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A Review Paper on Role of Indoor Plants in Interior Environment

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ABSTRACT

Numerous advantages of indoor plants in the indoor environment have been discovered, including better air quality, humidity control, and noise reduction. Studies have demonstrated that different plant species and sizes can have different effects on the indoor environment, and that appropriate placement and arrangement can increase their influence. These results have significance for design and policy since indoor plants can be incorporated into the designs of architects and designers to make indoor spaces healthier and more inviting. Additionally, regulations might be set up to promote the usage of indoor plants in businesses and public spaces. Future studies can examine the effects of indoor plants on particular features of the indoor environment as well as the best practices for their upkeep. However, keeping and caring for indoor plants can be difficult, and there are also some health dangers for sensitive people. Indoor surroundings also have constraints that may hinder the development and survival of indoor plants.

Keywords: indoor plants, air quality, dehumidifier, noise, maintenance, limitations

INTRODUCTION

Indoor plants have been used for centuries for their aesthetic and functional purposes. Not only do they add natural beauty and visual interest to indoor spaces, but they also have the ability to improve the quality of the indoor environment. Indoor air quality is a major concern in modern buildings, as many indoor pollutants can have adverse effects on human health. Indoor plants have been found to be effective in removing harmful toxins from the air, including formaldehyde, benzene, and trichloroethylene.[1] Additionally, plants can regulate humidity levels, reduce noise, and improve the overall ambiance of indoor spaces. As a result, indoor plants are becoming common in both residential and commercial design. In addition to their visual appeal, plants have a favourable impact on the indoor environment, that's why architects and designers are including them in their designs.

LITERATURE REVIEW

Improved Air Quality- By eliminating dangerous contaminants from the air, indoor plants can improve the quality of the air. Due to the use of specific building materials and household items, interior environments frequently contain toxins like formaldehyde, benzene, and trichloroethylene.[1] NASA research has shown that some plants, like the peace lily and spider plant, may eliminate up to 90% of indoor contaminants in just 24 hours. Through microscopic pores on their leaves known as stomata, plants have the capacity to take in these pollutants, transport them to their roots, where they are broken down, and utilize them as nutrients. The name of this procedure is phytoremediation. [1] Through photosynthesis, plants also release oxygen into the atmosphere, which can help to raise oxygen levels and enhance air quality. According to some research, houseplants can improve the indoor environment by lowering the amount of carbon dioxide and other volatile organic compounds (VOCs) in the air. [2] This results in a healthier environment. In general, the presence of indoor plants can greatly enhance the air quality in indoor areas, providing inhabitants with a number of health advantages.

Regulated Humidity- Humidity in the air can cause many problems such as dry skin, headaches and breathing problems. Humidity problems can occur in any season. One way to solve this problem is to add indoor plants that absorb moisture from the air. By transpiring, or releasing moisture into the air, indoor plants can assist control the humidity levels in enclosed spaces. Water vapour is discharged from the plant's leaves and into the atmosphere during transpiration. In dry interior settings, this procedure may help to raise the humidity levels, which may have various advantages. For instance, increased humidity can aid in reducing the signs and symptoms of dry skin, a dry throat, and other respiratory conditions. Additionally, they can lessen airborne static electricity, which is particularly advantageous in offices with electrical equipment. On the other side by collecting extra moisture from the air indoor plants can also assist in lowering humidity levels in extremely humid interior settings. This can be especially helpful in places like bathrooms or basements where high humidity levels can result in mould growth and other problems. Overall, indoor plants can be quite helpful in controlling the humidity levels in indoor spaces, creating a more cosy and healthier living or working environment. Plants with waxy or hairy leaves such as cacti or those that have large surface areas are the best to lower indoor humidity. Some popular examples of dehumidifier are Peperomia, Golden Pothos, Aloe Vera, Spider Plant, Peace Lily and many more.

