

## **Chapter 1 – BACKGROUND OF THE STUDY**

This chapter will provide background on the problem of Eco Brick From Aquatic Plant namely, Introduction, Research Concept, Purpose and Description, Objectives, Scope and Limitation, and the Definition of terms.

Plastic waste and environmental pollution are two of the biggest problems in the world today. The United Nations Environment Programme (UNEP, 2022) reports that more than 400 million tons of plastic are produced every year, and at least 14 million tons end up in rivers, lakes, and oceans. Countries like the Philippines struggle with managing plastic waste because of limited waste segregation and recycling facilities (Jambeck et al., 2015). This poor waste management causes pollution on land and water, which can harm animals, people, and the environment.

One creative way to help reduce plastic waste is by making eco-bricks plastic bottles tightly filled with non-recyclable plastic waste that can be used as building materials (EcoBrick Exchange, 2020). These eco-bricks can keep plastic out of landfills and oceans. However, most eco-bricks use polyethylene terephthalate (PET) bottles, which are not biodegradable and can still harm the environment over time (Hopewell, Dvorak, & Kosior, 2009). This means there is a need to look for more earth-friendly ways to make eco-bricks that use biodegradable or renewable materials.

Lakewood, a town in Zamboanga del Sur, Philippines, is known for its natural resources. The lake supports fishing, tourism, and other sources of livelihood for the people. However, it also faces problems such as the fast spread of an invasive water plant called *Hydrilla verticillata* (DENR-BMB, 2021). If not controlled, *Hydrilla* can replace native plants, damage fish habitats, and block water transportation (Langeland, 1996). Although *Hydrilla* is a problem, it can also be a useful resource.

*Hydrilla* is a water plant with long stems, thin leaves arranged in circles, and the ability to reproduce quickly from small parts of the plant. It can grow in many different water conditions and is considered one of the most invasive water weeds in the world (Global Invasive Species Database, 2023). Researchers have found that *Hydrilla* has a

high amount of cellulose fibers (Khan et al., 2018), which are strong plant fibers that can be used in making building materials.

Plant-based cellulose fibers are known to improve the strength, durability, and eco-friendliness of building materials (Mohanty, Misra, & Drzal, 2005). Using Hydrilla fibers in eco-bricks could make bricks that are stronger, more water-resistant, and better for the environment helping to solve both the problem of Hydrilla overgrowth and the drawbacks of PET-based eco-bricks.

This study aims to test the possibility of using Hydrilla-modified bricks as an eco-friendly alternative to regular bricks made from clay or concrete. It will check their strength, water absorption, environmental impact, and cost. The results will be compared to regular bricks to see if they are practical to use.

In Lakewood, where Hydrilla is abundant and plastic waste is still a problem, this research could offer two solutions at once controlling an invasive plant while creating green building materials. If successful, this could also bring new jobs, improve waste management, and support sustainable construction in local communities.

## **Research Concept**

The theoretical framework for evaluating the potential of Hydrilla modified brick production can draw upon several relevant concepts:

1. **Sustainable Development:** This framework emphasizes the importance of balancing environmental, social, and economic factors. The production of Hydrilla modified bricks aligns with the principles of sustainable development by utilizing renewable resources, reducing plastic waste, and potentially creating economic opportunities for local communities.
2. **Circular Economy:** This concept advocates for minimizing waste, maximizing resource efficiency, and promoting recycling and reusing materials. Hydrilla modified bricks can be seen as an innovative application of the circular economy

approach, as they repurpose aquatic plant material that would otherwise go to waste.

3. **Green Building:** Green building practices prioritize sustainability and minimize the environmental impact of construction. The evaluation of Hydrilla modified bricks in terms of mechanical properties, durability, and environmental sustainability aligns with the goals of green building.
4. **Material Engineering:** Material engineering concepts and principles can be used to evaluate the mechanical properties, water absorption resistance, and durability of Hydrilla modified bricks. This framework can assess the performance of the bricks and compare them to traditional building materials.
5. **Life Cycle Assessment (LCA):** LCA is a methodology used to quantify the environmental impacts of a product or process throughout its entire life cycle. Applying LCA to the production of Hydrilla modified bricks can provide insights into their environmental performance and compare it to that of traditional building materials.

## **Purpose and Description**

The increasing amounts of plastic waste globally have raised concerns about the potential environmental and health impacts. Eco-bricks have emerged as a potential solution to transform plastic waste into building materials. However, the traditional method of using PET bottles for eco-brick production has its limitations and does not promote environmental sustainability. Aquatic plants, such as Hydrilla, have been identified as potential sources of sustainable building suitable

## **Objectives of the Study**

The main objective of this study is to design, develop, and evaluate Hydrilla-modified bricks as a sustainable alternative to traditional building materials. Specifically, it aims:

1. To design a formulation for Hydrilla-modified bricks incorporating cellulose fibers extracted from Hydrilla plants collected from Lakewood, Zamboanga del Sur.
2. To develop Hydrilla-modified bricks and determine their mechanical properties, including compressive strength and durability, in comparison with conventional clay or concrete bricks.
3. To produce Hydrilla-modified bricks with optimized water absorption properties suitable for building construction applications.
4. To assess the environmental sustainability and cost-effectiveness of Hydrilla-modified bricks compared to traditional building materials.

