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A Review on Interiorscaping: Naturalizing Interiors

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

People in today's society spend the majority of their waking hours indoors. Individuals are increasingly separated from nature in the fast-paced metropolitan surroundings of the twenty-first century, leading to a variety of physical and mental health concerns. Even in the United States, there are about 27 million office employees who could get sick building syndrome. Interiorscaping addresses this gap by incorporating natural components into indoor settings, which promotes better air quality, stress reduction, and increased productivity. Interior landscaping is the practice of growing and arranging plants indoors. To enrich and enhance the look of the indoor environment, it entails choosing, installing, and maintaining plants. Indoor plants, green walls, and sustainable

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design ideas all contribute to healthier, more enjoyable living and working environments. The benefits of indoorscaping are: provides privacy, screens unpleasant view, define space, controls traffic, glare reduction, softening architecture. Different types of indoorscaping are being used like: vertical garden, softscaping, terrarium, dish tray garden, hanging garden, windowsill garden, waterscaping, aquascaping, etc. With growing concerns about climate change and the need for environmentally friendly practises, introducing greenery into indoor areas can help with carbon sequestration, energy conservation, and overall ecological balance. Today, Interiorscaping use both modern technology and the experience of nature, which leads to increased creativity and productivity and, in the end, the creation of spaces that has soothing effect on our mind and soul. Hence, not only would interior landscaping save power consumption but also foster the development of human energy in our homes, businesses, neighborhoods and cities.

Keywords: Indoorscaping; interiorscaping; ornamental plants; softscaping; urban landscaping.

1. INTRODUCTION

Plants were primarily utilized in the past for aesthetic, recreational, or fashion purposes. People now spend 80–90% of their time indoors due to increased building and lifestyle changes. As a result, modern cities face a number of health issues and societal challenges, including urbanization, climatic changes, ecological issues, environmental quality, and sustainable development [1,2,3,4,5]. Today, plants are utilized for economic, architectural, and most recently, health purposes. In this age of digital era, people are more focused now on creating an ecological space that mimics a natural environment [6]. It has been discovered that spending time outside in nature offers significant physiological and psychological health advantages. Making indoor gardens therefore gives us many opportunity to appreciate greenery in our daily lives and develops our passion for nature while also reaping its advantages [7,8,9,10].

The art and science of cultivating and arranging plants indoors is known as interiorscaping/ indoorscaping/ plantscaping. To enrich and enhance the look of the indoor environment, it entails choosing, installing, and maintaining plants. It is the use of ornamental plants for functional and aesthetic purposes. The first modern interior landscape on a grand scale was installed in 1967 in the Ford Foundation Building in New York [11]. Interiorscaping began in the early 1970s to create an outdoor-like environment for office workers and mall shoppers [12].

1.1 Need for Interiorscaping

1. Increased Urbanization: Urban lifestyle is associated with a number of detrimental effects on human health, including nitrogen and carbon dioxide pollution, heavy metals, radioactive materials, benzene, and others [13,14,15]. These pollutants are linked to a number of health concerns, including stroke, cardiovascular disease [16], lung cancer [17], chronic and acute respiratory disorders, headaches, dizziness, disruption of the immunological and reproductive systems [18] and premature deaths [19,20, 21,22].

2. Indoor Air Quality: More than 900 volatile organic compounds (VOCs) were found by the U.S. Environmental Protection Agency (EPA) in the air of public buildings [23]. Volatile organic compounds (VOCs) harm indoor air quality [24] and can cause acute illnesses and chronic diseases [25]. (Table 1).

3. Sick Building Syndrome**:** At times of peak heating and cooling demand, more air is recycled inside modern air-conditioned buildings than is exchanged with the outside environment, which could contribute to sick building syndrome [26,27]. According to the World Health Organization's June 1982 Report, some Sick Building Syndrome symptoms are categorized as illnesses, including eye, nose, and throat irritation, dry skin, dry mucous membranes, erythema (skin rash), mental exhaustion, headaches, high frequency of airway infections and cough, hoarseness and wheezing, hypersensitivity, nausea, and dizziness [28,29].

