Application of Cyperus involucratus Rottb (Umbrella plant) Combined with GLOBE Hydrosphere Water Quality Measurements for the Restoration of Water in Concrete Canal, San Pa Liang Community, Mueang, Chiang Mai

The GLOBE Program

RESEARCHERS Miss Napawadee Phokajirakun   Miss Arissara Songsawatwong
Miss Paparwarin Wangdee   Miss Yada Kuchkean Mr. Paramet Chaiyod
Level : Upper Primary

ADVISORS : Miss Rattanaporn Waenphet Miss Kuntalee Panin Mr. Kantapat Thapinta   Mr. Suppasit Kiatpattananon Mr. Nutchworapol Vongsoontorn
Scientific Advisor :   Asst. Prof. Dr. Anoda Ratchawet   SCHOOL: VAREE CHIANGMAI SCHOOL, MUEANG, CHIANG MAI

ABSTRACT

The objective of this research was to study the water quality in the concrete canal, San Pa Liang Community, Mueang District, Chiang Mai Province, and to assess the efficiency of the Umbrella Plant (Cyperus involucratus Rottb) in restoring wastewater. This was done using measurements according to the GLOBE Hydrosphere Protocol alongside laboratory experiments. Field water sampling was conducted at 3 locations : Upstream, Midstream, and Downstream, once a week for 4 weeks. Water quality variables measured included temperature, turbidity, pH, DO value, phosphate, nitrite, alkalinity, and electrical conductivity. The survey results found that water quality deteriorated as it flowed through the community area. Turbidity, phosphate, nitrite, and electrical conductivity values increased clearly in the midstream and downstream areas, reflecting contamination from household wastewater and community activities. Although the pH value was at a neutral level, other variables indicated a state of water pollution. In the experiment of wastewater treatment using the Umbrella Plant, designed as a control group and an experimental group over a period of 15 days, it was found that the plant could effectively reduce turbidity and absorb phosphate and nitrite, making the water clearer and increasing the DO value. This was due to the function of the root system and microorganisms that help decompose waste. Additionally, electrical conductivity decreased slightly, indicating a reduction in the amount of ions in the water. The comparison results before and after treatment indicate that the Umbrella Plant has high potential for restoring water quality in community canals, especially in reducing turbidity and excess nutrients, which are key factors in water pollution problems. This study helps create knowledge regarding the use of local aquatic plants to treat wastewater in an economical and environmentally friendly manner, while also promoting scientific skills, thinking processes, and STEAM integration for students. The results can be applied in the community for sustainable water management development.
Keywords: Umbrella Plant (Cyperus involucratus Rottb), Water Quality, GLOBE Hydrosphere

OBJECTIVE

1. To study the effect of the Umbrella Plant on the restoration and improvement of water quality in the concrete canal.
2. To analyze the changes in physical and chemical properties of water after treatment with the Umbrella Plant.
3. To compare water quality at the Upstream, Midstream, and Downstream positions of the concrete canal.
4. To apply water quality measurement according to GLOBE Hydrosphere to assess the efficiency of phytoremediation.
5. To propose guidelines for restoring wastewater quality that can be practically used in the San Pa Liang community.

QUESTIONS

1. How much can the Umbrella Plant restore or improve water quality in the concrete canal when compared to water in the control group without treatment plants?
2. How do the physical and chemical properties of water, such as turbidity, pH, DO value, nitrite, and phosphate, change after treatment with the Umbrella Plant?
3. How does the water quality of the concrete canal differ at the Upstream, Midstream, and Downstream positions, and how do community activity factors affect water quality?

MATERIALS AND EQUIPMENT

1. Field Water Sampling Equipment : 1000 mL water sampling bottle with tight lid, Rope and water basket, Rubber gloves, Pen and sample labels, Plastic bucket, Safety goggles
2. GLOBE Hydrosphere Water Quality Measurement Equipment : Water Thermometer, EC Mete, GLOBE , Turbidity Tube, pH Meter , DO Test Kit , Nitrite Test Kit, Phosphate Test Kit, Alkalinity Test Kit, Data Sheet.
3. Plant Treatment Experiment Materials : Umbrella Plants (approx. 1 month old), 6 plants, 6 experimental containers simulating the concrete canal (3 Control, 3 Experimental) , Water from the concrete canal (collected from Downstream on the same day)
4. Data Analysis Materials : Computer for data entry , Camera

RESEARCH METHODOLOGY

1. Survey the concrete canal, San Pa Liang Community: Determine study area and 3 sampling points: Upstream: Before entering community zone. Midstream: Through community (houses, shops). Downstream: After community, before exiting to large canal.
   Frequency: Collect samples once a week for 4 weeks.
2. Collect Water Samples: Collect at 20-30 cm depth. Record temperature. Label bottles.
3. GLOBE Hydrosphere Measurement (following GLOBE Protocols. Record data and take photos) : Water Temperature, Turbidity, pH, DO, Nitrite, Phosphate, Alkalinity and EC.
4. Preparation of Umbrella Plant Treatment Experiment :
   Design 2 sets: Control Group: Concrete canal water (No plants), 3 sets.
   Experimental Group: Concrete canal water + 2 Umbrella Plants (1 month old).
5. Water Treatment Experiment.
6. Data Analysis.
7. Organize data to analyze and draw conclusions, and disseminate knowledge from the study for further education.

