# DEVELOPMENT OF VALUE ADDED PRODUCTS FROM WATER HYACINTH

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Aryamol Vijayan
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# (AUTONOMOUS)


**PROJECT WORK**
**ON**

# DEVELOPMENT OF VALUE ADDED PRODUCTS FROM WATER HYACINTH

( B.Sc Final Year Home Science )
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Signature of Head of the Department

DEPARTMENT OF HOME SCIENCE ST. TERESA'S COLLEGE COCHIN-11

Examiners : 1. Mrs. Rajani Devi. T.R, M.Sc., M.Phil
Asst. Professor
Dept. of Home Science
Morning Star Home Science College
Angamaly South, Ernakulam Dt., Kerala-683 573

2.

Staff in Charge

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# DEVELOPMENT OF VALUE ADDED PRODUCTS FROM WATER HYACINTH

## CHAPTER 1

## INTRODUCTION

Common water hyacinth is an aquatic plant naturalized throughout the world, often invasive outside its native range. It is considered as the most productive plant on earth and now considered as a serious threat to biodiversity. These negative effects of WH lead to several research and developmental activities for the control of this notorious weed. Attempts to control this weed have high costs and labour requirements. (Sindhu, 2017). The water hyacinth is also known as the terror of Bengal because it is an exotic shrub which is growing at an alarming rate on the surface of the water body. It inhibits the growth of fish and other aquatic organisms due to cut down of light and lack of oxygen. Water hyacinths pose serious challenges to humanity and the environment. Considering the enormity of the menace associated with the growth and spread of the plant and the difficulty in achieving a single, generally acceptable control method, it is becoming increasingly imperative to explore the potentials of the plant. Some of the benefits that can be derived from the plant include biogas and biofuel production, medicinal functions, vermicomposting, compost production, and bioremediation. However, clogging of waterways, obstruction of water transportation, and fishing activities; breeding grounds for pests and diseases; and reduction of water quality, loss of biodiversity, and economic downturn in areas invaded by the plant are problems associated with it. The peculiarity in the invasiveness of each situation should determine whether or not the growth of the plant is a problem, especially if the opportunity to harness the potentials of the plant exists. There are three major methods for controlling the plants when control becomes inevitable: mechanical, chemical, and biological. To achieve the best control, integrating two or more control methods is advised.

This plant blocks waterways and limits boat traffic, recreation, flood control and wildlife use. By producing a dense canopy at the water surface, this exotic pest plant shades out native submersed plant species and can uproot native emergent species that are important to wildlife.

However, the plant has some benefits like medicinal functions, natural filtering, antibacterial functions, and the rapid and aggressive growth of the plant can produce biological wastelands.

Because unlike phytoplankton and other aquatic plants, water hyacinth does not release oxygen into the water. Here there is a need to remove such pest plants for a better water ecosystem. At this instance there is a need to make products out of it.

Preferably there is an increased use of products made of natural raw materials instead of plastic and synthetic items. It is both an ongoing trend and also part of reducing the use of plastic and synthetic waste thereby (Ayanda, et al., 2020).

Mainly concentrating on the development of decorative and value added products by upcycling, also known as creative reuse, is the process of transforming by-products, waste materials, useless, or unwanted products into new materials or products perceived to be of greater quality, such as artistic value or environmental value. Water hyacinth is now used also for making textiles, paper, as fodder for animals, green manure, compost and for camouflaging fish traps. It ferments rapidly due to its high water content and can supply biomass for biogas production. Since there are so many threats by the aquatic pest plants, there is a need to remove them from the water bodies. Rural communities affected by water hyacinth infestation can become involved by coping with and managing the issue through the microeconomic model, which will foster resilience and lead to more sustainable solutions for the water hyacinth control and management issues.(Harun, 2021) At the same time nowadays giving more importance to substances which can replace the plastic and such materials. It gives more ways of creativity and also there happens a reusing of these pest plants in a good way..In very recent times a group of 70 women based in Kodungallur has now made this possible by making products from the processed blades of water hyacinth stems collected from water bodies choked with weeds. The women's group includes differently- abled persons and is part of Kottappuram Integrated Developed Society which facilitated the venture. Thus the scientific knowledge and findings are applied to become a way to make income out of the process. (Sreemol, 2024)

