WATER HYACINTH: A PROMISING AND INNOVATIVE SOURCE FOR SUSTAINABLE INTERIOR

Thesis submitted to

ST. TERESA'S COLLEGE, ERNAKULAM

(Autonomous)

Affiliated to

MAHATMA GANDHI UNIVERSITY

In partial fulfilment of requirement for the award of the degree of MASTER OF SCIENCE in

HOME SCIENCE (BRANCH B)

RESOURCE MANAGEMENT & INTERIOR DESIGNING

By

FATHIMA FEBIN P.P.

Register No. AM21HRM005

DEPARTMENT OF HOME SCIENCE AND CENTRE FOR RESEARCH

JUNE 2023

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'Certified as bonafide research work'

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I hereby declare that the thesis entitled ‘‘***Water Hyacinth; a promising and innovative source for Sustainable Interior’*** is a bonafide record of research work done by me during the course of study, under the supervision and guidance of Dr. Susan Cherian, Associate Professor and Head, Department of Home Science and Centre for Research, St. Teresa’s College, Ernakulam.

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CERTIFICATE

This is to certify that the thesis entitled '***Water Hyacinth; a promising and innovative source for Sustainable Interior'*** is an authentic record of the original research work carried out by **Ms. Fathima Febin P.P.** with **Reg. No. AM21HRM005** under my supervision and guidance during the academic year 2022-'23.

Ernakulam **Dr. SUSAN CHERIAN**

05 - 06 - 2022

ACKNOWLEDGEMENT

Accomplishment of research work is a golden opportunity for learning and self development. I consider myself lucky and honoured to have so many marvellous individuals lead me through in completion of this project.

I thank Almighty in helping me to complete this project successfully and to submit this project.

I am grateful to Rev. Dr. Sr. Vinitha CSST, Manager, St. Teresa's College, Rev. Sr. Emiline CSST, Director, St. Teresa's College, Dr. Alphonsa Vijaya Joseph, Principal, St. Teresa's college, and Dr. Susan Cherian, Head of Department of Home Science for proving me facilities for smooth conduct of this study.

My sincere thanks to KIDS (Kottpuram Integrated Development Society), Kodungallur, for providing the information and guidance for the study conducted.

I express my sincere thanks to Dr. Susan Cherian, Associate Professor, Department of Home Science, who had been an unending source of encouragement for me during the course of my thesis work.

I feel privileged to express my sincere thanks to all my teachers in the Department of Home Science, for their help, encouragement, advises and support. I also express my gratitude to the authorities of St. Teresa's College library for granting me the permission to use the library facilities.

I owe a heartfelt gratitude to my parents, family member, friends and all well wishers for their prayers, timely support and encouragement.

FATHIMA FEBIN P. P.

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ABSTRACT

Water hyacinth has recently become a product of sustainable interiors. There is rising need for environmentally friendly, socially and commercially successful sustainable interior design goods as people become more aware of hoe their activities affect the environment. In many tropical and sub-tropical areas of the world, water hyacinth is a rapidly growing aquatic plant. It is a resource that may be collected and weaved into goods like furniture and home decor. It is a flexible, strong, and environmentally friendly material that can give any interior space a natural and distinctive feel. Reduce the use of synthetic materials and advance sustainable principles by using water hyacinth as a component of sustainable interiors. The methodology used in the study is a baseline survey among 100 samples residing in Ernakulam district. The samples were selected using convenience sampling technique. The study reveals that all the respondents use plastic material as interior accessories. Plastic, once hailed as a miracle material, has now become a nightmare that threatens the very existence of our environment and jeopardizes the well-being of all living beings. The study echoes the fact that all the respondents use plastic material as interior accessories. The need for sustainable products in interior design has become increasingly important in recent years. As society grows more conscious of environmental issues, there is a growing demand for sustainable and eco-friendly solutions in all aspects of life, including interior design. Sustainable products in interior design refer to materials, furniture, and accessories that are produced and used in a way that minimizes their impact on the environment. By incorporating sustainable products in interior design, we can create spaces that not only look beautiful but also contribute to a greener and more sustainable future. The study concludes ideas and creativity in the sample to design new products with Water Hyacinth to beautify their interior aesthetically and helps to reduce the impact caused by using non-bio degradable products in interior by replacing Water Hyacinth products.

Chapter 1
INTRODUCTION

Environmental pollution and global warming is a threat to human life making it miserable and so that for the future generation. Sustainable interior design gives emphasis to nature friendly materials which reduces negative impacts on nature as well as on people and also making people more conscious about reusing and recycling materials. Sustainable or natural friendly products in interior enhance and maximize indoor environment quality. Materials like rattan, bamboo, wicker, coconut shells and even grass are used in interior as construction material or as decor accessories. Using sustainable products in interior is a trend which will help in waste minimization and better use of materials.

The increased understanding of how human activity affects the environment has led to the emergence of sustainable interior design. People are looking for methods to lessen the impact on environment and encourage more sustainable practices as they become more conscious of the effects of their activities already caused in the environment. A design concept known as sustainable interior design focuses on making interior spaces that are energy-efficient, ecologically friendly and healthy for the inhabitants. Sustainable interior design tries to lessen the harmful effects on the environment by considering the complete lifespan of materials, from manufacturing to disposal. Sustainable design methods are the need of the hour in the field of interior design

to improve the present state of the environment. In addition to being good for the environment, sustainable design has a positive effect on people's health and well-being (Kwok and Sullivan, 2018).

The increased interest in wellness and healthy living is a major aspect influencing the development of sustainable interior design. Incorporating elements that support good indoor air quality, natural light, and healthy materials into sustainable interior design may aid people who are increasingly interested in creating environments that encourage health and well-being. The growth of sustainable interior design is a reaction of the public towards the increased understanding of how human behaviour affects the environment and the desire to create healthier and ecologically responsible living environments. Designing, embellishing, and furnishing indoor spaces with an eye towards reducing their negative effects on the environment and fostering social responsibility is referred to as sustainable interiors. Thus, sustainable interior design are made with eco-friendly products, which reduces undesirable impacts on environment through up-cycling or recycling waste materials which boost up indoor environment quality.

Additionally, there are now more choices for environmental friendly and sustainable materials like, bamboo, cork and recycled materials. The objective of sustainable interiors is to design spaces that are both visually beautiful and practical while also being healthful, energy efficient and environmental friendly. Environmental friendly home design include opting for products that are recyclable, biodegradable and renewable. This comprises recycles and repurposed materials as well as organic materials and stone. Whenever feasible, one should use natural illumination and put in energy efficient window insulation.

Avoid products that contain harmful chemicals, such as formaldehyde and volatile organic compounds (VOCs), which can cause health problems. Reduce energy use. Choose products that are durable, reusable and easy to repair. Recycle and repurpose materials whenever possible and dispose of waste responsibly. Consider the environmental impact of shipping and transportation. Choose things that may be recycled or repurposed to reduce waste and stay away from single use items. Instead of tossing any things you no longer need, donate or sell them.

The trend towards sustainable design as a whole, which first appeared in the 1970s and picked up steam in the 1990s, is where sustainable interior design derives its roots. During this time, designers, architects, and other professionals started to realize how important it was to develop structures and produce goods that were both socially and environmentally responsible. The launch of the Leadership in Energy and Environmental Design (LEED) certification programme in 1998 was one of the industry's initial turning points towards environmentally friendly interior design. The United States Green Building Council (USGBC) created this grading system to provide guidelines for ecologically responsible building practices and to encourage the use of renewable resources and energy-saving equipment. With more architects and designers incorporating sustainable concepts into their work, sustainable interior design started to take centre stage in the design industry in the early 2000s. Architects, designers, and other industry experts came together for the first time in 2007 for the Greenbuild International Conference and Expo to exchange ideas and best practices in sustainable design (Kubba, 2009; Krygiel, et.al., 2008). Building in the current scenario means building sustainably. Sustainability is a moral and ethical concern for the environment and future

generations (Piano, 2007). Building design is a social process, according to Norman Foster, (2006) which necessitates a knowledge of how people utilize space and how that relates to environmental responsibility. It also entails creating structures that are energy efficient and environmentally friendly in their construction.

Due to its natural and ecological qualities, water hyacinth has recently become a product of sustainable interiors. There is rising need for environmentally friendly, socially and commercially successful sustainable interior design goods as people become more aware of hoe their activities affect the environment. In many tropical and sub-tropical areas of the world, water hyacinth is a rapidly growing aquatic plant. It is a resource that may be collected and weaved into goods like furniture and home decor. It is a flexible, strong, and environmentally friendly material that can give any interior space a natural and distinctive feel. Reduce the use of synthetic materials and advance sustainable principles by using water hyacinth as a component of sustainable interiors. Additionally, it supports the local communities that cultivate and weave the plant into goods, generating jobs and money. Due to its biodegradability and renewability, water hyacinth has the potential to be an ideal eco-friendly material for interior design (Kamala, et.al., 2018).

Water hyacinth may be collected several times a year without the need for replanting, making it a very sustainable resource. Water hyacinth is a fast growing aquatic plant that, given the right circumstances, may quadruple its biomass in as little as two weeks (Nkansah-Boadu, et.al.,2019). Additionally, it takes up minerals and contaminants from the water, enhancing its quality and supporting healthy aquatic habitats. In general, the development of water

hyacinth as a sustainable interior product is a reaction to the rising need of eco-friendly and sustainable interior design goods that are socially conscious, ecologically sensitive, and commercially viable.

Sustainably build green building and green homes are healthier and comfortable to live in. The emissions of toxins from sustainable building materials are such less. Water hyacinth, a waterweed or plant which can completely cover water bodies and wetlands, become a threat to aquatic ecosystem. Reducing dissolved oxygen levels for fishes, block water flow and end up being an ideal condition for mosquitoes to spread. This can cause a serious problem to aquatic lives. Rapid growths of water hyacinth also affect the agricultural land and associated water sources. This could result in affecting agricultural food production.

Depending on population size and density, the aquatic plant; water hyacinth can have either good or negative effects on aquatic environments. However, excessive populations of water hyacinths can obstruct sunlight and lower water oxygen levels. Reduced habitat and food supplies may have adverse effects on aquatic plants and animals, including fish. In addition to obstructing rivers and reducing water flow, dense populations of water hyacinth can also cause flooding and other issues.

In the afflicted areas, efforts are being undertaken to manage and reduce water hyacinth populations using techniques including hand removal, biological management, and the application of pesticides. To stop the spread of water hyacinth and make sure it doesn't impact the ecosystem, it's crucial to properly dispose of it. Overall, water hyacinth may have both beneficial and detrimental

effects on aquatic environments, thus it's critical to regulate its population to prevent it from becoming a concern for the environment. A powerful greenhouse gas that contributes to climate change, methane, may also be released during the breakdown of water hyacinth. On the positive side, aquatic creatures like fish and crustaceans can find a home and food in water hyacinth. Young fish can also find cover and protection from its floating leaves and roots, helping to maintain healthy populations.

In order to reduce the problems caused by water hyacinth and to minimize their abundance and uncontrolled growth in the water bodies many research studies are conducted and found that it can be used to feed buffalo, cattle and swine. It is used even for land filling. An innovative idea to control the growth of this macrophyte is to it use as sustainable product in interior. Using water hyacinth as sustainable source will provide inexpensive and environmentally friendly products such as wallpaper, non-load bearing partition walls, baskets and so on. These also help from spending considerable money for de-weeding water hyacinth. In order to create high-quality, functional products that satisfy consumer needs while maintaining the sustainability and biodegradability of the source material, the development of products from water hyacinth necessitates an interdisciplinary approach, involving the integration of design, engineering, and material science (Kamala, et.al., 2018).

Some ways water hyacinth can be used in sustainable interior design are chairs, couches, and tables may all be made out of water hyacinth. It is a strong and portable material that can give any interior area a natural feel. Storage bins out of water hyacinth that you can use to organise things like toys, magazines, and towels. They serve as a greener substitute for plastic storage containers. To

provides a warm and natural lighting effect; water hyacinth can be weaved into the fabric. It is a distinctive and environmentally friendly replacement for conventional lampshades made of synthetic materials. Water hyacinth may be used to cover walls in a rustic, textured manner. Any interior area may benefit from the addition of nature because it helps to calm and relax people. Reduce the usage of synthetic materials and advance sustainable design principles by using water hyacinth as a sustainable interior product that will reduce climate change which is the most pressing threat to whole species (Hansen, et.al., 2012).

As people become more conscious of how their activities affect the environment and strive to incorporate more sustainable practices into their everyday lives, their views towards sustainable interiors are shifting. People are increasingly demonstrating a preference for ecologically conscious interior design goods that are made using sustainable practices and resources. They are looking for goods that are environmentally friendly over their whole existence, created from renewable resources, biodegradable, or recyclable materials. Furthermore, there is a growing need for pleasant, healthy living environments that support wellbeing. Sustainable interiors may help meet this demand by adding elements that support good indoor air quality, natural light, and healthy materials.

Due to perceived increased prices, a lack of knowledge or comprehension of sustainable design concepts, and a dearth of sustainable items on the market, some customers are still reluctant to adopt sustainable interior design practices. Many individuals do not understand or have a limited understanding of sustainable design ideas, which prevents them from realising the promise of sustainable design to address urgent environmental issues. A significant obstacle

to the broad adoption of sustainable design principles is this ignorance (Liu, et al., 2020). However, it is anticipated that views towards sustainable interiors will continue to change and improve as sustainable design practices and materials become more widely available, cheap, and accepted. Future demand for sustainable interiors is anticipated to be driven by the growing awareness of the need to protect the environment and encourage sustainable practices, making them a more and more attractive option for customers who are concerned about their environmental effect.