Table 1. Sources of indoor pollutants [30,31,32]

Pollutant	Source
Formaldehyde	Plywood, particle board, foam insulation clothes, carpeting, furniture and paper goods
Benzene	Gasoline, synthetic fibres, tobacco smoke, plastics, inks, oils and detergents
Trichloroethylene	Gasoline, synthetic fibres, tobacco smoke, plastics, inks, oilsand detergents

Table 2. Plants that remove pollutants [30,31,32]

Pollutant	Plants
Benzene	*Dracaena marginata, Hedera helix, Dracaena deremesis "Janet Craig", Dracaena deremensis "Warneckei, Spathiphyllum "Mauna Loa", Chrysanthemum morifolium, Gerbera jamesonii*
Trichloroethylene (TCE)	*Chrysanthemum morifolium, Gerbera jamesonii, Spathiphyllum "Mauna Loa",Dracaena marginata, Dracaena deremensis "Warneckei*
Formaldehyde	*Dieffenbachia* sp., *Azalea* sp., *Philodendron* sp., *Chlorophytum elatum, Epipremnum aureum, Chamaedorea seifrizii, Dracaena massangeana, Chrysanthemum morifolium*

1.2 Benefits of Interiorscaping

It improves the building's overall aesthetics, increases the building's worth, and subtly defines the interior spaces. It reduces physiological and psychological stress and increases productivity [33,34], reduces anxiety, improves mental and physical health [35,9], helps in faster recovery from illness [36,37], reduces noise levels [38] and improves air quality [39,40,41].

Office workers' general quality of life and job happiness are positively impacted by plants, vistas of green spaces outside their windows, or both [42]. Pollutants can be removed from the air in an ordinary house or workplace by one potted plant per 100 square feet of indoor area [43]. It also helps in cooling down the air and room indoor temperature [44,45], reduction in complaints of symptoms associated with "Sick Building Syndrome" [38] and helps in energy conservation [46]. Plants have been investigated to help in physical and mental stress reduction [47] and increase attention capacity of students [48] in schools (Table 2).

2. TYPES OF INTERIORSCAPE

Indoor Gardens: Green plantations that are shown indoors in a constrained, well-lit space are referred to as "green gardens" or "indoor plantations." This design is appropriate for room dividers, transitional areas in buildings, and courtyards. Indoor plants live as part of their three-dimensional surroundings and interact with humans in a variety of ways. A plant produces oxygen while converting carbon dioxide, light, and water into energy through the process of photosynthesis. Other creatures require oxygen to thrive, and these processes contribute to the Earth's carbon and oxygen cycles [49]. The process through which water moves from the root to the leaves of plants, where it evaporates and is discharged into the atmosphere is called transpiration. In this way through photosynthesis and transpiration, humidity and temperature is regulated by plants indoors [50,51,52].

This kind of interiorscape comprises moveable containers with flowers, plants, bushes, trees, and flowerbeds. This category of indoor plants includes single, multiple, or plant beds with various plant combinations. While plant beds are fixed elements, planters are moveable. A drainage system should be used to eliminate water, and plant beds must be well-insulated.

Window-sill gardens and hanging baskets fall into this category. For indoor landscaping in urban environments, Aglaonema modestum and Scindapsus aureus both have high APTI indices [53].

Plants suitable for indoor gardens: *Chamaedorea seifritzii*, *Philodendron scandens*, *Chlorophytum*, *Spathiphyllum sp*., *Asplenium nidus*, *Scindapsus aureus*, *Nephrolepsis* sp., *Philodendrons scandens, Cissus repens, Ficus pandurata*, *Ficus lyrata*, *Zamioculcas zamiifolia*, *Hedera helix, Begonia semperflorence, Sedum morganianum*) *Stapelia nobilis*, *Mesembryanthemum crystallinum, Schlumbergera truncata*, *Hoya carnosa* etc.