Reduced Noise Levels- By absorbing sound waves and fostering a calmer atmosphere, indoor plants have been shown to have a favourable effect on noise levels in indoor settings. According to studies, plants can lower noise levels by up to 5 decibels, which can be quite helpful in noisy environments. In a basic study in three different environments experiments were conducted : in first experiment a space was setup with no plantation, in second experiment a space where 3% of the total room volume was planted with both

Spathiphyllum and Araucaria, and in third experimental space where 3% of the total room volume was deployed with paper-based structures. To measure indoor noise a high frequency non-directional sound source (Super Tweeter Source) was set up in an indoor space (5.0m×5.0m×2.5m). The results showed the change of NRC, RT, EDT, D50 with plantation in a room, and in particular, it was much more effective in a low frequency band. Overall, it showed that plants are effective in reducing the amount of noise [3]

By absorbing sound waves, indoor plants can help to lower the noise levels in enclosed spaces. The plant's leaves, stalks, and other elements, as well as the soil in which it is potted, can all absorb sound waves.

The Boston fern and rubber plant are two examples of plants with dense foliage that are particularly good at absorbing sound frequencies. Additionally, plants with broad leaves and rough surfaces are more successful at reducing noise levels than plants with smooth surfaces. Indoor plants can help create a quieter, more comfortable atmosphere by reducing noise levels. This can be especially useful in noisy environments, such as crowded offices or residences close to busy roadways. Indoor plants can lessen noise levels as well as produce a tranquil and pleasant ambiance, which can lower stress levels and enhance general wellbeing. Air vibrations produce sound waves, and when those waves hit a surface, some of their energy is absorbed and some is reflected. Indoor environments may become noisy and uncomfortable as a result of this reflection's potential to produce echoes and reverberation. Plants in the home can assist to lessen these impacts by attenuating sound waves, which is a process known as sound absorption. When sound waves hit a surface, some of the sound energy is absorbed and dissipated instead of being reflected back into the space, causing sound attenuation.[4] Plants can absorb sound waves through several mechanisms, including:

- 1) Direct sound absorption: Plants can absorb sound waves through their leaves and stems. Plants with dense foliage and rough surfaces, such as the Boston fern or the rubber plant, are particularly effective at absorbing sound waves.
- 2) Sound deflection: Plants can also help to deflect sound waves by altering their direction, which can help to reduce the intensity of the sound.
- 3) Sound diffusion: Plants can also help to diffuse sound waves by scattering them in different directions, which can help to reduce the concentration of sound in specific areas of the room.

Improved Well Being: It has been discovered that having indoor plants has a favourable effect on psychological health, lowering stress levels and elevating mood. According to one study, people who were in a room with indoor plants experienced less tension and anxiety than people who were in a room without plants.[5]

Increased Productivity: Additionally, it has been discovered that having indoor plants around the office environment increases productivity. According to a University of Exeter research, workers were 15% more productive in offices with plants than they were in those without. Overall, research on how indoor

plants affect the interior environment as has consistently shown that adding plants to indoor spaces can have a number of advantages, such as better air quality, controlled humidity levels, decreased noise levels, and increased well-being and productivity. [5]

TYPE AND SIZE OF INDOOR PLANTS

The type and size of indoor plants used can impact their ability to improve the interior environment. By considering factors such as air-purifying abilities, size, and maintenance requirements, it is possible to choose plants that will have the greatest positive impact on indoor air quality and overall well-being.

Several research studies have investigated the impact of the type and size of indoor plants on the interior environment. Here are some examples:

- 1) Type of plants: According to a study that appeared in the Journal of Environmental Health Science and Engineering, different indoor plant species have diverse air-purifying capacities. The spider plant, snake plant, and golden pothos were the three plants whose capacity to absorb formaldehyde from the air was investigated in the study. The snake plant was shown to be the most efficient at eliminating formaldehyde, lowering levels by 89% in just 24 hours, according to the data. Both the spider plant and the golden pothos were efficient, bringing down formaldehyde levels by a respective 82% and 75%. The peace lily is good at eliminating benzene and trichloroethylene from the air, while the snake plant, also called mother-in-law's tongue, is particularly good at doing so. [6] It is crucial to take into account the specific contaminants present in the indoor environment when selecting indoor plants for their air-purifying properties and choose plants that are renowned for being successful at eliminating those pollutants.
- 2) Size of plants: The effect of plant size on indoor air quality was looked into in a study that was published in the Journal of HortScience. The weeping fig tree was used in the study to assess the air-purifying capacities of small, medium, and large plants of the same species. The findings demonstrated that larger plants were better at removing air contaminants than smaller ones. Due to their higher surface area for gas exchange, the researchers came to the conclusion that larger plants were more successful. [7]
- 3) Maintenance Requirements- A study published in the Journal of Environmental Psychology investigated the impact of plant maintenance on indoor air quality. The study found that poorly maintained plants can have a negative impact on indoor air quality, as they can become a breeding ground for bacteria and fungi. The researchers concluded that it is important to choose plants that are suitable for the indoor environment and to ensure that they are properly cared for in order to maximize their air-purifying abilities.

Overall, these studies demonstrate the importance of considering the type and size of indoor plants used, as well as their maintenance requirements, when selecting plants for their air-purifying abilities. By

choosing plants that are known to be effective at removing specific pollutants from the air, and by ensuring that they are properly cared for, it is possible to maximize their positive impact on the interior environment.

THE PLACEMENT AND ARRANGEMENT OF INDOOR PLANTS

The placement and arrangement of indoor plants can also have a significant impact on their ability to improve the interior environment. Here are some ways in which placement and arrangement can affect plant performance:

- 1) Proximity to Pollutants: Indoor plants should be placed in close proximity to the sources of pollutants that they are intended to remove. For example, if plants are being used to remove formaldehyde from the air, they should be placed near materials that release formaldehyde, such as furniture, carpets, or paint.[1]
- 2) Airflow and Ventilation: The placement of indoor plants can also affect airflow and ventilation in the room. Plants should be arranged in a way that does not impede the flow of air, as this can reduce their ability to remove pollutants from the air.
- 3) Light and Temperature: Indoor plants require adequate light and temperature to thrive, and their placement should take these factors into account. Plants should be placed in areas with sufficient natural light, or near artificial light sources if natural light is not available. They should also be kept away from windows or other areas where they may be exposed to extreme temperatures.[8]
- 4) Aesthetic Considerations: In addition to their air-purifying abilities, indoor plants are often used for their aesthetic value. The placement and arrangement of plants should take into account their visual impact on the interior environment, and should be arranged in a way that enhances the overall design of the space.

This study was published in the Journal of HortScience. Another study indicated that people's judgments of the quality of indoor air can be influenced by how attractive plants are. This study was also published in the Journal of Environmental Psychology. In summary, the placement and arrangement of indoor plants should be carefully considered in order to maximize their positive impact on the interior environment.

LIGHTING AND TEMPERATURE FOR INDOOR PLANTS

Here are some ways in which lighting and temperature can affect indoor plants and their impact on the indoor environment:

- 1) Lighting: For indoor plants to grow and thrive, they need enough light. Lack of light can cause growth to be slowed and diminish an organism's capacity to filter the air. On the other hand, too much light might result in leaf wilt or burn. As a result, it's crucial to pick plants that can thrive in a given interior environment's lighting conditions. For instance, although high light plants like fiddle leaf figs or bird

of paradises require more intense light, low light species like snake plants or ZZ plants may survive in low light.[8]

- 2) Temperature: Indoor plants have different temperature requirements depending on the species. Most indoor plants prefer temperatures between 60-75°F (15-24°C), although some plants can tolerate temperatures outside of this range. If the temperature is too low or too high, the plant may suffer from stress, disease, or death. Temperature can also affect the humidity level of the indoor environment, which can impact the plant's ability to regulate humidity and improve air quality.[8]

The growth and performance of indoor plants are influenced by temperature as well as lighting, according to studies. For instance, a study in the Journal of Environmental Horticulture discovered that temperature had an impact on the growth rate and biomass of specific indoor plants, and a study in the Journal of Plant Physiology discovered that light intensity had an impact on the rate of photosynthetic activity and the absorption of carbon dioxide by indoor plants.

