Potential of *Echinodorus Cordifolius* and *Vallisneria Natans* in Constructed Wetlands for the Removal of Water Pollution from Shrimp Farm Effluent

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**Abstract.** Management of shrimp aquaculture wastewater is still the major problems in fisheries. Objectives of this study are to set up laboratory-scale wetlands to evaluate the phytoremediator performance of *Echinodorus Cordifolius* and *Vallisneria Natans* in improving aquaculture wastewater as a treatment technology from the first day, 3 days, 7 days, 10 days, 14 days, 17 days and 21 days. The controlled and experimental design setup describes both constructed wetland by glass tank sizes with a circulation system. The controlled wetland doesn't have plants and an experimental wetland have plants with details as follows: *Echinodorus Cordifolius* had fresh weight 193.05±13.502 g, length of plant 55.5±2.081 cm, length of root 30.25 ±6.344 cm. *Vallisneria Natans* had fresh weight 57.58±0.05 g, length of plant 15cm, length of root 4cm. The results showed that the survival rate (SVR) of both aquatic plants in the experiment was 100% for *Echinodorus Cordifolius* and 16.7% for *Vallisneria Natan* in the 21-day experiment. Furthermore, the experimental wetland can be considered as an effective solution in reducing 95.68% of ammonium-nitrogen, 98.86% of nitrate-nitrogen, 60.02% of phosphate, 46.72% of chemical oxygen demand, 100% of iron, 97.4% of copper when compared with the concentration at the beginning of the experiment. To be concluded, the growth and development of *Echinodorus Cordifolius* and *Vallisneria Natans* in this wetland has a positive effect on reducing pollutants of shrimp aquaculture effluents in all the 21day experiment.

1. Introduction
In recent decades, considerable attention has been paid to the serious water pollution caused by the rapidly growing aquaculture industry. This industry has grown at an average rate around 8.9% per year since 1970, with 2.8% for farming systems of The State of World Fisheries and Aquaculture from FAO, 2004 and only 57% of the countries in the world had laws and regulations carefully designed in order to serve as a legal framework for fisheries management plans [1]. On the other hand, water quality is crucial to the success or failure of aquaculture. The raising of fish, crustaceans and mollusks is called aquaculture. Land aquaculture facilities have a great need for water resources because they require large amounts of high quality source water to feed and they also discharge wastewater into the water environment. The main source of waste water in aquaculture wastewater is the addition of industrial feed and antibiotics to promote the growth and development of aquaculture during the process of producing an excess of feed, antibiotics and stool. The wastes exist in water environment with high

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nutrient concentration like N, P. Wastewater from aquaculture processes is not treated and discharged into the environment can lead to physical and chemical degradation of the receiving waters. High concentrations of phosphorus, nitrogen in water areas cause eutrophication. Eutrophication disturbs the natural nature of the aquatic system, pushing red, hot tides and leading to the death of aquatic animals. This phenomenon can occur in rivers, lakes, reservoirs and coastal waters and is one of the most important problems worldwide, unable to use eutrophic water sources for water sources or life support aquatic. Due to the effects of excess phosphorus and nitrogen, this nutrient needs to be removed. Phytoremediation using constructed wetlands (CWs) has become a logical solution to improve the quality of contaminated waters by acting as a sink for various contaminants [2]. Phytoremediation utilizes the natural properties of aquatic plants to remediate contaminated water, soils or sediments[3], [4]. It has received increased attention over the recent decades, as an emerging and eco-friendly approach. by using plant grasses, reducing or stabilizing unwanted substances (such as nutritional or toxic metal contamination to overcome contaminated areas [5]. Applying the submerged macrophytes reduces the residual aluminum (Al) [6]. Phyto- and Bio-remediation technologies based on artificial wetland in recent years [7].

