

PAPER MANUFACTURED FROM WATER HYACINTH THE BACH DANG RIVER IN THU DAU MOT CITY, BINH DUONG PROVINCE

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Abstract

In recent years, water hyacinth (*Eichhornia crassipes*) has been widely recognized as an invasive aquatic plant that proliferates rapidly on rivers, canals, ponds, and lakes, obstructing waterway transportation, impeding water flow, and contributing to environmental degradation. Despite its abundance in large river systems such as the Bach Dang River in Thu Dau Mot City, Binh Duong Province, this biomass resource remains largely underutilized, leading to significant waste of natural materials and ongoing ecological challenges. This study proposes an eco-friendly alternative by transforming water hyacinth into handmade paper sheets with natural coloration, rustic aesthetic, and complete absence of harmful chemicals. The resulting products exhibit acceptable strength and surface quality, making them suitable for practical and decorative applications including coasters, shoe insoles, greeting cards, notebooks, biodegradable packaging, paper bags, and eco-handicraft items. Raw materials were collected directly from the Bach Dang River by a student research group. The research employed a combination of primary and secondary data collection methods, along with experimental, analytical, and synthesis approaches to develop and evaluate the manual paper-making process. The developed chemical-free production method successfully yielded durable paper sheets that are environmentally safe and biodegradable. The findings demonstrate the feasibility of converting an invasive plant into value-added sustainable products, thereby contributing to waste reduction, biomass reuse, and the promotion of green production practices. Although the study is

preliminary and limited by manual processing, lack of mechanization, and absence of standardized quantitative testing (e.g., tensile strength, water absorption, and biodegradability under controlled conditions), it provides a promising foundation for further optimization and scale-up. Future research should focus on improving uniformity, enhancing mechanical properties through natural additives, and conducting comprehensive performance and life-cycle assessments to support practical commercialization and broader environmental impact.

Keywords: biomass reuse; eco-friendly material; handmade paper; sustainable production; water hyacinth.

1. Introduction

Water hyacinth, also known as *Eichhornia crassipes* (Mart.) Solms, belongs to the Pontederiaceae family and originates from South America (Brazil). It was first introduced as an ornamental plant in Hanoi in 1905, and to date, water hyacinth has spread to more than 50 countries in tropical and subtropical regions. Water hyacinth is an aquatic plant present throughout the canal network because it has a very fast growth rate. In recent years, water hyacinth has been considered a weed, floating on rivers, canals, ponds, and lakes, obstructing boat navigation and hindering water flow. It is a fast-growing aquatic plant that thrives in water-adjacent environments, stagnant waters, or nutrient-rich waters. Water hyacinth can grow and develop over a relatively wide temperature range of 10–40°C, but optimal growth occurs at 20 and 30°C (So Khoa Học & Cong Nghe TP. Can Tho, 2022). With its rapid growth rate, water hyacinth causes many environmental problems such as obstructing water flow, clogging inland waterways, disrupting transportation, and reducing the growth of other aquatic organisms. When it dies and decomposes, water hyacinth releases a large amount of nutrients into the water environment. High densities of water hyacinth also limit fishing activities, interfere with water pumping for domestic use, irrigation, and power generation, and contribute to the decline of biodiversity (Negroni, 2024).

Water hyacinth is considered a major cause of serious environmental degradation and an economic burden that requires management (Irina Harun et al, 2021). In addition, water hyacinth has a strong capacity to absorb nutrients and chemicals from its habitat; its chemical composition depends on the environmental conditions in which it grows (Dellarossa1, 2001). Water: accounts for approximately 92.3% of the weight of water hyacinth, Cellulose: accounts for about 1.4% of the weight of water hyacinth. Cellulose is a type of dietary fiber that helps support digestion and has a laxative effect, Lipids: account for approximately 0.3% of the weight of water hyacinth. Lipids are fats that provide energy for the body, Protein: accounts for about 0.8% of the weight of water hyacinth. Protein is an essential nutrient for the body, playing a role in building and regenerating tissues, Minerals: account for approximately 1.4% of the weight of water hyacinth. Water hyacinth contains many important minerals for the body, including calcium, potassium, magnesium, iron, copper, and manganese., Other nutrients: Water hyacinth also contains several other nutrients such as vitamins, flavonoids, and tannins. These compounds have antioxidant, antibacterial, and anti-inflammatory properties. In terms of vitamins, it contains carotene at 0.66 mg% and vitamin C at 20 mg% (Ngo Ke Suong , 1997).

