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Analysis of the effects of green wall usage on the user's in indoor spaces

İç Mekanlarda Yeşil Duvar Kullanımının Kullanıcı Üzerindeki Etkilerinin Analizi

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Abstract

Green walls are constructed by covering the interior or external wall plane of a structure with plants, assuring sustainability, and functioning as a barrier to environmental hazards. Those used on the inner wall of the building are called living walls, and those used on the outer walls are called green facades. According to some studies, there are four types of green wall construction techniques: tree against wall, wall-climbing, suspended, and modular. Green facades can be built directly or indirectly, according to other studies, whereas living walls can be produced modularly or continually. Ecosystem services such as reducing noise, and dramatically enhancing air quality can all be provided by green walls. Increased cognitive function, patient recovery, and a more environmentally responsible approach are just a few examples. The study's aim is to analyze how green walls affect users, as well as to analyze and evaluate the benefits of employing green walls in spaces and advocate their usage in future projects. The qualitative research approach was used to analyze user thoughts by conducting a survey by making a literature review with keywords like green walls, the benefits of green walls, the psychological implications of green walls, interior space, and the user wants.

Key Words: Green wall, Users' Needs, Benefits of Green Walls, Vertical Garden, Indoor Spaces.

Özet

Yeşil duvarlar, yapının iç veya dış duvar düzlemlerinin çeşitli yöntemler sayesinde bitkilerle kaplanması, sürdürülebilirliğin sağlanmasında ve çevresel tehlikelere karşı bariyer işlevi görmesiyle inşa edilir. Yapının iç duvarında kullanılanlara yaşayan duvarlar, dış duvarlarında kullanılanlarına yeşil cepheler denilmektedir. Bazı araştırmalara göre dört tip yeşil duvar yapım tekniği vardır; ağaç duvara dayalı, duvara tırmanma, asma ve modül tipi. Diğer araştırmalara göre ise yeşil cepheler doğrudan ve dolaylı olarak inşa edilebilirken, yaşayan duvarlar modüler veya sürekli şekilde inşa edilmektedir. Gürültüyü azaltmak ve hava kalitesini önemli ölçüde artırmak gibi ekosistem hizmetlerinin tümü yeşil duvarlarla sağlanabilir. Artan bilişsel işlev, hastanın daha hızlı iyileşmesi ve ekolojik olarak çevreye daha duyarlı bir yaklaşım sadece birkaç örnektir. Çalışmada yeşil duvarların kullanıcılar üzerindeki etkilerini analiz etmek ve yeşil duvarların mekanlarda kullanılmasının faydalarını analiz etmek ve değerlendirmek ve gelecekte yapılacak olan projelerde de yeşil duvar kullanımının yaygınlaşmasına yön göstermek amaçlanmıştır. Araştırmada yeşil duvarlar, yeşil duvarların faydaları, yeşil duvarların psikolojik etkileri, iç mekan, kullanıcı ihtiyaçları gibi anahtar kelimeler ile literatür taraması yapılarak nitel araştırma yöntemi; anket çalışması yapılarak kullanıcı düşüncelerinin analiz edilmesi nicel araştırma yöntemi kullanılmıştır.

Anahtar Kelimeler: Yeşil Duvar, Kullanıcı İhtiyaçları, Yeşil Duvarların Faydaları, Dikey Bahçe, İç Mekanlar.

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Introduction

The increasing use of natural resources due to the increase in the world population has put researchers and people in a state of concern. With the increase in consumption, there has been a decrease in the sources of use and the concept of sustainability has come to light. Sustainability, in other words, the ability to be permanent, means the transfer of existing resources to future generations. Population growth not only increases consumption but also causes factors such as environmental pollution and global warming. There are many methods to avoid such negativities. Green walls, one of these methods, have been the focus of interior architects, architects, and landscape architects in recent years. They have many benefits both in terms of aesthetics and human health.

Environmental issues such as global warming, the ozone hole, which is getting worse by the day, pollution of the air, damage to natural resources, forest destruction, the urban heat island effect have risen dramatically since the industrial revolution and are now at a critical level. When the mentioned environmental issues are combined, negative events such as climate change and natural disasters that harm the lives of many people/users are experienced. To take precautions against such negativities, research studies by researchers should be considered. Environmental issues have reached a point where they may be seen on a global scale rather than only on a national level. Green roads, green roofs, and green wall applications have all been shown to be effective in combating environmental issues in studies.

Green walls aren't just for aesthetic purposes in the places where they're implemented. It also has numerous advantages for both the area and the user. The usage of a green wall on the outside of a building, for example, helps to balance the humidity and temperature differences between the structures. At the same time, the green walls applied in the building's interior offer a similar impression. The purpose of this study was to see how living green walls affected the user and the space, as well as to advocate the usage of living green walls in future project designs.

The Aim of the Research

This research was conducted to determine the impacts of green walls on users and examine the benefits of using green walls in spaces, as well as

ensuring the sustainability of future projects and spreading the usage of green walls. In this context, literature analysis and survey study were conducted. At the end of the survey, a survey study was conducted to determine whether the users are aware of green walls, how much they know about the benefits of green walls, and what effect the use of green walls in the interior has on them. In line with the obtained data, information was collected and analysed.

Scope of the Research

Studies about green wall systems have been developed for many parts of the world. However, in Turkey and K.K.T.C., there are few studies on green wall systems, their benefits, and their effects on users. As a result, the benefits of green walls and their effects on users will be investigated in this study. In addition, a survey study will be done with participants living in Turkey and K.K.T.C. to collect more detailed data on user opinions.