Sustainable water hyacinth products can contribute to environmental protection in a number of ways such as reducing the usage of synthetic materials. Sustainable water hyacinth products can take the place of synthetic materials, which are frequently made using non-renewable resources and add to pollution and waste. We may lessen the negative effects of our consuming habits on the environment by employing water hyacinth as a sustainable resource. It gives support for local communities. By using sustainable water hyacinth products, communities may benefit from the collection and weaving of the plant into goods, which generates jobs and revenue. This may support the social and economic well-being of the local communities where the plant is gathered. Water hyacinth is a resource that may be gathered again each year without the need for replanting. It grows quickly. This can support the sustainable use of natural resources and help ease the strain on other natural resource. The ability of water hyacinth to absorb nutrients and contaminants from the water, so enhancing water quality and promoting healthy aquatic habitats, makes it a very sustainable material. Water hyacinth removal from streams also lowers the chance of erosion and flooding. To lessen carbon footprint and contribute to climate change mitigation by

utilising sustainable water hyacinth goods. Because water hyacinth is a carbon-neutral substance, neither its production nor its disposal results in the emission of greenhouse gases.

The usage of synthetic materials is decreased, local people are supported, natural resources are conserved, aquatic habitats are improved, and our carbon footprint is decreased due to the use of water hyacinth sustainable goods. Depending on how they are created, made, and sold, water hyacinth goods may be market-oriented. Products made from water hyacinth might capitalize on the market's growing desire for sustainable goods in recent years.

Products made from water hyacinth should satisfy customer requirements and preferences while also addressing environmental and social issues in order to be market-oriented. This implies that water hyacinth goods have to be created utilising high standards of quality, dependability, and aesthetic appeal, as well as environmentally friendly production techniques and local economic development. Products made from water hyacinth may be advertised as environmentally friendly, sustainably produced, and socially responsible. This might appeal to customers who are concerned about their influence on the environment and want to make more sustainable decisions. They can also be marketed as different and one-of-a-kind, displaying the inherent beauty of the material and the skill of the craftspeople that make them.

Products made from water hyacinth need to be priced fairly and promoted skillfully if they are to succeed on the market. This can entail working together with shops and designers that uphold comparable principles and are dedicated to

sustainability, as well as reaching out to potential clients via social media and other marketing methods.

Water hyacinth products can be market-oriented if they are created, manufactured, and distributed with an emphasis on social responsibility, quality, and sustainability. Water hyacinth goods may be a competitive and profitable alternative in the interior design industry by appealing to the rising need for sustainable products. The use of the internet for communication, buying and selling transactions, and information distribution to create enterprises supports the development of these home-based businesses (Sianturi, et.al., 2019).

Depending on the location and the intended audience, different levels of knowledge may exist about water hyacinth items used in interior design. People may be more familiar with water hyacinth as a sustainable product in interior design in locales where it is easily accessible and often utilised. People might not be as aware of its application in interior design in other locations where it is less prevalent. Eichhornia crassipes, a kind of water hyacinth, is a crucial component of the aquatic ecology. It has previously been shown that water hyacinth is a very promising plant with enormous potential for wastewater treatment. It has been discovered that the water hyacinth has potential for usage as paper, organic fertiliser, biogas generation, human food, fibre, and animal feed (Jafari, 2010). However, there has been a rise in interest in environmentally friendly interior design in recent years, and water hyacinth items have become a popular option. Homeowners, architects, and interior designers are increasingly looking for environmentally friendly, socially responsible sustainable materials.

As a result, water hyacinth goods for interior design are now more widely available and promoted, especially in environmentally friendly and sustainable product categories. As a sustainable material option for interior design, water hyacinth has benefited from this increased awareness. As people become more aware of their environmental impact and strive to make more sustainable decisions, there is a growing interest and awareness in sustainable design practises and materials, including water hyacinth. This is true even though the level of awareness about water hyacinth products in interior design may vary.

Campaigns for education and awareness can raise people's understanding of water hyacinth as a sustainable product. This may be accomplished by promoting the advantages of employing water hyacinth and other eco-friendly materials in interior design through social media, advertising, and educational programmes. We can support the promotion of sustainable and ecologically responsible choices by raising people's understanding and awareness of sustainable design principles and materials.

There are various ways that sustainable interior design may support urbanisation and economic growth. Sustainable interior design techniques can lead to work in the manufacturing, design, and construction sectors. For instance, the usage of environmentally friendly materials like water hyacinth may provide local weavers and craftsmen work to harvest, prepare, and weave the material into furniture and home decor. This in turn may support local economic growth and the establishment of viable livelihoods. Sustainable interior design techniques may minimise waste, increase energy efficiency, and assist preserve natural resources. By easing the burden of resource depletion and environmental harm, this can reduce costs and promote economic growth. Creative and inventive

design solutions are frequently used in sustainable interior design techniques, which can stimulate new company ventures and encourage entrepreneurship. For instance, using recycled materials like cardboard or plastic bottles may stimulate the development of innovative product ideas and manufacturing techniques, opening up new business prospects and promoting economic growth.

Using sustainable interior design techniques may also draw tourists to metropolitan areas, boosting the local economy. Travellers looking for environmentally friendly and ethically responsible tourist experiences are becoming more and more interested in sustainable architecture and design. Urban regions may draw more tourists and bring in more money for the neighbourhood's small businesses and the general economy by supporting sustainable interior design techniques. By fostering job possibilities, protecting the environment, stimulating creative design ideas, and fostering tourism, sustainable interior design may support economic growth and urbanization. Urban regions may foster long-term economic growth and development while simultaneously promoting social and environmental sustainability by using sustainable interior design practices.

Interiors that are not sustainable can provide a number of risks to both human health and the environment. Indoor air pollution may be caused by non-sustainable interiors because they release volatile organic compounds and other dangerous substances into the air. This may result in headaches, allergies, allergies, and other health concern. Interiors that are not environmentally friendly may include hazardous substances including lead, asbestos, and formaldehyde. Serious health issues, such as cancer and neurological abnormalities, can be brought on by exposure to these compounds. Construction and renovation waste

can be significantly increased when non-sustainable interiors are used. This garbage may wind up in landfills, causing pollution and environmental damage. Non-sustainable interiors may also be energy inefficient, which would result in greater energy costs and more greenhouse gas emissions. This has the potential to harm the ecosystem and cause climate change. In order to build non-sustainable interiors, immoral methods may be used, such as forced labour or the exploitation of weaker groups of people. This may exacerbate societal inequality and unfairness.

Overall, interiors that are not sustainable may be harmful to people's health, the environment, and society at large. Adopting environmentally friendly interior design methods can lessen these risks and advance a healthier and more sustainable future.

A variety of aesthetic ideas that are in line with peoples' desires for beauty and elegance may be found in sustainable interiors, which also encourage environmental sustainability and social responsibility. Natural materials like bamboo, cork, and water hyacinth are frequently used in sustainable interior design because they give the room a feeling of warmth and authenticity. These materials frequently have distinctive textures and organic hues that may provide a restful mood. Sustainability may also be incorporated into interior design through the use of minimalist concepts, which prioritize longevity, utility, and simplicity. Clean lines, neutral hues, and uncluttered areas are common characteristics of minimalist interiors, which provide a feeling of serenity and order. Up cycled and reused materials can be used in sustainable interior design projects. These materials give the room a distinctive and eclectic feel. Reclaimed

wood and salvaged metal are examples of up cycled materials that may give a place personality and history while minimizing waste.

Design that emphasizes the relationship between nature and human welfare is known as "biophilic design," and it may be incorporated into environmentally friendly designs. Natural light and other aspects of nature, which foster a sense of serenity and tranquilly are frequently seen in biophilic interiors. Biophilic environments can have a variety of positive effects on both physical and mental health, such as boosting productivity, lowering stress levels, and enhancing air quality (Kellert and Calabrese, 2015). Overall, environmentally conscious interior design may provide a variety of aesthetic ideas that appeal to people's need for beauty and elegance while simultaneously advancing social responsibility and environmental sustainability. People may build rooms that are both lovely and responsible, supporting a healthier and more sustainable future, by embracing sustainable interior design ideas.

The usage of water hyacinth as a sustainable product in a variety of industries, including interior design, has been the subject of several research investigations. It has been demonstrated that using natural components in interior design enhances general well-being, increasing occupant happiness and productivity (Huang, et. al., 2020).

Water hyacinth is a nutrient-rich plant that may be fed to animals including sheep, goats, and cattle. It is the perfect feed for animals because of its high protein and low fibre content. Water hyacinth may be utilized to create bio-fuel through a procedure known as anaerobic digestion. The generated biogas may be utilized to produce heat, power, or even fuel for vehicles. Also, to provide a rich

fertilizer for plants, water hyacinth can be composted. It is the perfect component for compost due to its high nitrogen concentration and low carbon level. Water hyacinth is well renowned for its ability to effectively remove toxins from water bodies through bioremediation. As a result of its roots absorbing heavy metals, nutrients, and other impurities from the water, the water's quality is increased and pollution is decreased.

It is crucial to carefully assess the water hyacinth's possible drawbacks, including its invasiveness and potential damage to nearby ecosystems. In order to make employing water hyacinth in interiors a sustainable and ethical decision, suitable management and harvesting practices must be in place. For usage in interior design, water hyacinth may be a sustainable and eco-friendly material. It is a quickly renewable material that may be utilized to make a range of goods, including textiles, furniture, and wall coverings. Compared to synthetic materials, items made with water hyacinth are more environmentally friendly since they are recyclable and biodegradable. Additionally, by giving artisans and entrepreneurs a means of livelihood, the use of water hyacinth in interior design may benefit the community as a whole.

1.1. Relevance of the study:

Water hyacinth grows quickly and profusely, making it a readily available and renewable resource. Because of this property it creates a menace to the waterbodies and environment. Reducing the quantity of water hyacinth by using it as a raw material for interior accessories will lessen its detrimental effects on the environment. Utilizing this facility for environmentally friendly products lessens the need for finite resources and promotes a circular economy. Products

made from water hyacinth can benefit society and the economy, predominantly in areas where the plant is common. It can aid in the creation of revenue and enduring livelihoods by giving local businesses and craftspeople opportunity. Fibres from water hyacinths have a distinct visual appeal that makes them suited for a variety of interior applications. The biodegradability of water hyacinth, in contrast to manufactured materials, lessens the environmental effect of its life cycle. Using water hyacinth in interior design also lowers the carbon emissions brought on by conventional production methods and materials. The awareness on the significance of environmental conservation through sustainable practices of making water hyacinth-based sustainable items into interiors encourage and fosters a more sustainable way of living and urges people to make thoughtful decisions. The discussion of water hyacinth-based interior items is in line with the increasing focus placed on sustainability, the circular economy and the need to solve environmental problems. It presents a chance to produce interior items that are visually beautiful, useful, and ecologically beneficial while enhancing ecosystems and communities. Thus, the study accentuates development of interior accessories from water hyacinth.

1.2. Aim of the study:

- The study is conducted to understand the scope of water hyacinth as a promising and innovative source for sustainable interior designing.

1.3. Objectives of the study:

- To understand types of materials for accessories used in interiors.
- To find out opinion from homemakers regarding water hyacinth products.
- To develop water hyacinth accessories for making interior more sustainable.
- To assess the quality of appearance of the developed products.

1.4. Concepts used in the study

Water Hyacinth (Eichhornia Crassipes)**:** Water hyacinth is a free-floating perennial flowering aquatic plant found in water bodies which is considered as a pest due to its aggressive growth.

Accessories: Accessories in interior are items that add beauty and comfort in interiors.

Sustainable interior: Designing, embellishing, and furnishing indoor spaces with an eye towards reducing their negative effects on the environment and fostering social responsibility is referred to sustainable interiors.

Biophilic Designing: The type of designing in which the connectivity between natural environment and occupant are maximized through the use of nature and its elements.

Carbon footprint: A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by human activities.

Chapter 2

REVIEW OF LITERATURE

Researchers have found that using water hyacinth in interiors has several benefits. It is an eco-friendly material that is biodegradable and renewable. It has the potential to create a unique and aesthetic appeal in interior spaces. It can be used in various forms, providing versatility in design. Eco-friendly building materials and energy-saving design strategies may lower waste production and carbon emissions while also enhancing occupant quality of life. To create a constructed environment that is healthier and more sustainable, designers must use sustainable practices and include environmentally friendly materials into their designs. The literature pertaining to the study on **'*Water Hyacinth; a promising and innovative source for Sustainable Interior'*** is discussed under the following heading:

2.1. Pros and Cons of Water Hyacinth

2.2. Water Hyacinth: A Promising and Innovative Raw Material for Interior Designing

2.3. Water Hyacinth Diverse Products for Interior

2.1. Pros and Cons of Water Hyacinth

The water hyacinth (Eichhornia crassipes) is a free-floating macrophyte that is regarded as the most poisonous weed in the world due to its ability to grow quickly, adapt to a variety of environmental factors, and efficiently absorb nutrients. These qualities lead to the vast range of uses for phytoremediation that water hyacinth has (Ting, W. H. T., et.al.2018). Due to its affordability, environmental friendliness, and sustainability, phytoremediation has been suggested as an alternative to other traditional physiochemical and biological approaches to treat wastewater with high ammoniacal nitrogen concentration.

In Nigeria, small and medium-sized businesses are a significant contributor to the pollution of water resources. A few of these pollutants include heavy metal contamination, suspended sediments, and biological oxygen demand. Traditional treatment techniques, including chemical precipitation, don't offer long-term fixes since the contaminants are simply transported from the waste water to a sludge residue that is dumped in landfills. Eventually, the contaminants contaminate freshwater supplies by making their way there.

In Lagos, a coastal city in Nigeria, water hyacinth is a toxic species that grows quickly and readily clogs waterways, posing major difficulties for irrigation and navigation. This can be collected and applied to the sustainable treatment of some industrial wastewaters in accordance with the fundamental principles of sustainable development.