Vertical wall: Botanist Patrick Blanc, who was named an honorary fellow of the Royal Institute of British Architects, created the Vertical Garden. He received a patent for his first green wall, dubbed a "vertical garden." Stanley Hart White created and patented a green wall system in the late 1930s [54]. Most vertical surfaces in nature lack soil, which creates well-drained growth environments [55]. They improve urban biodiversity and subsequently the urban environment by allowing natural plants to colonise these systems [56,54]. Vertical gardens, green walls, living walls, and eco walls are other names for green walls. A vertical garden is a great way to include lovely plants in areas where there are no horizontal spaces for them. These are vertically grown green installations that use hydroponics or drip irrigation. Vertical gardens can make use of various modular panel types, geotextile fabrics, growing mediums, and irrigation systems. There are currently over 1000 vertical gardens around the world. Adopting living walls enhances the visual and aesthetic qualities of indoor environments [57,58,59]. The proper plant selection is critical in the design and operation of vertical living wall gardens. Not every plant can survive the vertical spaces. Species selection should be based on the climate and the design criteria for the particular type of the living wall system [60]. (Fig. 1) (Table 3).

Plants Suitable for vertical wall: *Pseudorhipsalis ramulosa, Ophiopgon japonicas, Anthurium crystallinum, Monstera delicosa, Aeschynanthus radicans, Chlorophytum bichetii, Cercestis mirabilis, Philodendron moonlight, Dracaena surculosa, Echinodosus cordifolius, Philodendron moonshine, Geogenanthus undatus Asplenium thunbergii, Monstera obliqua, Neoregelia carolinae, Nephrolepsis biserrata, Alocasia sanderiana, Ophiopogon jaburan, Syngonium podophyllum, Caladium lindenii, Anthurium andraeanum, Monstera karsteniana, Philodendron erubescens, Calathea makoyana, Phyllanthus myrtifolius, Philodendron cordatum, Philodendron Imperial Red, Peperomia caperata, Nephrolepis exaltata, Scindapsus pictus, Selaginella wallichii and Syngonium podophyllum, etc.*

In today's society, vertical gardens have an environmental, economic, and social impact. It helps in reducing temperature [61,62], regulating microclimate and decreasing the urban heat island [63,64]strengthening air quality [65,66], boosting energy efficiency [67,61,68], rainwater retention [69] as well as improving biodiversity. Economically, it improves acoustic insulation [69,70,68]. Green walls improve happiness and health by providing considerably better indoor conditions, primarily in terms of reduced CO2 concentration and higher relative humidity. Thus, green features have a tremendous influence on the indoor microclimate [71]. Plants like Mondo grass (*Ophiopogon japonicas*), Spider plant (*Chlorophytum comosum*), Moses-in-the-cradle (*Tradescantia spathaceace*) and Asparagus fern (*Asparagus densifolus*) thrive well in the indoor conditions [72].

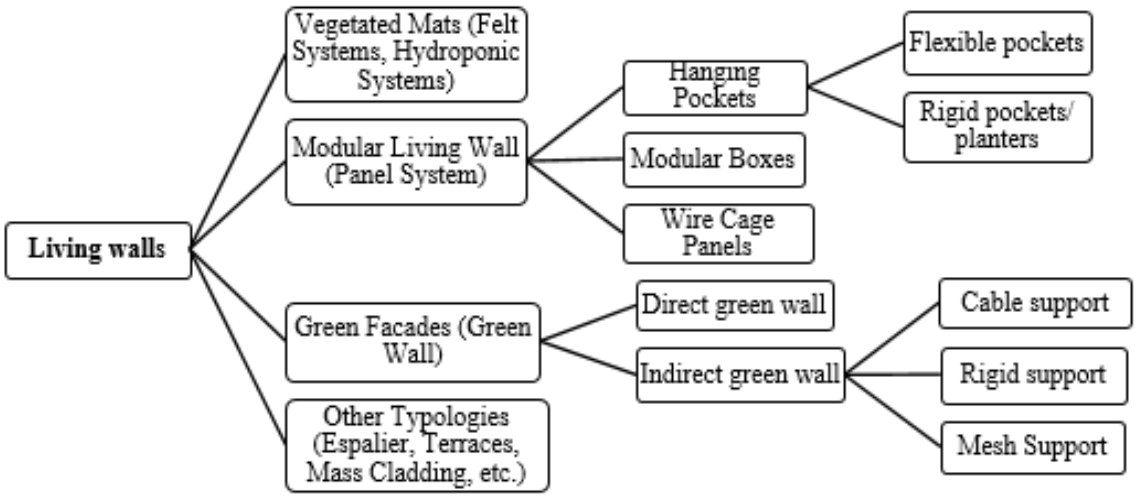

Fig. 1. Classification of vertical wall

Table 3. Plants and medium required for various types of vertical gardens [73]

