A STUDY OF THE INTEGRATION OF VEGETATION IN RESIDENTIAL BUILDINGS IN BENIN CITY, EDO STATE

BY

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CERTIFICATION

This is to certify that the work contained in this project for the degree of Bachelor of Science in Architecture was carried out by Alalor, Efemena Osemudiamen with matriculation number ENV1704525 of the Department of Architecture, Faculty of Environmental Science, University of Benin under my supervision.

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DEDICATION

This project is dedicated to the Almighty God who saw me through all my years of university.

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My gratitude to the Almighty God for seeing me through all these years in school, also to my supervisor ARC. OKEIMEN whose understanding, support and reviews made this project possible.

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1 CHAPTER ONE

1.1. INTRODUCTION

Greening the building envelope is a rapidly expanding area in the domains of ecology, horticulture, and the built environment given the opportunity to mix nature and buildings (linking multiple capabilities) in order to address environmental concerns in congested urban contexts. There is a chance to learn from traditional design when using green roofs and façades.

1.1 BACKGROUND OF THE STUDY

The earliest vertical gardens extend back 2000 years to the Mediterranean region, and ornamental roof gardens were first created by the civilizations that inhabited the basins of the Tigris and Euphrates rivers (the most famous examples of which were the Hanging Gardens of Babylon in the seventh and eight centuries B. C.). Northern European regions, such as Norway's sod roofs or the Mediterranean basin's climbing plants for shading vertical surfaces, have a number of examples of green roofs and façades dating to the 18th and 19th centuries. To support sustainable construction practises, modern building envelopes also contain cutting-edge materials and other technologies.

By incorporating plants, buildings with green roofs or façades can improve their efficiency while simultaneously delivering ecological and environmental benefits. There are numerous environmental benefits to greening the building envelope. The benefits that

are relevant to a larger scale (neighbourhood or city) are primarily focused on the improvement of air quality, urban wildlife (biodiversity), the mitigation of the urban heat island effect, and stormwater management; those that are relevant to a smaller scale (building) are primarily focused on the building envelope performances and the comfort of the interior and exterior.

There is evidence to suggest that being in natural environments and around plants may enhance mood and lessen negative mood. Additionally, research shows that, as compared to urban regions, exposure to flora and wildlife typically lowers physiological stress. It has also been demonstrated that residents of urban areas with greenery all around them have higher levels of wellbeing and lower levels of mental suffering. It makes sense to ponder how vegetation and green areas may have such positive mental effects. There are now three groups of hypotheses for these observations.

According to the first, plants have a positive impact on the climate of the working and living environment because they are living things. Particularly since they enhance air quality, plants are regarded as being healthful. In this sense, it has been demonstrated that indoor potted plants may eliminate the majority of airborne contaminants originating from both indoor and outdoor sources when supplied in adequate quantities. This has been researched in both lab settings and air-conditioned, naturally ventilated workplace settings. Even at undetectable levels, air pollution can result in "building-related disease" and headache, sore eye, nose, and throat, or nausea symptoms. Where indoor plants are present, employee health is enhanced and sick leave is decreased.

The use of cutting-edge, locally manufactured items and the use of novel design, construction, and operating techniques that are designed to reduce energy consumption and be environmentally responsible are two important aspects of most green buildings.

Plants can also purify the air by absorbing carbon dioxide (CO2). Studies that show that both business productivity and school performance decrease with rising CO2 levels point to the significance of this. But in addition to actual changes in air quality, the presence of plants may also cause a perceived change in the quality of the air.

Other researchers also looked into this issue in a scholarly setting. Students who worked in environments enhanced with plants stated that the air quality had improved, the researchers discovered. These findings imply that adding plants to the workplace to enhance its natural environment should improve the air quality. A green, planted environment mimics the natural world and promotes human physiology, according to the evolutionary explanation for plants' positive effects. According to proponents of the attention restoration theory, developed environments tend to reduce people's capacity for directed attention whereas natural environments tend to restore it. This theory contends that "directed attention fatigue" developed when a stimulus or task is focused on for an extended period of time.

Natural settings promote more effortless brain functions and place less demand on directed attention, restoring the capacity for attention. As a result, one can do better on tasks that require directed-attention skills after engaging with natural environments. This

point of view contends that having plants in the office should increase workers' directed-attention capacity, which in turn should increase their levels of focus and productivity.

The third category of explanations shifts the focus from physiological reactions to the relational and managerial effects of enrichment. The fundamental tenet of this argument is that adding amenities to the workplace shows that efforts are being made to improve employee comfort and the "environment." Thus, enrichment conveys managerial concern and attention, which may in turn encourage employees to pay more attention to and become more engaged in their work. The danger of disengagement is also decreased if people are physically, cognitively, and emotionally invested in their work.

Increased job satisfaction, productivity, and general well-being are all likely to follow from this. Adding plants to the environment should, in summary, indicate managerial concern and lead to an increase in involvement, attention, and environmental satisfaction. Additionally, there should be a general increase in workplace productivity and psychological well-being as a result of this.

1.2 PROBLEM STATEMENT

The great irony of constructing green is that many of the same ideas that are supposed to improve a building's performance over its entire lifespan also render a building very prone to moisture and mould issues during its initial few years of operation. While there are many advantages to green construction, there is also compelling evidence to imply a connection between failed construction projects and novel goods and designs. Simply put,

straying from the "tried and proven" frequently results in an increase in the likelihood of a building failing.

Typically, the environmental aims of green buildings are based on a set of internationally recognised benchmarks, such as Leadership in Energy and Environmental Design (LEED), a standard issued by the U.S. Green Building Council (USGBC). Achieving different point levels can certify the building as having earned silver, gold, or platinum status in the LEED certification system, which is a checklist and point system of suggested practises. These practises address concerns including conserving energy and water, recycling garbage, and using locally sourced, renewable items.

The main objective of these innovative products and methods is to produce buildings that have less of an adverse environmental impact, both during the building process and over the course of their useful lives. The goal of creating green should be actively pursued because it is certainly noble and desirable. But because of the significant transformation this would bring about for the design and construction sector, putting this into practise will certainly bring about new hazards that are both technical and legal in character.

The risk of failing to meet a building owner's expectation to achieve a certain degree of LEED certification is one of the most visible legal hazards (i.e. implied or even written warranties). Other dangers are less obvious, like the following:

- The inability of newly developed items to live up to the performance standards that were advertised, which is more common with new materials than with tried-and-true materials used in conventional buildings.

- Being willing to accept the higher quality of care that a green building might bring—what are currently regarded as "best practises" might become the new anticipated "standard of care."

- Failing to understand (or plan for) the potential financial and time effects of a green building.

The construction business has typically been conservative, depending on tried-and-true building materials and techniques. New building techniques and materials have not always been effective and have occasionally led to major building failures, particularly those involving moisture ingress and mould contamination. Many of the tried-and-true components used in lower-risk structures are hydrocarbon-based. Some of the novel carbohydrate-based building materials are being marketed for green buildings, but their long-term efficacies and performance levels are not yet demonstrated.

The design and construction industry is facing significant challenges as a result of the rapid development of new goods and creative building techniques related to green development. Building failures and legal action will almost certainly increase as a result of these developments. Numerous of these failures will be anticipated based on prior failures, and some of them may even be catastrophic.

1.3 SIGNIFICANCE OF STUDY

Incoming solar radiation cannot reach the building structure below thanks to the use of green roofs, a passive cooling technology. The type of green roof affects its insulation characteristics. Direct shade of the roof, evaporative cooling from the plants and the growth medium, extra insulation values from the plants and the growing medium, and the thermal mass impact of the growing medium are some of the aspects of green roofs that affect their thermal qualities. A vertical green layer can improve the efficiency of the building envelope by generating an additional layer of stagnant air that acts as insulation and lowers the need for air conditioning by 40–60%, producing the ideal (adiabatic) room behind the façade. Leaves, thanks also to the phototropism effect, filter the direct sunlight on the façade.

1.4 RESEARCH AIM AND OBJECTIVES

This study aims to investigate the integration of vegetation into the architecture of residential buildings. The objectives are to;

i. To cross examine the inner workings of green buildings.
ii. To examine the positive effects of the integration of vegetation in residential buildings in Benin City.
iii. To examine the problems caused by the integration of vegetation in residential buildings in Benin City.

1.5 RESEARCH QUESTIONS

These are some questions that will be addressed during the course of this study

1. What are the inner workings of the integration of vegetation in residential buildings in Benin City?
2. What are the problems arising from the integration of vegetation in residential buildings in Benin City?
3. What are the difficulties experienced in the integration of vegetation in residential buildings in Benin City?
4. What are the solutions to those problems caused by the integration of vegetation in residential buildings in Benin City?

1.6 SCOPE/LIMITATIONS OF STUDY

This study focuses solely on the integration of vegetation in residential buildings in Benin City, Edo State. It entails the past, present and future data, analysis, projects and existing facilities that fall under the integration of vegetation in residential buildings in Benin City alone.

2.0. LITERATURE REVIEW

2.1. HOW PLANTS AND GREEN SPACES BENEFIT YOUR BUILDING

Greenery and natural light in buildings provide benefits beyond aesthetic appeal. The building's occupants benefit from the green spaces, and the structure itself also gains from them.

It is impossible to dispute the scientific evidence showing the favourable effects of indoor greenery on worker productivity and wellness. When plants are used on the walls and roofs of buildings, the results are positive too:

- Plants reduce energy usage.
- Plants extend roof lives.
- Plants moderate temperatures in hot spots.
- Plants even can provide fresh vegetables for building occupants.

Outside and on top: Heat Islands

On its website, the Environmental Protection Agency provides a useful section on heat islands and methods for reducing their temperature.

Urban regions with few trees but many buildings, streets, and parking lots tend to have heat islands. In contrast to vegetation, which offers cooling shade and efficient evapotranspiration, the surfaces absorb heat and don't do a good job of releasing it. Up to 8 degrees Celsius can be removed from a room by adding trees and plants.

Using vegetation wisely can be an energy-saving feature and make a building more comfortable, especially one that exists in a heat island. “Researchers have found that planting deciduous trees or vines to the west is typically most effective for cooling a building, especially if they shade windows and part of the building’s roof,” the EPA writes.

Green roofs have some important benefits, they say:

- They serve as barriers for rainwater. Rainwater is absorbed by the vegetation, then passes through the ground, drainage layer, and plants before entering the sewage system. By doing this, the risk of flooding a sewage system at peak load is decreased as well as the amount of groundwater.
- By lowering the temperature of the roof, they save electricity. The sun's light is reflected by plants to the tune of 30%, with plants absorbing roughly 50%. Because of the decreased temperature, the building's air conditioners and solar panels are more effective.
- They increase the facility's worth. A roof can last at least 60 years and acts as a natural fire-resistant layer since it is shielded from sunlight, rain, and other environmental factors by the flora, substrate, and drainage layers. These elements, along with the decreased energy expenditures, increase the property's value.