The efficacy of water hyacinth in the treatment of wastewater is examined. The average removal of pollutants was found to be 53.03%, 64.41%, 65.4%, 47.22%, 94.67%, and 30.30% for total suspended solids (TSS), biochemical

oxygen demand (BOD), dissolved oxygen (DO), nitrate-nitrogen, cadmium, and iron, respectively, after a simple 5-week experiment in which water hyacinths were planted in wastewater samples obtained from three different industries. For cadmium, copper, and iron, the average Biocentration Factors (BCF) were 583.83, 734.41, and 2982.95, respectively (Ajayi, et.al. 2012).

Due to its alluring look and aesthetic value in the environment, water hyacinth was first introduced as an ornamental crop in several nations more than a century ago. Due to their capacity to adapt to a variety of fresh water environments and their involvement with human activities, the flowers unfortunately turned into invasive species. They were viewed as a substitute to fossil fuels in the twenty-first century since numerous studies discovered they could transform their content into fuel energy for less money and were acknowledged as an environmentally beneficial product. Since that water hyacinth is one of the species with the quickest rate of growth, its biomass has the potential to replace traditional fossil fuels and become a possible renewable energy source within the next ten years. (Rezania, et.al. 2015).

Water hyacinth is a well-known invasive species that mainly endangers the foundations of sustainability. Since the process must be carried out over time, the cost of controlling these invasive plants is high, and many Southern African nations are ill-prepared for this liability. Notwithstanding this obstacle, water hyacinth may be exploited to extract important resources that have both commercial and environmental benefits. The definition, identification, and matching of costs and benefits are where the control and utilisation approaches diverge visibly. The current research makes an attempt to address the productive

usage of water hyacinth by quickly assessing the body of available literature, which was then analysed using meta-analysis. The study makes the case that the economic viability of control techniques, which are used to determine the economic worth of water hyacinth, primarily rely on assumptions whose dependability and sustainability are in doubt, meaning restrictions on the use of this kind of control methods. Yet, because the costs and advantages of using water hyacinths can be quantified, they are subject to changes in temporal value and sensitivity analysis to potential changes in cash flows. Some academics have urged for the inclusion of other utilization options in the context of these comments, with biogas being cited as the most practical choice due to its ability to diversify the energy mix, cut greenhouse gas emissions, and enhance water quality. Given these findings, the purpose of this article is to further the adoption of biogas technology by contributing to policy and research conversations on the financial understandings of the material recovery from water hyacinth. These opinions are considered in relation to the sustainable development goals (SDGs) as a whole (Ilo, et.al. 2020).

Circular economy methods to resource usage that are available inside the community can enhance rural communities' adaptive capacity to become more resilient to environmental shocks (Rijke, et.al., 2021). A microeconomic model based on the valorization of water hyacinth is proposed, utilising a circular economy approach, in order to win the passionate support of rural communities impacted by the invasion of water hyacinth. In terms of how the community handles issues linked to water hyacinth, this approach seeks to be a pro-environmental behavioural change catalyst. The achievement of environmental objectives would ensure that the advantages outweigh the costs and continue to

be morally viable throughout time. The circular micro-economic model is seen to be an effective environmental push towards sustainable water hyacinth management because it has a defined environmental goal that focuses on a community's potential advantages (Harun, et.al. 2021).

According to some published research, integrated technologies and good management may be an effective solution, and water hyacinth could go from being viewed as a noxious aquatic weed to a valuable resource that can be used in bioremediation to remove excess nutrients from eutrophic waterbodies at a low cost. Low-cost, effective equipment and the production of value-added items from biomass from water hyacinths may be important system integration and innovation factors. All effective and sustainable management practices for the water hyacinth must simultaneously provide some form of social and economic value, as well as benefit the environment, in the socioeconomic and ecological sphere of global development (Yan, et.al. 2017).

The water hyacinth invasion has a significant impact on the rural residents impacted, especially those whose livelihoods depend on water bodies, such as fishing and riparian communities (Enyew, et.al. 2020; Honlah, et.al., 2019**;** Segbefia, et.al., 2019). A water hyacinth invasion has detrimental effects on the hydrology and environment, which then have socioeconomic effects since it interferes with people's everyday lives and health. Local rainfall events may be affected by the disruption of the hydrological water balance caused by the increase in evapotranspiration relative to surface evaporation in the infected regions. Water hyacinth obstructions in rivers will cause reduced water flows, which will encourage sedimentation, deoxygenation, and degradation of water quality. On lakes, weed canopies cut down on sunlight. This worsens other related

water quality issues such as water turbidity and temperature fluctuation. As a result of all these occurrences, fish and other aquatic creature populations decline as their habitat becomes less hospitable. Instead, because the plant contains a diversity of different species, disease vectors like snails and mosquitoes will multiply (Harun, et.al. 2021).

Limited access to waterways caused by dense weed mats causes tensions amongst the impacted populations for access to watercourses. Water hyacinth flies with the wind because it is buoyant and unanchored. This is particularly disruptive to fishermen since it makes boat navigation more difficult, delays fishing preparation, and causes tangled fishing nets and other equipment damage (Segbefia, et.al., 2019). The lake's overgrown water hyacinth makes it difficult for fishermen to take their boats and fishing equipment, which lowers their catch rates. The abundance of water hyacinth reduces the amount of soluble oxygen in the water and prevents sunlight from entering the water, both of which contribute to the drop in fish populations. The decaying water hyacinth can clog irrigation channels in the fields, preventing farmers from harvesting the maximum amount of rice, and eliminating them would be expensive (Maulidyna et.al., 2021).

The aggressive spread of floating water hyacinth has long been a source of conflict in Thailand and other tropical countries. Because to their ever-growing population, water hyacinth pollution and flow restriction are frequent in many rivers. Water hyacinth removal from rivers, which essentially entails removing the plants from the rivers and discarding them elsewhere, is the current answer to this problem (Keawmanee, 2015).

The organisations and people in the Basin have suffered because of water hyacinth. Negative social effects, such as a shortage of clean water, a rise in

vector-borne illnesses, community movement, social strife, and difficulties reaching water sources, have been identified by surveys. Reduced fish catches, higher transportation costs, challenges with electricity production and water extraction, fewer tourists, obstruction of irrigation canals, and environmental effects like deteriorating water quality, water loss through evapotranspiration, siltation, increased risk of flooding, and a decline in the diversity of aquatic life have all had significant economic effects that Basin communities can easily perceive (Mailu, 2001).

Eichhornia crassipes, an invasive water hyacinth, has the potential to threaten Lake Tana and the ecosystem services it provides. Its expansion is presently controlled by abstraction (manual removal), however problems with mat disposal and pool creation still exist. The purpose of this study was to evaluate the possible impacts of water hyacinth and how it is managed on both human health and water quality. Open water, habitats covered in water hyacinth, and habitats free of water hyacinth had their biotic and abiotic data gathered. From 45 sites, a total of 3673 invertebrates from 21 families were gathered. The most numerous family, accounting for 37.2% of all families, was Culicidae, followed by Unionoidae (19.4%) and Sphaeriidae (8.1%). Water hyacinth cleared environments had considerably greater densities of anopheline and culicine larvae (p 0.05). Water hyacinth-covered habitats had considerably greater water conductivity and total dissolved solids (p 0.05). In conclusion, biotic communities and water quality suffered as a result of the water hyacinth invasion. The physical removal of water hyacinth created an excellent environment for the growth of mosquito larvae. Therefore, merging mosquito larvae control strategies

with water hyacinth management practises should assist to reduce the region's potential risk of experiencing an epidemic of malaria (Gezie, et.al. 2018).

For Lake Tana in general and the fishermen in particular, water hyacinth poses a serious danger. Effects of water hyacinth vary on the size of the invasion, the usage of the impacted water body, and the measures employed for managing it. The survival of subsistence fishermen may be in jeopardy if the spread of this aquatic invasive plant continues at current rate since water hyacinth significantly lowers fishing efficiency. Without a well-planned and implemented preventative strategy, the growth of water hyacinth might harm not just the safety of the local community's residents and fishers, but also the lake's capacity to maintain itself. Due to the water hyacinth invasion of Lake Tana, the local population is in danger of losing its source of income from fishing (Asmare, 2017)

Water hyacinths have altered the composition of the plant communities. The fast growth of water hyacinth reduced the amount of sunlight reaching the environment, which ultimately resulted in species extinction. The study will aid in creating strategies for the responsible management of natural resources and offer valuable advice for preserving the short- to medium-term ecological balance in wetlands that are comparable (Lahon, et.al. 2023).

2.2. Water Hyacinth: A Promising and Innovative Raw material for Interior Designing

Water Hyacinth is used in interiors as different products developed by researcher. A composite constructed of water hyacinth fibre (WHF) and utilised polyurethane foam (PUF) based on palm oil was created as a novel stiff sound-

absorbing material. With mesh sizes ranging from 80 to 20, the NCO index was set to 100 and the WHF concentration to 1%wt. Investigations were done into the PUF composite's mechanical characteristics, morphology, flammability, and sound absorption coefficient (SAC). The compression strength of the PUF rose from 0.33 to 0.47 N/mm2 when the WHF size was decreased from 80 to 20. Additionally, using tiny fibres reduced the PUF composite's pore size, which enhanced the material's flammability and sound absorption. A PUF composite with a WHF mesh size of 80 and a SAC value of 0.92 was a workable sound-absorbing material. PUF made from both discarded palm oil and water hyacinth might therefore be a potential green substitute material for applications requiring sound absorption (Sukhawipat, et.al. 2022).

Several handicrafts use water hyacinth as a source of raw materials (Maulidyna,, et.al., 2021) such as Household accessories Baskets, tissue holder, coasters, placemats, and tray box. And in interior Carpet, table and chair set, lamp, wall clock and rope. Stems from water hyacinths are large and flexible, making them easy to cut and weave. In addition to the stem, dried water hyacinth petioles are also used to create vases, coasters, mats, shoes, sandals, belts, wallets, and other types of handcraft in nations like Indonesia and the Philippines (Patel, 2012). Water Hyacinth biomass may be expertly turned into long-lasting, beautiful furniture and crafts (Jafari, 2010). Following research, Water Hyacinth insulating boards have proven to be beneficial in the building industries. Due to its dependable physical characteristics, fibre boards constructed with Water Hyacinth fibre are also suitable for use as interior walls and low-cost roofing material. (Salas-Ruiz, et.al., 2019; Ndimele, et.al., 2011).

Boxes and envelopes are made of paper manufactured from Water Hyacinth stem. The fibre can be used with waste paper or jute to improve the quality of Water Hyacinth paper (Rahmawati, et.al., 2018). This paper can be used in interiors as wallpaper. The rope made of Water Hyacinth may clearly be used in this way, but it can also be used to make a variety of other things, like mat, bins and baskets (Jernelöv, 2017) (Rezania, et.al. 2015).

The use of natural fibres as reinforcement materials in the building sector has attracted attention. Examples include water hyacinth fibre, banana fibre, hemp, kenaf, jute, barley, bagasse, cattail, coir, cotton, date, durian, elephant grass, flax, palm, pineapple, reed, rice, sansevieria, sisal, sunflower and bamboo. Particularly abundant and simple to cultivate are bananas and water hyacinths. The aquatic weed species known as the water hyacinth plant (Eichhornia crassipes) belongs to the Pontederiaceae family. They cause the damage of rivers and water pollution by growing very quickly, spreading swiftly throughout the whole river, and floating on the water's surface. Banana plants are widespread and thrive best in warm climates. Banana and water hyacinth fibres have both drawn more attention recently. Typically, the lignin, cellulose, and hemicellulose matrix hold hollow cellulose fibrils from the water hyacinth and banana plants, respectively, together. It contains around 60%–70% cellulose, 40% lignin, and 20% hemicellulose, respectively. Materials' tensile strength and capacity to absorb moisture can be provided by cellulose and hemicellulose, while lignin offers biodegradation resistance. Additionally, the thickness, density, porosity, stiffness, resistance, conductivity, and air permeability of plant fibres are among the microstructures and features that most influence their mechanical and thermal properties. As a result, each type of natural rubber has unique properties and may

be used for various industrial purposes. We investigated the use of banana and water hyacinth fibres as reinforcing components in concrete (Niyasom, et.al. 2021).

Furniture made of Water Hyacinth is good for environment since the earth is given nutrients when old furniture is disposed. On the other hand, after being continuously heated by the sun, plastic ware gradually releases toxic gases into the atmosphere. (Rossi, et al, 2016).

It has been generally accepted to employ water hyacinth in the production of furniture, exhibitions, and displays, as well as interior design. The water hyacinth's suppleness makes it simple and enjoyable to handle in novel ways since it readily adopts the shape of whatever item it is attached to. Because of this, it may be used in relation to the form-follows model. Philosophy of function. It would be fair to deal with both of the current environmental hazards deftly in ways that mitigate their negative effects on the environment as part of environmental sustainability (Sianturi, et.al., 2019).

*Source: https://plants.ifas.ufl.edu/plant-directory/eichhornia-crassipes/

Plate 1: Water Hyacinth Plant

2.3. Water Hyacinth: Diverse Products for Interior

In many of the tropical nations, the rapid growth of floating water hyacinth has long been a cause of strife. Water hyacinth pollution and flow restrictions are widespread in many rivers due to their constantly expanding population. The current solution to this issue is removal of water hyacinth from rivers which effectively means taking the plants out of the rivers and throwing them somewhere else. The issue continues over time since they are merely band-aid fixes, as was already mentioned. My approach is to transform allegedly "natural rubbish" into marketable commodities that might provide revenue for rural Thai people. The stretchy but sturdy qualities of water hyacinth are well recognised and may be used to create eco-friendly fabrics (Keawmanee, 2015).