According to statistics from the Ministry of Agriculture and Rural Development, the area covered by water hyacinth in Vietnam is estimated at approximately 100,000 hectares, mainly concentrated in the provinces of the Mekong Delta, Central Vietnam, and Northern Vietnam. Water hyacinth grows rapidly, can reach a height of 3–4 meters, occupies water surface areas, obstructs inland waterway transportation, and causes environmental pollution (Nguyen Hong Hai Duy, 2024).

There have been many studies worldwide on water hyacinth: Application of water hyacinth in constructed wetland models for treating aquaculture wastewater (Nguyen, 2015), Study on the ability of water hyacinth to remove nitrogen and organic phosphorus from fish pond wastewater (Khoi et al., 2012), Use of water hyacinth mixed with bottom sludge or livestock manure to produce biogas and organic fertilizer (Dobelmann, 1998), Dried water hyacinth processed into powder for organic fertilizer production and soil improvement (Srivastava & Dhar, 1988), Burning water hyacinth to produce ash for use as fertilizer (Adeoye et al, 2001), Protein extraction from water hyacinth plants (Taylor K.G., 1971), Assessment of the potential for protein production from water hyacinth in areas of vigorous growth (Virabalin et al, 1993).

2. Literature Review

The study conducted fieldwork to examine community identity and to investigate the application of water hyacinth from San Bua Bok in product design and home decoration. San Bua Bok is a community enterprise located in Phayao Province. Pulp derived from the plant was used to produce paper, from which five products and home decoration designs were developed. Subsequently, user satisfaction with these products was evaluated. The results demonstrated that the optimal material ratio for papermaking was 70% water hyacinth and 30% hemp fiber. Finally, the product that achieved the highest level of satisfaction was the notebook design, with a score of 4.63 (Krairoop Charoensopa et al, 2022).

Biochar produced from water hyacinth has been investigated for its ability to adsorb nitrate ions (NO_3^-) from aqueous solutions under various conditions, including pH, biochar dosage, contact time, and initial nitrate concentration. Experimental data were analyzed using pseudo-first-order and pseudo-second-order adsorption kinetic models, as well as Langmuir and Freundlich adsorption isotherm models. The results showed that the maximum nitrate adsorption capacity reached 5.9597 mg/g at pH = 4, using 1 g of biochar, a contact time of 120 minutes, and an initial NO_3^- concentration of 50 mg/L. The nitrate removal process followed both pseudo-first-order and pseudo-second-order kinetic models; however, the Langmuir isotherm model provided a better fit to the experimental data than the Freundlich model. These findings indicate that biochar derived from water hyacinth has strong potential for application in the treatment of water and wastewater containing nitrate ions (Nguyen Dat Phuong et al, 2021).

The authors conducted a study to fabricate cellulose nanofibers from water hyacinth (WH) using a household blender and applied them as a reinforcing agent in recycled paper. Water hyacinth was selected to help reduce negative impacts on water resources. Pure cellulose was isolated from water hyacinth by chemical treatment, with the main components being 55% cellulose, 19% hemicellulose, and 14% lignin. FTIR analysis indicated that lignin and hemicellulose were effectively removed. The cellulose was then mechanically fibrillated into nanofibers, which enhanced the properties of recycled paper,

including moisture resistance, thermal stability, and mechanical strength (Meriko Ewnetu Sahlie et al, 2022).

3. Research Methods

3.1. Methods of Primary and Secondary Data Collection

The study was conducted by collecting and reviewing documents from books, newspapers, and domestic and international research articles available on the Internet. These materials focus on paper products made from water hyacinth as well as from other raw materials. The review examines the methods and processes used to produce such products, along with their advantages and disadvantages. One of the most significant advantages of producing application-based products from water hyacinth is the reduction of negative environmental impacts and the minimization of resource waste.