1.7 Plants for Green Walls

On the sides of buildings or other vertical structures, there are areas called "green walls" where plants are growing.

This could apply to fences, retaining walls, outside building walls, or even a building's interior. The benefits of planting a green wall are many, including:

- Visually enhances unappealing wall spaces.
- Cools the sides of a building from direct summer sunlight, reducing indoor cooling needs.
- Provides an extra layer of insulation for building sides.
- Reduces traffic and other urban noises from building interiors.
- Reduces the urban heat island effect in cities.
- Improves carbon sequestration and air quality in urban areas.
- Provides additional wildlife habitat in urban areas.
- Provides additional points for L.E.E.D. certified buildings (Leadership in Energy and Environmental Design Green Building Rating System™).
- Provides additional green space in a vertical format.

Since ancient times, brick buildings have been adorned with vines like English ivy, creeping fig, and Virginia creeper. Along the climbing stem, these kinds of vines develop accidental roots or discs that stick to brick and wood. Brick and wood can be harmed by these roots, which can get within the cracks between brick and mortar. These vines can be difficult to remove from building sides without spending a lot of money and labour.

Trellis or wire

In addition to the conventional usage of vines, there are a number of innovative technical advancements and alternative ways to create green walls. Making a freestanding or attached trellis is the easiest and most affordable way to build a green wall. A wood or metal frame that is fixed to the ground is a freestanding trellis. Keep at least 6 to 8 inches away from the wall to allow air to circulate and prevent mould and moisture build up on the building's sides.

Freestanding structures surrounding buildings (such fences) may need to obtain building permits or adhere to other municipal ordinance regulations. The trellis will provide support for vines like coral honeysuckle (Lonicera sempervirens), clematis (Clematis spp.), and yellow jasmine (Gelsemium sempervirens), which climb using non-attaching tendrils. The type of plant used can depend on the height of the wall being covered; some species can grow to heights of more than 70 feet. Frequently found in hardware stores, wood lattice has a limited lifespan and necessitates constant maintenance.

The use of cables or coated wire is an affordable substitute for a trellis. Cables are secured into the ground and connected to wall anchors or roof eaves in a manner similar to stringing beans with string or wire. Alternatively, vines can be put in planters at the base and allowed to grow in the ground while climbing the wire. In comparison to other green wall systems, ground-planted vines require the least upkeep in terms of watering and care. According to the desired foliage density, the wires are strung at different intervals. From a number of vendors, wall anchor and wire kits are available.

Green Walls

Similar to a freestanding trellis, green walls use a metal structure that isn't attached to the building's sides to support panel-style planting units that are filled with light soil. A waterproof barrier must be placed between the growing media and the wall surface of metal frames that are fastened to the building's sides. The panels come in a variety of designs and grid sizes and are modular parts that snap onto the metal structure. The soil medium is a layer that traps water while allowing it to drain easily. On the side of the vertical structure, plants are sown into the ground. Useful plants are those that grow very slowly (less than a foot tall), such as groundcovers, ferns, perennial flowers, small shrubs, and even culinary herbs. Tropical species can be used to create indoor green walls, and plant species can be chosen for sites with shade or sunlight. By eliminating the volatile organic compounds that are released by paints, adhesives, caulking, and carpeting, indoor green walls help to purify the air within buildings. For green walls, additional irrigation is necessary. This is done using a drip system on the top wall piece, which filters water through the individual wall panels. In order to collect excess water and recycle it using a pump, permeable gravel strips are frequently utilised at the base of green walls.

Vertical Gardens

As opposed to green walls, vertical gardens use felt fabric as the soil medium for the plants. Vertical gardens use a metal frame that is attached to the building's sides or can stand alone, much like a green wall. To provide stability and waterproofing for the building wall, a thin rigid plastic sheet is fastened to the metal frame. The plastic sheeting

is covered with a corrosion-resistant felt layer that serves as a base for the plant roots that grow there as well as a source of water. Many epiphytes, including orchids and bromeliads, will cling to the felt layer, including ferns, mosses, sedums, and many others. The felt is watered from the top with additional water that falls to the base, much like a green wall.

Tropical climates would be ideal for growing the following plants for green walls:

Tropical Flowers

African violet (Saintpaulia)

Amaryllis (Hippeastrum)

Anthurium (Andraeanum)

Blanket Flowers (Gaillardia)

Blood Lily (Scadoxus Multiflorus)

Bougainvillea Glabra

Ferns

The alpine wood fern (Dryopteris wallichiana)

Maidenhair fern (Adiantum)

Austral Gem Bird's Nest fern (Asplenium dimorphum x difforme)

Cretan brake fern/Ribbon fern (Pteris cretica)

Asparagus Fern (Asparagus aethiopicus)

Vines

Bougainvillea

Bleeding Heart Vine (Clerodendrum thomsonae)

Morning glory (Ipomoea spp.)

Golden Trumpet (Allamanda cathartica)

Grasses

Panicum (Panicgrass)

Bread Grass (Brachiaria brizantha)

Guinea grass (Megathyrsus maximus)

Rhodes grass (Chloris gayana)

Cynodon

1.8 GREEN LANDSCAPE

Give the same careful consideration to the design of the landscape as you do the homes because the surrounding area sets the scene for a home and is an integral part of the complete façade. This does not entail a large lawn that requires a lot of labour and

resources, along with a few maple seedlings. A better plan would consume less water, avoid woody areas close to the house, lower the house's heating and cooling demand, and restore the soil.

A healthy soil has a wide range of advantages, including absorbing rain and snowmelt, directing water into the ground, and promoting plant growth.

Native plants require little care and only the water that is already present in the environment. The roof can be used to collect rainwater for other gardens. But soil is where a landscape starts.

In addition to being lovely, a well-planned combination of trees, shrubs, and herbaceous plants has the potential to strengthen the house's energy and resource saving features.

Plants aren't only decorative landscaping elements. Vegetables and other edibles can be planted, if the site conditions permit, and this has several advantages. Food from gardens is typically more flavorful and nutritious for you than that found in supermarkets, and gardening is a fulfilling and healthy lifestyle option.

Consider newspaper and site-specific vegetation that has been chipped as mulch. During construction, trees that must be removed can be chipped and used as mulch for the landscape. In the shape of sheets, shreds, or chopped pieces, newspaper works well as a mulch in gardens. It prevents weed growth and keeps the soil wet.

Trees

Probably the most well-known tree associated with the tropics is the palm tree, but there are a wide variety of other tropical trees to choose from, including citrus trees, bananas, frangipani, money trees, avocados, African tulip trees, rubber trees, and other focal plants.

There are other additional possibilities, depending on your needs in terms of space, finances, and style. If your area is extremely limited, there are even decorative fruit trees that may be kept in pots.

Shrubs

Shrubs and vines make up your garden's next layer. Again, there are a tonne of alternatives, but the following are some of the most accessible: Ipomoea, Bougainvillea, Jade vine, Coral vine, Croton, Hibiscus, Jasmine, Fire bush, Oleander, Yucca, Saw palmetto,

If you have a very tiny landscape, you might decide to skip the shrubs and use a few vines on trellises instead to add height if you aren't utilising trees.

Flowers

Most people grow tropical gardens for the beautiful flowers, which are its main draw. The first plant that comes to mind is an orchid, but due to their high maintenance requirements, not all gardeners are willing to give these stunning plants the time they truly need.

Fortunately, there are lots of different tropical flower choices available: African violets, Lobelia, Petunias, Begonias, Salvia, Bird of Paradise, Ferns, Cannas, Gardenias, Lemon Grass, and Fringe Flowers.

Even though not all of these are regarded as tropical plants, a tropical garden would benefit from their vibrant hues and interesting shapes.

Plant masses of just a few different flower varieties to create harmony in your little garden. By selecting a range of plants in the same colour scheme—or that don't match at all, if that's more your style—you may make it appear wilder. To add colour and enhance the green tones of your tropical landscape, use vibrant flowers. However, don't feel as though you must stick to tropical types; in this case, a combination of flowers that wouldn't often thrive together might look incredibly beautiful. Along with dahlias, lobelia, and exotic canna, consider agapanthus, jasmine, honeysuckle, and hibiscus.

Grasses

Ornamental grasses provide a lovely texture to a tiny garden, but they are the final component of a little tropical garden. When the flowers aren't blooming, they also add colour.

Pick just one species of grass and use it repeatedly around your tree or in the front of your garden bed if you have a tiny area.

Sun, Heat, Humidity.

A tropical garden should be located where warmth is concentrated since tropical plants flourish in heat and humidity. Tropical garden designs are more successful in climates with a short growth season when they are situated in full sunlight and are surrounded by heat-retentive materials like concrete, walls, or buildings. Plantings in hotter climates are susceptible to sunburn. For your tropical garden, find the ideal environment and location.

Water

The majority of tropical plants need moisture to thrive, and the more you provide, the bigger they will get. To avoid dragging a hose to the garden during the dry seasons, plan your tropical garden close to a water supply.

For tropical plants in containers, water is essential. Make sure to check the soil every day for dryness throughout the hottest part of the summer and water as necessary. Some tropical plants require such a lot of moisture that it is advisable to place pots inside of large saucers or tubs that you can fill as necessary. You stop mosquitoes from breeding, make sure to treat any standing water with Bacillus thuringiensis israelensis granules.

NATIVE PLANTS

Plants that have mastered local circumstances are used in effective landscape design. Because native species require the least amount of outside assistance to live, they conserve water and use fewer or no chemical pesticides and fertilisers. Because newly planted specimens might take years to mature, trees are especially important. Make a map and note any plant species that appear to be doing well.

Soil

On a construction site, soil types are rarely homogeneous. There may be isolated areas of clay, sand, or loam. The alkalinity and acidity of the soil can also differ, affecting the kinds of plants that will thrive in various climates. Observing native plants can reveal information about the soil kinds. Soil test services are reasonably priced and are provided by cooperative extension offices, land grant colleges, or commercial labs. The outcomes may save you years of aggravation and incompatible soil and plant types.

Topography

A good design is heavily influenced by the topography of the area. The hydrology of the land will be impacted by a big outcropping or low-lying swale, which should affect planting decisions. Early recognition of these areas will make it easier to spot issues and possibilities. Rain and snowmelt can be collected by natural drainage structures like swales, while a menacing protrusion can be transformed into a prominent landscaping element that is surrounded by native vegetation.

Microclimate

A site's unique microclimate is influenced by a variety of factors, including wind, temperature, rain, solar exposure, snowfall, and elevation. The more you are aware of the local weather, the better. The National Climatic Data Centre has historical weather information available, or you may simply ask a long-time neighbour.