## **Hypothesis**

Based on the problem statement, the following hypotheses can be developed:

1. Hydrilla modified bricks have mechanical properties comparable, if not superior, to traditional building materials like clay or concrete.
2. Hydrilla modified bricks have better water absorption resistance than traditional building materials like clay or concrete.
3. The production of Hydrilla modified bricks is an environmentally sustainable alternative to traditional building materials like clay or concrete.
4. The production of Hydrilla modified bricks will have a lower environmental impact than traditional building materials like clay or concrete.
5. Aquatic plant-based eco-bricks have the potential to become a sustainable and viable option for building materials, thereby reducing plastic waste globally.

## **Scope and Limitations of the Study**

This study focuses on creating and testing Hydrilla-modified bricks to determine their strength, durability, and water absorption capacity. The Hydrilla used was collected from Lakewood, Zamboanga del Sur, dried, and processed into small pieces before being mixed with cement and aggregates to make bricks.

The research covers the preparation of materials, the mixing process, molding of bricks, and testing through strength tests, water absorption tests, and impact (drop) tests. The standard size of bricks used in this study is 200 mm × 100 mm × 55 mm to ensure uniformity.

The study is limited to:

1. Using only Hydrilla as the plant material in the brick mixture.
2. Testing only three properties: compressive strength, water absorption, and impact resistance.
3. Producing and testing bricks in a small-scale setting, not in an industrial or large-scale production facility.
4. Air-curing the bricks at room temperature without using special curing chambers.

### **Significance of the Study**

The proposed research on evaluating the potential of Hydrilla modified bricks as an eco-friendly building material has significant implications for environmental sustainability, waste management, and economic development.

Firstly, the use of Hydrilla cellulose fibers to produce eco-bricks could help reduce plastic waste by providing an alternative to PET bottles and other non-biodegradable materials traditionally used in eco-brick production. This will help address the growing problem of plastic pollution globally and contribute to a more sustainable future.

Secondly, the research study could potentially create new economic opportunities for local communities, particularly those that have abundant aquatic plant resources. The use

of aquatic plants like Hydrilla in building material production could provide a sustainable source of income and promote eco-tourism.

Thirdly, the evaluation of mechanical properties, durability, water absorption, and environmental sustainability of Hydrilla modified bricks could potentially lead to the development of new and more sustainable building materials. Hydrilla modified bricks may offer advantages, such as better mechanical and physical properties, longer lifespan, and lower environmental impact compared to conventional materials like clay or concrete.

Finally, the proposed research study contributes to the development of sustainable building practices while promoting the use of renewable resources. This study's findings could provide a better understanding of the potential of using aquatic plants as a source of sustainable building materials and help promote environmental sustainability globally.

### **Definition of Terms**

**Aggregate** – Granular construction material such as sand, gravel, or crushed stone used to provide volume, stability, and resistance to wear in concrete and bricks. In this study, mixed aggregates are combined with cement, water, and Hydrilla fibers to produce Hydrilla-modified bricks.

**Biodegradability** – The ability of a substance to naturally break down into simpler compounds by the action of microorganisms. The Hydrilla fibers used in this study contribute to the partial biodegradability of the bricks, making them more environmentally friendly compared to purely synthetic materials.

**Brick Strength** – The maximum compressive load a brick can withstand without breaking or deforming. This property is tested in the study to compare the performance of Hydrilla-modified bricks and conventional building bricks.

**Cellulose Fibers** – Organic fibers composed of cellulose, a carbohydrate polymer found in the cell walls of plants. In this study, cellulose fibers are extracted from Hydrilla to improve mechanical strength, durability, and water resistance of the bricks.

**Cement** – A powdered binding substance that sets, hardens, and adheres to other materials when mixed with water. In this research, cement binds the aggregates and Hydrilla fibers to form solid bricks.

**Compressive Strength** – The capacity of a material or structure to withstand loads that reduce its size. In this study, compressive strength testing determines whether Hydrilla-modified bricks meet standard building material requirements.

**Eco-Bricks** – Traditionally, eco-bricks are plastic bottles packed tightly with unrecyclable plastic waste to create reusable building blocks. In this study, the term refers to Hydrilla-modified eco-bricks cement-based bricks that integrate Hydrilla fibers as a sustainable component.

**Hydrilla** – *Hydrilla verticillata*, an invasive aquatic plant capable of rapid growth and dense mat formation, often causing ecological imbalance. In this study, dried Hydrilla collected from Lakewood, Zamboanga del Sur, is processed and incorporated into brick production as a partial replacement for sand.

**Impact Absorption** – The ability of a material to absorb and dissipate energy from a sudden force or collision. In this research, drop tests measure the impact absorption capability of Hydrilla-modified bricks.

**Water Absorption** – The percentage of water a brick can absorb when submerged, used as an indicator of porosity and durability. This study measures water absorption in Hydrilla-modified bricks to determine their quality and moisture resistance.