Constructed wetlands also understood as artificial or treatment wetlands, use the same processes that locates in natural wetlands, it seems a feasible option to solve water pollution problems because of their low cost of maintenance and operation. Various types of CWs are now being combined into hybrid systems to achieve better treatment performance, the aquatic plant ‘s potential of CWs makes them very attractive from an economic and technical point of view, since they can adequately reduce contaminants in polluted waters[8]. Aquatic macrophyte diversity of Echinodorus occurred in the Pantanal wetland and upper basin in Brazil [9] Echinodorus cordifolius was the best plant for arsenic removal[10]. Work presented the use of the plant E. cordifolius for remediating diethylene glycol (DEG) contaminated waters. E. cordifolius has the potential to reduce the concentration of all MEG, DEG, and TEG from wastewater by taking them up through the root and accumulating it in the leaf [11]. V. natans commonly coexist in nature and are commonly used in efforts to restore aquatic ecosystems. V. natans is relatively low growing, does not form a canopy and depends on light penetrating down near the sediment for growth. Its root is relatively well developed and a significant proportion of nutrient can be absorbed from the sediment [3],[12]. Re-vegetation in river using V. natans helped to improve water quality slightly more and change interactions of the water quality parameters substantially[13]. V. natans provide new insight into ecological-based removal of antibiotics in aquatic systems[14].

These results demonstrate the suitability of the Echinodorus Cordifolius and Vallisneria Natans for phytoremediation of shrimp discharge, and the usefulness of CWs to improve the water quality. The aim of this study was to evaluate the potential of phytoremediation of waste waters using the E. cordifolius and V. natans in CWs on a laboratory scale.

2. Materials and Methods

2.1 Experimental Design
The experiment was arranged at the Environmental Monitoring Department, 3rd floor, Nguyen Tat Thanh University. Echinodorus Cordifolius and Vallisneria Natans are grown in styrofoam tanks with clean water and added nutrients to aquatic plants. Firstly, total of 8 plants E. Cordifolius and 360 plants of V. Natans were well carefully selected with similar morphology and characteristics to conduct this study, all plants seperated 2 group (Group 1 for the control, Group 2 for the experiment tank with total 4 plants of E. Cordifolius and 180 plants of V. Natans/each group). Second activities are collecting water samples from shrimp farming near the Saigon River, which cultured for freshwater crayfish.

At the first days, Setup 2 models of constructed wetland named the control "Control" and the experiment "Experiment". Experimental tank received plants of group 2, there are 4 plants of Echinodorus Cordifolius planting in the 2nd and 3rd compartments with 2 plants/each compartment. And 4th compartment of the experiment planted 180 plants of Vallisneria Natans with the same weight and size.
Images | Information
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1. | Glass tanks with the detailed dimensions as follows:
   - Tank length: $L = 1000$ mm, Tank width: $R = 450$ mm, Tank height: $H = 600$ mm
   - Volume of submersible part in glass tank was 98 liters and the volume of the plastic tank with circulating pump was 90 liters. The combination of glass tank and plastic is created the circulation system.
   - This tank is divided into five main compartments as follows:
     + The first compartment regulates water flow.
     + The next two compartments consist of 3 layers of stone from the bottom with thickness:
       - Cobblestone pebbles thickness of 100mm (size of 20mm stone)
       - Pebbles with a thickness of 100mm (5mm stone size)
       - Pebbles are 175mm thick (stone size 2mm)
     + A large compartment left from the bottom of a layer of sand with a thickness of 30mm.
     + The final compartment is used to regulate the outflow and is connected to a plastic tank with a circulating pump with a 27mm plastic tube.
   - Waste water when being put into a plastic tank will be pumped back to the glass tank with a capacity of 18.3ml/s, the wastewater will be circulated continuously for 21 days.
2. | Figure 1. The phenomenon of Echinodorus Cordifolius and Vallisneria Natans in Constructed wetlands.
3. | Experiment | Control

2.2 Sampling

Plants of group 2 has total of 4 plants of *E. Cordifolius* and 180 plants of *V. Natans*, to be cut trunks, leaves and roots and dried at 65 °C (dried to constant weight after two weighing) to weigh amount of dry weigh, also known the control. The first purpose of a comparison a plant's dry weight between the control and the experiment was after 21 days of experimental setup. After 21 days, the plants were grown in which the waste water environment was collected and weighed, measured the size of rooting and dried at 65° C (dried to constant weight after 2 weighing) to weigh the dry weight.