ABOUT NATIVE PLANTS

Zones and microclimates

Zone ranges are frequently mentioned in books, periodicals, and plant labels to inform readers of the ideal growing conditions for a particular plant. Zones are simply a place to start, though, so keep that in mind. They're pretty general and don't take into consideration regional circumstances. Despite an apparent zonal match, there may be pockets of warm, chilly, sunny, shaded, dry, or wet places on any site inside any zone that might kill a plant that ought to thrive. A plant may also be able to flourish outside of its designated zone thanks to such microclimates.

Rainfall, soil type, pH, and the quantity of direct sunshine the plant would receive are other factors that limit the kind of plants that can be chosen.

MORE ABOUT NATIVE PLANTS

Trees: minutes to remove, years to replace

Trees and shrubs can make a house more comfortable in summer and winter.

It may be easier to build on a clear-cut site, but it’s hard to find something that multitasks better than trees. They can block cold winter winds and the hot summer sun, all while making the oxygen we need to breathe. Whether you’re deciding what trees to save or where to plant new ones, there are several things to consider.

It’s easier to build on a cleared job site than a wooded one. But before you cue up the chainsaw or backhoe, consider the long-term benefits of standing trees. They take a long time to reach maturity, when they become large enough to grace a site by blocking wind

and providing shade. They're also expensive to replace. Take time to think about how trees (or the absence of trees) will affect the house when preparing a site for construction, and make decisions accordingly.

On a hot day, it is far more comfortable to rest under the shade of a tree than in the glare of the sun. The Environmental Protection Agency (EPA) estimates that plantings can reduce cooling costs by 25 percent.

Trees and shrubs make effective windbreaks when they're planted (or left standing) some distance from the house, lifting wind up and over buildings. The result can be lower energy consumption and greater comfort. Windbreaks can also control drifting snow and create habitats for birds and animals.

About soil

Healthy soil provides a long list of benefits, from absorbing rain and snowmelt, replenishing groundwater sources, and encouraging plant growth. Soil also provides a home for microbes that break down pollutants.

Some soil will inevitably be disturbed during construction; that's an unfortunate given. The intent should be to do as little permanent damage as possible.

Disturbed and compacted soil can lead to erosion as well as the failure of existing plants, making it more difficult to restore vegetation later. Encouraging and preserving the symbiotic relationship between soil and plants maintains the health of the soil and decreases loss due to erosion.

Bringing topsoil to the building site from another source creates two potential problems: The site where it is harvested may suffer ill effects; and the imported soil may hold contaminants or undesirable plant species.

It's often necessary to adjust the grade of a lot to improve drainage and to site the house gracefully among its surroundings. The more extensive and abrupt the grade changes, however, the greater the disturbance to the soil. It's up to the designer to find the right balance between grade changes that improve the site's aesthetics and environmental concerns.

1.9 INDOOR GREENERY

Plants that require a low amount of light and water to thrive are typically known as indoor plants. Ambius considers these plants as examples of common indoor plants:

- Dracaena
- Hedera Helix
- Sansevieria Zeylanica Superba
- Scindapsus

More examples of common indoor plants include the following:

- Aglaonema
- Dracaena
- Ferns

- Philodendrons
- Palms
- Pothos
- Spathiphyllum
- Succulents

Good indoor plants will tolerate lower light and humidity. Also, they will be less likely to deal with pests. Plus, they usually do not grow too much (you wouldn't want an indoor plant to grow at a rapid rate). The best indoor plants include the following:

- Aglaonema – It is attractive, tolerates low light, and does not grow too quickly.
- Aspidistra – You should not need to give it a lot of water and it will handle low light. If you'd like to take a vacation and don't want to be concerned about your plant, aspidistra is a great one for you.
- Succulents – Make sure you give them bright light.
- Dracaenas

CHAPTER THREE

3.0. RESEARCH METHODOLOGY

3.1. INTRODUCTION

The addition of plants and vegetation to residential buildings has proven to have numerous benefits to the aesthetics and general use and efficiency of a residential building and its occupants. Benin City, being one of the oldest civilizations in Nigeria, holds its vegetation and its relation to their cultural past in high esteem and has a lot of vegetation around their homes.

The project's data gathering and analysis methodologies are covered in this chapter. This chapter will go into great detail on the collection and data process. Important issues will be explored in this chapter including sample size, research design, target population, data collection procedures and questionnaires, data analysis techniques and ethical considerations.

3.2. RESEARCH DESIGN

The survey's research method was used for this study. This was considered appropriate because survey design generally can be used to effectively obtain information and opinions in real time. Figures gotten from surveys are more accurate and recent as per the use of real time figures and data. The survey technique will also allow the researcher to examine several variables and use multi-variate statistics to analyse data.

3.3. PURPOSE OF RESEARCH

The purpose of this research is to investigate and compile the effects, both positive and negative, of vegetation (plants of any type and breed) on human life and the possibilities of integrating vegetation into residential buildings in Benin City.

3.4. SOURCES OF DATA

3.4.1. PRIMARY SOURCES

The primary data were obtained through questionnaires given to members of the general public and residents in and around Benin City, Edo State. The questionnaire will be

supported by direct observation of the study area. These questionnaires will give us an insight into the lives and living habits of some residents of the target environment.

3.4.2. SECONDARY SOURCES

Secondary data to be utilized comprise published and unpublished works by scholars' archives which include textbooks, journals, internet updates and statistical data from local government, as well as existing literature relevant to the research. These documents provide good information on concepts relevant enough to back up the study under investigation.

3.5. POPULATION OF THE STUDY

This is the target population which constitutes the total number of people in the study area.

The study was conducted in Benin City, Edo State, Nigeria. The population of Edo State, according to the Edo State Government is 9.5 million, a number disputed by the Nigerian Government and judged unreliable by the National Population Commission of Nigeria. The population consists of the entire populace of Benin Edo State.

Benin City is the capital and largest city of Edo State, Nigeria. It is the fourth-largest city in Nigeria according to the 2006 census, after Lagos, Kano, and Ibadan, with a population estimate of about 3,500,000 as of 2022.

3.6. SAMPLING FRAME

Sampling frame, refers to the list of all items in the population from which samples will be selected. It comprises all the elements in the population from which the sample will be selected. The sampling frame for this study would cover the buildings with vegetation in Benin City, Edo state.

3.7. SAMPLE SIZE

For convenience, abandoned residential buildings around Egor local government would only be taken into consideration and 120 questionnaires will be distributed around the local government.

3.8. SAMPLING TECHNIQUES

Out of the population, 120 persons were selected using the simple random sampling (SRS) technique and 106 returned theirs filled. This was a result of time and financial constraints.

3.9. PROCEDURE OF DATA COLLECTION

The researcher personally collected data from the respondents. After the distribution of the questionnaire, respondents were given three days to fill out the questionnaire. This time frame was given in order to give enough time to the respondents to reflect on the items on the questionnaire to facilitate valid and correct or near correct responses.

3.10. DATA COLLECTION INSTRUMENT

The major instrument used for this study is the questionnaire. The questionnaire was structured in a way that lets the researcher peer into the mind of the respondents and their interactions with the vegetation around them.

3.11. METHOD OF DATA ANALYSIS

Data analysis has been defined as those techniques used whereby the researcher extracts relevant information from the data which would enable a summary description of the subject studies to be made.

The use of sample percentage was employed. Tables were used in presenting the data for the purpose of simplicity and clarity.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1. DATA PRESENTATION AND ANALYSIS

SECTION A

Section A in the questionnaires focused on the type of property where the respondents live and the plants within its vicinity. The results for each question are presented in Figures 4.1 to 4.11.

The results show that apartments were the most common property types among respondents (43.4%) with multi-storey properties being the least common (19.8%). Approximately 32.1% of the respondents had no plants/gardens on their properties, 30.2% had vegetables and 17.0% had fruit trees. Weeds formed the dominant vegetation in the vicinity at 47.4% and vegetables were the least dominant at 11.4%. Sparse and medium density vegetation around properties were recorded for 44.3% of the respondents each with just 11.4% having high vegetation density. Properties with gardens which were maintained at some point in time made up 39.6% and those which were overgrown made up 22.7%. The majority of respondents (61.3%) reported having plants at home. Of this number, 72.3% reported having outdoor plants, 10.8% had indoor plants and 16.9% had a combination of indoor and outdoor plants. On the issue of caring for plants at home, 35.8% of the respondents reported that they took care of plants ‘often’ with only 7.5% doing so ‘always’. A much higher percentage of the respondents (64.2%) indicated that they do not enjoy engaging in gardening. The majority also reported that they prefer having outdoor plants (67.0%) to indoor plants (33.0%). Additionally, there was more preference for plants of natural origins (78.3%) than for artificial plants (21.7%).