Vertical garden type	Plant	Construction type	Media
Wall climbing	Climbing plants	The necessity for supporting construction is minimal.	soil in a planting box or on the ground
Hanging down	Plants with downward growth pattern	According to the story, planter boxes and supporting structures should be constructed	Soil in planted box on every storey of a building
Modular	Short plants	Facades should be created with supporting structures for hanging or putting modules	Lightweight artificial growth medium panel

Table 4. Plants suitable for Terrarium [74]

Pilea glauca	Peperomia prostata	Nephrolepis exaltata 'Fluffy Ruffles'	Marcgravia sintenisii	Selaginella uncinata
Ficus pumila	*Humata heterophylla*	*Dischidia ovata*	*Bolbitis heteroclite 'Difformis'*	*Fittonia albivenis*
Dicranum scoparium	*Selaginella kraussiana 'Aurea'*	*Hypoestes phyllostachys*	*Ophiopogon planiscapus*	*Asplenium bulbiferum*
Saxifraga stolonifera	*Asparagus aethiopicus*	*Hedera helix*	*Calathea makoyana*	*Dionaea muscipula*
Muehlenbeckia complexa	*Chlorophytum comosum*	*Soleirolia soleirolii*	*Epipremnum aureum*	*Sphagnum capillifolim*
Tillandsia	*Pilea cadierei*	*Polystichum Tsus-Sime*	*Peperomia obtusifolia*	*Acorus gramineus 'Minimus Aureus'*
Aphelandra squarrosa	*Echeveria elegans*	*Syngonanthus chrysanthus*	*Neoregelia Tricolor x fireball*	*Cryptanthus bivittatus*

Terrarium/ Bottle garden: A terrarium is a tiny landscape that grows in a closed glass or plastic container with a high moisture retention capacity and is used for displaying or keeping plants [74]. The terrarium was invented in 1850 and was originally used to carry living plants from far parts of the world when sea voyages took months or years. These gardens may generally be stored on any smooth surface without worrying about rotting due to water seepage because they don't have any drainage holes for water. With proper maintenance, a terrarium will produce a humid environment that will safeguard sensitive, tropical plants that are difficult to cultivate in our homes' generally dry atmosphere. They come in two varieties: open and covered. Three layers are required: the drainage layer, the soil layer, and the plant layer. The "expressive terrarium" is a brand-new intervention technique in the field of ecological arts therapy. It could be applied to community-based interventions in schools and colleges, individual and group therapy and more [75]. (Table 4).

Dish & tray garden: A dish garden is a collection of plants that are grown in a shallow dish or bowl. The dish garden is a tiny ecosystem that can be landscaped to resemble a scene in nature. Shallow container of two inches deep preferably ceramic is recommended . Yar and Kazemi investigated how dish gardens helped hospitalised children's physical and neuropsychological development. Results showed that the intervention increased relaxation indicator, neuropsychological indicator, reduced anxiety and depression in the experimental group [76].

Plants suitable for dish/tray garden: Blooming plants**-** Bromeliads, *Kalanchoe blossfeldiana*, *Cyclamen persicum*, *Rosa chinensis* var. minima, *Saintpaulia ionantha*, Begonia sp. , *Hatiora gaertneri*, *Chrysanthemum indicum*, *Schlumbergera bridgesii*, *Euphorbia pulcherrima*; Trailing plants- *Epipremnum pinnatum*, *Syngonium podophyllum*, *Philodendron bipinnatifidum*, *Philodendron hederaceum*, *Hoya carnosa*, *Hedera helix*, *Ficus*

pumila ; Upright plants: *Aglaonema commutatum*, *Dieffenbachia seguine*, *Chamaedorea elegans*, *Spathiphyllum wallisii*, *Peperomia obtusifolia*, *Dracaena trifasciata*, *Crassula ovata*, *Pellaea rotundifolia*, *Asplenium nidus*, succulents, etc.