Because of its quick spread into new regions of freshwater bodies and rapid development, water hyacinth is regarded as the worst aquatic weed in the world. The feasibility of utilising water hyacinth as a raw material for compost and handmade paper manufacture in Bangladesh was looked at. With a liquid to solid ratio of 7:1, potassium hydroxide was used for potash pulping at various alkali concentrations (8–12%) for two hours at 145 °C. Hydrogen peroxide was used to bleach the pulp, and the brightness, tear index, and tensile index of bleached and unbleached pulps were compared using the corresponding TAPPI criteria. Compost was created by combining the generated black liquor with water hyacinth, kitchen bio-waste and straw. The compost's qualities were evaluated using the techniques that have been published. Indicating a considerable impact of bleaching on the quality of water hyacinth paper, the brightness, tensile index, and tear index of bleached hand sheets were found to be 37.2%, 49.2 N m/g, and 6.79 m.Nm2/g, respectively.

The nitrogen and potassium content of the bio-waste compost were dramatically boosted by the addition of black liquor. Thus, WH may be utilised as a raw material for creating handmade paper, and the by-product of the manufacturing process can be added to compost to enhance its nutritional value. To reduce the water hyacinth infestation in water bodies, such a cottage industry of green water hyacinth goods might be formed. This technology may also provide new potential sustainable living options (Islam, M. N., et. al. 2021).

Water Hyacinth ac be turned into biofuels, many techniques have been researched in the energy sector. Water hyacinth has mostly been examined as a substrate for the generation of biogas; however, when the weed is combined with other biomass resources (anaerobic co-digestion processes) such cow dung and elephant grass, fresh rumen waste, or alone, some encouraging results have been observed. It has also been demonstrated that both untreated and pretreated water hyacinth may produce bioethanol. The synthesis of biohydrogen from water hyacinth has also recently been studied, with encouraging findings. There have also been reports of the fabrication of briquettes from water hyacinth for industrial (combustion) and home (cooking) scales; in the latter instance, it was essential to combine water hyacinth with other materials (coal or wood) to create sufficient combustion parameters (Román, S., et.al. 2020).

Study carried out by Phaisarntantiwong and Suwanakeree (2018) to develop product designs for working women's and men's attire and accessories. The methods employed were based on a descriptive investigation of the basketry structure found in Thailand's central area. Water hyacinth and cotton were blended in a 30:70 ratio to create the cloth used in the design. In order to create a

new handbag with a distinctive design for women, the 4P Marketing Strategy concepts, natural colour applications, and product development were all used.

As bio-thermoplastic polymers are biodegradable, eco-friendly, and nontoxic, they are currently often employed as reinforcement for natural fibres of various types in matrix materials. The usage of synthetic materials manufactured by humans may be reduced by using natural fibres, which are also one of the sustainable resources for creating lightweight composites. In this opinion, using waste bio fibre as reinforcement in bio-based composites for environmentally acceptable semi-structural applications. Waste fibres from water hyacinth plants were extracted, characterized, and used to make bio epoxy-based eco-friendly composites from fibres that had undergone chemical treatment.

Eichhornia crassipes, sometimes known as water hyacinth, is an aquatic perennial invasive plant. Initially, water hyacinth fibres were evaluated using a variety of methods, including chemical analysis, X-Ray Diffraction, Fourier transform infrared, Thermogravimetric analyser and like. Casting is used to create the bioepoxy-based composites that re reinforced with raw, NaOH and saline treated Water Hyacinth fibres. The composite specimens were then subjected to tensile, flexural, impact, hardness, thermal, dynamic and surface morphological testing. This work established water hyacinth fibres potential for usage as a reinforcing material in bioepoxy composites to create totally bio-based environmentally acceptable structures (Sumrith, et.al. 2020).

To combat the depletion of energy resources and to meet the rising global demand for energy, this objective is crucial. The dried biomass may also be made into briquettes, which are ideal as a co-firing agent in coal power plants, as an

alternative to fuel energy. So, in the future, the production of briquettes from compacted biomass leftovers may reduce the need for coal to provide more energy. The other use of water hyacinth is as a soil supplement for sandy soil, which can enhance the soil's hydro-physical and chemical properties and provide growing crops with a variety of nutrients. The potential of water hyacinth to bio remediate, or remove contaminants from home and industrial waste water effluents, has also attracted interest (Rezania, et.al. 2015).

Water hyacinth, known for its rapid growth and ability to flourish in water bodies, offers an exciting opportunity for interior designing. Its fibrous stems and vibrant foliage can be transformed into beautiful and eco-friendly products. This plant may be utilised as the primary ingredient in the creation of a wide range of handicrafts, including wallets, chairs, tables, sandals, purses, and baskets. Additionally, water hyacinth may be used to make organic fertilisers and biogas. With proper treatment, water hyacinth may clean up contaminated water brought on by heavy metal pollution. In other words, water hyacinth has both positive and negative economic effects. The survival of this aquatic ecosystem depends on the proper management of this species (Maulidyna, A., et.al., 2021).

Chapter 3
METHODOLOGY

Research methodology deals with the objective of a research study, the method of defining the research problem; the type of hypothesis formulated the type of data collected and the methods used for collecting and analyzing the data. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. In the modern world, polluted with non-bio degradable materials that causes environmental problems, use of ecofriendly products as far as possible becomes a necessity for rejuvenating the environment. Water hyacinth found in tropical and sub-tropical regions; a harmful species in many areas due to its invasiveness and capacity to interfere with ecosystems and human activities. To reduce its detrimental effects, it is crucial to regulate and control its growth carefully. The study on '***Water Hyacinth: A Promising and Innovative Source for Sustainable Interior'*** aims to develop sustainable interior design products, evaluate and educate home makers about the importance of sustainable products.

The methodology adopted for the study comprised of three phases as follows:-

3.1. Phase I: Household Survey to find out types and materials used for interior accessories

3.2. Phase II: Development of interior accessories with Water Hyacinth

3.3. Phase III: Evaluation of the Water Hyacinth products developed

3.1. Phase I: Household Survey

To gather the data material and type of accessories used in interior, a baseline survey in online mode, called e-survey is conducted. Online surveys are practical for both participants and researchers, offering a quick and affordable approach to gather an extensive amount of data (Hosseinzadeh, et.al., 2019), regardless of place or time zone, from a broad range of people (Williams and Arthur, 2017).

To evaluate and understand the awareness about sustainable interior design and negative impacts of types materials used as interior accessories, an online survey is being conducted among hundred homemakers.

The survey comprised of following steps:

3.1.1. Study Locale

3.1.2. Selection of Sample

3.1.3. Selection of Tool

3.1.4. Collection, Consolidation and Analysis of the Data

3.1.1. Study Locale

The area selected for the study is urban and rural areas of Ernakulam district, Kerala. Because of the fact that Ernakulam has a rich network of backwaters, and has been declared as National waterways by central government of India. Water bodies in the area are currently overflowed with water hyacinth, which is problematic for tour operators, fishermen, and boaters and serves as a breeding ground for mosquitoes. This is a menace in Ernakulam district.

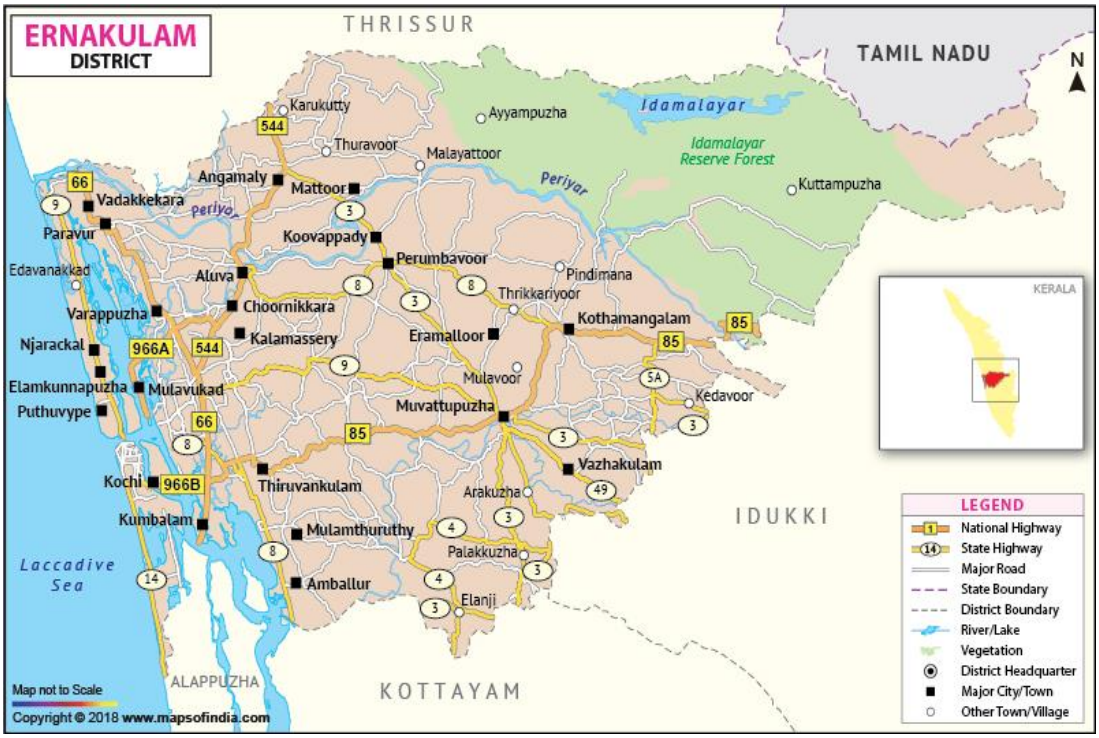


Figure: 3.1 - Study Locale

3.1.2. Selection of Sample

Sample size of the study consist of 100 individuals. Sampling technique adopted for the study is convenience sampling. A non-probability sampling technique called convenience sampling includes choosing research participants who are willing and accessible. Also, there are certain practical and convenient benefits. Convenience sampling is a useful and effective technique for gathering information from participants who are readily available, which can help guarantee an excellent response rate (Creswell, 2014).

3.1.3. Selection of Tool

The major focus of each study is the tool selection. The necessary information that is essential for the study has been gathered using a well constructed questionnaire. A questionnaire is essentially a tool used to gather data, including demographics, views, and other information, about the study topic from participants. This basic structured questionnaire gives general information regarding the awareness and knowledge about sustainable interior designing and bout using water hyacinth as excellent source for sustainable products. Questionnaire developed as the tool for the study which include a set of the structured questions to collect the general information, information pertaining to 'Water Hyacinth: A Promising and innovative source of Sustainable Interior designing' is provided in Appendix 1.

3.1.4. Collection, Consolidation and Analysis of the Data

The questionnaire was provided online in Google form. The data received was consolidated and tabulate with the help of software and keenly speculated with proper statistical tools. The tools that considered are percentiles and graphs.

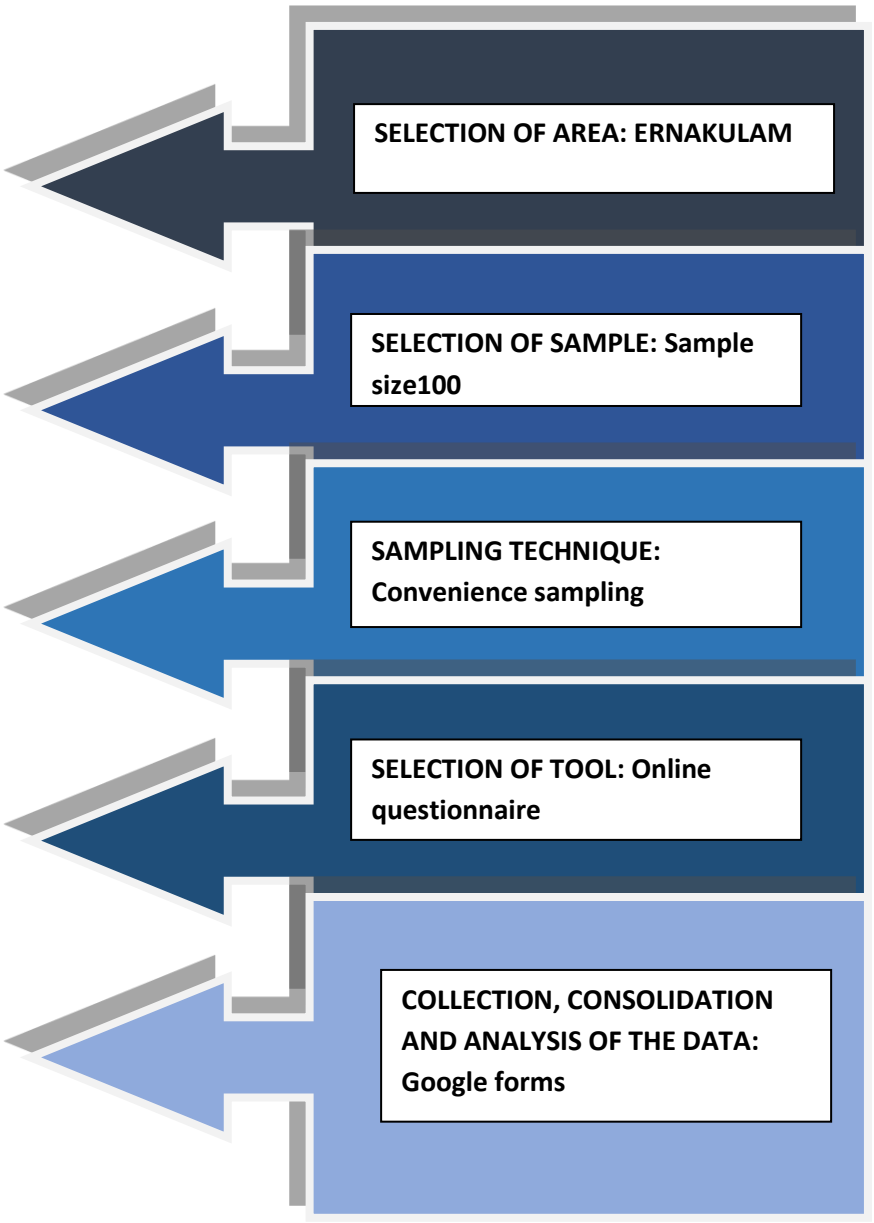


Figure: 3.2

Research Design for Phase 1 Survey

3.2. Phase II: Development of interior accessories with Water Hyacinth

Recent researches have revealed that water hyacinth may be converted into a sustainable product development material, offering an alternative to conventional materials that might have negative environmental effects. Phase II of the study includes development of various interior accessories using water hyacinth. The study attempts to develop six handmade products, which include both functional and decorative accessories used for decorating home interiors.