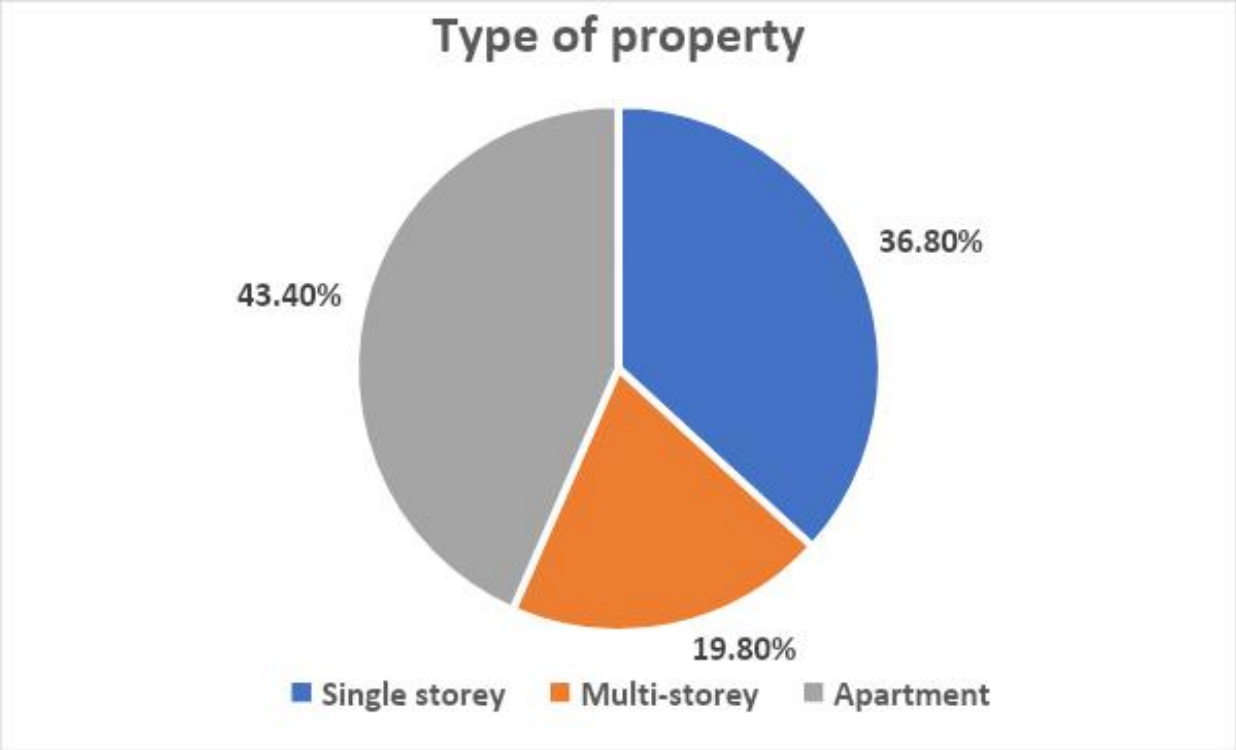

Figure 4.1: Type of property the respondents live in

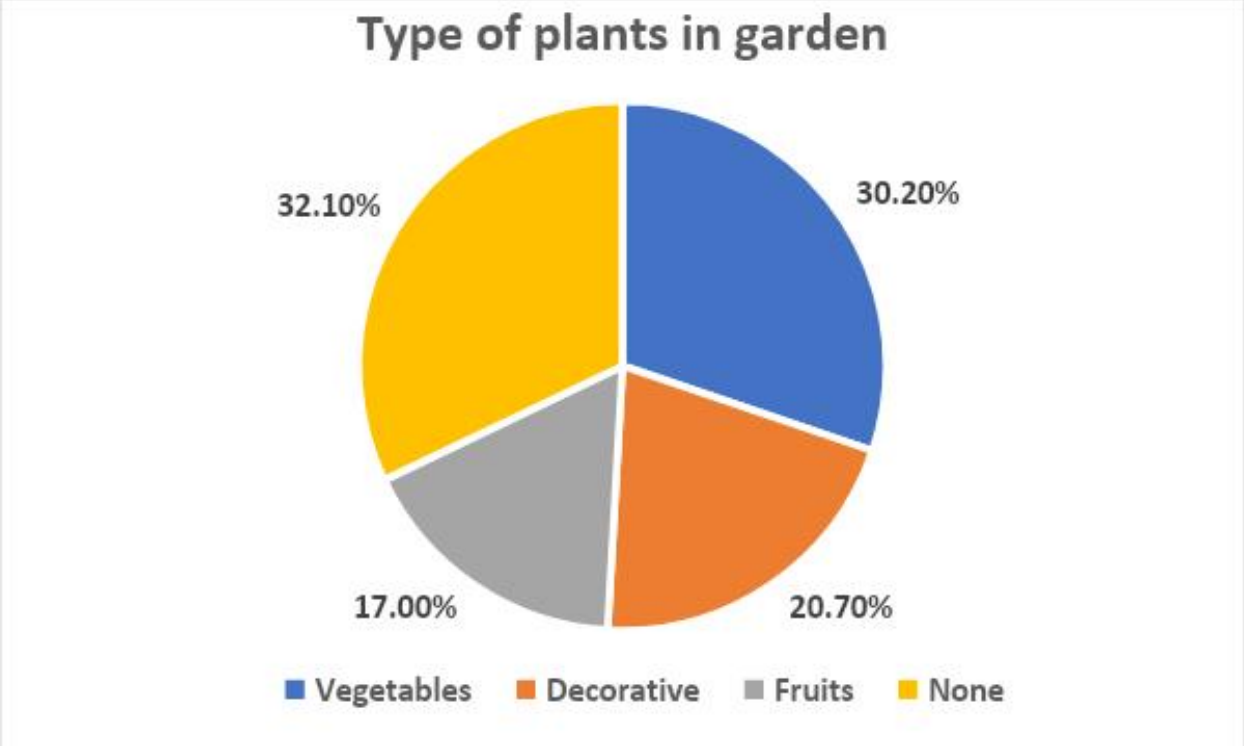

Figure 4.2: Type of plants in the garden of the property

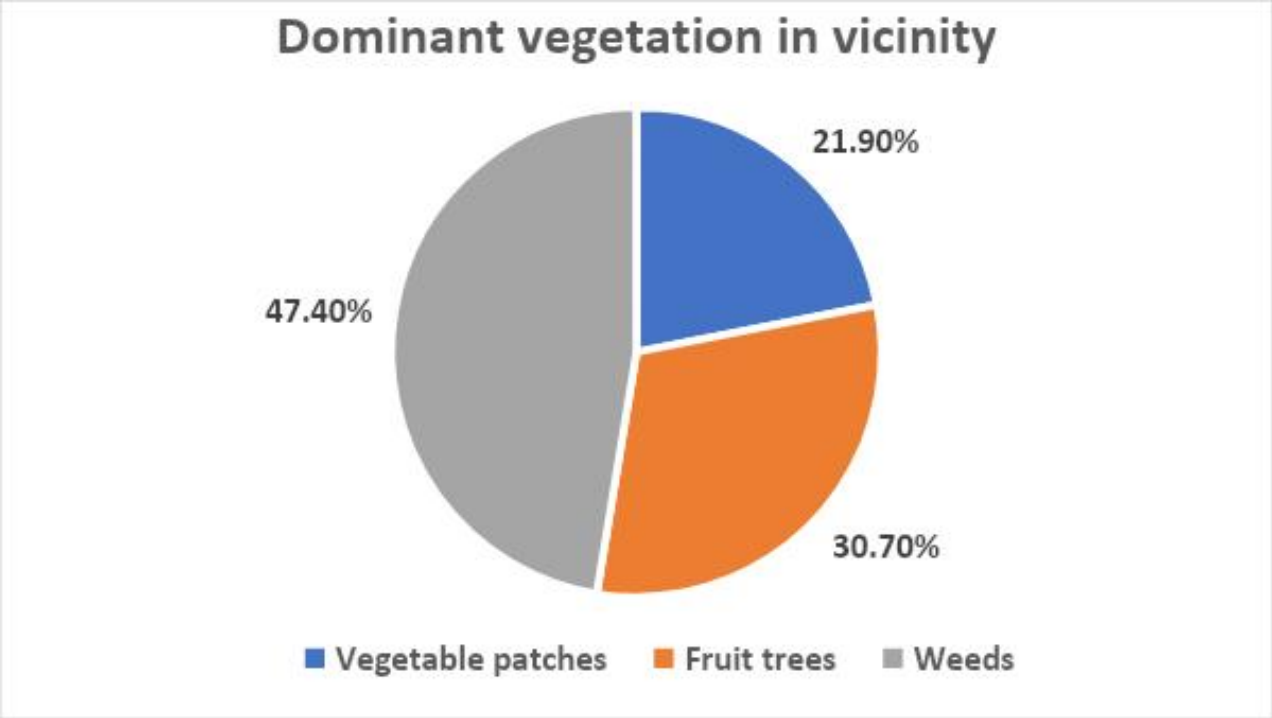

Figure 4.3: Dominant vegetation type in the vicinity of the property

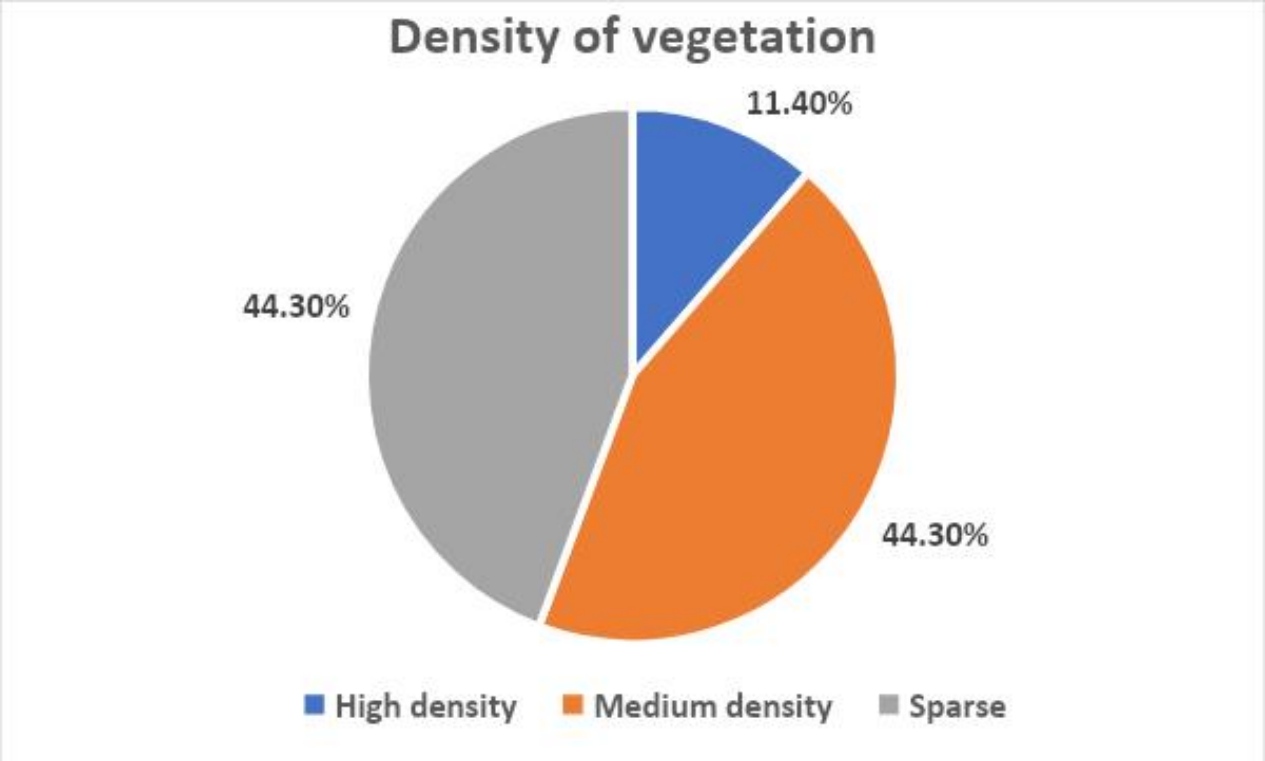

Figure 4.4: Density of vegetation in the vicinity of the property

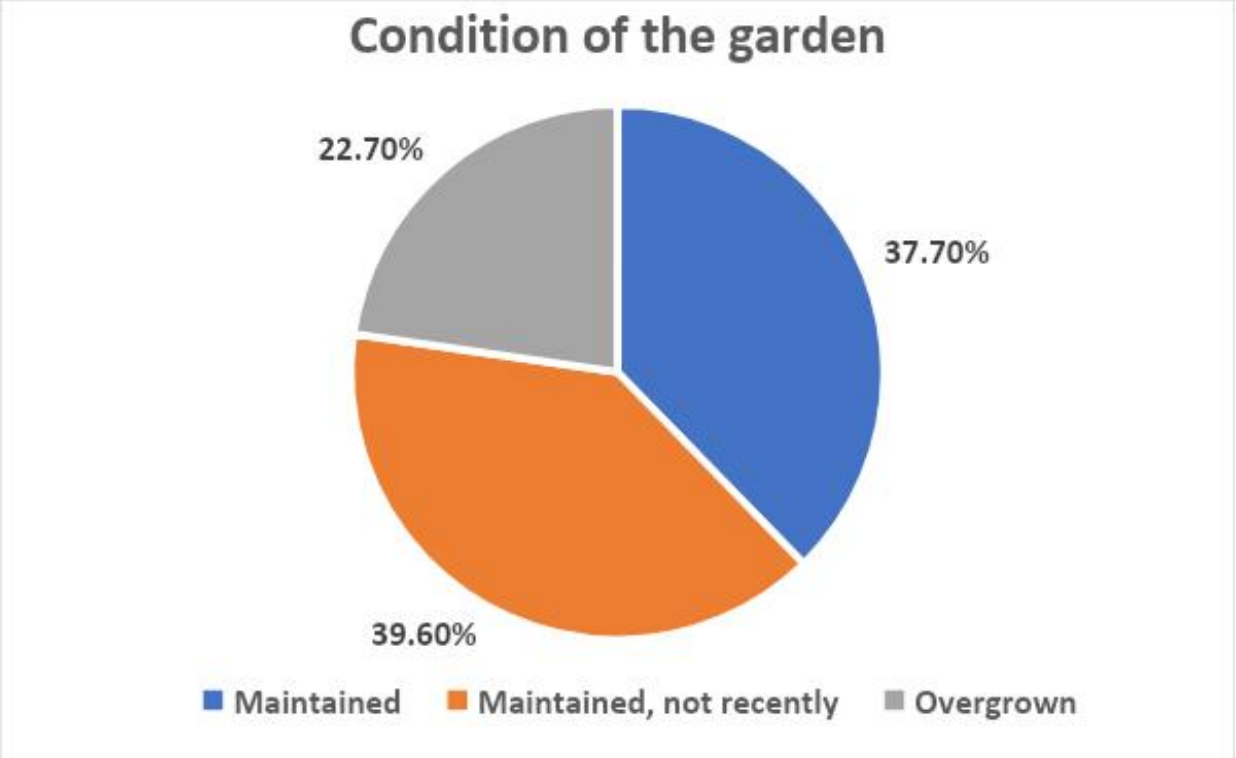

Figure 4.5: Condition of the garden around the property

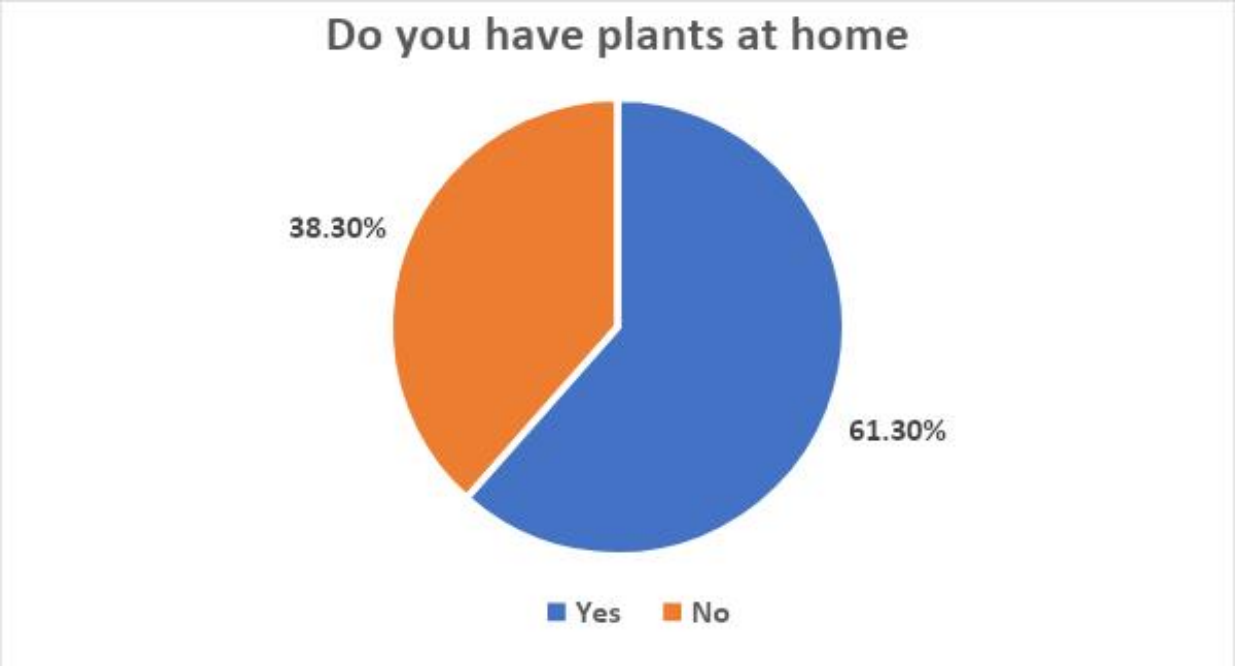

Figure 4.6: Presence of plants at home

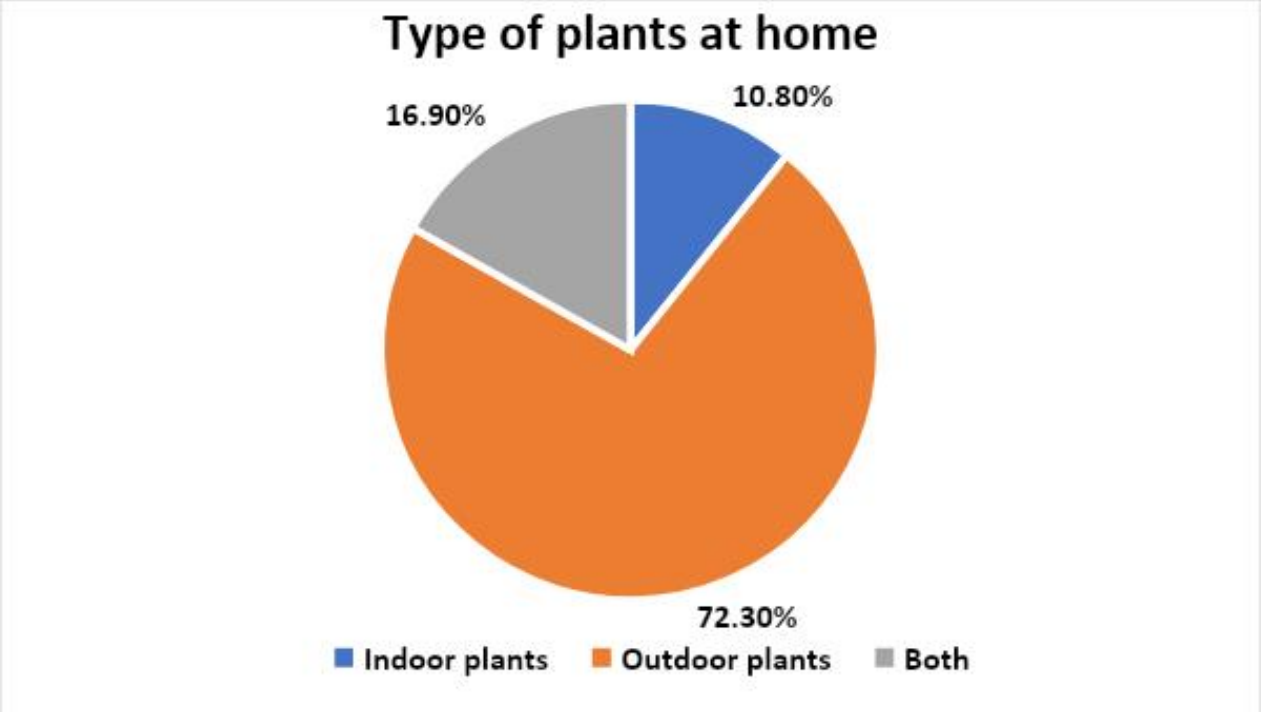

Figure 4.7: Types of plants at home

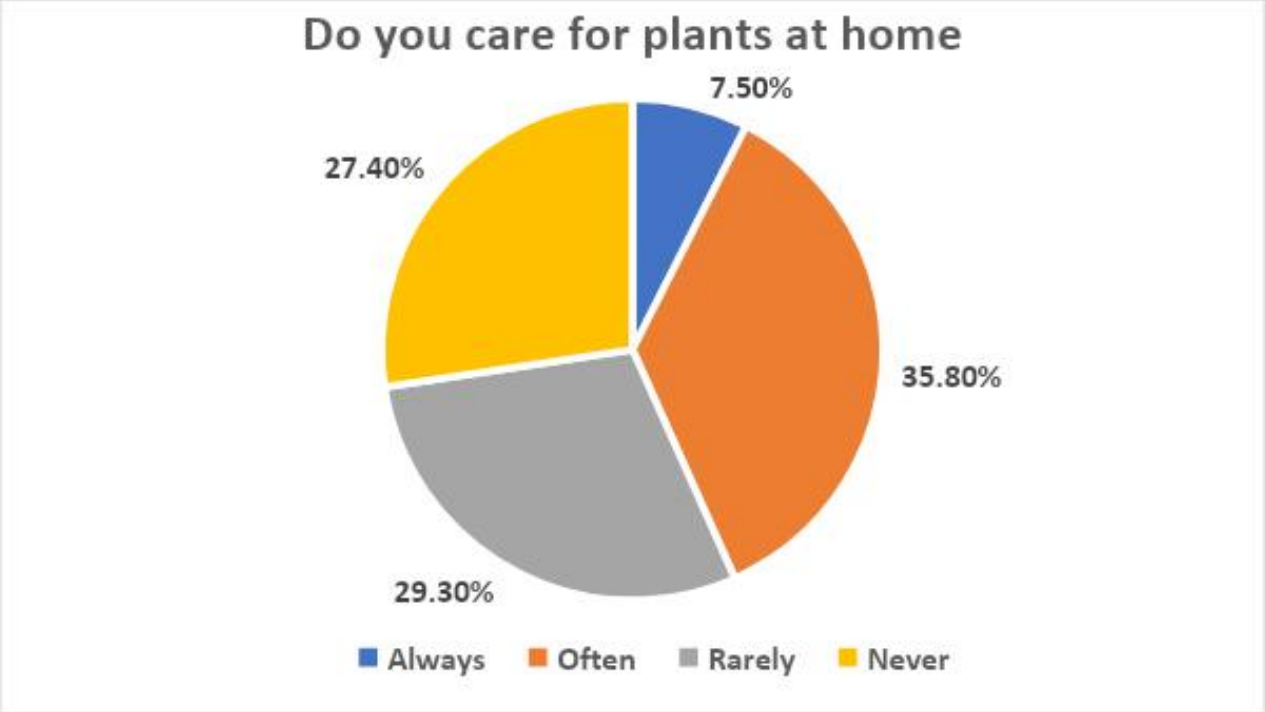