The second purpose of a comparison physical and chemical indicators in the control does not plants to the experiment tank with plants of group 2 in order to monitor the changes of indicators in the experimental and the controls throughout the experiment. Samples were collected and stored with 2
liters in a plastic bottle in a refrigerator at 4°C with proper storage in the laboratory of Nguyen Tat Thanh University where proper equipment is in operation. Analysis of activities performed at this laboratory and before filtration, pH, EC, total dissolved solids (TDS), °C of water samples were determined using a combination of pH, conductivity, total dissolved solids, and temperature measurement (Mi805 Milwaukee, CO, USA). DO is determined by Milwaukee Dissolved Oxygen Meter (MW 600, CO, USA). The HI83399-02 is a multi-parameter photometer for measuring important water quality parameters such as NO3-N, NH4+-N, PO4-P, COD, Cu, Fe in this study. Ammonium NH4+-N was analyzed by the method according to D1426 water environment technique and Nessler method in a sample solution named HI93715A-O, medium scale, HI93715B-O medium scale. Analyze NO3-N Nitrate by cadmium reduction method in a sample solution named HI 93728-01. COD analysis using the USEPA method 410.4 in a sample solution named HI 93754A-25. Copper analysis of the EPA method in a sample solution named HI93702-01. Analyze phosphorus PO4-P by amino acid method in a sample solution named HI93717-01. Analyze iron by Phenanthroline method in a sample solution named HI 93721-01. Physical and chemical indicators such as pH, temperature, turbidity, salinity, DO, TDS, EC, for daily monitoring in 21 days of experimental set up. Water samples were collected at the the first day, 3 days, 7 days, 10 days, 14 days, 17 days and 21 days for analysis of indicators chemical oxygen demand (COD), ammonium-nitrogen (NH4+-N), nitrate-nitrogen (NO3-), phosphate (PO43-), iron (Fe) and copper (Cu).

2.3 Statistical Analyses
Mean values and standard errors of water quality parameters were calculated from replicates, to be done within each treatment on one sampling time to understand differences between the control and the experiment. This differences compared to National Standards of [15] or [16], and WHO Guidelines [17].

3. Results and discussion

3.1 Water quality
Table 1 illustrated the concentration of the analyzed in-situ parameters of this study with air temperature 27-28°C at the laboratory of Nguyen Tat Thanh University. Results of indicators at the beginning and end of experiments compared to National Standards (QCVN 0 –MT, 2015 and QCVN 01-BYT, 2009) and also World Health Organization, 2006. Main purpose of this report was to describe methods used to compare water-quality conditions to the National Standards & WHO Guidelines.

The water temperature in this study ranged from 25.6 ± 0.14 °C to 29.95 ± 0.07 °C with an average 27.94 ± 1.13 °C for the control and ranged from 25.7 ± 0.0 °C to 29.95 ± 0.07 °C with an average 27.98 ± 1.11 °C for the experiment. In practical terms, this means that this water temperature affects the high solubility of many chemical compounds and thus the effects of some pollutants on aquatic life, for example, Optimal growth performance of plants with temperatures in the range of 20 - 30°C [18].
Table 1. Classification function coefficients for discriminant analysis on the first day and the 21 day in shrimp farm effluent treated with Echinodorus Cordifolius and Vallisneria Natans under constructed wetlands.