The products that demonstrate the potential for creative and sustainable responses to environmental problems include water hyacinth wall paper, basket, tissue box, multi storage box, placemat and décor accessories. Raw materials used for all the products were water hyacinth dried and processed.

Plate 2: Dried Water Hyacinth – Raw material used

Methodology for developing these water hyacinth interior accessories is given below:-

3.2.1. Water Hyacinth Wallpaper

3.2.2. Water Hyacinth Basket

3.2.3. Water Hyacinth Tissue Box

3.2.4. Water Hyacinth Multi Storage Box

3.2.5. Water Hyacinth Place Mat

3.2.6. Water Hyacinth Interior Decor Accessory

3.2.1. WATER HYACINTH WALLPAPER

Beautiful spatial effects are produced by using natural materials in interior design. The surface of this interesting wallpaper is made up of water hyacinth plant parts. Each and every metre of this gorgeous wallpaper is distinct because to its observable natural structure. The inherent grain of the material gives beige, brown and ochre colour life, and in an interior, they harmonise wonderfully with dark wood furniture. These materials may also be chemically dyed to complement the interiors.

Material Required: Water Hyacinth stem (dried and flattened), Baking material.

Making Process: Water Hyacinth wall paper can be made by a backing material is often put to the water hyacinth which can be paper or fabric in order to make the wallpaper robust and long-lasting after the flattened water hyacinth are bonded together. You may use a number of materials, including paper or fabric, to create this background.

The water hyacinth wallpaper is completed with a protective coating once the backing has been placed to make it more long-lasting and water-resistant. The wallpaper is then prepared for installing. The resulting wallpaper is eco-friendly, durable, and visually striking, making it a popular choice for interior design.

3.2.2. WATER HYACINTH BASKET

Amazing, authentic and comfy designs have evolved throughout time. Water hyacinth, a plant commonly found in lakes, rivers, and other bodies of water worldwide, is used to weave a distinctive basket. This basket may serve as storage, a decorative element, and a treasure for craft enthusiasts who value finely crafted items. A sturdy item with a contemporary design to take care of daily needs. It may be washed and dried quickly.

Materials Required: Water Hyacinth stalks dried in sun.

Making Process: Leaves are separated from cleaned and sorted water hyacinth. These stems are dried in enough sunlight. These dried stems are woven into sheets. There are variety of different woven patterns to choose from. These sheets are shaped to desired design of basket and stitched or glued together. Products dyes and ornaments can also add to enhance its appearance.

3.2.3. WATER HYACINTH TISSUE BOX

Sustainable and innovative tissue box made of water hyacinth can make an eco-friendly fashion statement in the interior at the same time these are durable and sturdy. This exquisite artistry is perfect to add to the decor

Materials Required: Water hyacinth, Cotton fabric, base board.

Making Process: Dried water hyacinth stem is flattened and glued on the base board. These board are the folded into desired shape here, the tissue box can be opened to refill the tissue paper and also the opening on the top to take the tissue out these opening is made prior to gluing of water hyacinth. The inside of the box is made smooth by fixing cotton fabric. Externally this can be finished with coating or clear lacquer.

3.2.4. WATER HYACINTH MULTI STORAGE BOX

Storage box of different size can be made out of water hyacinth. This hand crafted box can be used as gift box, storage box and utility etc. these boxes are finished with coating of clear lacquer foe easy maintenance, use dry soft cloth to clean this product. It is an excellent choice to accessorise vanity and living room decor.

Materials Required: flattened water hyacinth stem, cotton fabric, base board

Making Process: The foundation board is covered with a flattened and glued dried water hyacinth stem. Here, the board is folded into the required form. The tissue box may be opened to replenish the tissue paper, and there is an aperture on top that allows you to remove the tissue. Cotton cloth is fixed inside the box to provide a smooth interior. This may be completed outside with a coat of clear lacquer. The making process is similar to that of tissue box.

3.2.5. WATER HYACINTH PLACE MAT

Place mat can be beautifully handcrafted out of water hyacinth. The natural tone and texture will add a touch of warmth and rustic charm to home and interior space.

Materials Required: Water hyacinth

Making Process: The water hyacinth stem are dried a woven to the desired measurement. The edges of the mat are neatly secured by weaving technique and sewing it down or also can be glued. The mat can of different shape like square, rectangle, oval or circle.

3.2.6. WATER HYACINTH INTERIOR DECOR ACCESSORIES

Decor accessories using water hyacinth to enhance the look of the interior, and to develop eco-friendly products. Accessories in the interior are made of plastic or other synthetic materials can be replaced by natural and sustainable products like this.

Materials Required: Dyed water hyacinth stem, Resin and hardener, wooden frame of size 15cm X 15cm X 5cm.

Making Process: The wooden frame is placed over silicone moulds; it will help in removing the resin after the setting time.

The resin is prepared by mixing hardener and pours resin to the wooden frame. Water hyacinth pieces are added after the first layer of resin. The second layer is added on the top of water hyacinth and allowed to set for 24 hours to cure. Cover the mould with box or plastic container to keep hair and other dust particles from resin while it dries. De-mould the cured resin, the leaked out epoxy can be cut out to the shape of frame.

3.3. Phase III: Evaluation of the Water Hyacinth products developed

The evaluation comprises of the following steps:

3.3.1 Development of the Evaluation Performa

3.3.2 Evaluation of the Water Hyacinth Products

3.3.1 Development of the Evaluation Performa

The evaluation performa helps the evaluators to evaluate the effectiveness and viability of the product. By ensuring that the finished product satisfies both corporate and customer objectives, a well-designed product assessment process may offer insightful information about consumer wants and preferences (Mohammed and Abdullah, 2017). For this, an evaluation performa was developed by the researcher in five point scale. The score accredited is 1 - poor, 2 - fair, 3 - good, 4 - very good, and 5 - excellent. On the basis of this scale, the score of each product is calculated and analysed. The products were evaluated based on its appearance, creativity and Usefulness. The evaluation performa developed for the assessment of water hyacinth products is given in Appendix 2.

3.3.2 Evaluation of the Water Hyacinth Interior Accessories

For the purpose of evaluation a panel of 10 homemakers were constituted. The panel evaluated the products with help of evaluation performa and awarded scores. The awarded scores were collected and tabulated and given in Chapter IV: Results and Discussion.

Chapter 4
RESULTS AND DISCUSSION

Water hyacinth products made from or utilizing this aquatic plant, known for its rapid growth and adaptability. Water hyacinth has attracted interest recently as a sustainable and eco-friendly material for a range of applications, including interior design and home decor. The long, strong, and flexible fibres of water hyacinth may be used to weave and create a wide range of products, from furniture and wall coverings to home accessories and decor. Products made from water hyacinths offer distinctive and organic aesthetics, bringing a touch of organic charm to interior settings. Additionally, using water hyacinth as a material encourages sustainability because it is biodegradable, abundant, and frequently derived from populations that are invasive or overabundant and can affect ecosystems. In addition to improving the aesthetic appeal of places, the usage of water hyacinth products is in line with the rising trend towards environmentally friendly and sustainable design.

The study on ***'Water Hyacinth; a promising and innovative source for sustainable interior'*** was conducted to promote the sustainability in interiors and create awareness about sustainable interior products developed from water hyacinth. The study also aims in discussing the pros and cons of water hyacinth in the environment. Different accessories and decor items are produced from

water hyacinth stem, which is a sustainable alternative for plastic or synthetic products.

The study was conducted in three phases and the results of the study is presented accordingly.

4.1. Phase I: Household Survey to find out types and materials used for interior accessories

4.2. Phase II: Development of interior accessories with Water Hyacinth

4.3. Phase III: Evaluation of the Water Hyacinth interior accessories developed

4.1. Phase I: Household Survey to find out types and materials used for interior accessories

The study sample consist of 100 homemakers. The research method used to select the sample was convenient sampling method. The tools used for research is online questionnaire. The data was collected by converting the questionnaire to google form and circulating through WhatsApp. The result obtained is consolidated tabulated and presented below.

4.1.1. General information of the respondents

General information of the respondents is very crucial in studies conducted in various fields. General information collected for the study includes age, family income, area of residence – whether rural or urban. The data consolidated, tabulated and presented in Table 4.1.

	Particulars	Respondents	
		N=100	%
1	Age (in years)		
	• Below 30	87	87%
	• 31-50	9	9%
	• Above 50	4	4%
2	Family income per month		
	• Below Rs. 10,000	15	15%
	• Rs. 10,001- Rs. 30,000	45	45%
	• Rs. 30,001- Rs. 50,000	20	20%
	• Above Rs. 50,000	20	20%
3	Area of residence		
	• Rural	70	70%
	• Urban	30	30%

Table 4.1. General information of the respondents

The table gives general information about the respondents. A total of 100 homemakers responded to the questionnaire conducted as part of this study. The table highlights that out of the selected sample, eighty seven percentage aged below thirty years old, nine percentages between thirty one years and fifty years old, only four percentages were above fifty years old. The study shows that fifteen percentage of the respondents have monthly income below Rs.10,000,

monthly income of 45% of the respondents ranges from Rs. 10,001 to Rs. 30,000, twenty percentage have income ranges between Rs. 30,001 and Rs. 50,000 and another twenty percentage above Rs. 50,000. Respondents are from various part of Ernakulam district. Majority of the respondents (70%) are from rural side of Ernakulam district, remaining 30% is from Urban area.

4.1.2. Age of the Respondents

The age of the respondents is one of the most important characteristics to speculate views and ideas about the problem. The rise in numerical of the age gives an idea of maturity of the respondent. The age of respondents are classified as follows:

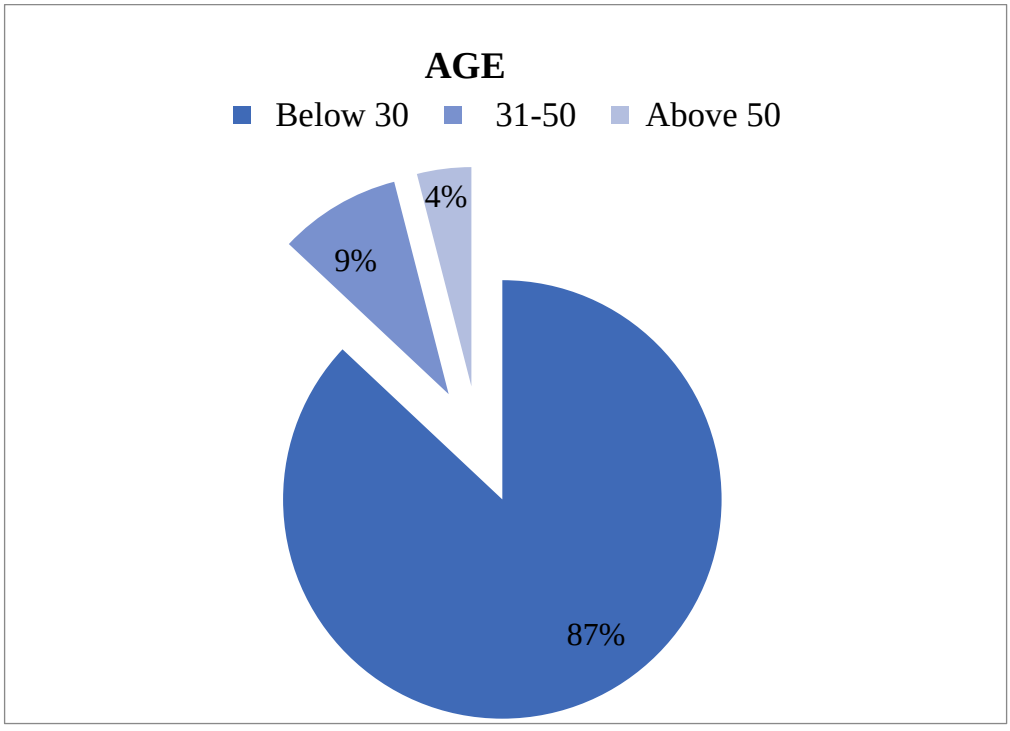


Figure 4.1. Distribution of Samples according to Age

From the above pie chart, it is evident that majority (87%) of the respondent are below thirty. This age group consists of young homemakers. Nine percentages of the respondents are in between the age of thirty one to fifty and only 4% of the respondents are above the age of fifty.

4.1.3. Family Income

Distribution of respondents according to their family income is given in figure 4.2.