Figure 4.8: Taking care of plants at home

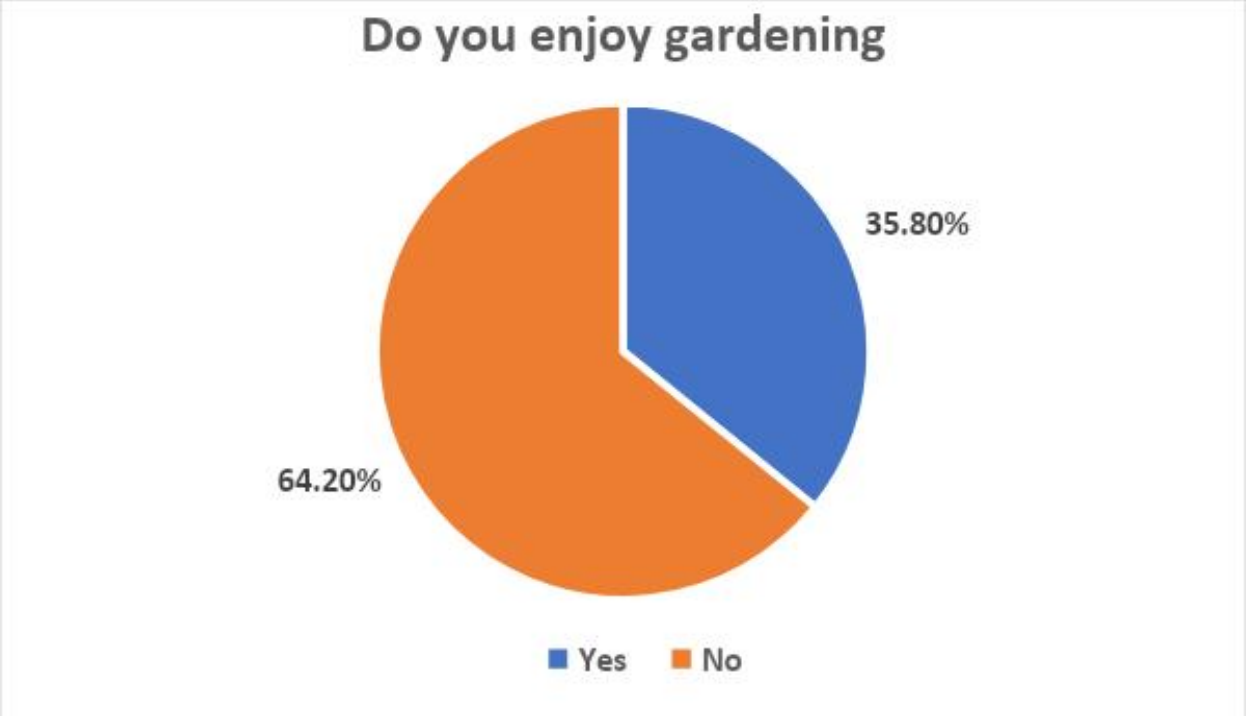

Figure 4.9: Enjoyment of gardening by respondents

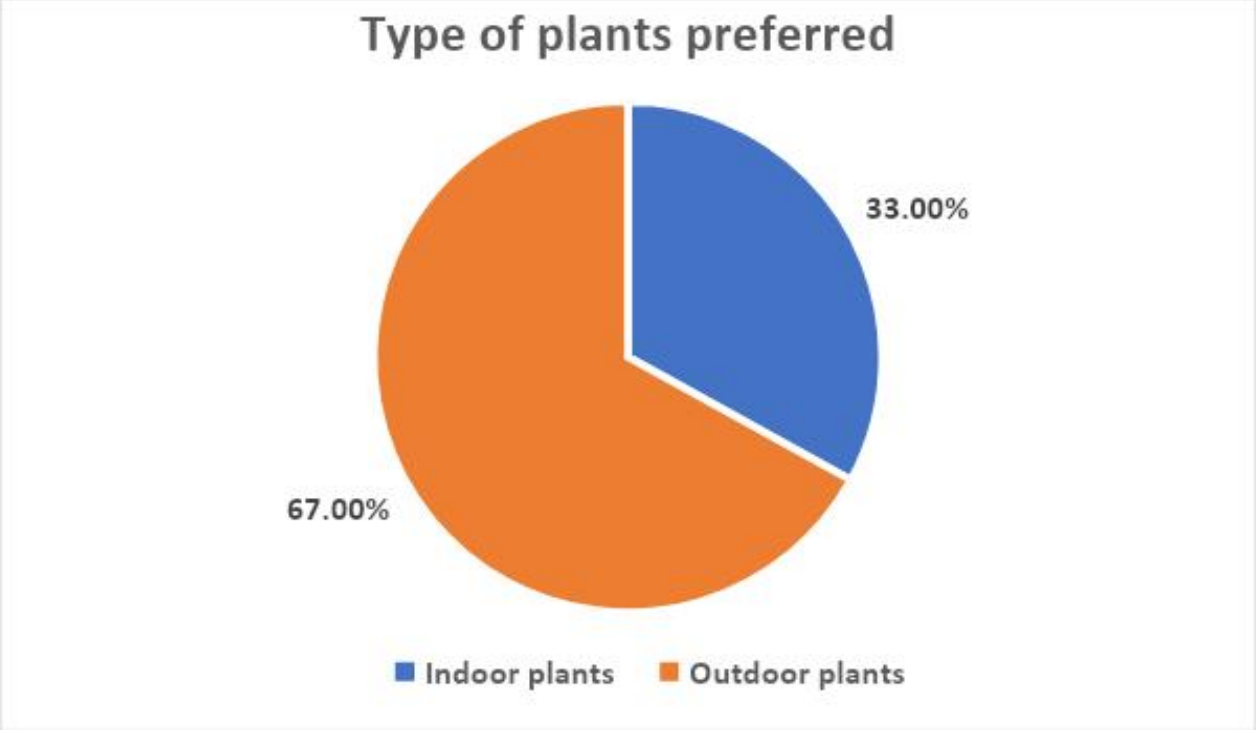

Figure 4.10: Preferred type of plants

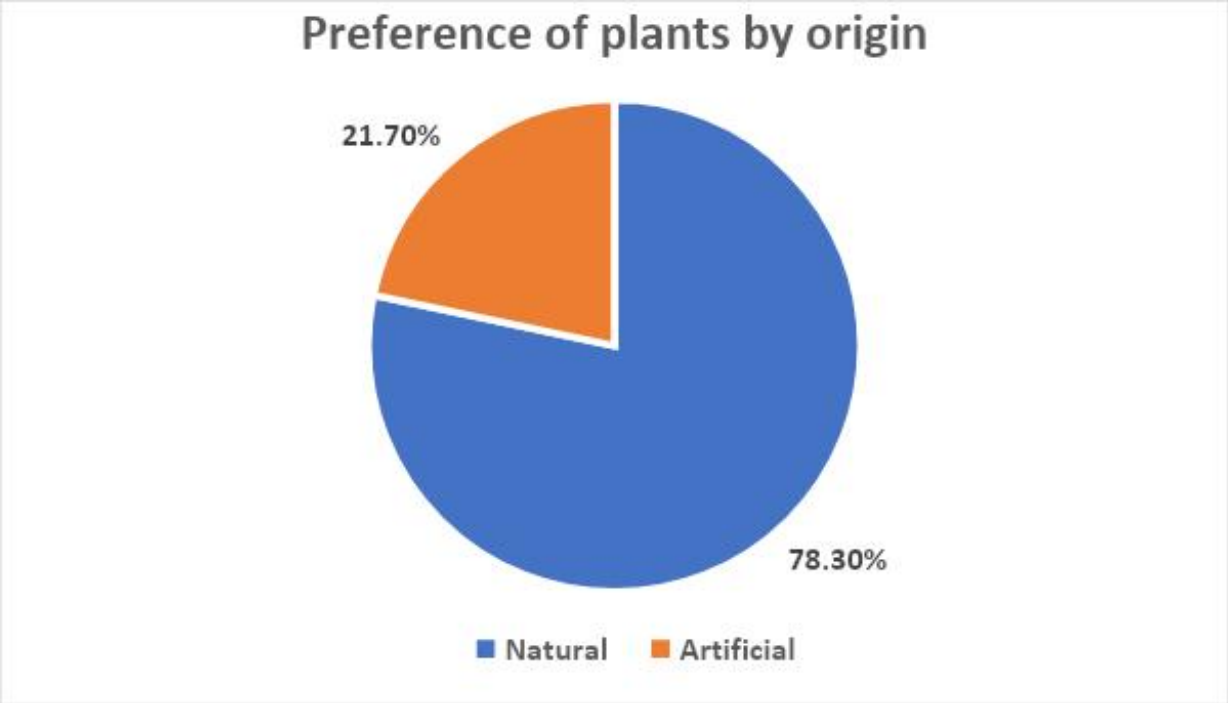

Figure 4.11: Preferred plant origin

SECTION B

This section focused on the importance and perceived benefits of having plants in indoor environments. The results are presented in Figures 4.12 to 4.17.

On the importance of plants, the portion of respondents who indicated that they are 'extremely' important was the highest (41.5%) and those who indicated that plants were not important were the least at 11.3%. The highest percentage of respondents held neutral views concerning having indoor plants (35.8%), while the least had no preference for indoor plants (11.3%). In the same vein, the largest percentage of respondents (38.6%) were neutral on the prospect of plants messing up the internal environment, while those who thought they 'extremely' messed up indoor environments made up 8.5%. About 19.8% of respondents opined that plants reduced stress levels with only 11.3% in disagreement. A large number of respondents (49.1%) indicated

that plants improve air quality, while just 3.7% thought they did not improve air quality. Approximately 41.5% of respondents held neutral views on plants improving productivity, and 10.4% did not agree with that assertion.