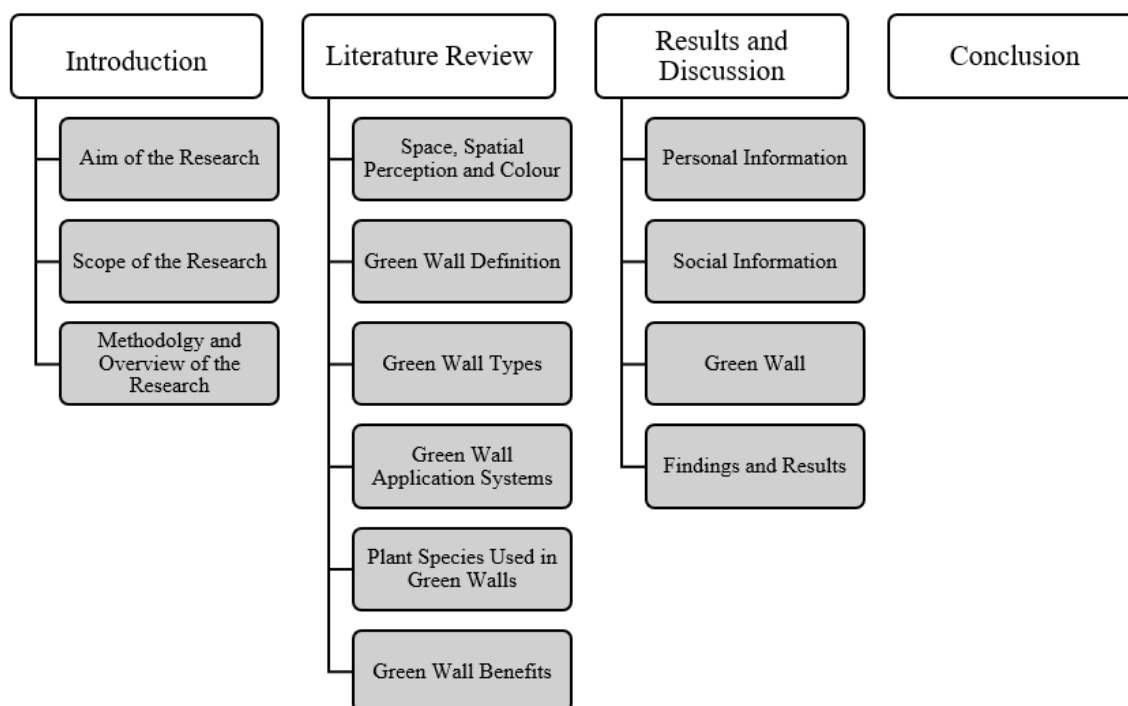
Methodology and Overview of the Research

Both qualitative and quantitative methodologies were used in this study. Literature research on related issues such as space, colour, space perception, the effects of colours on users, green facades, living walls, application techniques, type of plant used, and benefits of green walls are researched for the qualitative portion of the study.

In order to examine the effects of green wall systems on the user, firstly, after defining what the green walls are, how many types of green walls and how they are applied to understand the effects on the users in Turkey and the TRNC a survey study was conducted.

In the overview of this study, after the introduction to the subject in Chapter 1 as 'Introduction', the data analysed in the literature review were evaluated in Chapter 2. Section 3 presents the findings of the survey study with questionnaires. In the last part (Chapter 4), a conclusion was reached in line with the data obtained in the study (Table 1).

Table 1.
Overview of the Research Table.



Literature Review

In this section, space, spatial perception, colour, green walls, types of green walls, construction methods of green walls, plant species used in green walls and finally the benefits of green walls have been researched by literature review.

Space, Spatial Perception, Colour

People have built closed spaces to take shelter from natural disasters and the negative effects of the environment since the beginning of settled order. The concept of space first originated as a user need. Villages and cities developed as the number of such places increased. Changes in the responses of spaces to user needs and wishes have happened because of technological improvements and changes in the materials used in the construction of places. It is not needed for a space to be bordered by concrete barriers on all sides for it to be created. At this point, the most essential distinction between space and volume develops. The restriction that generates the space can be physical in the sense that it prevents mobility, or it can be just visual in the sense that it creates a texture on the floor that can only be sensed through other senses. Almost all the user's needs are met in this location (Aslan, Aslan , & Atik, 2015).

Perception is the process of using the senses to comprehend knowledge and experiences, and spatial perception is the result of this process. Users examine, observe, and finally analyse a location to achieve spatial perception. To offer spatial perception, there are four categories of perception. Dimensional perception, visual perception, thermal perception, and aural perception are the four types of perception. Form, colour, substance, texture, and light all have an impact on visual perception (Aslan, Aslan , & Atik, 2015). People's perceptions of a space determine whether their goals and needs are met in that space. The materials, interior layout, physical dimensions, and colours are chosen to have a direct relationship with spatial perception. The function of space determines the size of that space. For example, to determine the square meter of a house, the user who will live in that house is considered, a calculation is conducted correspondingly, and the space limits are created. If the house's boundaries were as large as a shopping mall, the user would be left with many unused spaces. However, leaving the house's limits narrow may not be sufficient for the user who would live there. In other words, determining a space's dimensions is directly proportionate to meeting user needs.

Another element in the dimensional perception of spaces is the colours used in the space. Colour, according to scientific studies, generates

electromagnetic waves. Colour is the visual impression of light on the eye, which is determined by its structure and propagation through objects. The interdependence of physical, physiological, and psychological events leads to colour perception in the visual environment (Aslan, Aslan, & Atik, 2015). Each colour has psychological effects on the user. In many studies on the colour-space relationship, it has been stated that colours tend to play an important role in dimensional perception. Warm colours like red, yellow, and orange have a smaller effect on spaces (Yıldırım, Çapanoğlu, Çağatay, & Hidayetoğlu, 2012); cold and lighter colours like blue and green, on the other hand, are shown to make the space feel much larger (Yıldırım, Hidayetoğlu, & Çapanoğlu, 2011). At the same time, each hue has psychological effects on people. For example, in fast food places, mostly yellow and red colours are used because it evokes hunger and being fast. Blue, for example, has a cleansing, comforting, tranquillizing, and calming influence on humans. It also aids people in thinking, making decisions, and coming up with innovative ideas (Göler, 2009). Blue, on the other hand, is always chilly and has a relaxing impact on the nervous system (Aydınlatan, 2001). As another example, the colour green is a combination of blue and yellow. Yellow gives warmth, blue gives calmness and peace to green. The green colour is the symbol of trees and plants in nature. Green is the colour of spring, vitality, and positive serenity. Green is a quiet and peaceful colour that evokes nature and paradise. In decoration, it evokes silence and not being disturbed, so it is a colour used in hospital rooms or theatres. In summary, colours have a great impact on spatial perception such as colour can make the space's atmosphere like as wanted, reveals unity or difference, can characterize the furniture, defines the form of the space.