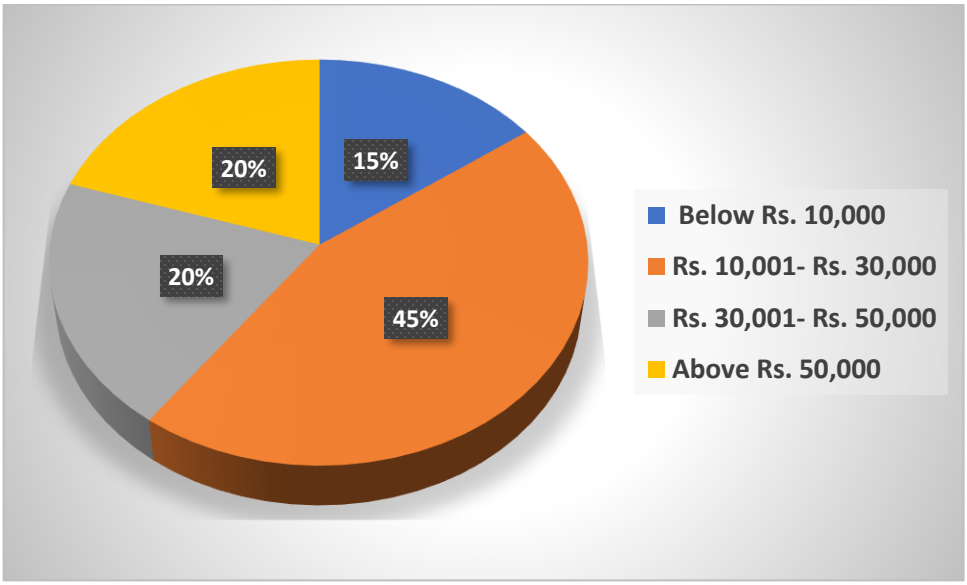


Figure 4.2: Family Income

The respondents vary according to their family income. 15% of the respondents have monthly income below Rs.10,000, monthly income of 45% of the respondents ranges from Rs. 10,001 to Rs. 30,000, 20% have income ranges between Rs. 30,001 and Rs. 50,000 and another 20% above of the respondents were Rs. 50,000.

4.1.4. Area of Residence of the Respondents

According to area of residence of the respondents they were classified and given in Figure 4.3.

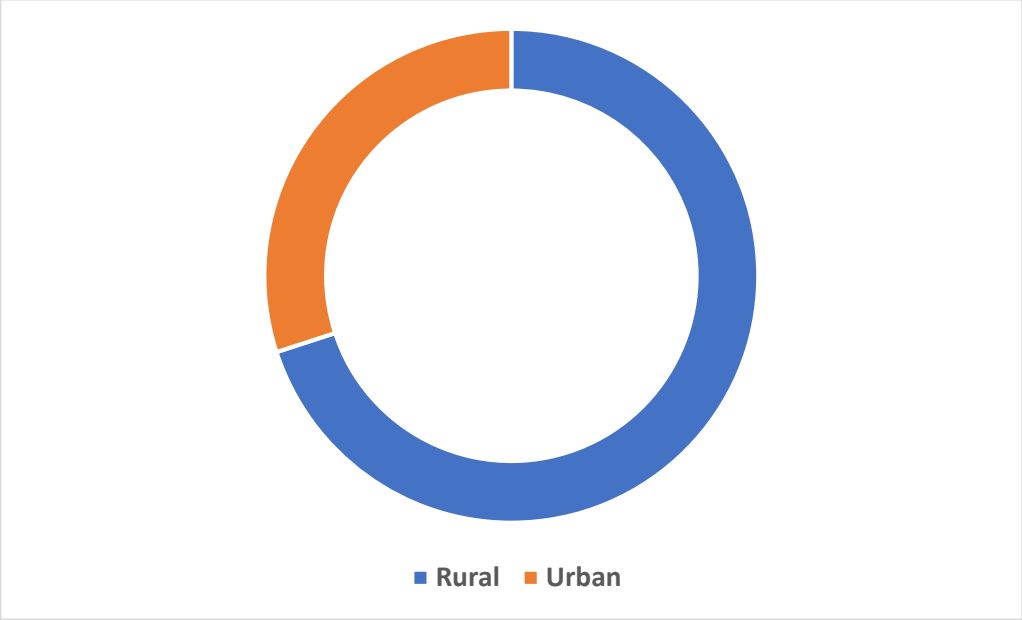


Figure 4.3: Area of Residence

The study comprised of majority of the respondents (70%) from rural side of Ernakulam district, remaining 30% of the respondents is from urban area of Ernakulam district.

4.1.5. Materials used for purchased indoor accessories

The material with which purchased interior accessories were made is found out and presented in figure 4.4.

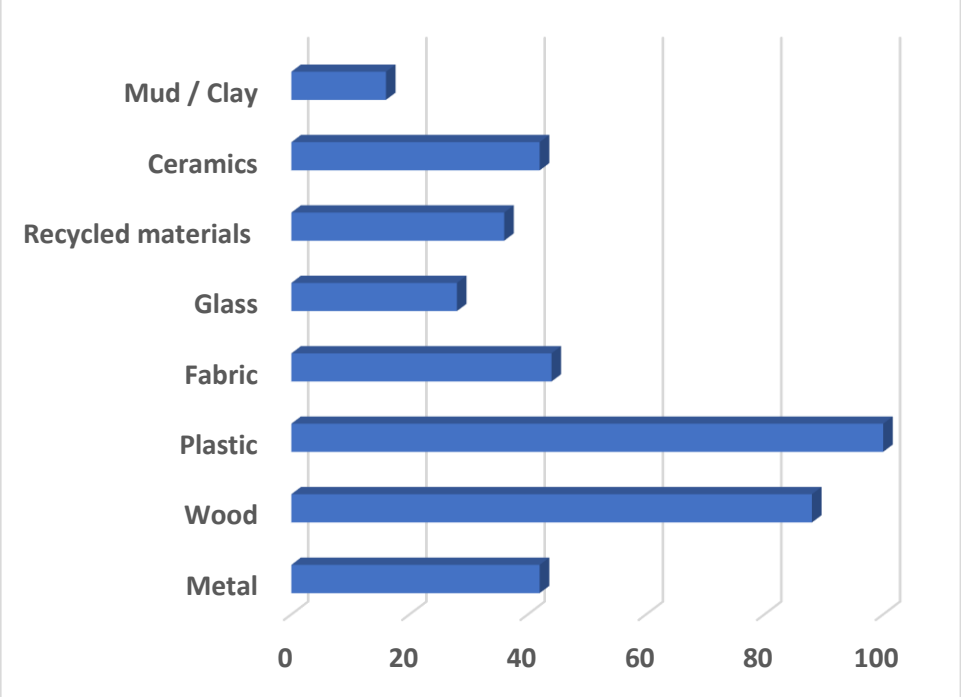
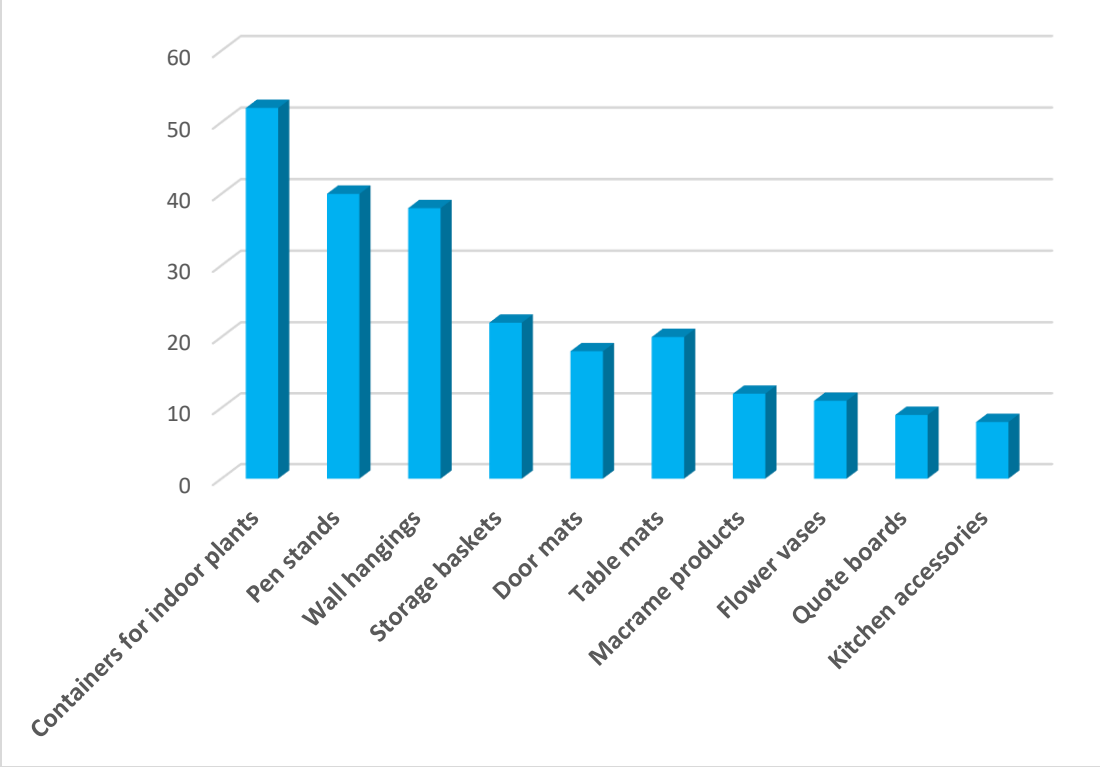


Figure 4.4: Material used for purchased indoor accessories

There various types of material with which purchased interior accessories were made. They are plastic (100%), wood (88%), fabric (44%) metal (42%) ceramic (42%) recycled material (36%), glass (28%) and mud/clay (16%). The study reveals that all the respondents use plastic material as interior accessories. Plastic, once hailed as a miracle material, has now become a nightmare that threatens the very existence of our environment and jeopardizes the well-being of all living beings.

4.1.6. Hand-made accessories used in interiors by the respondents

Various hand-made accessories and decor items used in the interiors of the respondents where found out and presented in Figure 4.3.



4.5: Hand-made accessories used in interiors of respondents

Hand-made accessories and decor items used in the interiors by the respondents include containers for indoor plants (52%), pen stands (40%), wall hangings (38%), storage baskets (22%), door mats (18%), table mats (20%), macramé products (12%), flower vases (11%), quote boards (9%) and kitchen accessories (8%).

4.1.7. Materials used for making accessories

Raw materials used for making the hand-made accessories are also equally important. The disposal and waste management of these accessories can be unsustainable and effect the environment. Certain materials used for making accessories are listed below:

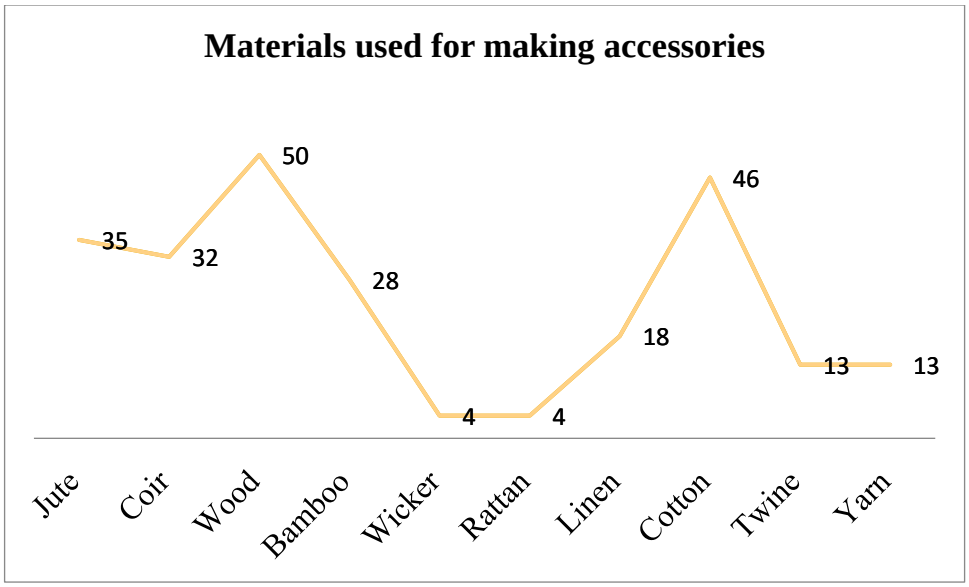


Fig 4.6: Materials used for making accessories

The study shows that around fifty percent of the respondents use wood as the raw material for making accessories. 46% of respondent use cotton fabric and cotton as the material. Jute and coir are frequently used in interiors, 35% and 32% responded. Wicker and rattan materials are least responded materials of the list, i.e. four percent of responders. Twenty eight percent responders use bamboo as a material for making interior accessories.

4.1.8. Awareness of Water Hyacinth products

Water hyacinth is a flexible and renewable material that has gained attention recently as an innovative solution for eco-friendly interiors. It is an aquatic plant that grows swiftly in warm climates and may be harvested for a number of purposes, such as textiles, furniture, and home decor. As a sustainable material, water hyacinth provides a variety of advantages over traditional materials. It is environmentally friendly, renewable, and biodegradable.