INTRODUCTION

Water resources are essential natural resources for the survival of humans, animals, and plants, as they play a vital role in consumption, agriculture, and as habitats for living organisms. Furthermore, ecosystems and human society rely on water resources to improve the quality of life of the community. Water resources are therefore part of the Earth System, linked to the atmosphere, soil, biology, etc. Currently, the problem of deteriorated water quality has become more severe, especially in urban areas with high population density, such as Mueang District, Chiang Mai Province. The continuous expansion of communities and economic activities has affected many public water sources due to community wastewater and improper waste management. One clearly affected area is the concrete canal in the San Pa Liang community, which is an important drainage canal for the community and part of the ecosystem in Chiang Mai city. From student surveys, it was found that the concrete canal in San Pa Liang faces problems of polluted water, foul odor, turbidity, and high sediment quantity. The main cause is the illegal discharge of wastewater from households and shops, including the continuous dumping of garbage into the canal. This causes water quality to deteriorate as it flows through the community area, severely affecting the Hydrosphere system and aquatic life, and directly reflecting the imbalance of the Earth System. Realizing this problem, students became interested in studying methods to restore water quality in the concrete canal using natural methods by choosing the Umbrella Plant (Cyperus involucratus Rottb). This is an aquatic plant with properties for absorbing organic substances and improving water quality according to phytoremediation principles. It is also a plant that is easy to grow in the community and easy to find. Using the Umbrella Plant in an experiment combined with water quality measurement according to GLOBE Hydrosphere Protocols will help obtain accurate, reliable scientific data that can be used as a guideline for practically restoring wastewater in the concrete canal. This study is therefore important for both solving community environmental problems and developing scientific skills in learners. It uses the process of survey, observation, experiment, and analysis according to GLOBE guidelines, which link the relationship of soil, water, atmosphere, and living organisms holistically. The study results can be used as supporting information for community decision-making and as a model for phytoremediation innovation that can be applied sustainably.

OUTCOMES

This study involves the analysis of water quality in the concrete canal, San Pa Liang Community, Mueang District, Chiang Mai Province, and an experiment on the effect of the Umbrella Plant (Cyperus involucratus Rottb) on wastewater restoration. Data from field surveys and laboratory experiments were processed and compared.
The research results are presented in 3 parts, as follows :
1. Field Water Quality Measurement Results
   Measurements at Upstream – Midstream – Downstream found :

- Temperature: 22.5–23.5°C, normal for natural canals.
- Turbidity : Increased at downstream (35 cm), indicating more suspended sediment from community runoff.
- pH : Constant at 7.1 (neutral), suitable for life.
- DO : Increased from 9 to 19 mg/L. May be due to flow through open areas or aquatic plants producing oxygen.
- Alkalinity : Increased to 80 mg/L at downstream, showing accumulation of bicarbonate/solutes.
- Phosphate : Increased from 0.22 to 0.50 mg/L, reflecting contamination from household wastewater/detergents (risk of Eutrophication).
- Nitrite : Increased from 0.2 to 0.5 mg/L, indicating organic decomposition and wastewater contamination.
- Electrical Conductivity: High level (929–967 µS/cm), indicating high dissolved ions/salts, consistent with polluted community water.

2. Plant Treatment Experiment Results Umbrella Plants absorbed excess nutrients (Phosphate, Nitrite), reducing their values clearly. Roots/stems trapped sediment, reducing turbidity. Root respiration and microorganisms increased DO. Water became clearer; color and odor decreased.
3. Comparison of Treatment Efficiency Comparing before and after treatment : Turbidity decreased (Sedimentation). Phosphate and Nitrite decreased (Nutrient absorption). DO increased (Improved water condition). EC decreased slightly (Ion reduction).

In conclusion, the Umbrella Plant has high potential for treating community wastewater, especially in reducing turbidity and excess nutrients.

CONCLUSION

The study of the concrete canal water quality and the Umbrella Plant experiment found that the canal water deteriorates due to community impact. Turbidity, phosphate, nitrite, and EC were high, especially in midstream and downstream areas receiving household wastewater. Although pH was neutral, high turbidity and nutrients indicate unsafe water quality.   The Umbrella Plant treatment experiment showed it could improve water quality in multiple aspects. Roots trapped sediment (reducing turbidity), absorbed phosphate and nitrite (reducing rot causes), and hosted microorganisms that decomposed waste (increasing DO and reducing odor). These changes align with Constructed Wetland principles. Comparing before and after treatment, turbidity decreased the most, followed by phosphate and nitrite. DO increased to suitable levels, and EC decreased slightly. Therefore, the Umbrella Plant is effective in treating concrete canal wastewater and can be practically applied in the community. Overall, students saw the relationship between community wastewater problems and natural restoration methods alongside scientific measurement. This fostered analytical thinking, problem-solving, and STEAM integration for sustainable environmental restoration.

REFERENCES

Chulalongkorn University. (2020). Use of Aquatic Plants in Constructed Wetland Wastewater Treatment Systems. Bangkok: Chulalongkorn University Press.
Department of Water Resources. (2021). Monitoring and Assessment of Water Quality in Public Water Sources. Bangkok: Department of Water Resources.
GLOBE Program, IPST. (2009). Earth System Science Textbook, Key Stage 2 (1st ed.). Inter-Education Supplies.