| Parameters          | The first day | At 21 days | National Standards | WHO Guidelines |
|---------------------|--------------|------------|--------------------|----------------|
|                     | Control      | Experiment |                   |                |
| Temperature (°C)    | 27.35 ± 0.07 | 25.7 ± 0.0 | 25.6 ± 0.14        | *              |
| pH                  | 6.8 ± 0.02   | 8.13 ± 0.06| 8.21 ± 0.01        | 5.5 - 9<sup>a</sup> | 6 - 9<sup>c</sup> |
| EC (µs/cm)          | 1114 ± 6.01  | 1138 ± 0.71| 1122 ± 2.83        | *              |
| TDS (mg/l)          | 636 ± 2.83   | 644.5 ± 11.19| 646 ± 10.32      | < 1000<sup>b</sup> | 1500<sup>c</sup> |
| DO (mg/l)           | 4.55 ± 0.07  | 8.55 ± 0.07| 7.6 ± 0.14        | ≥ 2<sup>a</sup> | ≥ 2<sup>c</sup> |
| COD (mg/l)          | 107 ± 1.41   | 57 ± 1.41  | 47 ± 4.24         | < 30<sup>a</sup> | < 50<sup>c</sup> |
| NO<sub>3</sub>-N (mg/l) | 17.65 ± 0.49| 0.2 ± 0.0  | 3.55 ± 0.0        | < 15<sup>a</sup> | < 30<sup>c</sup> |
| NH<sub>4</sub>+-N (mg/l) | 9.03 ± 0.10 | 0.39 ± 0.01| 0.48 ± 0.03      | < 0.9<sup>a</sup> | < 5.0<sup>c</sup> |
| PO<sub>4</sub>3-P (mg/l) | 77.4 ± 5.9  | 30.8 ± 0.6 | 33.6 ± 1.7        | < 0.5<sup>a</sup> | < 15<sup>c</sup> |
| Fe (mg/l)           | 0.58 ± 0.01  | 0.035 ± 0.01| 0 ± 0            | < 2.0<sup>a</sup> | < 5.0<sup>c</sup> |
| Cu (mg/l)           | 0.77±0.014   | 0.02±0.014 | 0.035±0.007      | < 1.0<sup>a</sup> | < 0.2<sup>c</sup> |

Note:

<sup>a</sup> (QCVN 08-MT, 2015): National Technical Regulation on Surface Water Quality, Vietnam.

<sup>b</sup> (QCVN 01-BYT, 2009): National technical regulation on drinking water quality, Vietnam.

<sup>c</sup> (World Health Organization, 2006): A compendium of standards for wastewater reuse in the Eastern Mediterranean Region from WHO, for Jordanian Standard.

Figure 2 showed that the average pH value recorded for the control is 7.72 ± 0.29 and for the experiment is 7.56 ± 0.25. The pH concentration of the control range is from 6.89 ± 0.02 to 8.13 ± 0.06 and the pH concentration in the experimental range was from 6.82 ± 0.03 to 8.21 ± 0.01. This range is within the allowable limits of class B2 in (QCVN 08: 2015) and (World Health Organization, 2006) for conserving aquatic ecology and for animals with the threshold of pH 6-9. The electrical conductivity average recorded for the control was 1131 ± 19.7 µs/cm and for the experiment was 1132 ± 18.2 µs/cm. The conductivity in the control ranged from 1099 ± 1.41 to 1171 ± 1.14 µs/cm and the conductivity in the experimental ranged 1106.5 ± 2.12 to 1165.5 ± 0.70 µs/cm. As a result, the conductivity of both control and experiment had significantly changed during 21 days. The average concentration of total dissolved solids (TDS) in the control tank was 645 ± 11.29 mg/l and ranges from 626.5 ± 0.07 to 667 ± 0.0 mg/l. The experiment average of TDS was 646 ± 10.33 mg/l and this range ranged from 632.5 ± 3.5 to 664.5 ± 0.7 mg/l. The trend of total dissolved solids in both control and experiment was a limit standard of National Standards as concentration of TDS < 1000 [16] - National technical regulation on drinking water quality and WHO in Table 1. The table 1 presented that the Fe concentration at the first day was 0.58 ± 0.01 mg/l and a trend of Fe concentration in both control and experiment tended to decrease at the end of this study at 21<sup>th</sup> day.
Figure 2. Change of pH (A), electrical conductivity (B), total dissolved solids (C), dissolved oxygen concentration (D) in shrimp farm effluent treated with *Echinodorus cordifolius* and *Vallisneria natans* at various times under constructed wetlands.