Stonescaping: Stone and plants are combined in a landscape using rocks, stone gardens, and stone landscaping to define space and create a beautiful natural setting. It is a low- maintenance option to green gardens due to its anti-weather qualities. Stone gardens are frequently used in Japanese landscapes to create a pleasant living environment. They're mostly made of pebbles and tiles. The use of varied stone sizes and forms achieves massing. However, it has now taken up residence in India's major cities. Entrance lobbies, courtyards, meditation areas, and other areas where it can connect with the outside environment are all excellent places for this kind of interior gardening.

Plants suitable for stonescaping: *Sedum* spp., *Cupressus semperviren*, *Lithops francisci*, *Crassula ovata*, *Kalanchoe blossfeldiana*, *Portulaca grandiflora*, *Aeonium undulatum*, *Aloinopsis rubrolineata*, *Glottiphyllum linguiforme*, *Dudleya pulverulenta*, *Echeveria* spp., *Haworthiopsis attenuata*, *Graptopetalum paraguayense*, *Hylotelephium paraguayense*, *Jovibarba globifera, Sedeveria letizia*, *Sinocrassula yunnanensis*, *Stapelia gigantea*, *Tylecodon buchholzianus*, *Adromischus cristatus*, *Fockea edulis*, *Argyroderma testiculare*, *Caralluma adscendens*, *Conophytum ficiforme*, *Malephora crocea*, etc [77].

Waterscaping: A calming effect is produced by water gardening. It has been demonstrated that waterscapes are more advantageous to psychological and mental health than green spaces [78]. In lobbies, restaurants, meditation spaces, and corridors, it incorporates fountains, ponds, streams, or miniature waterfalls. Through mitigation and restoration techniques, waterscapes, which are landscapes containing a sizable body of water and include streams, rivers, lakes, wetlands, the shoreline, and their riparian zones, can promote psychological health [79,80]. By lowering noise and enhancing the urban soundscape, running water sounds can help enhance psychological and mental health [81].

Plants suitable for indoor pool plants: *Acorus calamus*, *Cypress* spp., *Ficus elastica*, *Nymphea* spp., *Howea forsteriana*, *Strelitzia reginae*, *Pistia stratiotes*, *Zantedeschia aethiopica*, *Dypsis lutescens*, *Caryota urens, Veitchia merrillii, Washingtonia robusta, Washingtonia robusta,* etc.

Kokedama: It is a japanese variant of bonsai, literally translates to “moss ball” [82]. The plant is placed in the centre of a circular root ball that has been moulded into that shape. Materials required to make Kokedama are peat moss, akadama soil and sphagnum peat moss. Akadama soil is mined in Japan from volcanic soil and has the ability to absorb water while spreading nutrients to the roots.

Plants suitable for kokedama: *Epipremnum pinnatum*, *Noeregelia ampullaceal, Pilea polybotrya*, *Peperomia griseoargentea*, *Codiaeum variegatum*, *Chlorophytum comosum*, *Spathiphyllum wallisii*, *Fittonia albivenis*, *Davallia fejeensis*, *Ficus retusa*, *Zamioculcas Zamiifolia*, etc.

Aquascaping: Aquascaping is the art of aesthetically arranging water plants, stones, cave art, driftwood, or pebbles in an aquarium [83]. An aquascape is an ecosystem in which each living and nonliving component contributes to the biological and chemical harmony necessary for the plants and animals to coexist in the enclosed aquatic habitat, as well as to the aesthetic attractiveness of the aquarium. Aquascaping can be done in a variety of ways, including Dutch, Japanese, natural, Iwagumi, Jungle, Biotype, and Paludarium designs. Iwagumi design is currently among the most well-liked aquascaping trends out of all of them. [84].