Illumination and temperature are significant elements that can influence the development and functionality of indoor plants, as well as their effects on the indoor environment. It is possible to create a healthy and aesthetically pleasing environment by selecting plants that are appropriate for the range of temperatures and available light levels in a specific indoor space.

CARE FOR INDOOR PLANTS

While there are many advantages to having indoor plants around, they also need constant care and upkeep to grow.[12] The following are some difficulties in caring for indoor plants:

- 1) Watering: Indoor plants need regular, suitable watering, which can be difficult to accomplish. Underwatering can cause the plant to wilt and eventually die, while overwatering can result in root rot and other problems.
- 2) Light and temperature: For indoor plants to develop and thrive, they need to receive enough light and heat. It might be challenging to create the ideal environment, especially in places with little light or rapid temperature changes. Without sufficient light, plants may become leggy, lose color, or fail to produce flowers or fruit. Indoor plants require adequate lighting to grow and thrive. Indoor plants have specific temperature requirements that vary depending on the type of plant. Some plants prefer cooler temperatures, while others thrive in warmer environments. Maintaining the proper temperature can be a challenge in spaces where temperature fluctuations are common, such as near windows or doors.
- 3) Pests and diseases: Indoor plants may be vulnerable to pests like mealybugs, scale insects, and spider mites as well as ailments like powdery mildew and root rot.[9] These problems can spread quickly to nearby plants and can be difficult to diagnose and treat.
- 4) Proper potting and soil are crucial for the health of indoor plants. The wrong kind of soil or pot might cause drainage problems, root troubles, and other problems.

- 5) Maintenance and trimming: To guarantee healthy growth and guard against pest and disease problems, indoor plants need routine maintenance and pruning. This can take some time and calls for knowledge and expertise.

Despite these difficulties, buying indoor plants is still a wise investment because of the positive effects they have on the indoor environment. Indoor plants can flourish and offer a variety of advantages with the right care and attention, including bettering air quality, lowering stress levels, and enhancing aesthetic appeal. Before bringing plants indoors, it's critical to understand the precise maintenance demands of each species and to set up a maintenance schedule that satisfies those needs.

Although indoor plants can have a variety of positive effects on the interior atmosphere, they can also be hazardous to sensitive people's health. [11] Here are a few possible health dangers linked to indoor plants.

- 1) Allergies: Indoor plants can produce pollen and other allergens, which can trigger allergies in sensitive individuals. Common allergenic plants include ragweed, chrysanthemums, and daisies.
- 2) Irritation: Some indoor plants can produce volatile organic compounds (VOCs), which can cause eye, nose, and throat irritation in sensitive individuals. Examples of plants that can produce VOCs include rubber plants and peace lilies.
- 3) Poisoning: Certain indoor plants can be toxic if ingested or if their sap comes into contact with the skin. Examples of toxic plants include philodendrons, dieffenbachias, and pothos.
- 4) Mold: Overwatering or poor ventilation can cause mold to grow on indoor plants, which can release spores into the air and cause respiratory issues in sensitive individuals.
- 5) Insects: Indoor plants can attract insects such as aphids, spider mites, and whiteflies, which can trigger allergic reactions in some people.

It is important to note that the health risks associated with indoor plants are relatively low for most people, and can be minimized through proper care and maintenance of the plants. Sensitive individuals, such as those with allergies or respiratory issues, may want to avoid certain types of plants or take precautions such as using an air purifier or limiting exposure to the plants. When introducing indoor plants into interior surroundings, it's critical to take these restrictions into account. By solving these issues, it is feasible to develop stunning, healthy, and growing indoor gardens that offer the room's occupants a number of advantages. Some Popular indoor plants [13] are:

- 1) The snake plant: often referred to as mother-in-law's tongue, is one of the simplest plants to maintain and is excellent at cleansing the air by absorbing pollutants like formaldehyde and benzene.
- 2) Spider Plant: This easy-to-care-for plant is another excellent air filter. Additionally, it creates tiny plantlets that can be grown into new plants.
- 3) Peace Lily: This plant is renowned for its lovely white blossoms and capacity to enhance the quality of indoor air. Pollutants such as benzene, formaldehyde, and trichloroethylene can be eliminated by it.