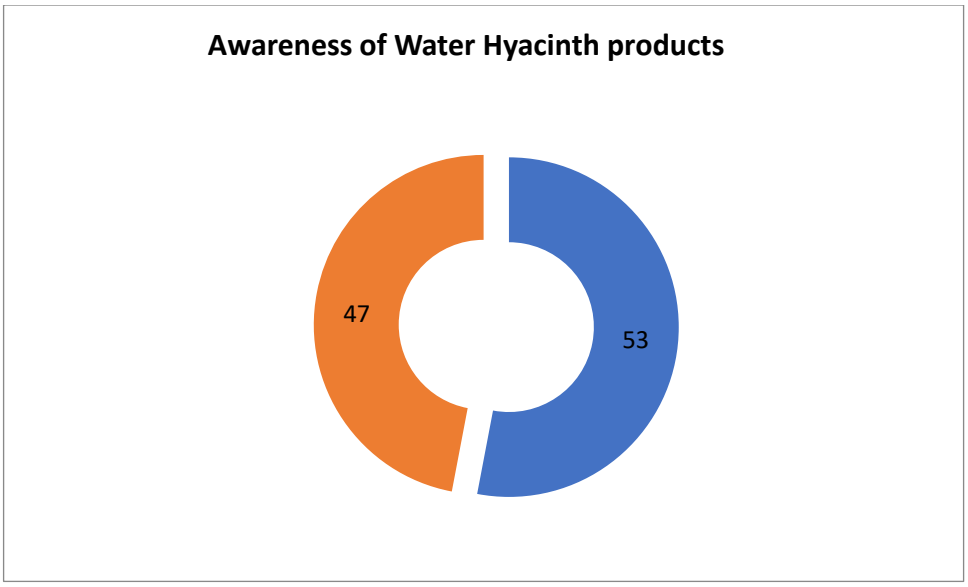


Fig 4.7: Awareness of Water Hyacinth Products

From the above chart it has been seen that more than half of the respondents (53%) are aware of products developed from Water Hyacinth. The rest 43% of the respondents were unaware about water hyacinth and its contribution to interior designing.

4.1.9. Opinion regarding the advantages of water hyacinth products

Water bodies in the district Ernakulam is more and many of them are infested by water hyacinth. It is important to acquire information about the respondent's opinion about the advantages of water hyacinth products. The graph provided below (Figure: 4.8) will provide an insight on the level of their awareness on the advantages of the topic.

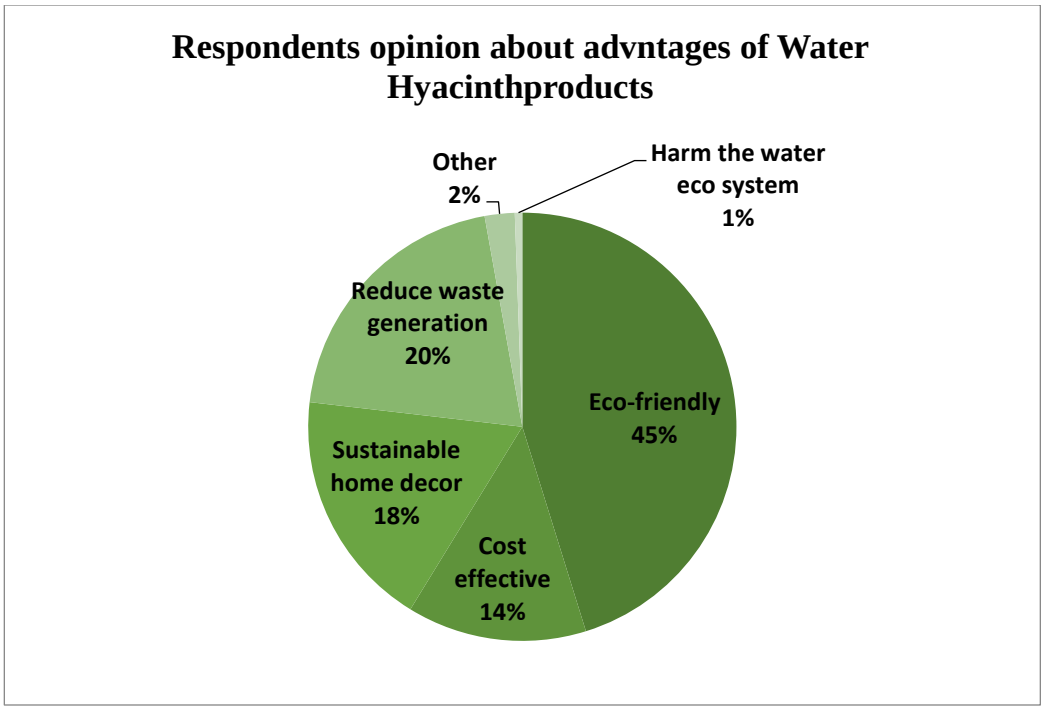


Fig 4.8: Opinion about the advantages of water hyacinth products

The study indicates that around 45% of the respondents think the products are eco-friendly. 20% of the respondents shows us that these products reduce waste generation, white 18% are in the opinion that it will be a sustainable home decor. 14% opines that Water Hyacinth products are cost effective, two percent says that it may have other advantages and one percent says it may harm the water eco system.

4.1.10. Opinion on the limitation of Water Hyacinth products

Entrepreneurs and product developers show and create many programs for promotion of the products. Still there are some limitation for these products, in the opinion of the respondents. These limitations include lack of technical

know-how, non-availability of the materials, lack of time, lack of space required to make these products and lack of creativity.

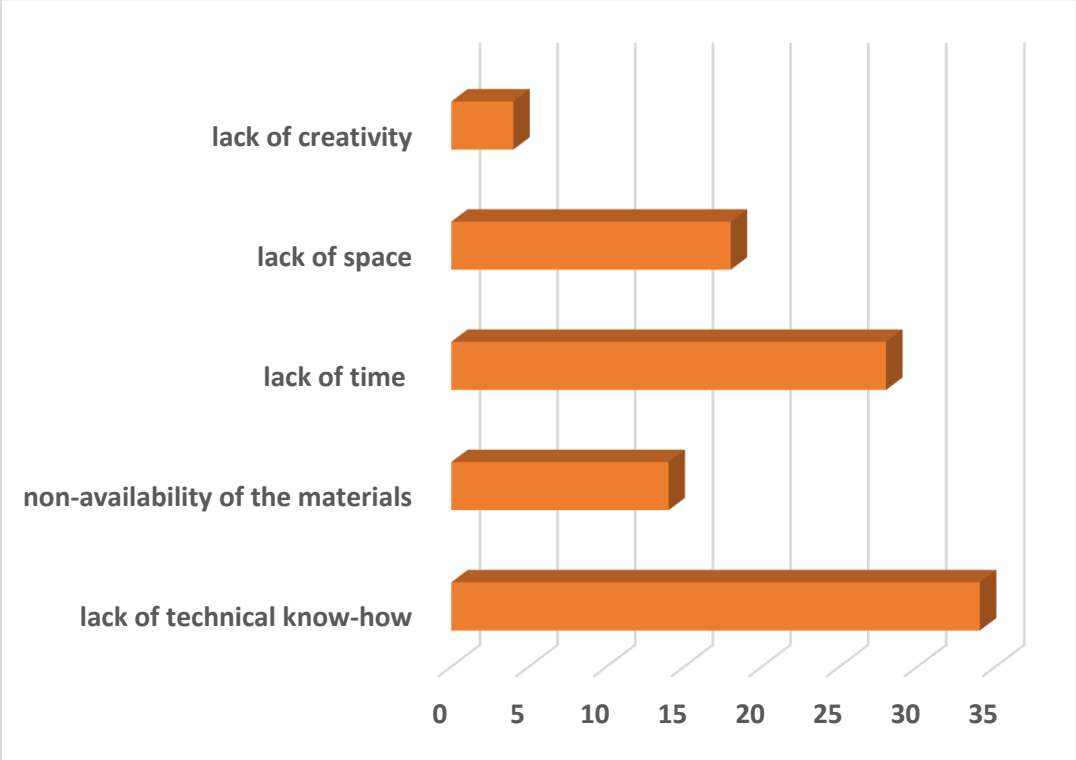


Fig 4.9: Opinion on the limitation of Water Hyacinth products

The above given diagram reveals that 37% of the respondents says that they are unaware of the techniques used in making of the water hyacinth products. 28% of the respondents complaints about the lack of time while 18% of the respondents complaints on lack of space. 14% of them says about non-availability of raw materials and 4% express lack of creativity.

4.1.11. Interest in Water Hyacinth product development classes

Opinion of the study about their interest in attending the product development classes from water hyacinth matters in the study of sustainable products development from water hyacinth. Sustainable interior products are preferred by people nowadays due to the environmental problems. Products developed from water hyacinth are eco-friendly and it is also beneficial to aquatic ecosystem. Figure 4.10 express the interest of the respondents regarding attending water hyacinth product development classes.

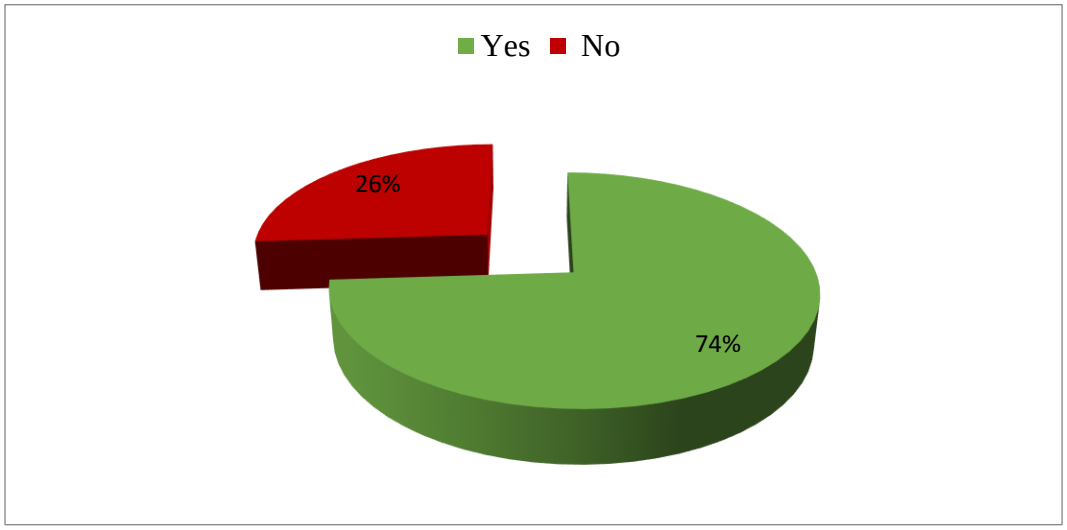


Fig 4.10: Interest in Water Hyacinth product development classes

From the above chart it has been seen that majority of the respondents is interested in product development class from Water Hyacinth. To specifically understand around seventy four percent of the individual are interested in these classes and twenty six percent are not interested in Water Hyacinth product development classes.

4.1.12. Reason for interest in product development classes

The studies show that majority of the respondents are interested in product development classes from Water Hyacinth, the reason for their interest varies. The study provided below gives us an idea on the reason for respondent's interest in product development classes.

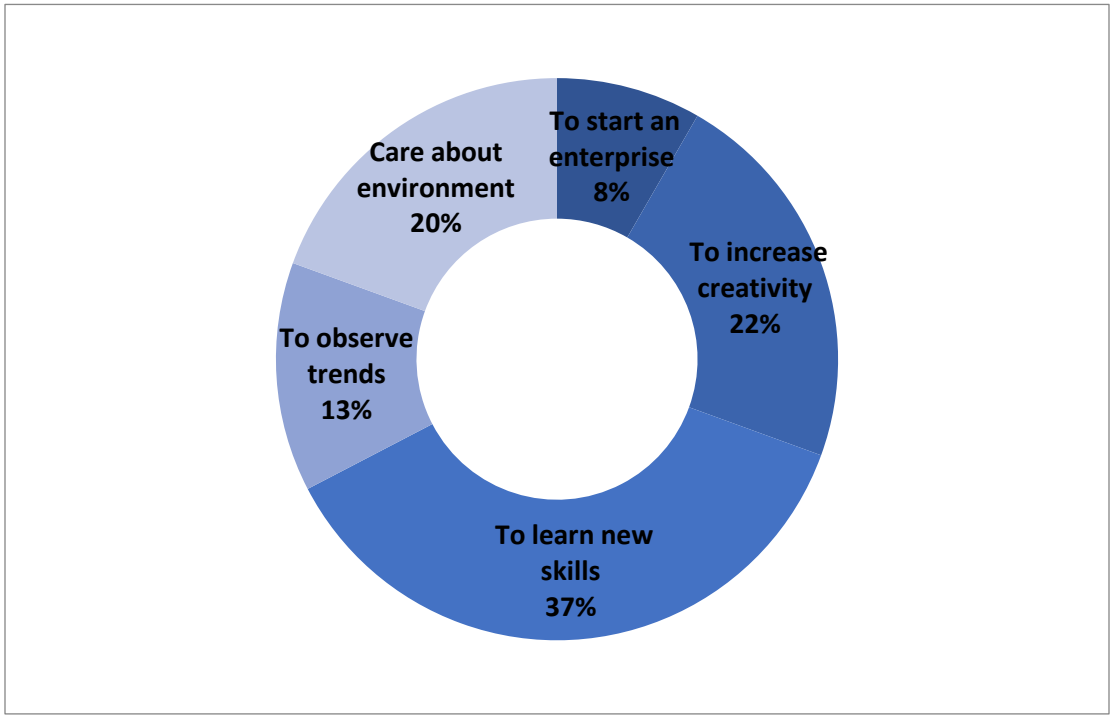


Fig 4.11: Reason for interest in product development classes

The study reveals that 37% of individuals are interested to learn it as a new skill. 22% respondents use it as an opportunity to increase their creativity. While 20% have the interest because of the mindset of care about environment. 13% percent is to observe the trends and 8% are interested to learn product development classes from water hyacinth to start an enterprise.

4.2. Phase II: Development of interior accessories with Water Hyacinth

Water hyacinth brings a unique and natural touch to interior spaces. Its fibrous stems and vibrant foliage offer a visually appealing and organic aesthetic. Its long, flexible stalks can be woven into intricate patterns, creating stunning furniture pieces, lamps, baskets, and other home decor items. The natural texture and warm tones of water hyacinth bring a sense of serenity and earthiness to any living space. By incorporating these accessories into our interiors, we can infuse our homes with a touch of nature, creating a harmonious and sustainable living environment.