Results presented that the dissolved oxygen concentration (DO) in figure 2 of both control and experiment in the first day was worth 4.55 ± 0.07 mg/l and both trend decreased from the 3rd day to the 6th day. The dissolved oxygen concentration in the the control was only 1.15 ± 0.07 mg / l and the peak of the decrease in dissolved oxygen concentration was from the 3rd day to the 6th day fluctuating dissolved oxygen concentration around 0.65 to 0.7 mg/l and tends to increase again at 7 days. Oxygen concentration from here and maintain a steady increase until day 12 is 5.6 ± 0.28 mg this trend was in 15th day with 9.2 ± 0.21 mg/l and ranged from 7.15 to 8.25 mg/l until the end of 21st day. Especially, the experiment also tended to decrease like the the control. On the second day, the dissolved oxygen was only 3.95 ± 0.35 mg/l, decreased to 0.6 mg/l compared the first day. The onset and peak of the decline in dissolved oxygen concentration was 3rd day and 6th day dissolved oxygen concentration, with a range from 0.65 to 0.7 mg/l and tends to increase gradually. On the 7th day and maintain a steady increase on the 16th day was 5.95 ± 0.77mg / l and increased to 7.6mg/l on the 21th day. According to table 1, the average of dissolved oxygen (DO) between the 3rd day and the 6th day was not in a limit of national Standards and WHO. Results provided useful information to better understand the adverse effects of algal blooms from water pollution, on survival rate of submerged macrophytes as *Vallisneria Natans* [19].
Figure 3. Remaining concentration of ammonium-nitrogen (A) and nitrate-nitrogen (B) in shrimp farm effluent treated with *Echinodorus cordifolius* and *Vallisneria natans* at various times under constructed wetlands.

The figure 3 presented that NO$_3^-$-N concentration of the experiment was lower than the control level during the 21 days experimental set up. At the beginning of this study, NO$_3^-$-N concentration was 17.65 ± 0.49 mg/l, and this concentration was higher than the permitted limit of class B2 in (QCVN 08-MT: 2015 / BTNMT) regulating NO$_3^-$-N < 5mg/l, but it was in a limit of WHO. In natural resources, if NO$_3^-$-N in surface water is less than 1mg/l nitrate NO$_3^-$-N, which is not a good thing for aquatic life. After 21 days of experiment, the concentration of NO$_3^-$-N in the control decreased to 3.55 ± 0.021mg/l. In the experiment, the concentration of NO$_3^-$-N was 0.2 ± 0.0mg/l. It is important that nitrates and nitrites in this wetland can be removed by plant uptake.

The NH$_4^+$-N concentration at the first day was 9.03 ± 0.09mg/l, and the water quality was higher than the permitted limit of national Standards and WHO regulations. Both trend of the control and the experiment decreased from the 3rd day to the 21th day. At the end of this study, the NH$_4^+$-N concentration in the control decreased to 0.48 ± 0.02 mg/l and in the experiment reduced to 0.38 ± 0.01mg/l. Ammonium loading decreased dissolved oxygen concentrations and pH values, stimulated biofilms growth, increased growth of algae [20]. It happened in the control during experimental time. Another work [21] illustrated *Echinodorus cordifolia* and the non-vegetated control also removed high percentages of NO$_3^-$- load (63% and 60%, respectively). Load decreases followed concentration decreases, where NO$_3^-$-N and NH$_4^+$-N had variable load decrease efficiencies from the first day to the 21th day.