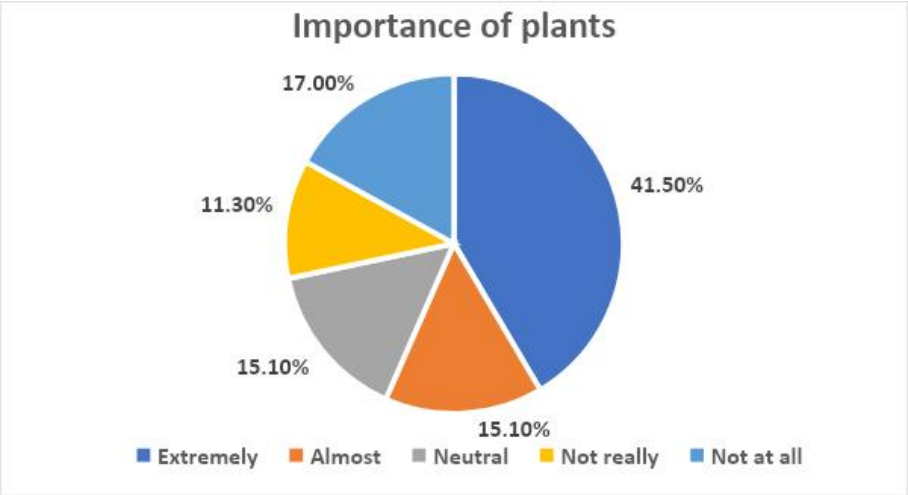

Figure 4.12: Importance of plants

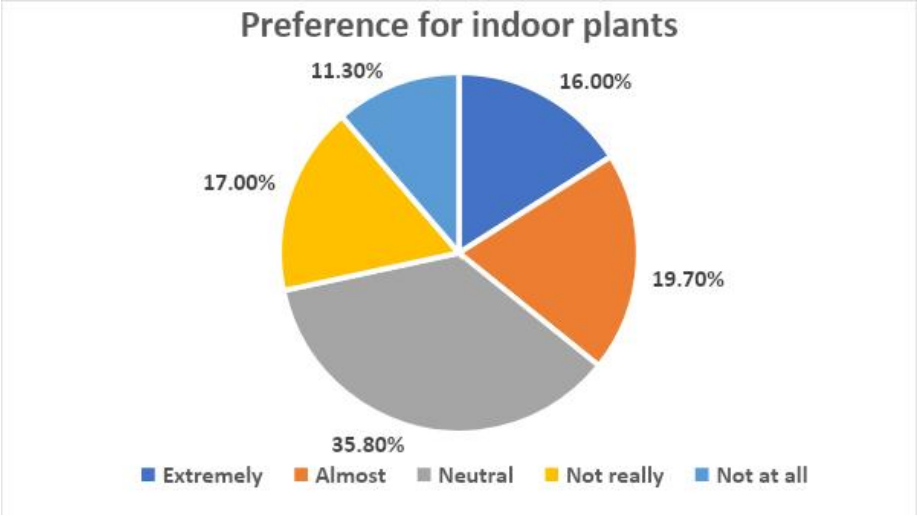

Figure 4.13: Preference for indoor plants by respondents

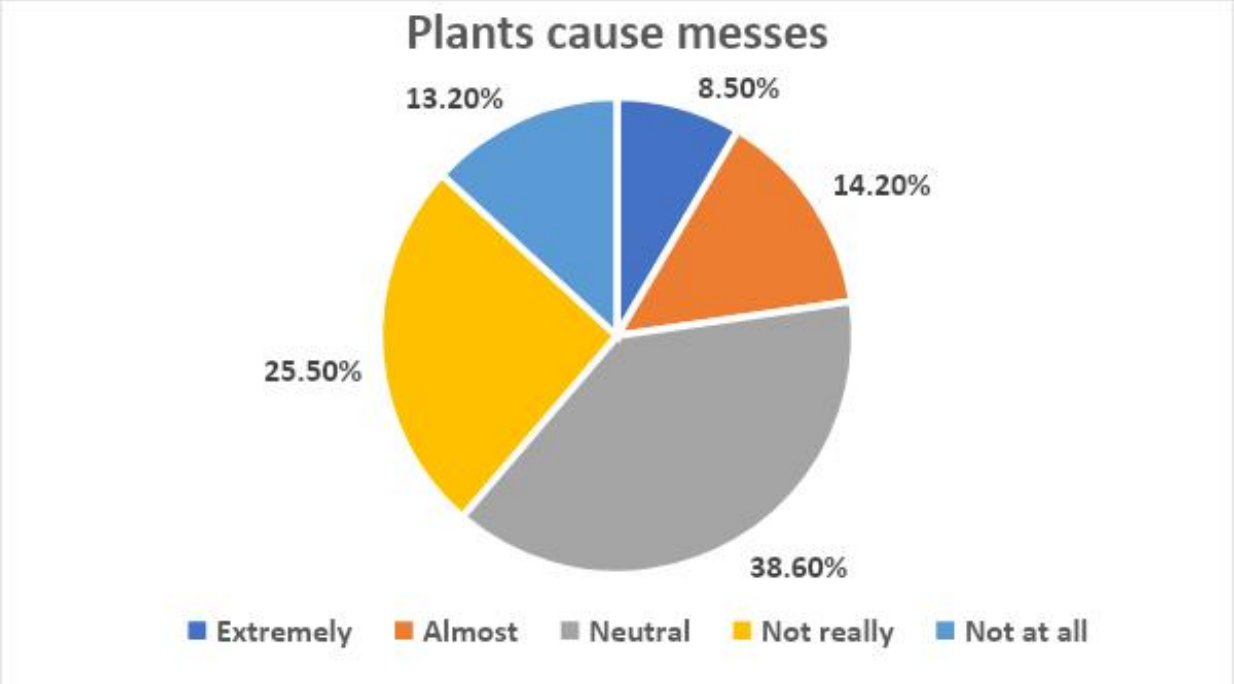

Figure 4.14: Plants messing up the indoor environment

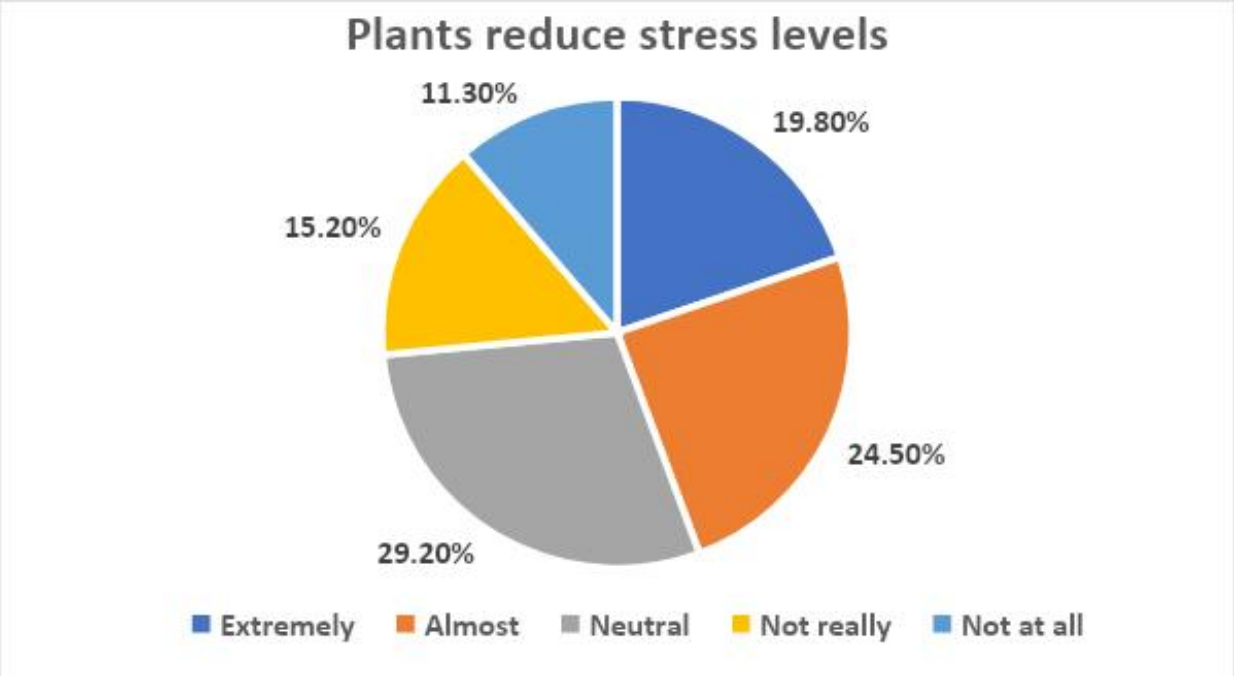

Figure 4.15: Plants aid in reducing stress levels

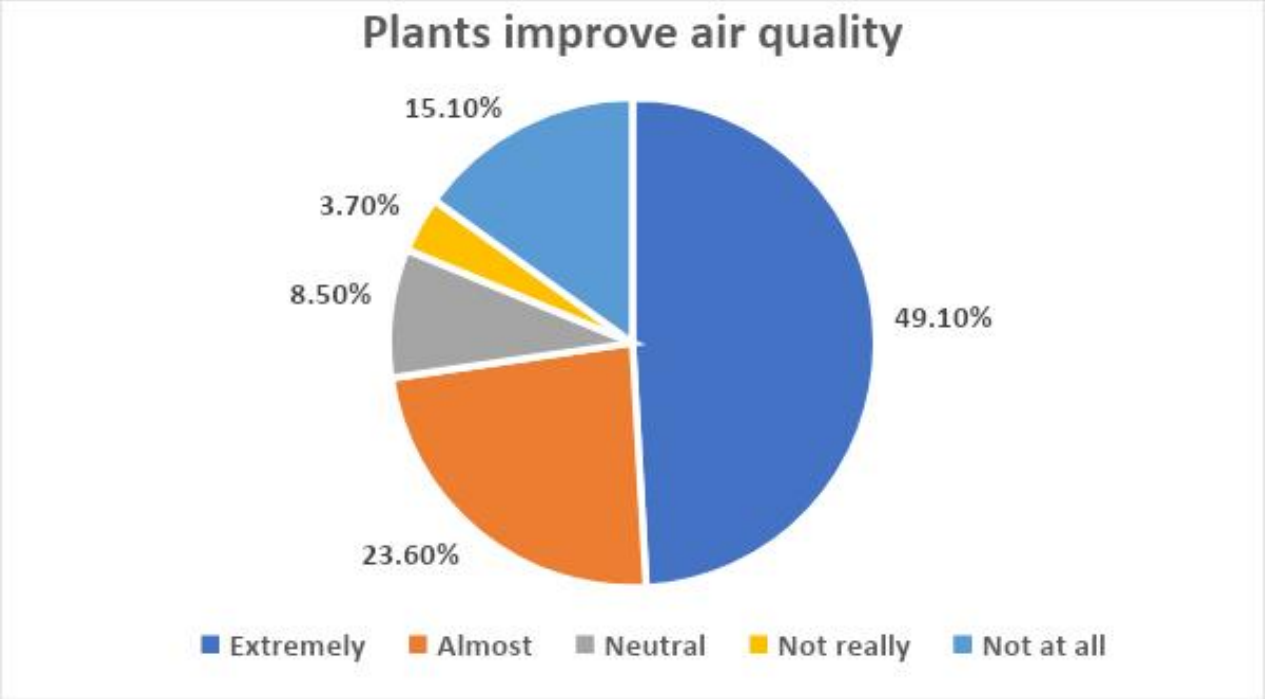

Figure 4.16: Plants aid in improve air quality

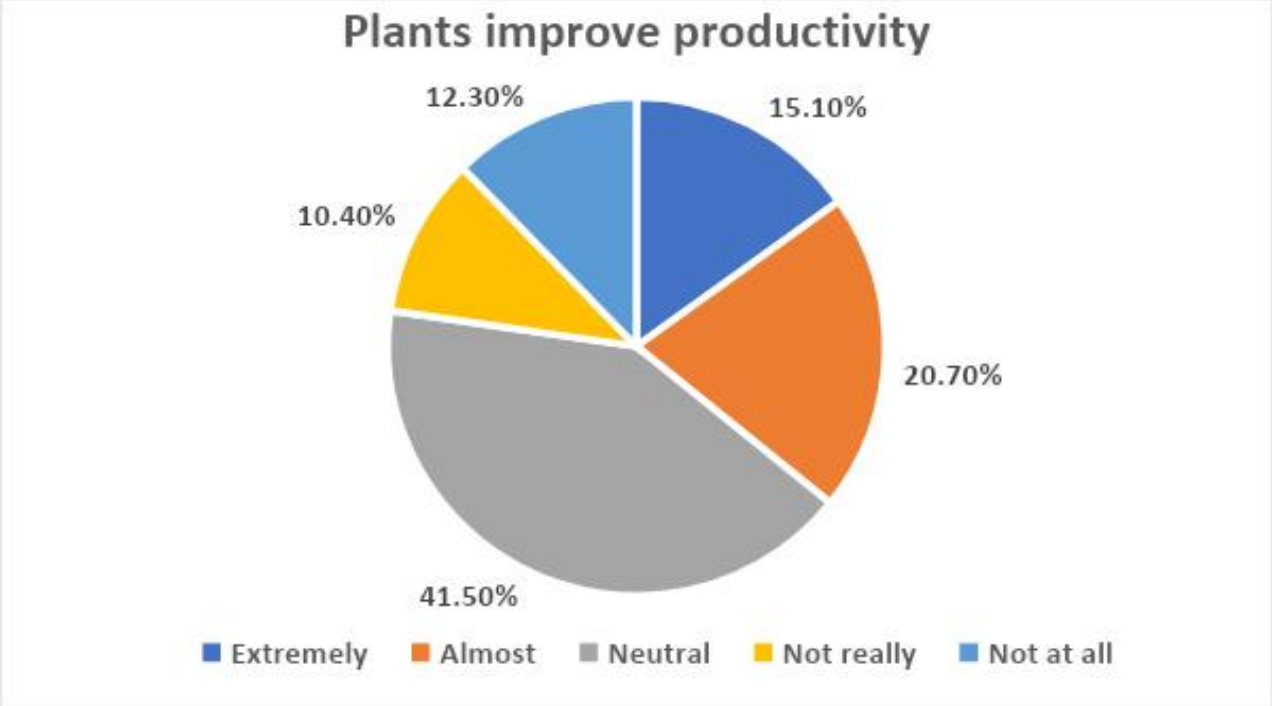

Figure 4.17: Plants aid in improving productivity

4.2. FINDINGS AND DICUSSION

The responses gathered from the participants in this study generally favour the presence of plants around residential areas. Plants are important components of the environment for a variety of reasons including the removal of carbon dioxide from the environment, serving as sources of food and the performance of a wide range of ecosystem services. Additionally, it has been indicated that plants are important in the indoor environment by a majority of the participants in this study. This view is echoed in studies in the literature (Malys *et al.,* 2016; Persiani, 2021).

Most respondents have stated that they have a preference for having plants outdoors and that they favour natural plants over artificial plants. These assertions are also made in the study by Ruiz-Hernandez *et al.* (2021). While a higher portion of respondents was neutral on the reduction of stress levels by the presence of plants in the indoor environments, there are several plants which have been identified to have this effect when placed in the indoor environment. Among these are peppermint, basil, chamomile, lavender, jasmine, aloe vera, chrysanthemum, gerbera (Joyner, 2019; Kot, 2022). A high number of respondents supported the notion that plants aid in improving the quality of indoor air. This has been recorded in the literature as a normal function of plants in the environment due to their ability to remove carbon dioxide from the air and replace it with oxygen (Persiani, 2021). Another way through which plants improve the quality of indoor air is the reduction of the temperature within buildings as reported by Mari *et al.* (2019). These factors combined lead to better comfort and less stress on the occupants of the building and directly contribute to productivity in various activities (Deng and Deng, 2018) although the largest percentage of participants held neutral views on this.

Generally, the views of the participants of this study concerning the roles which plants play and their roles in the indoor environment are positive and consistent with studies and other publications in the body of literature.

CHAPTER FIVE

5.1. INTRODUCTION

Plants are important parts of the environment. They are nice to look at and several studies over time have shown that their presence in indoor environments can cause an improvement in the psychological and emotional well-being of humans. It has also been outlined that they are able to reduce feelings of stress and anxiety while improving comfort. Other benefits of having plants in indoor environments have been identified by research to include boosting self-esteem, improving enthusiasm and encouraging self-care, improving memory and retention, in addition to improving air quality.

5.2. SUMMARY OF RESEARCH WORK

This study assessed the integration of vegetation in residential buildings in Benin City, Edo State, Nigeria. Also, the perceived effects of indoor plants on residents of houses were evaluated. An exploratory methodology was adopted for the purpose of the study. Data for the study was collected by way of structured questionnaires distributed to a total of 106 respondents. Analysis of data was done using frequencies and percentages with a presentation on pie charts. The findings for the study revealed that the presence of plants in indoor portions of residential houses in the study area was low (10.8%) with most having outdoor plants. Plants were deemed to be extremely important in the environment and their effects were identified to include reduction of stress levels, improvement of air quality and productivity of individuals.

5.3. CONCLUSION