Green Wall Definition

The phrases green wall, living wall, plant wall, and vertical garden are all used interchangeably, although they all refer to the same thing. A vertical garden is a green surface created by keeping the plants alive in the vertical plane, usually with iron construction and other carrier systems installed on a wall or building. The climate, aspect, and light conditions of the area to be vertically planted are the first factors to be considered. Plant selection should be made by looking at the climate of the region, the altitude and the zone values that show the cold resistance of the plants. The temperature and humidity requirements and growth rates of the plants that will take place in vertical planting should be

close to each other. The first green walls were built in BC. It was first noticed about 1500 when Egyptians began to cultivate grapes (Saki & Küçükali, 2020). It was roughly 30 years ago when green walls were first introduced to the public sphere. Patric Blanc, a French botanist, created the first living wall system (Weinmaster, 2009). Green walls refer to the use of plants to green vertical surfaces such as walls, facades, partition walls, and blind walls, as well as the growing of plants on, up, and within a building's wall.

Green Wall Types

Green wall systems are divided into two categories based on their intended use: green façades and living walls. Climbing plants that grow directly against the wall (using aerial roots, leaf tendrils, and adhesion pads) or have an indirect support system (e.g., wire, mesh, trellis) are commonly used in green façades (Vox, Blanco, & Schettini, 2018). Green façades often take a long time to cover and have a limited plant selection. Living walls, on the other hand, allow for more constant vegetation development over the surface and the utilization of a variety of plant species (Perini, Ottel , Haas, & Raiteri, 2013). Living wall systems, on the other hand, may need constant nutrition and watering (Manso, Teot nio, Silva, & Cruz, 2021).

Green Wall Application Systems

In literature, there are different number of building systems of green walls. According to Safikhani et al., (2014), there are four types of green wall building techniques exists tree-against-wall type, wall-climbing, hanging-down type, and module type. Although tree-against-wall systems are not technically vertical greenery systems, their results are comparable. Plants can cover wall surfaces directly or utilize trellises to ascend in wall-climbing kinds, which are typical in traditional architecture (Sheweka & Magdy, 2011). Wall climbing is simple but covering whole facade surfaces with flora takes effort. Plants with long pedicels on balconies or top of buildings produce hanging-down kinds. This kind is a combination of a green roof and a green facade. All facades will be green in a short time if hanging-down type plants are used on each level of the building; moreover, the facade will be colourful and aesthetically appealing if different types of plants are used. The final technique, module type, is the other technique. Module plants have the advantages of being fast-growing, colourful, variety, appealing, and easy

to replace when they get spoilt or wilted (Yu & Hien, 2011).

According to the Manso et. al., (2021), Palermo & Turco (2021) and Addo-Bankas et. al. (2021): green façades can be built in two ways directly and indirect because they are low systemic technology, with few constituent pieces, and a minimal level of interaction between plants and walls. Also light, easy to install, and often intended at promoting the natural growth of plants, primarily climbing plants, which can have evergreen or deciduous leaves and grow to a large height, taking several years to cover the entire wall. Living walls can be continuous and modular. Permeable screens, such as foam or felt layers, are used as a substrate in which plants are individually put to create continuous living walls. They lack a dirt base and have been observed to clog easily, limiting their use in various wastewater treatment methods. Containers containing substrate material such as soil or mineral granules, on the other hand, are put into a supporting framework one above the other or mounted directly on the vertical surface in modular living walls. Plant and substrate containers in the shape of trays, vessels, planter tiles or flexible bags, pocket-typed planters, and panels make up modular living walls. All of them need support structures.

Plant Species Used in Green Walls

The choice of plants, which are the most important elements used in green walls, may vary due to the climatic conditions of the region, the humidity level, as well as the benefits and harms that it spreads on the plants.

There are ways to choose plants to use when building a green wall. First, attention should be paid to the growth of the plant and the location of the wall to be built. Then creativity is a must to

get the most out of your green wall by making good use of available resources. Aesthetics and taste are a personal matter, but when it comes to vertical gardening it is essential to practice some form of symmetry. Various flowering plants can be tried to be grown, plants with leaves of different sizes can be combined. Finally, biodiversity will bring vertical gardening to your green space, providing much-needed biodiversity in our naturally overbuilt urban environment (Fantastic Gardeners, 2021).

Ferns (Figure 1) are very adaptable and moisture resistant plants that may swiftly cover enormous areas by growing on walls. They're best for vertical planting since they like to grow downwards. Sword ferns, bird's nest ferns, and blue star ferns are the simplest to incorporate into your living wall. Ferns, which bring out the deep and light hues of green, are prevalent on green walls. Bromeliads (Figure 2) have shallow roots and require minimal room to flourish. As a result, they complement the green wall well. The blooms are unusual and persist for a long time. Succulent plants (Figure 3) do not require much care, their habitat is wide. Therefore, their use is quite common. Even if no care is taken, the plant will not die, it can even grow better. Species such as Crassula, echeveria and sedum are mostly used in green wall designs. Vines (Figure 4) do not require intensive care. It is a type of plant that loves sunlight and spreads quickly (Fantastic Gardeners, 2021). Basil, parsley, chives, dill, mint, thyme, oregano, marjoram, lemon balm, and cilantro are the best herbs to use on green walls (Leonard, 2020). Pothos, golden pothos, devil's ivy, tradescantia; are classic houseplants all over the world (Figure 5 & Figure 6). These plants are one of the more forgiving indoor plants, tolerant to low light, high light, watering, dry periods, rich soils, poor soils, neutral, alkaline, and acid conditions (Rathour, 2017).