3.2. Methods of Implementation

To produce paper from water hyacinth, the following materials are required:

Materials: To create a complete product, the necessary raw materials are listed explicitly as follows:

Table 1. Materials and Equipment

Number	Raw Materials	Quantity/ Unit
1	Water hyacinth stems	500 grams
2	Tray	1 piece
3	Mold	2 piece
4	Calcium carbonate (CaCO ₃)	200 grams
5	Baking soda	100 grams
6	Pot	1 piece
7	Basin	1 piece
8	Blender (Panasonic)	1 piece
9	Knife	1 piece
10	5 kg scale	1 piece
11	Scissors	2 piece

Source: The Author Group, 2025

Implementation Process

The students collected the materials from the Bach Dang River in Thu Dau Mot City, Binh Duong Province, including water hyacinth, cornstarch (corn flour), baking soda, and calcium carbonate (CaCO₃).

Duration: 72 hours for the production of four paper products, including two products measuring 20×30cm and two products measuring 15×15cm.

The group members carried out the process of producing paper from water hyacinth according to the following procedure:

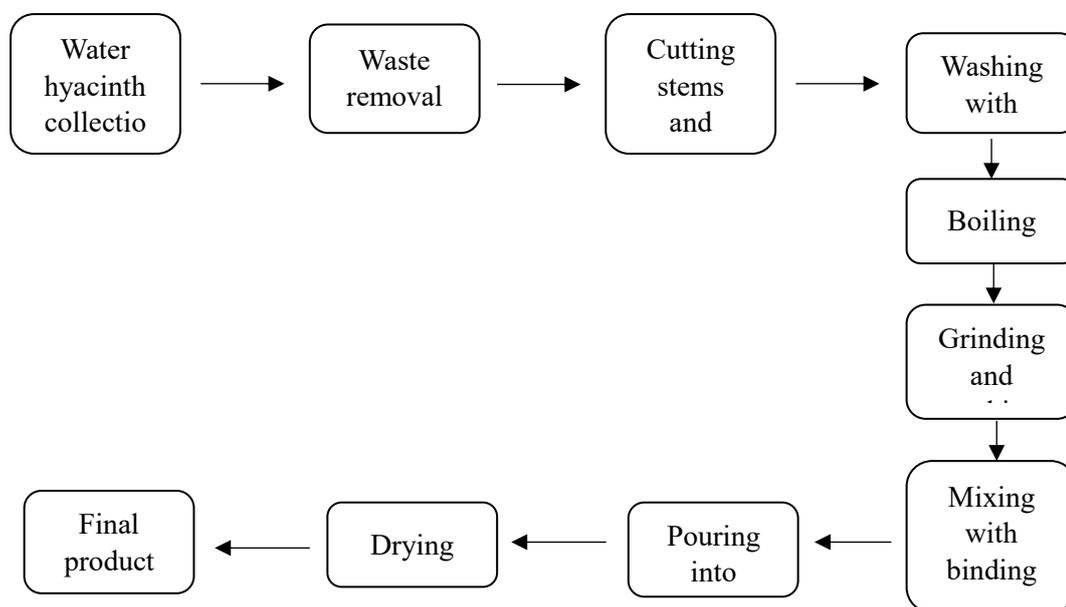


Figure 1. Product Manufacturing Process

Source: The Author Group, 2025

Step 1: Material Collection

Students collected water hyacinth from the Bach Dang River in Thu Dau Mot City, Binh Duong Province.

Step 2: Removal of Debris and Mud

All attached algae, mud, and dirt on the water hyacinth were carefully removed. This step must be carried out thoroughly and meticulously, as insufficient cleaning may negatively affect the quality of the final product.



Figure 2. Pre-treatment process for removing mud and sediment from water hyacinth

Source: The Author Group, 2025

Step 3: Removal of Leaves and Roots

Leaves and roots were removed because they contain a high amount of impurities, sap, and moisture, which can cause the paper to deteriorate easily and reduce its durability. The stem of the water hyacinth is richer in cellulose fibers, which enhances bonding strength and paper durability. In addition, the stem is easier to process than the roots, which often contain sand and mud, making production more difficult. Using only the stem also results in a brighter and more uniform paper color, whereas leaves and roots may darken the paper. For these reasons, only the stems were used to ensure optimal paper quality.