- 4) Rubber Plant: The rubber plant is a well-liked houseplant with big, glossy leaves. It is quite effective at eliminating pollutants from the air and is simple to maintain.
- 5) Fiddle Leaf Fig: This plant has become very popular in recent years due to its large, beautiful leaves. It is known for its ability to remove toxins from the air and is a great statement piece in any room.
- 6) Pothos: This plant is known for its ability to thrive in low-light conditions and is great for beginners. It is a great air purifier and is known for removing toxins like formaldehyde and benzene.
- 7) Aloe Vera: This plant is not only beautiful, but also has a number of health benefits. The gel inside the leaves can be used to soothe burns and skin irritations, and the plant is also great at purifying the air.

DISCUSSION

There are several advantages to adding indoor plants to interior spaces, and doing so has consequences for both design and public policy. Architecture and interior design professionals can take into account the advantages of indoor plants and include them into their projects. This may entail choosing plants that are appropriate for the room's lighting, temperature, and humidity levels. Lighting and temperature are critical factors that can affect the growth and performance of indoor plants and, consequently, their impact on the interior environment. Humidity plays an important role in places like washrooms where high humidity levels can result in mold growth.

It may also entail carefully placing and arranging plants to maximize their effect on both noise reduction and air quality. The positioning and arrangement of indoor plants can significantly affect how well they can enhance the interior environment. For instance, a study discovered that the positioning of plants in respect to ventilation systems can alter how well they can purify the air. By placing plants in close proximity to sources of pollutants, ensuring adequate airflow and ventilation, considering light and temperature requirements, and taking aesthetic considerations into account, it is possible to create a healthy and visually appealing indoor environment.

Even though there have been many studies on how indoor plants affect the indoor environment, there is always room for more in this area. Some suggestions for additional study include:

- 1) Conducting long-term studies: For a complete understanding of the effects of indoor plants on the interior environment, further long-term studies on indoor plants are required.
- 2) Examining the effects of various plant species: There are thousands of plant species that could be employed indoors, despite the fact that many research has concentrated on a few popular ones. Future studies might examine how various plant species affect things like humidity, noise reduction, and air quality.
- 3) A small amount of study has been done on the effects of indoor plants on mental health, despite the fact that studies have shown that they can enhance air quality and reduce noise. Future research may examine how indoor plants affect productivity, well-being, and stress reduction.[14]

4) The majority of studies on indoor plants have been carried out in controlled conditions, including laboratories or offices, to better understand their effects in various contexts. Future studies might examine how indoor plants affect various environments, including homes, schools, and hospitals.

By conducting further research in these areas, we can continue to expand our understanding of the benefits of indoor plants and their impact on the interior environment, and develop better strategies for incorporating them into indoor spaces.

CONCLUSION

A wide range of positive benefits of indoor plants on people are now being documented by several studies. The value of indoor plants goes beyond just how they help the community to meet physiological and financial needs. Community's physical and emotional health are all enhanced by plants, and they also make the community safer. The reasons behind why humans react to plants are starting to be explored. According to the literature review, indoor plants can have a variety of advantages, such as better air quality, controlled humidity, and decreased noise levels. The ability of indoor plants to remove harmful pollutants from the air, control humidity levels, and absorb sound waves can result in a more comfortable and healthy living or working environment. The Peace Flower, Spider Plant, Cacti, Golden Pothos, Aloe Vera, Boston Fern, Rubber Plant are a few common examples of indoor plants that might offer these advantages. The correct placement, lighting, temperature, and upkeep are all significant variables that may have an impact on how well they can enhance the indoor atmosphere, also purifying the air and controlling humidity. However, indoor plants need regular care, such as correct watering, upkeep, and protection against pests and diseases. Despite these difficulties, buying indoor plants is still a wise investment because of all the positive effects they have on the indoor environment.

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