## RELEVANCE OF THE STUDY

Kerala is a land which is rich with the abundance of backwaters. Economic relevance of our backwaters on the basis of tourism and production is very high. The rapid growth of aquatic pest plants are affecting the water bodies of Kerala in many terms like creating restrictions on aquatic transportation, effect on the oxygen presence on the water thus the effect on life in the aquatic ecosystem. Water hyacinth is one of the most noxious weeds that has affected agriculture, fishing and livelihoods across the State. The only way to control the weeds is to put them to alternative use. In this situation it is very important to clear the aquatic pest plants effectively from the water bodies. Common water hyacinth is the commonly seen aquatic pest plant in Kerala. So clearing of the pest plant in a very creative and useful way and making attractive products out of it. This study is conducted by looking for various ways of making creative items out of a pest plant.

## OBJECTIVES OF THE STUDY

- To develop value added products out of water hyacinth plants.
- To evaluate the products developed.

# CHAPTER 2

# REVIEW OF LITERATURE

The review of literature of the study titled "Development of Products using Water Hyacinth" is given under the following headings:

- Aquatic pest plants
- Threats of water hyacinth on the environment.
- Threats of water hyacinth in Kerala
- Developmental products from aquatic plant

## 2.1 AQUATIC PEST PLANTS

Aquatic plants are the plants which are adapted to grow in water. Plants like lotus and hydrilla are examples of aquatic plants. Aquatic pest plants pose a major threat to the quality of the Bay of Plenty region's wetlands, waterways and lakes. They often form dense beds of vegetation, impeding draining, encouraging stagnation and silting, damaging indigenous freshwater ecosystems, and making recreational activities, such as swimming and boating, difficult (Wikipedia).

### 2.1.1 Types of Aquatic Pest Plants

- **Agency pests** -These are pests of a national significance that are managed by, or subject to, programmes coordinated by the Crown. They pose significant threats to the New Zealand environment, economy and way of life.
  Eg: Didymo, Hydrilla, Water hyacinth, salvinia

- **Exclusion and eradication pest plants** - These are pests we want to prevent from entering the region, or eradicate from the region. Land owners and occupiers are legally obliged to notify Bay of Plenty Regional Council of any occurrence of these plants on their property. Bay of Plenty Regional Council leads the control of these pests if found, with an aim to eradicate them. Council will undertake and fund monitoring surveillance and control of any infestation of these plants.
  Eg: Alligator weed, Marshwort, Senegal tea, Spartina.

- **Containment pests** -These are pests that we want to minimize the effects of and prevent their further spread. Land owners, occupiers and agencies are bound under statutory obligations and laws to take responsibility for controlling these pests on their property. The Bay of Plenty Regional Council will assist by providing advice on how to control and dispose of these pests, coordinating and supporting approved programmes (such as Biodiversity Programme, Care Group or Community Control Programme).
  Eg: Egeria, Hornwort, Lagarosiphon

- **Restricted pests**- These are pests we want to reduce the further spread of and will support community and occupier efforts to control in places where they are a problem. Land owners, occupiers and agencies are not required to control these pests on their properties but are encouraged to do so. Assistance may be available and where they are a problem the Regional Council will support community and land owner efforts
  Eg: Mexican water lily, Parrot's feather, Elodea canadensis

Water hyacinth is one of the most noxious weeds that has affected agriculture, fishing and livelihoods across the State. The only way to control the weeds is to put them to alternative use [The Hindu, Feb .2019].

## 2.2. THREATS OF WATER HYACINTH ON ENVIRONMENT

With high rates of regeneration, survival, and growth, it is generally difficult to clear water bodies infested with water hyacinth. Water hyacinth has a variety of negative impacts once introduced into a freshwater environment. It forms dense, impenetrable mats which clog waterways, making boating, fishing and almost all other water activities impossible. It also reduces biodiversity by crowding out native plants at the water's surface and below. Water hyacinth mats also degrade water quality by blocking the air-water interface and greatly reducing oxygen levels in the water, eliminating underwater animals such as fish.