Figure 1. Ferns (Strengé, 2020)



Figure 2. Bromeliads (Vanzile, 2021)



Figure 3. Succulent plants (Skiba & Esseveld, 2016)



Figure 4. Vines (O'Toole's Garden Centers, 2021)



Figure 5. Tradescantia and Pothos (Live Wall, 2021)



Figure 6. Devil's Ivy (Wolfe & Wolfe, 2020)

Green Wall Benefits

Green walls conserve energy, reduce sound transmission through buildings, and help in the treatment of grey water. It may shade and protect bare walls while also lowering surface and air temperatures. They can be employed as a feature in new construction as well as to retrofit existing structures. At scale, green walls can provide ecosystem services such as urban heat island reduction, water management, noise reduction, and improved air quality. Furthermore, their implementation may have other benefits, such as contributing to the aesthetic enhancement and recreational use of public places, enabling the use of urban agriculture, nourishing biodiversity, and increasing people's health and well-being.

Air Quality Improvement

Urban environments typically contain greater concentrations of air emissions that are harmful to human health. According to the European Environment Agency, urban residents are often subjected to levels of air emissions above the limit values. Plant types, depending on their shape and scale, can sequester atmospheric contaminants and ingest carbon dioxide to improve their vital functions. Evergreen conifers can be more beneficial than deciduous species as they hold their leaves all year long.

Energy Consumption Reduction

Green walls can increase energy efficiency in buildings. Performance varies according to system characteristics, physical characteristics of buildings and local climate conditions. Green walls can have an energy efficiency of 34% and living walls of 59% to 66% during the cooling time in the CSA climate, according to studies.

Sound Transmission Reduction

Few research studies show how the addition of a green wall can have a major effect on the reduction of sound transmission. Some authors have shown that green walls often have good sound absorption properties compared to other cladding materials.

Greywater Treatment

Local greywater recycling can save water by 9% – 46% (Manso, Teotónio, Silva, & Cruz, 2021) inside the household. Greywater use, providing simultaneous treatment, may be a cost-effective option to using freshwater to fulfil certain water needs in houses. If a greywater system is built in the house, no substantial additional costs are needed for the use of greywater as a green roof or green wall irrigation.

The mentioned benefits of green walls can be titled as environmental benefits. Green walls also have user-scale benefits like reducing psychological and physiological stress, increased sense of well-being, developing the ability to refocus attention, relaxation of the mind and reduction of mental stress, increased performance on cognitive tasks, faster recovery and pain tolerance for patients, more environmentally friendly approach.

Results and Discussion

The use of green walls has become a highly preferred trend in recent years, both in terms of aesthetics and because of its benefits. They can be used in many interiors. For example, restaurants, hotel lobbies, cafes, clinics, hospitals, residences, and offices are examples of these places. In this part of the study, the data obtained as a result of the survey study will be included. The survey was carried out with the participation of people aged between 18-75 living in the TRNC and Turkey. The survey study consists of three parts: personal information,

social information, and questions about the green wall.

Personal Information

In this part of the survey, questions of gender, age, nationality, educational status, and occupation were included.

Gender

Participation in the survey study was 58.5% female and male users were 41.3% (Figure 7). Participation in the survey was mostly female users.

Age

The response to the study was 38.5% between the ages of 18-25, 46.2% in the 26-40 age group, 13.1% in the 41-55 age group, 1.5% in the 56-65 age group, and finally 0.8% in the 66-75 age group (Figure 8). As a result of these data, the majority of the participants participating in the survey were between the ages of 26-40 and 18-25.

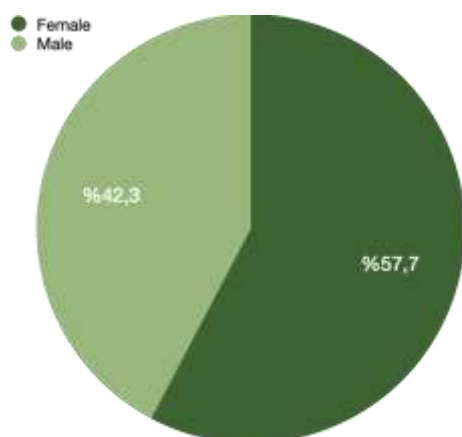


Figure 7. Gender graphic (Authors)

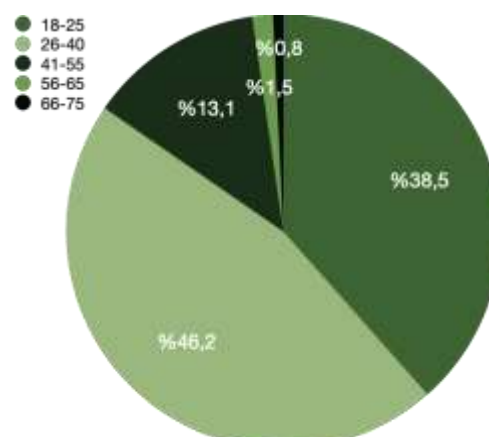


Figure 8. Age range graphic (Authors)

Nationality

Participation in the survey study is mostly from Turkey with 62.3%. Participation from the TRNC resulted in 37.7% (Figure 9).

Education Level

51% of the participants who participated in the study were university graduates, 32% higher education graduates, 14% high school graduates, and 1% primary and secondary school graduates (Figure 10).

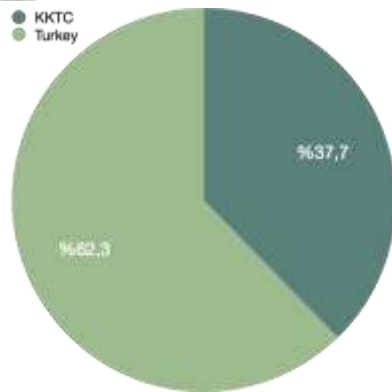


Figure 9. Nationality graphic (Authors)

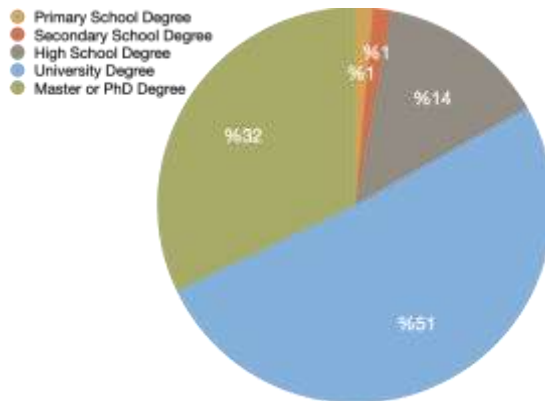


Figure 10. Education level graphic (Authors)

Occupation Status

37% of the participants are employed, 36% are students, 16% are unemployed and 11% are self-employed (Figure 11).