Figure 4 showed that the PO$_4^{3-}$-P concentration at the first day was 77.4 ± 5.9mg/l, and this concentration was significantly higher than the permitted limit of national Standards and WHO regulations. Both trend of the PO$_4^{3-}$-P concentration in the control and the experiment decreased from the first day to the 21th day. At the end of this study, the PO$_4^{3-}$-P concentration in the control decreased to 33.6 ± 1.69mg/l and in the experiment reduced to 30.8 ± 0.56mg/l mg/l. Phosphorus removal from domestic wastewater by *E. cordifolius* [22]. Another result mentioned that the TP removal by Echinodorus cordifolius from domestic wastewater was 16%. Similar [23].
Figure 4. Remaining phosphate concentration in shrimp farm effluent treated with *Echinodorus cordifolius* and *Vallisneria natans* at various times under constructed wetlands.

PO$_4^{3-}$-P content of the experiment was significantly lower than that of the control, which indicated that this aquatic plants could remove phosphorus from the water by plant uptake or plant-associated effects. *V. natans* has water purifying ability [24], could effectively absorb nitrogen, phosphorus and other nutrients from the water[25]. The trend of the PO$_4^{3-}$-P concentration in the experiment decreased because the processes and mechanisms for aquatic plants to take up phosphorus (P) in wetland soils and sediments by *V. natans* [26].

Figure 5. Remaining concentration of chemical oxygen demand (A) and copper (B) in shrimp farm effluent treated with *Echinodorus Cordifolius* and *Vallisneria Natans* at various times under constructed wetlands.

Figure 5 showed that an average of COD concentration at the first day was 107 ± 1.41 mg/l, the COD concentration decreased to 17 ± 1.4 mg/l on the 14th day of the control and 15 ± 1.4 mg/l on the 14th day & 17th day of the experiment, to be the lowest concentration of COD. And the both trend of the control and the experiment had a slight increase to the 21th day. *E. cordifolius* was reported to have the ability to remove reduce EG and COD in wastewater [7].

Figure 5 also presented the Cu concentration at the first day was 0.77 ± 0.01 mg/l. The Cu concentration in both control and experimental tanks tended to decrease to the 21th day, this Cu concentration had a trend from the 3rd day to the 21th day, in a limit <2mg/l of WHO guidelines. This proves that it is possible for the *V. natans* growth to absorb Cu because *V. natans* are likely to reduce Cu concentrations in sediments [27].
3.2 Plant growth

*E. Cordifolius* and *V. natans* were harvested and washed and cleaned thoroughly with deionized water and then weighed to estimate the total biomass, root biomass and leaf biomass of each wetland.

| Control | Experiment |
|---------|------------|
| The first day | The first day |
| ![Image](image1.png) | ![Image](image2.png) |
| The 21th day | The 21th day |
| ![Image](image3.png) | ![Image](image4.png) |

**Figure 6.** Morphology of *E. Cordifolius* and *V. natans* cultured in shrimp farming effluent.

The results showed that the survival rate (SVR) of both aquatic plants in the experiment was 100% for *E. Cordifolius* and 16.7% for *V. Natans* in the 21-day experiment. The above-ground biomass of *E. Cordifolius* significantly increased with increasing ammonia-nitrogen concentrations in water body, indicating that excessive water ammonia-N can did not give significant toxicity to this plants. The below-ground biomass of *V. natans* significantly decreased, suggesting that excessive sediment pollution can result in significant damage to the root of *V. natans*. In addition, high ammonia-N levels place a greater stress on submerged plants than sediment [27].