Figure 3. Cutting off the leaves and roots to obtain the water hyacinth stems

Source: The Author Group, 2025

Step 4: Washing with Water

After removing the leaves, roots, and branches, the water hyacinth stems were thoroughly washed to eliminate impurities such as mud, sand, and microorganisms adhering to the surface. This process improves the quality of the final paper by preventing contamination that may affect its color, strength, and structure. Furthermore, thorough washing helps remove excess sap, reduce unpleasant odors, and prevent premature decomposition during processing. As a result, material handling becomes easier, and the finished paper achieves better brightness and uniformity.



Figure 4. Washing the stems thoroughly with water

Source: The Author Group, 2025

Step 5: Peeling and Fine Cutting

Removing the outer peel of the water hyacinth stems prior to papermaking helps eliminate the outer layer that contains a high level of impurities, plant sap, and microorganisms, thereby improving the quality of the final paper. This outer layer is typically coarse and contains fewer cellulose fibers. In contrast, the inner portion of the stem is richer in cellulose, which enhances the paper's strength, bonding ability, and smoothness.



Figure 5. Peeling the outer layer of the water hyacinth

Source: The Author Group, 2025

After peeling, the water hyacinth stems are finely cut into short segments approximately 2–5cm in length, depending on the processing requirements. The chopped fibers are then

soaked in clean water or a suitable solution to soften the material in preparation for the subsequent processing steps.



Figure 6. Chopping the cleaned water hyacinth stems into small pieces

Source: The Author Group, 2025

Step 6: Grinding and Cooking

The grinding and cooking of water hyacinth stems play a critical role in the papermaking process, as they transform raw materials into high-quality pulp suitable for producing smooth, durable, and aesthetically pleasing paper. Fine grinding facilitates faster and more effective cooking by increasing the surface area of the material, allowing better contact with water or chemical agents during cooking.

After grinding, the material is cooked in water or a specialized solution to soften the cellulose fibers and remove remaining impurities, plant sap, and microorganisms. The cooking process also helps break down lignin—a natural compound in plants that can cause paper to become brittle and discolored over time. As a result, paper made from water hyacinth exhibits improved durability, lighter color, and more stable quality.



Figure 7. Boiling the finely chopped water hyacinth stems

Source: The Author Group, 2025

Overall, grinding and cooking are essential stages in the pretreatment of water hyacinth prior to papermaking. Through these processes, the stems are converted into fine pulp with good bonding properties, flexibility, and a smooth surface, ensuring consistent paper quality suitable for various applications.

After grinding and cooking, the water hyacinth pulp is preliminarily dried. The material is cooked for approximately 3 hours, during which water is regularly added, the mixture is continuously stirred, and care is taken to prevent burning. After the first 30 minutes, the water is replaced to ensure the fibers soften evenly. Prolonged cooking causes sugars in the water hyacinth to be released, which may turn the pulp yellow. Therefore, water is replaced every 30 minutes to prevent discoloration.

At the same time, baking soda is added after each water replacement to shorten the cooking time and improve the brightness of the pulp. This stage is the most critical in determining the final quality of the paper. Cooking duration directly affects paper bonding strength: longer cooking generally results in stronger fiber bonding, and vice versa.

The preliminary drying process removes excess moisture from the pulp and enhances its natural bonding properties. Drying should be carried out in a well-ventilated environment, avoiding humid conditions to prevent mold formation or fiber agglomeration. Partial drying improves the elasticity and flexibility of the pulp, making it easier to mix with binding agents in the subsequent step.



Figure 8. Grinding it into a fine pulp and putting it into the pot to boil again

Source: The Author Group, 2025

Step 7: Mixing with Binding Agents

The pulp mixture consists of water hyacinth fibers, baking soda, and calcium carbonate (CaCO_3), which are thoroughly mixed to form a homogeneous pulp. The materials used

to produce paper sheets measuring 20×30cm and 15×15cm include 70g of water hyacinth pulp, 20g of CaCO₃, and 10g of baking soda.