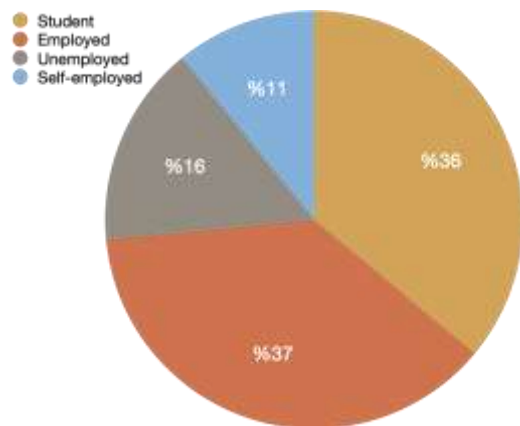


Figure 11. Occupation status (Authors)

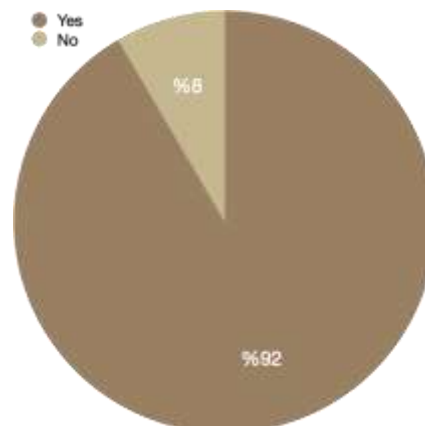


Figure 12. Whether or not the participant heard about sustainability (Authors)

Social Information

In this part of the survey study, seven questions were asked to the participants. In general, these questions consist of issues related to sustainability and green walls.

Have you ever heard about sustainability?

All 130 participants in the study answered yes or no whether they had heard of sustainability. The participants who answered yes resulted in 91.5% and 8.5% of the participants who answered no

(Figure 12). From this analysis, it has been understood that the majority of the participating springs have an idea about what sustainability is.

Do you know Green Walls are one of the most important key elements of sustainability?

Participants were asked for their opinions on whether green walls are an important element of sustainability. All the participants answered the question that was answered as yes or no. 60.8% answered yes, 39.2% no (Figure 13).

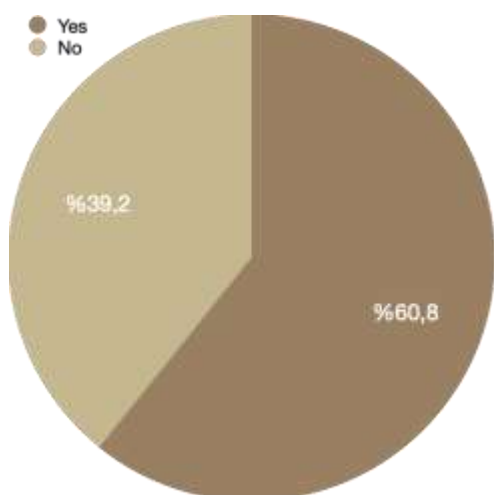


Figure 13. whether green walls are an important element of sustainability (Authors)

Do you know the difference between living walls and green façades?

Participants were asked whether they knew the difference between living walls and green facades, with yes or no answers. According to the answers of 130 people, 53.8% answered yes and 46.2% no, it was understood that most of the participants knew the difference between them (Figure 14).

Have you ever visited a place/space that has a green wall inside?

Participants were asked if they had ever been to a place with a green wall on the interior wall surface. While 68.2% said they had been when they answered yes, 31.8% said they had not been when they answered no. As a result, it was

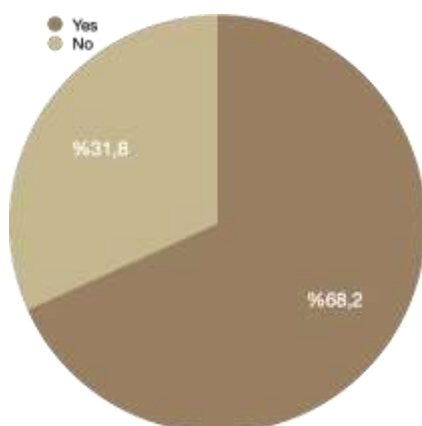


Figure 15. Whether they have been in a place with a green wall (Authors)

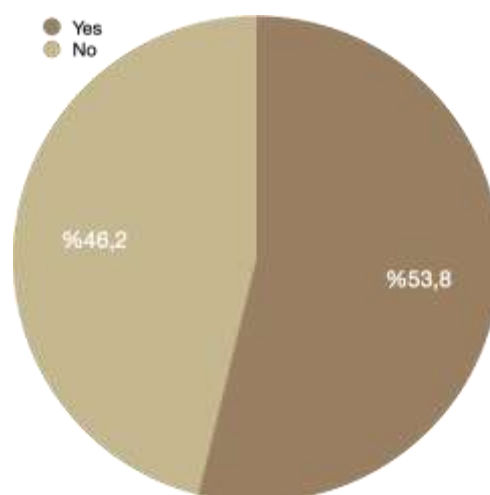


Figure 14. A living wall and green façade (Authors)

discovered that most of the participants were in a place with the green wall before (Figure 15).

If you visited a place/space that has a green wall, what was the place?

When the participants were asked where it was if they had previously visited a place with a green wall on the wall plane of the interior, 59.6% of them stated that they visited in a public place and 40.4% in private places (Figure 16).

What do you think about the use of the green wall in indoor spaces?

When asked whether the green walls used indoors are useful or not, 90.6% answered that they found it useful, and 9.4% answered that they did not find it useful (Figure 17).