Water hyacinth is a major freshwater weed in most of the frost-free regions of the world and is generally regarded as the most troublesome aquatic plant. Despite its adverse impacts, it has been widely planted as a water ornamental around the world because of its beautiful, striking flowers. Hyacinth spreads rapidly by producing stolons or "daughter" plants. Water hyacinth will never be completely eradicated, however management is necessary to control its rapid growth, as the mats it forms can double their size in 6-18 days.[UF IFAS University of Florida, 2022]

Mainly concentrating on the development of decorative and value added products by upcycling, also known as creative reuse, is the process of transforming by-products, waste materials, useless, or unwanted products into new materials or products perceived to be of greater quality, such as artistic value or environmental value. Water hyacinth is now used for making textiles, paper, as fodder for animals, green manure, compost and for camouflaging fish traps. It ferments rapidly due to its high water content and can supply biomass for biogas production.

## 2.3. THREATS OF WATER HYACINTH IN KERALA

Water hyacinths (Eichorniacrassipes) have become a significant problem in Kerala for several reasons:

- **Rapid Growth**: Water hyacinths are fast-growing aquatic plants that can reproduce quickly under favorable conditions. Their ability to cover the surface of water bodies rapidly makes them a menace in Kerala's rivers, lakes, and canals.
- **Blockage of Waterways**: As water hyacinths multiply and spread, they can block waterways, hindering the natural flow of water. This can lead to flooding during the monsoon season and disrupt the movement of boats and ships, impacting transportation and commerce.
- **Water Quality Degradation**: Water hyacinths have a detrimental impact on water quality. They absorb nutrients such as nitrogen and phosphorus from the water, which can lead to imbalances in the aquatic ecosystem. This nutrient uptake can also result in the growth of harmful algae and a decline in dissolved oxygen levels, harming aquatic life.
- **Ecological Imbalance**: The presence of water hyacinths can disrupt native aquatic ecosystems by outcompeting native plant species and reducing the availability of sunlight and oxygen in the water. This, in turn, affects fish populations and other aquatic organisms, leading to a decline in biodiversity.
- **Economic Impact**: The spread of water hyacinths can have economic consequences. It can affect fishing activities, reduce the availability of potable water, and hamper agricultural irrigation systems. Tourism, which is a significant industry in Kerala, can also suffer as the picturesque backwaters and water bodies get choked with these invasive plants.
- **Health Concerns**: Stagnant water bodies covered in water hyacinths can become breeding grounds for disease vectors like mosquitoes, potentially increasing the risk of vector-borne diseases in the region.
- **Cost of Management**: Managing water hyacinths requires significant financial resources. Efforts to mechanically remove and dispose of the plants, as well as the development of alternative uses for the harvested biomass, can be expensive.

To address these problems, Kerala has implemented various strategies and initiatives, as mentioned in the previous response, to control the growth of water hyacinths, mitigate their negative impacts, and explore ways to utilize the plant in a sustainable manner. These efforts aim to strike a balance between environmental conservation, economic sustainability, and community well-being (Kumar, 2023).

## 2.4. DEVELOPMENTAL PRODUCTS FROM AQUATIC PLANTS

As a result of improvement of human science and technology, in the process of paper recycling, the technology solved the pollution problems of wastewater treatment and drinking, and the cleaning production is realized nowadays

About 40% of the fiber raw materials in the paper pulping industry comes from waste paper of which the amount and proportion will continue to grow.

Waste paper recycling has great economic and environmental benefits in reducing pollution, improving the environment, saving primary fiber resources, saving energy and protecting forest resources. Waste paper recycling is an important aspect to realize the sustainable development of the paper industry and social sustainable development. It embodies the green economy, circular economy and low carbon economy, the three 21st century actively promoted economic models in the world (www.paperpulpmachine.com., 2018).