Incorporating water hyacinth accessories can create a harmonious blend of nature-inspired elements within the living environment. Water hyacinth offers versatility in terms of its applications. It can be woven into various interior accessories such as furniture, home decor items, baskets, lampshades, wall coverings, and more. Its pliability and durability make it suitable for a wide range of design styles and functions.

The six decorative accessories developed by the researcher using water hyacinth for the study is given below:

1. Water Hyacinth Wallpaper
2. Water Hyacinth Basket
3. Water Hyacinth Tissue Box
4. Water Hyacinth Multi Storage Box
5. Water Hyacinth Place Mat
6. Water Hyacinth Interior Decor Accessory

Plate 4.3: Water Hyacinth Wallpaper

Plate 4.4: Water Hyacinth Basket

Plate 4.5: Water Hyacinth Tissue Box

Plate 4.6: Water Hyacinth Multi Storage Box

Plate 4.7: Water Hyacinth Place Mat

Plate 4.8: Water Hyacinth Interior Decor Accessory

4.3. Phase III: Evaluation of the Water Hyacinth products

After the product development the products are analysed and valued by 10 homemakers with the help of Evaluation Performa. The data collected were consolidated, analysed and presented as follows:-

4.3.1. Assessment of Water Hyacinth Wall Paper

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	44	42	44

Table 4.2 Rating of Water Hyacinth Wall Paper

While assessing Water Hyacinth Wall Paper, from above graph it is clears that the panel of homemakers had given forty four score out of fifty for both appearance and Creativity. In the criteria usefulness it is to be improved.

4.3.2 Assessment of Water Hyacinth Basket

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	50	49	50

Table 4.3 Rating of Water Hyacinth Basket

Water Hyacinth Basket is most rated product. The panel members given a score of fifty for the appearance of the basket, and the creativity. The usefulness of the basket is scored forty nine. From the above table the assessment is clear that panel members are impressed by the product.

4.3.3 Assessment of Water Hyacinth Tissue box

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	49	49	48

Table 4.4 Rating of Water Hyacinth Tissue box

From the table given above we are arriving at a conclusion that Water Hyacinth tissue box also have a good scale of rating. For appearance and usefulness it has a score of forty nine. Forty eight is the score given for the creativity of the product. Therefore the product is to be made more creatively.

4.3.4 Assessment of Water Hyacinth Multi storage box

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	48	48	46

Table 4.5 Rating of Water Hyacinth Multi storage box

Panel of Homemakers has rated forty eight for the appearance and usefulness of Storage box. The creativity of the box is given forty six. Pane members think that there is scope of improvement in developing the product. The qualities like appearance, usefulness and creativity needed improvement.

4.3.5 Assessment of Water Hyacinth Placemat

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	47	47	48

Table 4.6 Rating of Water Hyacinth Placemat

The table given above has the information about the rating and score given to Water hyacinth Placemat. The rating shows that the creativity of the product is forty eight out of fifty. Forty seven is the score given to the Appearance and Usefulness. The appearance of the place mat needed alteration and improvement according to the assessment of score given by the homemakers.

4.3.5 Assessment of Water Hyacinth Décor Accessory

Qualities	Appearance	Usefulness	Creativity
Rating by panel members	46	46	48

Table 4.7 Rating of Water Hyacinth Décor Accessory

Water Hyacinth Décor Accessory has the score of forty six for the appearance and usefulness. Forty eight is given to the creativity of the product. The appearance and usefulness of Water Hyacinth Décor according to rating of homemakers need improvement. The panel members are impressed with the creativity of the product.

Water hyacinth products	Wall paper	Basket	Tissue box	Multi storage box	Placemat	Decor accessory
Total score (150)	130	149	146	142	142	140

Table 4.8 Total scores of products evaluated by homemakers

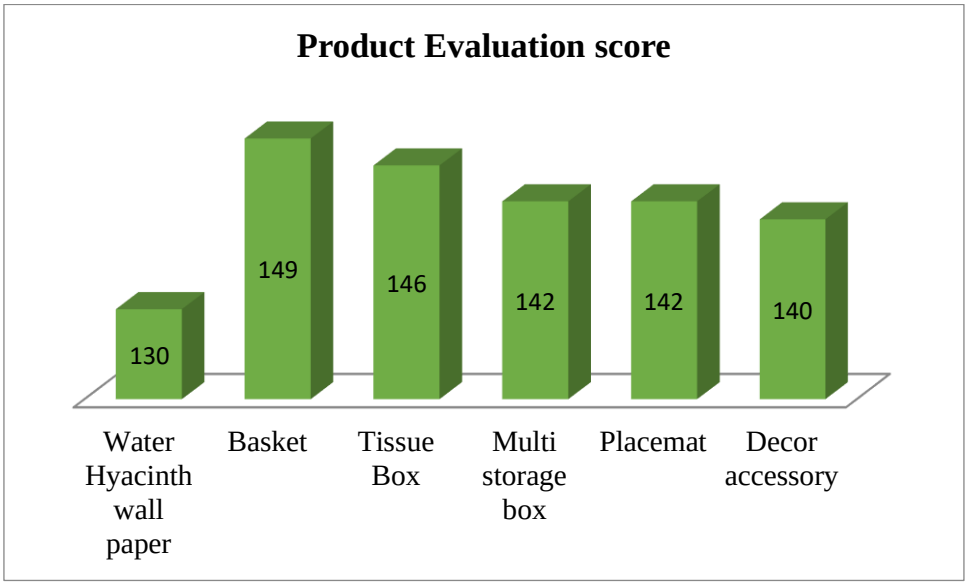


Fig 4.12: Evaluation score for the products

From the above results it is evident that the maximum score is for basket made of Water Hyacinth. Specifically it scored one hundred and forty nine out of one fifty. Tissue box score one forty six. Multi storage box and placemat have one forty two, while décor accessory scored one forty by the homemakers. To the lowest score one thirty is given to Water hyacinth wall paper. The majority of the homemakers were impressed by the products especially the baskets and tissue box.

Chapter 5

SUMMARY AND CONCLUSION

We live in a world where sustainability and eco-friendliness have become crucial considerations in every aspect of our lives. From the food we eat to the products we use, people are increasingly seeking options that are environmentally conscious. In this context, water hyacinth emerges as a remarkable solution for replacing interior accessories which cause harm to environment.

The results obtained from the study on '***Water Hyacinth: A Promising and Innovative Source for Sustainable Interior'*** is consolidated and given in following points:-

1. The study is conducted to understand the scope of water hyacinth as a promising and innovative source for sustainable interior designing.
2. Objectives of the study is to understand types of materials for accessories used in interiors, to find out opinion from homemakers regarding water hyacinth products, to develop water hyacinth accessories for making interior more sustainable and to assess the quality of appearance of the developed products.
3. The methodology adopted for the study comprised of three phases-
    - Phase I: Household Survey to find out types and materials used for interior accessories
    - Phase II: Development of interior accessories with Water Hyacinth
    - Phase III: Evaluation of the Water Hyacinth products developed

4. The area selected for the survey is urban and rural areas of Ernakulam district.
5. Sample size for the survey consist of 100 individuals.
6. Tool used for the study is a well constructed questionnaire as Google form
7. Age group of the study consists of young homemakers. Majority (87%) of the respondent are below thirty. Nine percentages of the respondents are in between the age of 31 to 50 and only 4% of the respondents are above the age of fifty.
8. 15% of the respondents have monthly income below Rs.10,000, monthly income of 45% of the respondents ranges from Rs. 10,001 to Rs. 30,000, 20% have income ranges between Rs. 30,001 and Rs. 50,000 and another 20% above of the respondents were Rs. 50,000.
9. There various types of material with which purchased interior accessories were made. They are plastic (100%), wood (88%), fabric (44%) metal (42%) ceramic (42%) recycled material (36%), glass (28%) and mud/clay (16%).
10. The study reveals that all the respondents use plastic material as interior accessories. Plastic, once hailed as a miracle material, has now become a nightmare that threatens the very existence of our environment and jeopardizes the well-being of all living beings.
11. Hand-made accessories and decor items used in the interiors by the respondents include containers for indoor plants (52%), pen stands (40%), wall hangings (38%), storage baskets (22%), door mats (18%),

table mats (20%), macramé products (12%), flower vases (11%), quote boards (9%) and kitchen accessories (8%).

12. The study shows that around fifty percent of the respondents use wood as the raw material for making accessories. 46% of respondent use cotton fabric and cotton as the material. Jute and coir are frequently used in interiors, 35% and 32% responded. Wicker and rattan materials are least responded materials of the list, i.e. four percent of responders. Twenty eight percent responders use bamboo as a material for making interior accessories.
13. More than half of the respondents (53%) are aware of products developed from Water Hyacinth. The rest 43% of the respondents were unaware about water hyacinth and its contribution to interior designing.
14. The study indicates that around 45% of the respondents think the products are eco-friendly. 20% of the respondents shows us that these products reduce waste generation, white 18% are in the opinion that it will be a sustainable home decor. 14% opines that Water Hyacinth products are cost effective, two percent says that it may have other advantages and one percent says it may harm the water eco system.
15. 37% of the respondents says that they are unaware of the techniques used in making of the water hyacinth products. 28% of the respondents complaints about the lack of time while 18% of the respondents complaints on lack of space. 14% of them says about non-availability of raw materials and 4% express lack of creativity.

16. 74% of the individual are interested in the Water Hyacinth product development classes.
17. Reason for their interest is that, 37% of individuals are interested to learn it as a new skill. 22% respondents use it as an opportunity to increase their creativity. While 20% have the interest because of the mindset of care about environment. 13% percent is to observe the trends and 8% are interested to learn product development classes from water hyacinth to start an enterprise.
18. Raw material selected for the product development is dried water hyacinth
19. They six product developed from water hyacinth are Wallpaper, Basket, Tissue Box, Multi Storage Box, Place Mat and Interior Decor Accessory
20. Maximum score is for water hyacinth basket, it scored 149 out of 150. Tissue box score 146. Multi storage box and placemat have 142, while décor accessory scored only 140. The lowest score 130 is given to Water hyacinth wall paper.

CONCLUSION

The need for sustainable products in interior design has become increasingly important in recent years. As society grows more conscious of environmental issues, there is a growing demand for sustainable and eco-friendly solutions in all aspects of life, including interior design. Sustainable products in interior design refer to materials, furniture, and accessories that are produced and used in a way that minimizes their impact on the environment. By incorporating sustainable products in

interior design, we can create spaces that not only look beautiful but also contribute to a greener and more sustainable future. Hence the study highlights the need for eco-friendly, bio degradable water hyacinth products which promote healthier indoor air quality.

EXPECTED OUTCOME

- The study helps to reduce the impact caused by using non-bio degradable products in interior by replacing Water Hyacinth products
- The study will inculcate ideas and creativity in the sample to design new products with Water Hyacinth to beautify their interior aesthetically.

FUTURE PLANS ON THE PROJECT

- To develop and sell the new Water Hyacinth products developed
- Provide consultation for those who are interested to develop Water Hyacinth products
- Publish paper based on the study.

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APPENDIX 1

QUESTIONNAIRE TO ELICIT INFORMATION REGARDING TYPES AND MATERIALS OF INDOOR ACCESSORIES USED

1. Name:
2. Phone no:
3. Age
    a) Below 30 ☐
    b) 31-50 ☐
    c) Above 50 ☐

4. Family income per month
    a) Below 10,000 ☐
    b) 10001-30,000 ☐
    c) 30,001-50,000 ☐
    d) Above 50,000 ☐

5. Type of residence
    a) Urban ☐ b) Rural ☐

6. Handmade accessories used in interior
    a) Storage baskets ☐
    b) Door mats ☐
    c) Place mats/ Table mats ☐
    d) Macramé products ☐
    e) Quote boards ☐
    f) Pots for Indoor plants ☐
    g) Pen stands ☐
    h) Flower vases ☐
    i) Others if any.....
7. Materials used for making accessories
    a) Jute ☐
    b) Coir ☐
    c) Wood ☐
    d) Bamboo ☐
    e) Wicker ☐
    f) Rattan ☐
    g) Linen(fabric) ☐
    h) Cotton ☐
    i) Twine ☐
    j) Yarn ☐
    k) Others if any.....

8. Material for other accessories used in interior

Metal ☐
Wood ☐
Plastic ☐
Fabric ☐
Glass ☐
Recycled materials ☐
Any other (specify)……

9. Have you heard of water hyacinth products?
   a) Yes ☐ b) No ☐

10. In your opinion what are the advantages of water hyacinth products?
    a) Eco friendly ☐
    b) Cost-Effective ☐
    c) Sustainable house decor ☐
    d) Reduce waste generation ☐
    e) Any other specify ……..

11. Limitations of water hyacinth products?
    a) Higher initial cost ☐
    b) Availability ☐
    c) Inconvenience ☐
    d) Any other specify ……..

12. Are you interested in product development classes on water hyacinth?

a) Yes ☐ b) No ☐

13. If yes, Reason for interest

a) To start an enterprise ☐
b) To increase creativity ☐
c) To learn new skill ☐
d) To observe trends ☐
e) Care about environment ☐
f) Any other specify ……..

APPENDIX 2

EVALUATION PROFORMA FOR EVALUATING WATER HYCINTH PRODUCTS

Sl. No.	WATER HYCINTH PRODUCTS	Appearance	Usefulness	Creativity	TOTAL SCORE
1	Water Hyacinth wall paper				
2	Basket				
3	Tissue box				
4	Multi storage box				
5	Placemat				
6	Décor accessory				

NB : Kindly assess the decorative accessories in 5 point scale as given below:

Key: -

Excellent - 5 points
Very good – 4 points
Good – 3 points
Satisfactory – 2 points
Poor – 1 point.