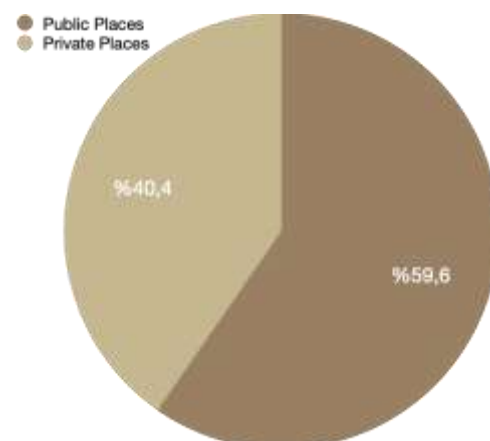


Figure 16. What was the place (Authors)

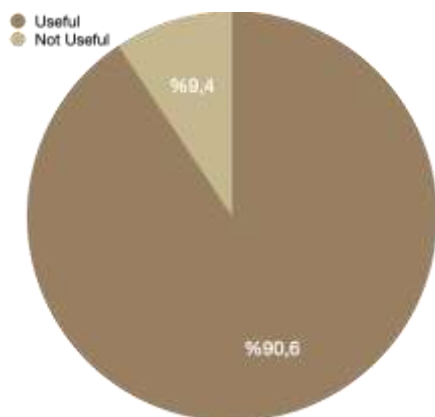


Figure 17. Useful or not (Authors)

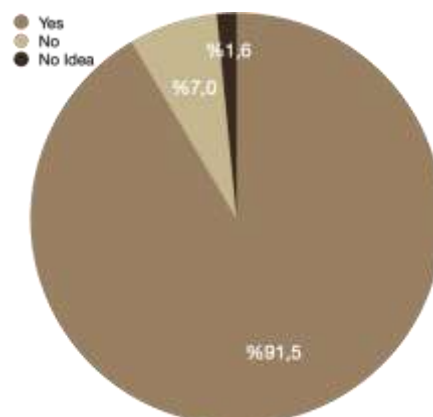


Figure 18. Different effects on the design of the spaces (Authors)

Do you think Green Walls have any different effects on the design of the spaces?

Participants were asked whether green walls have a different effect on interior design when used indoors. Of the responses received, 91.5% of the users thought that the use of green walls in the interior made a difference, 7% did not think that it made a difference, and 1.6% answered that they had no idea (Figure 18). At the same time, the interpretation of user opinions was also asked in this question, and some of the comments received are as follows:

- Helps to strengthen the indoor and outdoor connection.
- Visual beauty, psychological comfort.
- It offers a more friendly and spacious environment.
- Each space design is designed in line with human needs. Thus, I think that green walls have extremely positive and relaxing effects on human psychology.
- I think it is a more heart-warming design that reflects natural life.
- Green walls not only have very good visual effects in design but also have great effects on psychological and air cleanliness and temperature drops, depending on the areas in which they are used.
- By changing the general ambience of the place, they bring nature closer to us.

- If a live plant is used, I find it very useful because it provides oxygen regeneration in the space.

Green Wall

In this section, the participants were given certain green wall benefits based on the data obtained through the literature review, and they were asked to rate them as 1 strongly agree and 5 strongly disagree.

The Colour green gives relaxation.

The participants were asked to what extent they agreed with the relief of the green colour. According to the answers given, 50% of the participants strongly agree with the situation, 18% agree, 10.9% are not sure, 9.4% disagree, and finally 11.7% strongly disagree (Figure 19).

Green walls make the place more aesthetic.

The participants were asked their thoughts on how green walls could make a place more aesthetic, and to what extent they participated in the situation. According to the data obtained, 43.8% of the participants strongly agree, 20.8% agree, 14.6% are not sure, 8.5% disagree, and finally 12.3% strongly disagree (Figure 20).

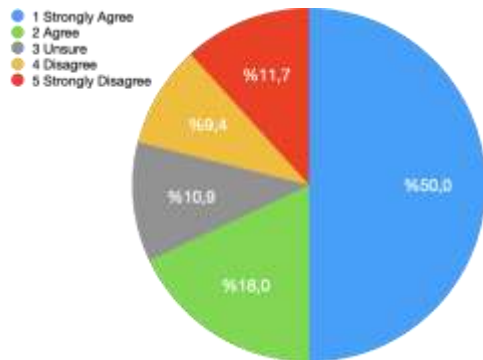


Figure 19. Giving relaxation (Authors)

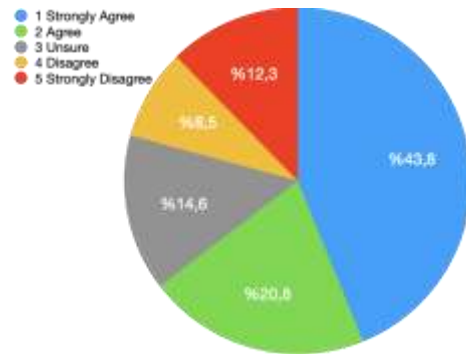


Figure 20. Making the place more aesthetic (Authors)

Green walls can reduce psychological and physiological stress.

Participants were asked to rate the situation where green walls prevent psychological and physiological stress. 50% of the responses strongly agree, 20% agree, 10.8% are not sure, 6.2% disagree and 13.1% strongly disagree are the other responses (Figure 21).

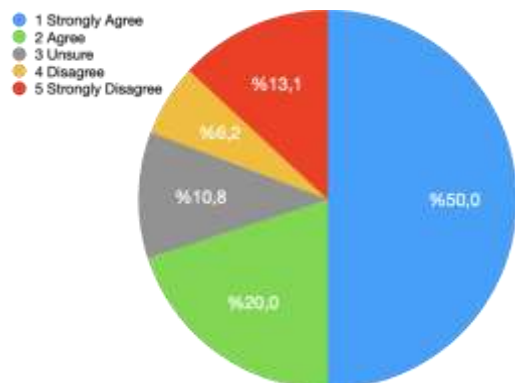


Figure 21. Reducing psychological and physiological stress (Authors)

Green walls develop the ability to refocus attention.

Participants were asked to rate whether green walls helped refocus. While 30.8% of the participants strongly agree with the given situation, 21.5% agree, 28.5% are not sure, 10.8% do not agree, and finally, 8.5% strongly disagree (Figure 22).