- **Calcium carbonate (CaCO₃):** 20g of CaCO₃ is diluted with water to form a dilute solution.
- **Baking soda:** 10g is added directly to the cooking pot containing the water hyacinth pulp.
- **Water hyacinth:** Finely ground water hyacinth pulp is used.

This mixing process creates a uniform pulp, ensuring strong bonding between fibers and preventing separation in the final product. Thorough mixing is essential to evenly distribute the binding agents throughout the pulp. The resulting paper is not chemically bleached and therefore has a natural light brown color rather than the white appearance of conventional paper.

Step 8: Pouring into Molds

After the pulp mixture is thoroughly combined with the binding agents, it is poured into paper molds. These molds may be made of wood, plastic, or metal and are available in various sizes and shapes depending on the intended application. During molding, the pulp is evenly spread and lightly pressed to form thin paper sheets with uniform thickness. In some cases, molds are designed with patterns or textures, allowing the production of artistic paper products with high aesthetic value.

Step 9: Drying

After the pulp is poured into the molds, the products are dried for approximately 8–10 hours. The drying time may be shorter or longer depending on weather conditions and sunlight intensity.

Step 10: Final Product

The finished paper products are decorated and designed to enhance their visual appeal. In addition, the products can be used to manufacture shoe insoles and cup coasters. In the field of arts and handicrafts, water hyacinth paper is an ideal material for creating paper artworks, interior decorative items such as lanterns, and other handicraft products with high aesthetic value.

4. Results and Discussion

Based on the water hyacinth pulp prepared in the previous steps, students proceeded to shape the products by pouring the mixture into paper molds to form and produce finished items. This process goes beyond the production of basic paper sheets and expands into recycling applications, creatively generating various useful products available on the market, such as decorative cards, cup coasters, decorative notebooks, paper bags, shoe insoles, and many other items.

To recycle and manufacture paper products with shapes and functions similar to those commercially available, additional supporting materials must be prepared. These materials include paper molds in various designs, decorative tools such as watercolors, glitter, pigments, and different types of adhesives to enhance the aesthetic quality and functionality of the products. In addition, tools such as scissors, cutting knives, rulers, and paper - pressing devices are essential to ensure precision and high-quality finishing.

Recycling and creative production using paper not only contribute to environmental protection but also offer unique economic and artistic value.

Table 2. List of Materials for Product Manufacturing

Number	Material	Quantity	Unit
1	Finished paper	100	gram
2	Wooden paper frame	2	pieces
3	Plastic pipe (0.5 m)	1	pieces

Source: The Author Group, 2025

Based on the mixture prepared in the previous section and the materials listed above, students proceeded to shape the paper using frames according to the following process:

Implementation Procedure:

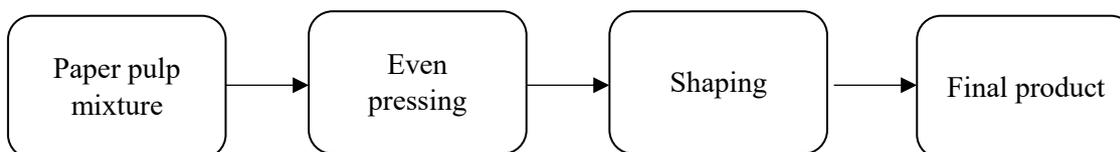


Figure 9. Implementation Procedure

Source: The Author Group, 2025

Step 1: Even Pressing of the Paper Pulp

After the paper pulp mixture has been prepared, it is poured into molds measuring 20×30cm and 15×15cm, depending on the intended product. The mixture is evenly spread within the mold to ensure full surface coverage and to form the initial shape of the paper sheet. A 0.5m plastic pipe is then used for the rolling and pressing process.

The pressing process is carried out gently with repeated movements. This step helps remove air bubbles trapped in the mixture and ensures uniform thickness across the entire surface of the paper. Special care must be taken to avoid tearing or displacing the pulp within the mold.