Results in figure 6 & 7 showed that over 21 days, the survival rate of *E. cordifolius* 100% and weight increased over time until the end of the experimental arrangement. The fresh weight of *E. cordifolius* after 21 days increased from 193.6 grams to 367.75 grams. As for the dry weight after drying of *E. cordifolius*, the result of the first day was leaf weight of 13.30 ± 0.44 g, roots of 2.85 ± 0.74 g, stem of 1.69 ± 0.30 g. After 21 days, results showed an increase in leaf weight of 18.17 ± 5.33 g, with dead
leaves 3.98 ± 1, 62 g, stem 1.85 ± 1.26 g, roots of 3.52 ± 2.52 g and old roots 2.85 ± 1.02 g. Especially the production of young plants weighing 0.40 ± 0.22 g. E. cordifolius will selected for constructed wetland by nutrient removal, stress resistant species, recycling of effluents [28]. After 21 days, results showed an increase in leaf weight of 0.55 g, root-in-blood of 0.14 g, which showed that E. cordifolius in the experiment were able to adapt to the discharge environment of shrimp farming, even though the water had P, N High, but the tree still shows good growth and development. The faster the plants adapt and grow, the more nutrients will be removed from the wastewater.

![Figure 7. Expression of dry weight growth of E. Cordifolius & V. natans in this study](image)

V. Natans had a 100% survival rate in the first 9 days of the experiment and there was a death on the 10 days after 21 days of testing, the survival rate of the chives was only 16.7%. The fresh weight of V. Natans was reduced from 57.62 grams to 4.68 grams after 21 days. The dried weight of chives was found to have a weight of 2.12 g of leaves and a root of 0.6 g from roots. Results showed a higher N concentration led to declined abundance of V. natans, the decline being most pronounced for plants grown in high-nutrient sediment in this experiment[12]. The growth of plant weight during the experiments of the wastewater treatment system is technically and economically important. Last biomass of 16.7%. plants of V. Natans help a highly oxygenated zone around the root base because of changes protect roots against low oxygen conditions. V. natans that may help this plant adapt to submerged conditions in contaminated water [29]

4. Conclusion

Combined E. Cordifolius and V. natans in Constructed Wetlands on a laboratory scale successfully removed the contaminated pollutants. The survival rate (SVR) of plants in the experiment was 100% for Echinodorus Cordifolius and 16.7% for Vallisneria Natans at the 21st day experiment. Results presented in the table 1 that the experiment can be considered as an effective solution in reducing Ammonium-Nitrogen (NH4+-N) concentrations with 95.68%, Nitrate-Nitrogen (NO3-N) with 98.86%, Phosphate (PO43-P) with 60.02%, COD 46.72%, Fe 100%, Cu 97.4% when compared to the first day of the experiment, and also in a limit of National standard and WHO guidelines. It is clear that the growth and development of Echinodorus Cordifolius with Vallisneria Natans in the experimental constructed wetland has a positive effect on reducing pollutants of shrimp aquaculture effluents in all 21 day experiment because water parameter of the experiment was lower than the control, which indicated both plants improved the water quality from the shrimp farming effluent by plant uptake or plant-associated effects. The results support consistent comparisons can be used to identify and prioritize water-quality issues for further investigation. Particularly on large wetland, we need biological treatment of wastewater, focusing on the phytoremediation potential of selected aquatic plants of Echinodorus
**Cordifolius**, for example, building eco-gardening and protecting natural wetland is based on a global approach to the biocontrol solutions.