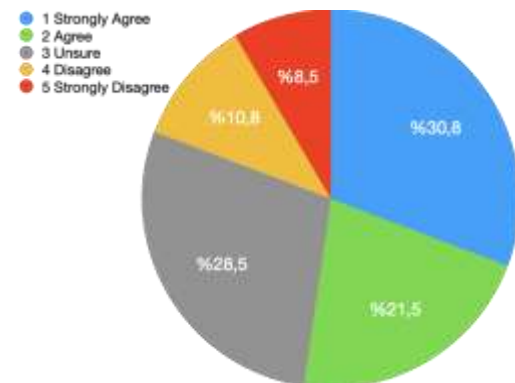


Figure 22. Ability to refocus attention (Authors)

Green walls can improve the air quality of the room.

It was requested to evaluate the situation where green walls renew and improve the air in the room. 42.6% of the participants strongly agree with the given situation, 17.8% agree, 17.1% are not sure, 7.8% disagree and 14.7% strongly disagree (Figure 23).

Green walls can make energy saving.

Participants were asked to rate whether they agree with the issue that green walls save energy. While 30% of the answers strongly agree with the given situation, 16.9% agree, 24.6% are not sure, 12.3% disagree and 16.2% strongly disagree (Figure 24).

1 Strongly Agree
2 Agree
3 Unsure
4 Disagree
5 Strongly Disagree

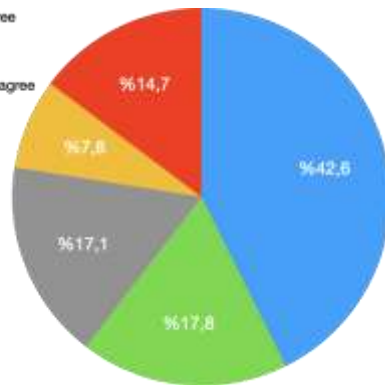


Figure 23. Improving air quality (Authors)

Green walls can reduce the sound therefore it can provide privacy.

The participants were asked whether they support the situation where green walls do not absorb sound and provide privacy, and they were asked to evaluate. According to the answers given by the participants, the rate of strongly agreeing with the given situation was 29.5%, the rate of agreement was 20.9%, the rate of being unsure was 20.2%, the rate of disagreement was

1 Strongly Agree
2 Agree
3 Unsure
4 Disagree
5 Strongly Disagree

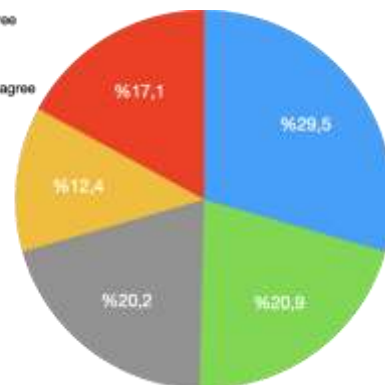


Figure 25. Providing privacy(Authors)

Green walls can arrange the room's humidity.

The participants were asked to evaluate the balancing of the indoor humidity of the green walls. According to the evaluation given, the participants strongly agree with the situation 32%, agree 16.4%, be unsure 23.4%, disagree 14.1% and strongly disagree 14.1% (Figure 27).

1 Strongly Agree
2 Agree
3 Unsure
4 Disagree
5 Strongly Disagree

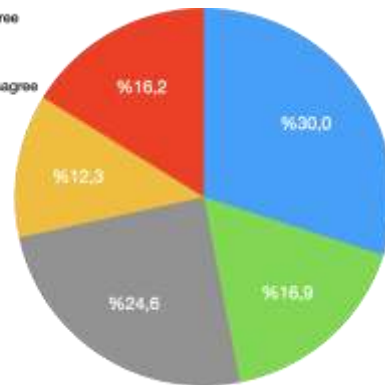


Figure 24. Making energy (Authors)

12.4%, and the rate of strongly disagreeing was 17.1% (Figure 25).

Green walls can arrange the room temperature.

Participants were asked to rate the green walls balancing the indoor room temperature. While 27.7% of the participants strongly agree with the given situation, 22.3% agree, 22.3% are not sure, 8.5% disagree and 19.2% strongly disagree (Figure 26).

1 Strongly Agree
2 Agree
3 Unsure
4 Disagree
5 Strongly Disagree

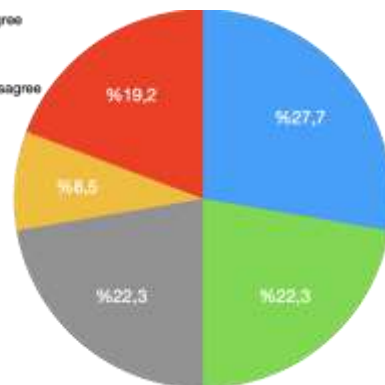


Figure 26. Arranging the rooms' temperature (Authors)

Green walls can improve human health.

The positive effects of green walls on human health were asked and the participants were asked to evaluate how much they participated in this situation. While 38.8% of the participants strongly agree with the given situation, 18.6% agree, 21.7% are not sure, 9.3% disagree and 11.6% strongly disagree (Figure 28).

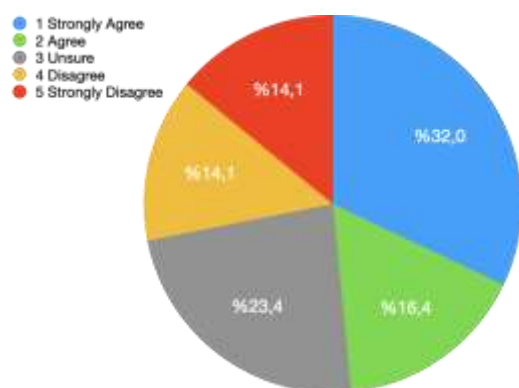


Figure 27. Arranging the rooms' humidity (Authors)

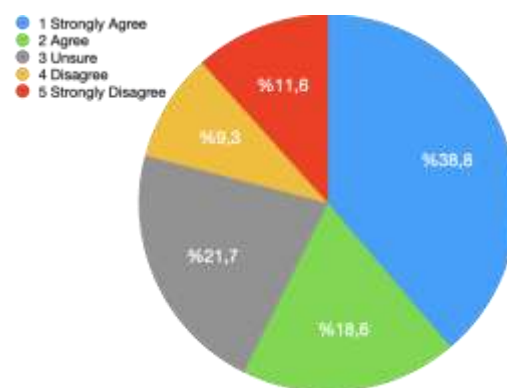


Figure 28. Improving human health (Authors)