Even pressing not only provides the paper with the necessary flatness and smoothness but also contributes to improved strength after drying. This step should be repeated until the pulp achieves uniform consistency and the paper surface becomes smooth and even, with no visible irregularities.

Step 2: Shaping

After pressing, the paper sheets are dried for 24–48 hours. Once the water hyacinth paper has dried and reached suitable rigidity, students proceed to refine the shape to create finished products. Required tools include sharp scissors, craft knives, templates, sandpaper, and protective adhesive.

For shoe insoles, an existing insole can be placed on the dried paper sheet as a template. The outline is traced, then cut with scissors or a knife. After cutting, the fit is checked against the shoe size and adjusted if necessary.

Similarly, for cup coasters, a cup or plate can serve as a template. The outline is traced onto the paper and cut accordingly. After shaping, the edges are lightly sanded to remove rough areas, resulting in a smoother and more refined appearance. If further adjustment is needed, the product may be lightly moistened, pressed again, and dried to ensure flatness.

To enhance durability, a thin layer of adhesive may be applied to the product surface to provide moisture resistance and structural reinforcement. Additionally, decorative techniques such as coloring, pressing dried flowers, or printing patterns may be applied to improve aesthetic appeal.

Finally, the products are inspected to ensure that shoe insoles have suitable flexibility for comfort, while cup coasters have sufficient rigidity to maintain their shape during use. After completion, the products may be packaged or displayed for use or commercial purposes.

Step 3: Final Product

After completing the production process, the finished items include:

Cup coasters: Creative handcrafted products resulting from the shaping process.

Production time: 12 hours

The finished product reflects creativity in shaping and conveys environmental significance.

Product specifications:

Weight: 100g

Composition: water hyacinth stems, baking soda, and calcium carbonate (CaCO_3)



Figure 10. Shoe Insoles and Cup Coasters

Source: The Author Group, 2025



Figure 11. Other Products Made from Water Hyacinth

Source: The Author Group, 2025

4. Conclusion and recommendations

4.1. Conclusions

Based on the disintegration test, the paper was found to decompose in water after approximately 3 hours. The product is tearable and exhibits good bonding strength. As the paper is handmade, its thickness can be adjusted depending on the intended application. The paper shows a certain degree of flexibility and high durability. This raw paper can be applied to various products such as decorative notebooks, packaging, cup coasters, and other items with high practical value in daily life. Since the paper is produced from discarded materials and is environmentally friendly, the production cost is relatively low. All processing steps are carried out manually, making them easy to implement, with readily available raw materials that are biodegradable.

The study identifies the significant potential of water hyacinth, an aquatic plant often regarded as a weed or a cause of waterway obstruction, as a valuable renewable raw material for the paper manufacturing industry. Chemical composition analysis indicates that the stem of water hyacinth contains a relatively high cellulose content and a low lignin content, enabling efficient pulp processing with lower chemical consumption compared to some conventional raw materials.

The research team successfully developed and tested a handmade process for producing paper from water hyacinth, encompassing material collection, pretreatment, pulping, bleaching, grinding, shaping, and drying. The results show that the resulting paper has relatively stable quality, acceptable mechanical strength, and a fairly smooth surface. It can be applied in various fields such as greeting cards, biodegradable packaging, gift wrapping paper, and decorative handicraft products. Notably, this production process is environmentally friendly, does not involve toxic chemicals, and does not generate hazardous waste, contributing positively to current trends in green manufacturing.

The study also highlights the socio-economic value of utilizing water hyacinth. In many localities, water hyacinth grows uncontrollably or drifts freely in rivers, canals, and ponds, negatively affecting waterway transportation, aquaculture, and ecological environments. Harvesting and using water hyacinth as a raw material for paper production not only helps mitigate environmental problems but also creates additional income opportunities for local communities, particularly in rural and riverine areas where resources are abundant but economic development opportunities are limited.

However, several limitations were identified. The quality of the paper is not yet fully uniform, the production process remains largely manual, productivity is low, and mechanization has not been implemented. Furthermore, the current products mainly serve artistic and handicraft purposes and cannot yet fully replace industrial paper used in printing or office applications. Therefore, to expand the scope of application and enhance product value, further research is needed to improve processing technologies, optimize production methods, and incorporate natural additives to enhance paper durability and aesthetic qualities. In addition, collaboration among researchers, enterprises, and local communities is essential to develop a sustainable water hyacinth paper production model aligned with circular economy principles and environmental protection.