Hyacinth paper has been in production for a while now in Kenya and other parts of the world. An organization originally experimented turning water hyacinth into paper in 1980 in Bangladesh. The water weed is converted into pulp and used to make paper. It takes 8 hours to dry the paper in the sun. Some of the water hyacinth paper products include lanyards and notecards.Islam N., 2021)

Researchers have attempted to use hyacinth as an absorbent for heavy metals, water pollutants, and others. Although a large number of studies have been done on using the stems and leaves of water hyacinth as absorbent, there are several interesting and novel applications of water hyacinth.(VijaykumarGuna, 2017). Water hyacinth (Eichhorniacrassipes) is one of the most invasive and widespread aquatic weeds in the world having a growth rate of up to 220 kg/ha/day. Its population can double every 5–15 days depending on site conditions. The plant has a unique ability to extract nutrients efficiently and quickly from water and possesses a high reproductive rate. Nutrient run-off from agricultural areas and excessive use of fertilization stimulates the massive growth of this aquatic weed and leads to rapid degradation of aquatic ecosystems.

Bangladesh is a unique example of this scenario where high-yielding crops depend heavily on the use of chemical fertilizers. Apart from the severe ecological degradation and biodiversity loss, the socio-economic and public health issues associated with water hyacinth proliferation in water bodies are huge. The vigorous growth of Water hyacinth mats leads to depletion of dissolved oxygen and increase of water loss due to evapotranspiration resulting in loss of fisheries, and degradation of fishing habitat. The species is also a major hindrance to water transport and fosters epidemic outbreaks of mosquito-borne disease caused by providing massive vector (e.g., mosquito) breeding sites. The blockage of irrigation canals and rapid siltation caused by Water hyacinth results in inefficient flood controls and degraded water quality for swimming and other productive uses of water. In Bangladesh, the widespread presence of Water hyacinth also affects the inland aquaculture sector by reducing oxygen in the water, increasing sediment accumulation rates and decreasing the volume of water bodies, which in turn leads to fish mortalities and low fish yields. Because of these problems, many management programs of Water Hyacinth have been put in place based on costly

chemical, physical, or biological controls, but have had little lasting success. Thus, the control of this weed depends largely on harnessing such alternative potential uses. (Islam N., 2021)

# CHAPTER 3

# METHODOLOGY

The methodology of the study titled "Development of Products using Water Hyacinth" is given under the following headings:

1) Collection of sample
2) Preparation of sample
3) Procedure for the development of the product
4) Advantages and disadvantages observed during the process of production.

## 3.1. COLLECTION OF THE SAMPLE

The raw materials used for the preparation of value added products are the long stems of water hyacinth plants. Water hyacinth is a pest plant which is abundantly seen on the backwaters and ponds of Kerala which causes certain harmful effects to the ecosystem.
Collection of samples is the primary step of the process.
Fresh water hyacinth plants are collected from the backwaters and ponds.
The collected plants are sorted to take plants with long stems.
The sorted plants are washed and chopped out the leaves and root from the stem.

## 3.2. PREPARATION OF THE SAMPLE

- The sample which is needed for the product preparation should be processed before making the products.
- The stems are cleaned by cutting out its leaves and roots.
- The stems are cut into stripes.
- Dry it in sunlight.

## 3.3. VALUE ADDED PRODUCTS FROM WATER HYACINTH

The products developed from the water hyacinth plants are:

- Table coaster
- Craft paper
- Table heat pad

### 3.3.1. .Table Coaster

- Collect long water hyacinth plants and remove roots and leaves from them.
- Dry the stems in shade for 7 days.
- Braid the stems together to form a very long braided strip.
- Roll the braid by applying pressure. Make it as a disc. Use glue while rolling.

Collect long water hyacinth plants and remove roots and leaves from them

↓

Dry the stems in shade for 7 days.

↓

Braid the stems together to form a very long braided strip.

↓

Roll the braid by applying pressure. Make it as a disc. Use glue while rolling.

### 3.3.2. Craft paper

- Commonly the water hyacinth is found as very long stalks and small experiments on the water bodies. While making artifacts and decorative items it can only use long stalked water hyacinth plants. But for making paper and textile products small plants also can be used. So the removal and usage of water hyacinth plants will be effective.
- Pulping of boiled water hyacinth stalks with addition of starch will give it a suitable consistency and texture for paper production.
- Dyes can be applied for giving the paper some pastel coloured tints. Frames with tiny nets are used like a mold during the paper production. Sun drying is suitable. The paper will not be so white or bright but it can give tints. Bleaching also can be experimented with for whitening the paper.