Plants provide a vast range of benefits to humans and the environment with these benefits ranging from improving the aesthetic quality of the environment to better air quality and comfort

of people living around them. As such, this study was conducted to assess the integration of plants in residential buildings in Benin City. From the findings made, it is concluded that the integration of plants in residential buildings was low although most buildings have plants in the external areas of their vicinity. Additionally, it was also realised that most respondents do not have an understanding of the benefits which plants confer on humans and the environment as evidenced by the high number of neutral responses when queried about the effects of plants in indoor environments.

5.4. RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

Efforts should be made towards educating members of the general public on the importance of having plants in and around the home in an effort to encourage them to inculcate the practice. Such education could be organised by the government or workers in charge of developing buildings. Additionally, the academic curriculum should include course which cover these aspects at all levels.

Proper methods to care for plants around the house should be taught to students and other members of the public.

The practice of gardening should be encouraged.

5.5. CONTRIBUTION TO KNOWLEDGE

This study presented the state of integration of plants in residential areas in Benin City along with the perception of residents of the city in the effects of having these plants in the home. The

findings of this study are a veritable contribution to the body of knowledge in that the information gathered can be used as a basis for future research. Also, members of the public can use knowledge gathered from this study to design and develop better houses which provide avenues for maximum comfort and productivity. Additionally, the information herein can be used by policy-makers to set guidelines for having green areas around residential areas.

5.6. AREAS FOR FURTHER RESEARCH

Areas for further research as related to this study would include evaluating the various types of plants which provide the maximum aesthetic and health benefits when grown in or around the home, proper care of these plants and the effects of knowledge intervention on the practice of individuals as relates to having plants around the home.

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APPENDIX

Summary of the respondents' views on questionnaire queries

SECTION A

Question	Option	Frequency (%)
Type of property	Single storey	39 (36.8)
	Multi-storey	21 (19.8)
	Apartment	46 (43.4)
Type of plant in garden	Vegetables	32 (30.2)
	Decorative	22 (20.7)
	Fruits	18 (17.0)
	None	34 (32.1)
Dominant vegetation in vicinity	Vegetable patches	23 (21.9)
	Fruit trees	33 (30.7)
	Weeds	50 (47.4)
Density of vegetation	High density	12 (11.4)
	Medium density	47 (44.3)
	Sparse	47 (44.3)
Condition of the garden	Maintained	40 (37.7)
	Maintained, not recently	42 (39.6)
	Overgrown	24 (22.7)
Do you have plants at home?	Yes	65 (61.3)
	No	41 (38.3)
Types of plants at home	Indoor plants	7 (10.8)
	Outdoor plants	47 (72.3)
	Both	11 (16.9)
Do you care for plants at home?	Always	8 (7.5)
	Often	38 (35.8)
	Rarely	31 (29.3)

	Never	29 (27.4)
Do you enjoy gardening?	Yes	38 (35.8)
	No	68 (64.2)
What type of plants do you prefer?	Indoor plants	35 (33.0)
	Outdoor plants	71 (67.0)
Preference of plants by origin	Natural	83 (78.3)
	Artificial	23 (21.7)

SECTION B

Question	Options	Frequency (%)
Importance of plants	Extremely	44 (41.5)
	Almost	16 (15.1)
	Neutral	16 (15.1)
	Not really	12 (11.3)
	Not at all	18 (17.0)
Preference for indoor plants	Extremely	17 (16.0)
	Almost	21 (19.7)
	Neutral	38 (35.8)
	Not really	18 (17.0)
	Not at all	12 (11.3)
Plants cause messes	Extremely	9 (8.5)
	Almost	15 (14.2)
	Neutral	41 (38.6)
	Not really	27 (25.5)
	Not at all	14 (13.2)
Plants reduce stress levels	Extremely	21 (19.8)
	Almost	26 (24.5)
	Neutral	31 (29.2)

	Not really	16 (15.2)
	Not at all	12 (11.3)
Plants improve air quality	Extremely	52 (49.1)
	Almost	25 (23.6)
	Neutral	9 (8.5)
	Not really	4 (3.7)
	Not at all	16 (15.1)
Plants improve productivity	Extremely	16 (15.1)
	Almost	22 (20.7)
	Neutral	44 (41.5)
	Not really	11 (10.4)
	Not at all	13 (12.3)