Plants suitable for aquascaping: *Hemianthus callitrichoides*, *Anubias afzeli, Vesicularia montagnei*, *Microsorum pteropus*, *Hemianthus micranthenoides, Rotala wallichil, Cypres helfen, Rotala rotundifolia*, *Barelaya longifolia, Hygrophila corymbosa, Lemna sp., Pistia stratiotes, Salvinia auriculata* etc.

Holyscaping: There are some plants that are considered sacred in India. Installing a statue of the deity or scripture and surrounding it with plants like Tulsi (basil), Kunda (star jasmine), Champa (Indian magnolia), and Lotus creates a holy scape.

Plants suitable for Fengshui/ Vastu: Rubber tree (*Ficus elastica*), Citrus tree (*Citrus limon, Citrus sinensis*), Peony (*Paeonia lactiflora*), Chinese money plant (*Pilea peperomioides*),

Orchids, Fern (*Polypodiopsida*), Money tree (*Pachira aquatic*), Lucky Bamboo (*Dracaena sanderiana*), Jade (*Crassula ovata*), Snake plant (*Sansevieria trifasciata*), Peace lily (*Spathiphyllum*), Pothos (*Epipremnum aureum*), Calathea (*Calathea makoyana*), Aloe (*Aloe barbadensis*), etc.

Micro-farming: Micro farming is a low-input, high-yielding type of farming that is often carried out manually in urban or suburban areas. To maintain the natural fertility of the land, modern micro farmers combine high-tech advancements with conventional methods. The only difference between it and green gardens is that the plants are gathered for later use. For indoor plants, such as tomatoes, spinach, herbs, and some floral plants, it is ideal.

3. CONCLUSION

Interiorscaping not only serves the aesthetic purposes in indoor spaces but also have various functional and architectural purposes such as air purification, disinfection, humidifier, traffic control, acoustic balance ,etc. Interiorscaping has been and will be an integral part of our life after COVID-19 pandemic. Hence, Interiorscaping creates a spaces that has soothing effect on our mind and soul. Despite being mostly tropical species, indoor and interior landscape plants can be used all over the world. Additionally, research reveals that indoor plants provide advantages for people's psychological, physiological, and cognitive health in addition to cleansing the air. The benefits of using vegetation in indoor environments extend beyond the impact of plants on indoor air quality [85].

4. FUTURE SCOPE OF INTERIOR-SCAPING

The future scope of interiorscaping is promising, with several trends and developments suggesting a continued and growing importance in various domains. Here are some key aspects that contribute to the future scope of interiorscaping:

- Increasing awareness of the impact of indoor environments on mental health and well-being will drive a greater demand for interiorscaping. Green spaces have been shown to reduce stress, enhance mood, and improve overall mental health.

- Biophilic design principles, which emphasize a connection to nature in the built environment, will become more prevalent. Interiorscaping aligns well with these principles, leading to an increased adoption of green elements in interior design.

- As sustainability becomes a central concern in architecture and design, interiorscaping offers a solution by contributing to improved indoor air quality, energy efficiency, and reduced environmental impact. The use of eco-friendly materials and sustainable design practices will be a key focus.

- In urban planning, there will be a greater emphasis on incorporating green spaces within buildings and public spaces. Residential developments will increasingly feature interiorscaping as a selling point, contributing to a higher quality of life for residents.

- The growing interest in interiorscaping will lead to increased demand for professionals with expertise in horticulture, landscape design, and interior architecture. This will create opportunities for education and training programs catering to the specific needs of the interiorscaping industry.

By recognizing its significance in promoting human well-being, environmental sustainability, and economic viability, stakeholders in architecture, interior design, and urban planning can contribute to creating healthier, more sustainable, and aesthetically pleasing environments for current and future generations. In conclusion, the future of interiorscaping looks dynamic and promising, driven by a combination of factors including a growing awareness of well-being, sustainability concerns, technological advancements, and evolving design preferences. As the importance of creating harmonious indoor environments becomes more apparent, interiorscaping is likely to play a central role in shaping the future of architecture and design.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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