Collect the water hyacinth plants.

↓

Remove the leaves and root from the plant chop the water hyacinth stems

↓

Boil the stems in water.

↓

Add sago starch into the mixture.

↓

Grind the mixture along with some waste paper and dye

↓

Keep the mixture stand for some days.

↓

Take the mixture using a frame with cotton cloth into it.

Allow it to dry in sunlight.

Remove the paper from the frame.

The process and production of paper is also a low cost procedure and a good eco-friendly method. Since there is a situation of threat for trees due to paper production, this will be a very innovative and useful turn into effective environmental conservation.

The papers which are the byproduct can be used for art and crafts. The pale dull color, and crinkly edges gives it an aesthetic appearance.

### 3.3.3. Table heat pad

- Collect long water hyacinth plants and remove leaves and roots from them.
- Dry the stems in shade.
- Make a base using thin steel wires like a circle partition.
- Wind the dried stem strips on the wire loop to cover it as a circle.

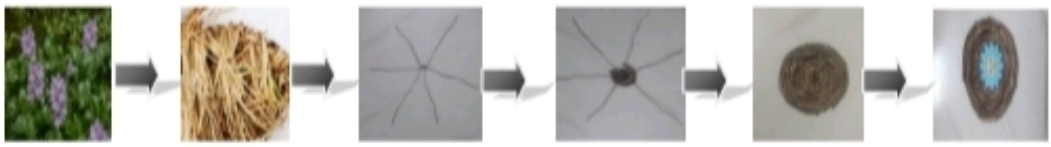
Collect the water hyacinth.

Remove the leaves and roots from the plant

Dry the stems

Make a loop using steel wires

Wind the dried stem strips on the wire.



## 4. ADVANTAGES AND DISADVANTAGES OBSERVED DURING THE PROCESS OF PRODUCTION

Result which is acquired on the study conducted on the production of value added products by using Water hyacinth is given below:

**Advantages**

- The removal and innovative use of a commonly seen aquatic pest plant in Kerala can be effective by the study conducted above.
- Attractive artifacts can be made out of water hyacinth.
- By extending the study into a production unit can be effective for pest plant removal and also for an income on handcrafts.
- The products are attractive for appearance and can be produced eco-friendly and cost effectively.

**Disadvantages**

- The raw material which is the stem will become light weight on drying. Nowadays the idea of making products out of water hyacinth is getting advanced and it is taking place by the use of looms and machineries.
- There is a seasonal availability for the raw material. The water hyacinth plants are not available in times of increased salinity in the water bodies. So, it can be a disadvantage to focus on production on a large scale.

# CHAPTER 4
# RESULT AND DISCUSSIONS

The results for the study conducted on the "Development of products from water hyacinth" is given under the evaluation of products made out of the water hyacinth plants. The value added products made out of the water hyacinth plants are :

Table coaster

Craft paper

Table Heat Pad

## 4.1 EVALUATION OF PRODUCTS

### 4.1.1Evaluation of durability of the Table coaster

Table 1: Evaluation of durability of the Table coaster

| Properties | Very good | Good | Satisfactory | Poor | Very poor |
|---|---|---|---|---|---|
| Waterproof | | | ✓ | | |
| Resistance to moisture | | | ✓ | | |
| Resistance to fungal effect | | ✓ | | | |

From the above evaluation it is found that the table coaster which is made out of the water hyacinth stalks is an innovative product.

By the time period of 3 months, it is observed that the product is resistant to fungal disintegration since the primary raw material is well prepared in sunlight. The product is not waterproof but the product is easy to manage in terms of contact with water by easy sun drying.