4.2. Recommendations

Due to the limited research duration, the produced paper was dyed to achieve a more complete and refined appearance. In addition, the papermaking formula can be further

applied to develop various practical products for daily use, such as shoe insoles, cup coasters, and similar items.

Water hyacinth paper can be used not only for packaging applications but also for the development of a wide range of everyday products, including paper bags, pen holders, shoe insoles, and many others. This approach maximizes the utilization of raw materials, minimizes waste generation, and contributes to environmental protection.

References

- BeMiller, J. N. (2009). *Food Starch: Chemistry and Technology*. Academic Press.
- Biện Văn Tranh. (2010). *Environmental Pollution Textbook [Giáo trình Ô nhiễm môi trường]*. NXB: College of Natural Resources and Environment.
- Britannica, T. E. (2024). sodium bicarbonate. Britannica.
- Bùi Thị Kim Hoàng. (2009). Paper production from water hyacinth [Chế tạo giấy từ cây lục bình]
- Bùi Thị Kim Hoàng. (2009). Research on handmade paper production from water hyacinth and paper mulberry [Nghiên cứu sản xuất giấy từ bèo Lục Bình và cây Dướng bằng phương pháp thủ công]. Faculty of Forestry, Nong Lam University, Ho Chi Minh City
- Dellarossa1, V. C. (2001). Eichhornia crassipes-based tertiary treatment of Kraft pulp mill effluents in Chilean Central Region. *Hydrobiologia* 443:187.
- Krairop Choensopa, Wat Ploysri. (2022). Making paper and home décor products from water hyacinth [Làm giấy sản phẩm từ cây lục bình và trang trí nhà cửa]. Positive School Psychology.
- Meriko Ewnetu Sahlie . (29(06), 230). Water hyacinth: a sustainable cellulose source for producing nanocellulose fibers and their application as reinforcement material in recycled paper [Lục Bình: nguồn cellulose bền vững để sản xuất sợi nano cellulose và ứng dụng làm vật liệu gia cố giấy tái chế]. *Polymer Research*.
- Muhammad Aiman Mohamad Sharil, M. H. (2023). Paper Bag Production using Banana Stem Via Kraft Pulping Proces. Universiti Tun Hussein Onn Malaysia Publisher's Office.
- Nguyễn Hồng Quân. (2015, 07 13). Urgently preventing the spread of water hyacinth [Cấp thiết ngăn chặn sự phát triển của lục bình]. Retrieved from <https://www.sggp.org.vn/cap-thiet-ngan-chan-su-phat-trien-cua-luc-binh-post162170.html>
- Nguyễn Xuân Trường. (2014). *Chemistry Grade 12 Textbook [Sách giáo khoa Hóa học lớp 12]*. Publisher: Vietnam Education Publishing House.
- Parizad Sheikhi. (2013). An Optimum Mixture of Virgin Bagasse Pulp and Recycled Pulp . *Sugar Cane Bagasse*.
- Phóng viên. (2022, 01 05). Solutions to the water hyacinth problem [Lời giải cho cây lục bình]. Retrieved from VOV Giao Thông: <https://vovgiaothong.vn/loi-giai-cho-cay-luc-binh-d16888.html>
- Sở Khoa học và công nghệ TP. Cần Thơ. (2022). Research on using water hyacinth (Eichhornia crassipes (Mart.) Solms) as a substrate for cultivating white oyster mushroom (Pleurotus pulmonarius (Fr.) Qué.) in Thua Thien Province, VietNam [Nghiên cứu sử dụng cây lục bình (Eichhornia crassipes (Mart) Solms) làm giá thể trồng nấm sò trắng (Pleurotus pulmonarius (Fr.) Qué.) tại Thừa Thiên Huế]. *Journal of Agricultural Science and Technology – University of Agriculture and Forestry, Hue University, Volume 6, Issue 3*.