Findings and Results

It was analysed that female user, 18-25 and 26-40 age groups, university graduate users and working users mostly responded to the survey study. It was learned that most of the participants had heard of the concept of sustainability before. It has been observed from the answers received that green walls are known to be an important element of sustainability. Most of the participants know the difference between a green facade and a living wall. According to the answers, more than half of the users who participated in the survey stated that they had been in a place with a green wall in their interior before. According to the answers to the question of whether the place they visited was a public place or a private place, it was learned that more than half of the users who participated in the survey visited a public place. At the same time, users think that the use of green walls in the interior is beneficial for the place and themselves. Accordingly, it has been analysed that they think that the use of green walls in the interior has different effects on interior design. According to user comments, green walls refresh a space, strengthen the connection between indoor and outdoor, add psychological relaxation and visual pleasure, bring the natural environment indoors, renew and strengthen the oxygen in the interior, and are therefore beneficial for human health.

According to half of the users participating in the survey, the green colour gives people peace of mind. While 43.8% of the participants strongly agree that the use of green walls makes a place look more aesthetic, 12.3% strongly disagree. According to the answers, half of the users who participated in the survey strongly agree that green walls reduce psychological and physiological stress, while 13.1% strongly disagree. While 30.8% of the participants think that green walls help them to focus again, 8.5% strongly disagree. 42.6% of respondents think

that green walls improve indoor air quality. While 30% of the answers to the survey study strongly agree that green walls save energy, 16.2% strongly disagree. The green walls have many indentations and protrusions due to the plants it contains, so the sound does not hit these volumes and pass behind the plane, and its spread in the room is low. Depending on this situation, 29.5% of the users completely agree with the privacy that can be achieved due to the soundproofing of the green walls, while 17.1% strongly disagree. While 27.7% of users strongly agree with the green wall's ability to regulate indoor temperature, 19.2% strongly disagree. At the same time, 32% of users strongly agree with green walls' ability to regulate indoor humidity, while 14.1% of users strongly disagree. According to the answers to the survey, 38.8% of the participants think that green walls have positive effects on human health, while 11.6% of them do not.

Conclusion

This study was conducted to analyse the effects of green walls on users, to investigate and evaluate the benefits of using green walls in spaces, and to guide the widespread use of green walls in future projects. In this context, both quantitative and qualitative research methods were used in the research by making a literature review and a questionnaire study.

Green walls are one of the green infrastructure systems that help prevent environmental problems such as global warming and climate change. Green walls are constructed by planting an interior wall or a building's exterior wall plane. The green walls used in the interior are called living walls, and the green walls used in the exterior wall are called green facades. Living walls are modular if stacked using containers with fillers such as earth or minerals; by using permeable layers such as foam or felt, plants can

be built in a continuous form if they are added to this system separately. Green facades are constructed by attaching plants directly to the wall plane or indirectly mounting them to the wall plane with modular guides such as traction cables, gratings, stainless steel ropes. At the same time, the use of special boxes positioned at intermediate heights or on the ground can be seen on green facades. According to the data analysed as a result of the literature review, the construction method of green walls was examined in four types, such as the tree-based type, the wall-climbing, the hanging type, and the module type in some studies, as well as the information mentioned in some studies. Plants used in the type based on the tree wall can cover the surface of the wall as it is. The wall-climbing type is the type that is used quite a lot in traditional architecture. In this system, which has a simple structure, cages can be used to lengthen the plants, and the surfaces of the wall facades can be covered with plants. When the hanging types are examined, they are long-stemmed plants that are used hanging on the balconies of the facades or the tops of the buildings. Plants used in modular type have the advantage as they can be changed quickly when deformed. In this system, colourful, showy, different varieties and easy growing plants are preferred. It is preferred to use long-lived plants that are easy to care for, such as succulent plants, vines, and moss on green walls.

Green walls, which have an important role in ensuring the continuity of sustainability, provide benefits to both the environment and people. When these benefits are examined, it is observed that green walls increase the air quality, regulate and clean the airflow in the space, and make positive contributions to the environment by keeping the humidity and heat balances under control. The plants selected according to the climatic characteristics of the region to be used and the green walls designed to meet the needs of the environment have effects such as carbon emission and energy saving. In addition to such environmental benefits, there are also benefits that it creates for humans. Green walls reduce both psychological and physiological stress. The visual perception created by the green colour and plants gives a feeling of comfort by leaving a calm and peaceful impression on people. It provides the opportunity to regain the ability to focus by reducing mental stress. While an increase in the performance of cognitive tasks can be observed, it can also create benefits in the field of health by affecting the rapid recovery of sick users.

According to the majority of male and female users between the ages of 18-75 living in Turkey and the TRNC who participated in the survey, they answered that the green walls used in the interior have a different touch in the interior design and are beneficial for the space and the user. More than half of the participants in the study have an idea about the concept of sustainability and have been in a place where a green wall is used indoors. In general, the green colour gives a sense of comfort to half of the users surveyed. At the same time, nearly half of the participating users think that green walls add aesthetic beauty to the interior. Half of the participants agree with the reduction of physiological and psychological stress, while 30.8% agree with the improvement of the ability to refocus. The participants stated that they agreed with the role of green walls in improving air quality with 42.6%. While 30% of users strongly agree with the energy-saving of green walls, 16.9% only agree. 29.5% of users think that green walls provide privacy as they are soundproof. 27.7% of users strongly agree that green walls can adjust the room temperature, while 22.3% only agree. And at the same time, 32% of users think about the contribution of green walls in regulating indoor humidity, while 16.4% only think about it. The rate of users who think about the positive effects of green walls on human health is 38.8%, and the rate of users who only think about it is 18.6%.

In this context, the answers to the survey study were analysed and the benefits of the use of green walls indoors on the user were interpreted according to the opinions of the users living in Turkey and the TRNC. The increase in the use of green walls indoors in Turkey and the TRNC and their use in future projects will create positive effects for users. This research, which was made as a result of the data obtained, is important in terms of being an example for the studies and designs to be made and being used as a source.

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