4.1.2. Evaluation of durability of the Craft paper

Table 2 : Evaluation of durability of the Craft paper

| Properties | Very good | Good | Satisfactory | Poor | Very poor |
|---|---|---|---|---|---|
| Waterproof | | | | ✓ | |
| Resistance to moisture | | | | ✓ | |
| Resistance to fungal effect | ✓ | | | | |

From the above inferences it is found that the relevance of the product is good. The idea of producing paper from aquatic pest plants is found effective since large numbers of trees are used only for the sector of paper production. In such a situation the effective execution of the paper production out of water hyacinth will help to lower the stress over the trees. The product is not waterproofed. But resistant to fungal disintegration.

4.1.3. Evaluation of durability of the Table heat pad

Table 3: Evaluation of durability of the Table heat pad

| Properties | Very Good | Good | Satisfactory | Poor | Very poor |
|---|---|---|---|---|---|
| Waterproof | | | ✓ | | |

| | | | | | |
|---|---|---|---|---|---|
| Resistance to moisture | | | ✓ | | |
| Resistance to fungus | | ✓ | | | |

From the above evaluation it is found that the product is usefull and by the time period of 3 months, it is observed that the product is resistant to fungal disintegration since the primary raw material is well prepared in sunlight. The product is not waterproof but the product is easy to manage in terms of contact with water by easy sun drying. By the use of this product it is an alternative to plastic.

## 4.2. EVALUATION OF PRODUCTS ON ITS APPEARANCE AND PROPERTIES

Products were evaluated by 10 experts and rated in a score of five. The evaluation was done on the criteria of its aesthetic appearance, functionality and neatness.

### 4.2.1. Evaluation of developed products:

Table 4: Evaluation of table coaster

| **Products** | **Aesthetic appearance (5)** | **Functionality (5)** | **Neatness (5)** | **Overall score (15)** |
|---|---|---|---|---|
| Table coaster | 4 | 4.4 | 3.9 | 12.3 |

Table 5: Evaluation of craft paper

| Products | Aesthetic appearance (5) | Functionality (5) | Neatness (5) | Overall score (15) |
|---|---|---|---|---|
| Craft paper | 4.6 | 4.8 | 4.6 | 14 |

Table 6: Evaluation of table heat pad

| Products | Aesthetic appearance (5) | Functionality (5) | Neatness (5) | Overall score (15) |
|---|---|---|---|---|
| Table heat pad | 4.1 | 4.4 | 3.8 | 12.3 |

Three products were made in this study. Among that craft paper got most acceptances on its aesthetic appearance and its functionality. Table coaster and table heat pad got moderate acceptance on the evaluation. It is evaluated that the functionality of both table coaster and table heat pad is rated highly while the aesthetic appearance and neatness off the products got compromised.

## SUMMARY AND CONCLUSION

Water hyacinth is a major freshwater weed in most of the frost-free regions of the world and is generally regarded as the most troublesome aquatic plant. Despite its adverse impacts, it has been widely planted as a water ornamental around the world because of its beautiful, striking flowers. This plant have some adverse effect like blocking of waterways, reducing oxygen concentration in water therefore affect the life of aquatic organisms. So there is a need of removing the weed plants.

The following were the highlights of the conducted study:

- It is possible to make value added products out of an aquatic weed plant.
- The stem of water hyacinth plants can braided and woven to make artifacts.
- Making of table coaster and table heat pad is an effective way to replace the use of plastic.
- Paper made out of water hyacinth can be used as craft paper due to its aesthetic appearance. It cause a positive impact on cutting of trees for paper production.

The production of value added products out of water hyacinth was successful. But there are difficulties in making products manually. Use of looms and other machineries make the production process easier. Three products were made in this study. Among that craft paper got most acceptance on its aesthetic appearance and its functionality.

Table coaster and table heat pad got moderate acceptance on the evaluation. It is evaluated that the functionality of both table coaster and table heat pad is rated highly while the aesthetic appearance and neatness off the products got compromised.

For the observation of durability checking of the products both table coaster and table heat pad is observed to be less affected by the moisture since it can be easily dried on sunlight in case of contact with water. Paper is easily got affected on contact with water. All the three products table coaster, craft paper, and table heat pad were not affected by the fungal degradation. Durability tests for all the products were conducted on a time period of 3 months.

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