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**Reference**
[1] Ichiro Nomura, 2006 The State of World Fisheries And Aquaculture.
[2] S. Liao and W. Chang, 2004 *J. Aquat. Plant Manag.*, vol. 42, pp. 110–118
[3] Y. Tang, B. Fu, X. Zhang, and Z. Liu, 2019 *Knowl. Manag. Aquat. Ecosyst.*, vol. 420, no. 12.
[4] P. K. Rai 2009 *Heavy Metal Phytoremediation from Aquatic Ecosystems with Special Reference to Macrophytes*, vol. 39.
[5] S. Rezania *et al* 2015 *J. Environ. Manage.*, vol. 163, pp. 1–18.
[6] Q. W. Lin *et al* 2017 *Environ. Saf.*, vol. 145.
[7] C. Treesubsuntorn, R. Dolphen, D. Siswanto, and P. Thiravetyan 2017, *AIP Conf. Proc.*, vol. 1908.
[8] S. D. Jose Marrugo Negrete, German Enamorado Montes, Jose Durango Hernandez, Jose Pinedo Hernandez, 2017 *Chemosphere*, no. 167, pp. 188–192.
[9] V. Pott, A. Pott, L. Lima, S. Moreira, and A. Oliveira, 2011 *Brazilian J. Biol.*, vol. 71, no. 1 supplement 1, pp. 255–263, 2011.
[10] C. Prum, R. Dolphen, and P. Thiravetyan, 2018 *J. Environ. Manage.*, vol. 213, pp. 11–19.
[11] P. Teamkao and P. Thiravetyan, 2010 *Chemosphere*, vol. 81, no. 9, pp. 1069–1074.
[12] J. Gu *et al.*, 2016 *Water (Switzerland)*, vol. 8.
[13] T. Zhu *et al*. 2016 *Ecol. Eng.*, vol. 86, pp. 113–119.
[14] L. Zhu *et al*. 2020 *Water Res.*, vol. 170, p. 115354, 2020.
[15] QCVN 08-MT:2015, *National Technical Regulation On Surface Water Quality (Quy Chuẩn Kỹ Thuật Quốc Gia Về Chất Lượng Nước Mặt)*.
[16] QCVN 01-BYT:2009, *National technical regulation on drinking water quality (Quy Chuẩn Kỹ Thuật Quốc Gia Về Chất Lượng Nước Ăn Uống)*.
[17] World Health Organization 2006, *A compendium of standards for wastewater reuse in the Eastern Mediterranean Region World Health Organization Regional Office for the Eastern Mediterranean Regional Centre for Environmental Health Activities CEHA*. 2006.
[18] Tuong LQ and Nam NP 2017, *Journal Water Resour. Environ. Eng* ISSN 1859-3941, vol. 56, pp. 9–15.
[19] M. Jiang, Y. Zhou, X. Ji, H. Li, Z. Zheng, and J. Zhang, 2018 *Environ. Pollut.*, vol. 246, pp. 819–826.
[20] L. Yan, X. Mu, B. Han, S. Zhang, C. Qiu, and O. E. Ohore, 2019 *Sci. Total Environ.*, vol. 659, pp. 691–698.
[21] M. T. Moore and R. Kröger, 2011 “Evaluating plant species-specific contributions to nutrient mitigation in drainage ditch mesocosms,” *Water. Air. Soil Pollut.*, vol. 217, no. 1–4, pp. 445–454.
[22] P. T. Jirawan Torit, Wipawan Siangdun, 2012 *J. of Environmental Sci. Heal. Part A*, vol. 47, pp. 794–800.
[23] F. Su *et al* 2019, *Int. J. Environ. Res. Public Health*, vol. 16, no. 23, pp. 1–12.
[24] H. Li, Q. Li, X. Luo, J. Fu, and J. Zhang, 2020 *Sci. Total Environ.*, vol. 701.
[25] H. Zhang *et al* 2020 *Ecotoxicol. Environ. Saf.*, vol. 194.
[26] X. Xing *et al*. 2018 *Sci. Total Environ.*, vol. 616–617, pp. 386–396, 2018.
[27] Z. Zhu *et al.*, 2016 *PeerJ*, vol. 2016, no. 4, 2016, doi: 10.7717/peerj.1953.
[28] B. Y. Zhang, J. S. Zheng, and R. G. Sharp, 2010 *Procedia Environ. Sci.*, vol. 2, pp. 1315–1325.
[29] L. Gan, W. Zhang, F. Fang, and L. Yang, 2019 *Aquat. Bot.*, vol. 162, no. November, p. 103189.