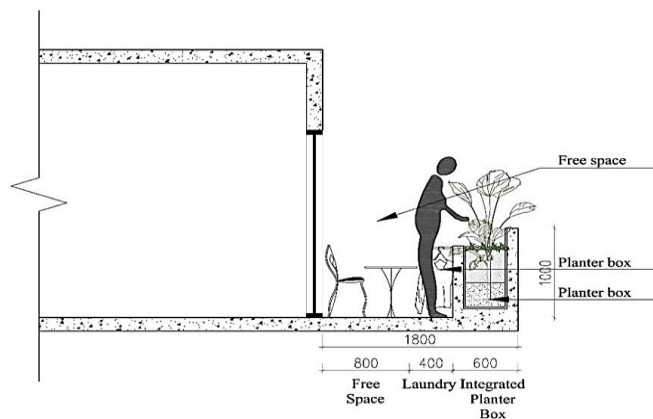
**Table 5. Benefits of growing edible plants by non-gardeners.**

	Benefits	Mean	Std. Deviation
ISL	Improve social life	2.28	0.739
FF	Access to fresh food	3.65	0.876
IMC	To improve micro-climate	3.94	0.685
IA	Improve Aesthetic	3.99	0.647

## 6. Discussion and Recommendation

While participation in community gardens requires time, it seems to be a major problem for urban residents. As an alternative, this study proposes building integrated farming to encourage and increase awareness of urban farming. This will enhance the housing community's skills and interests. Urban farming can be facilitated within the interstitial spaces of residential buildings with simple architectural interventions.

The findings show that interstitial spaces in high-rise residential areas are mainly used for storage/laundry. Only a minority of the urban residents use the interstitial spaces to grow plants using potted plants. Figures 1 and 2 suggest how architecture can intervene to have adequate space to accommodate urban farming during the design stages within the balcony space. The balcony can be extended from the common standard size of 900 mm to 1800 mm. This proposal complies with The Uniform Building by Laws (UBBL) [36] clause 116, balconies 1800 mm or more "shall be protected along the edges with suitable railing, parapets or similar devices not less than 1000 mm in height". In this context, the integrated planter box of 1000 mm high can be built as a parapet wall around the edge of the balcony.

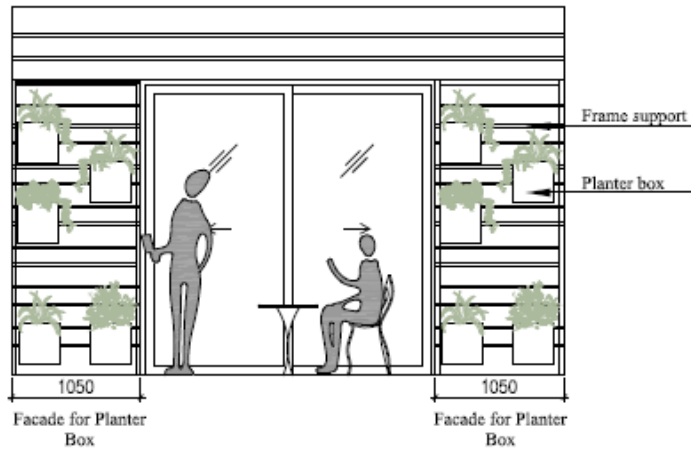


**Fig. 1. Proposed urban farming integrated balcony.**

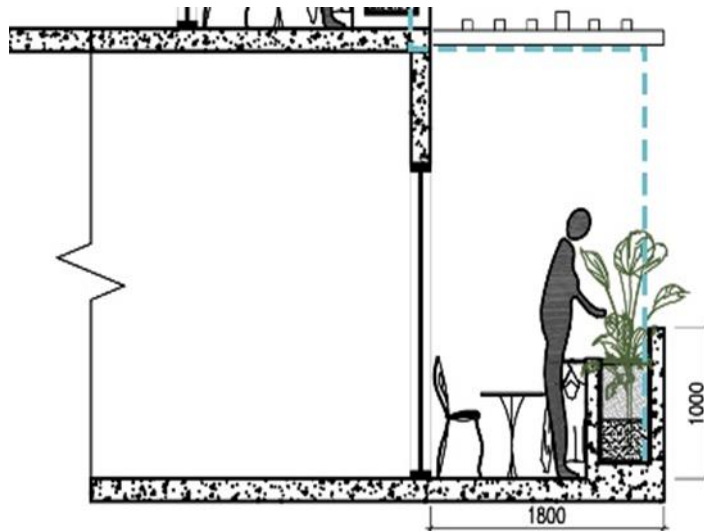
Figure 2 shows a framing of the façade of the same space (balcony) whereby planter boxes are placed. The architects must consider the appropriate framing and treatment necessary for the building walls to ensure durability and protection of the wall from excessive moisture and root penetration.

Exposure to the sun provides favourable growing conditions for herbs and vegetables. Nevertheless, a conducive gardening space must consider the user and the use of the space for other activities. Therefore, shading devices on the façade are needed

to filter the excessive sun exposure (as shown in Fig. 3). This provides a meaningful environment and as suggested by Sthapak and Bandyopadhyay [18] that interstitial space as a microclimate modifier that improves the comfort level of the space.



**Fig. 2. Proposed wall façade and planting.**



**Fig. 3. Integration of effective shading device at the balcony.**

Terraced houses' front and back yards are constantly exposed to direct sunlight. Therefore, growing plants in yards without shading devices can be uncomfortable for residents as it will be hot and humid. In addition, the current open concept of the yards lacks privacy and security, one of the non-gardeners' concerns. Therefore, providing shadings such as pergola and tall trees will diminish the yard's exposure to direct sunlight. As Ulrich [29] suggested, aesthetic performance is important for human conscious experiences and behaviours. The findings show a strong preference for nature over urban scenery while improving

the microclimate, as highlighted by Mari et al. [1], and access to fresh food (as shown in Fig. 4). Pergolas are temporary structures enhancing the open space's aesthetics while increasing the outdoor space's functionality. It also offers strong support for climbing plants while providing privacy and security. The front and rear facades of the terrace houses can adapt to accommodate urban farming as in the concept shown in Fig. 2 above.

## 7. Conclusions

Due to urbanisation, people have been more distant from farming activity. Mass construction of housing and high-rise habitat have reduced the access to exterior space to small balconies or yards that are rarely used because they do not offer practical use. Those spaces have been defined as interstitial spaces. They are the transition spaces between inside and outside and hold great potential to connect urban residents to the outside, especially nature.

However, due to the fast-paced modern lifestyle, housing interstitials have been neglected and are now only used for laundry and storage. Thus, this study investigates the preferences of urban residents to encourage urban farming in the interstitial housing spaces to reconnect the people with the lost farming activity while reviving the interstitial spaces in housing. This will benefit urban residents in accessing fresh food, creating a comfortable micro-climate, providing aesthetics, and healthier living.

The results show that skills, interest, time, and space size are the main factors discouraging urban residents from practising urban farming. Therefore, the study posits that interstitial spaces can be used for urban farming if urban residents have adequate conducive spaces (size and sun protection). Building integrated farming can be a potential solution to enrich urban residents' knowledge, skills, and interest in farming and create more environmentally and socially sustainable private open spaces. In addition to providing aesthetic value to the façade, building integrated farming provides knowledge on the type of plant to grow, access to fresh vegetables, healthy activities for urbanites, temperature reduction, and conducive space for social interaction.

Architects should consider using balconies, and front and rear yards effectively during the design stages to accommodate farming activities that can benefit the urban population socially, environmentally, and economically.

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