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Sustainable Management of Decontamination Constructed Wetlands: Research on the Industrial and Scientific Development of Aquatic Plants

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Abstract: This pilot paper focuses on the suburban constructed wetlands that operate for the main purpose of wastewater treatment and explores the possibility of decontamination constructed wetlands based on the industry-academic model to establish a positive circular economy production chain from the perspective of a sustainable economy. Through a four-stage humanistic investigation process, using focus interviews, literature analysis, expert opinions, field investigations, patent search analysis, context, and decision analysis processes, it is proposed to use plants around the wetland as production products to develop manufacturing, electricity, and gas supply possibility of business and construction products as the main product. The related aquatic plants are developed and utilized in the Republic of China patents, namely, watery plants> root-floating plants> floating water plants> submerged water plants. Among them, the water-protruding plants are fibrous. It is most characterized in textiles, papermaking, board, furniture, etc., followed by biological nutrient solutions or extracts used for fertilization, control, or beauty. Therefore, it is still possible to reuse the wetland plants to develop related innovative products. Provide sustainable management of decontamination constructed wetland as a reference for wise use.

Key words: constructed wetlands, sewage treatment, sustainable development, aquatic crops, industry-academic cooperation

1. Introduction

Wetlands are the transition between terrestrial and aquatic systems. In addition to the low cost of using constructed wetlands to treat people's livelihood wastewater, the technology is not only mature in Europe, America, Japan, and other countries, but Taiwan has also been promoting the establishment of river pollution since 2002. Decontamination-type constructed wetlands, including surface flow and underground flow constructed wetlands, underground infiltration, contact oxidation between gravels, grass ditch grass belts, artificial floating islands, and other projects [2], using the natural purification function, purifying the sewage discharged by human beings, so it also has a certain degree of experience and maturity in the construction of decontamination constructed wetlands and the integration of related technologies.

The ecological landscape of wetlands creates a sustainable environment and a sustainable society in line with the "Sustainable Development Policy Framework". Especially after the Environmental Education Law was passed in 2017, various natural environment and ecological landscape introduction activities have flourished. Not only do schools use the artificial wetland landscape inside the campus to introduce their own decontamination artificial wetlands, but the community also uses the wetland landscape and surrounding rural resources to drive industry-university management. Soil and Water Conservation Bureau, Council of Agriculture, Executive Yuan (2016) presented a series of industry-academia innovations in soil and water ecological environment education in [1].

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However, in terms of sustainable economic development, due to the public health viewpoints of pollutant control and ecological conservation concerns in the decontamination constructed wetlands, whether the surrounding wetlands can be successfully developed with the circular economy as economic commodities, and whether to establish a positive production chain, it is indeed necessary to put forward a feasible industry-academia plan to implement it. Based on the position of circular economy development, this paper explores the possibility and practice of decontamination-type constructed wetlands to develop products according to their production capacity.

Constructed wetland sewage treatment technology mainly uses biological, chemical, or physical treatment mechanisms to achieve degradation by means of aquatic plants planted in wetlands, animals in the medium, microorganisms, contact with gravel, water drop aeration, and bottom filler filtration. The purpose of suspended solids, pathogens, organic or inorganic pollutants in water, regardless of whether the constructed wetland is planned with Free Water Surface System (FWS) or Subsurface Flow System (SFS), the cultivation of aquatic plants is a process of decontamination Among them, the commonly used aquatic plants in constructed wetlands are shown in Table 1.

2. Literature

Table 1 Common aquatic plants in decontamination constructed wetlands.

Classification	Name
Emergent plants (E)	Phragmites australis, Typha orientalis, Canna indica, Juncus effusus, Carex bilateralis, Alternanthera philoxeroidex, Commelina communis, Artemisia smithii Mattf., Eleocharis dulcis, Iris tectorum, Ludwigia octovalvis, Calla palustris, Zizania latifolia, Pontederia cordata. Schoenoplectus tabernaemontani, Cyperus alternifolius, Limnophila sessiliflora
Submerged plants (S)	Hydrilla verticillate, Ceratophyllum demersum, Vallisneria spiralis, Utricularia, Potamogetonaceae
Floating plants (F)	Eichhornia crassipes, Lemna minor, Centella asiatica, Pistia stratiotes, Salvinia natans, Eichhornia crassipes
Rooted floating leaf plant (R）	Ipomoea aquatica, Oenanthe javanica, Nymphaea tetragona, Trapa natans, Nelumbo nucifera, Ludwigia x taiwanensis Peng, Nuphar pumila

The above plants are tested for water pollution indicators such as pH, dissolved oxygen (DO), biochemical oxygen demand (BOD5), chemical oxygen demand (COD), ammonia nitrogen (NH3-N), or suspended solids (SS). The results of the tool experiment show a certain decontamination effect. Taking the BOD removal of cattail as an example, Wu Liu, Yu-Hsiueh, Wu, Chun-Lin, Cheng, Hsiu-Mei and Chung, His-Chu (2010) Monthly test statistics, and the BOD removal of cattail was 38.4±0.80~58.4±7.80 g/m^2 in [3].

3. Methods

This study takes the decontamination-type constructed wetland in the suburbs of a county, city and city in Taiwan as the object, and explores the improvement of sustainable management of sewage treatment in Taiwan's constructed wetland at the present stage, as one of the prospective explorations for the establishment of a circular economy development plan system for constructed wetlands. Since decontamination-type constructed wetlands involve many issues of environmental ecological conservation and pollutant treatment, their development based on the circular economy must be handled in accordance with the principles of wise use of other zones in Article 16 (5) of the Wetland Conservation Law. There are environmental ethics and public health ethics constraints, as well as the inevitable norms of national

conservation and land use laws and regulations, which must be discussed from a multi-faceted point of view.

The relevant research process structure is shown in Fig. 1. It is mainly divided into four stages. The phenomenon-based method is used to conduct research. Initially, focus interviews and literature analysis are used to establish the topic of the problem. The idea and development of wetlands and the formulation of sub-topics, after matching and matching the results of wetland environmental basic investigation and patent data collection and analysis, and then using situational analysis and decision analysis to explore the effective utilization of wetlands in this case through industry-academia development. possibility. The coding management of the above-mentioned patent materials is coded in the order of environmental classification, characteristic classification, scientific name, international patent classification, serial number (DP2), the characteristic is floating water (F), the scientific name is Pontederia crassipes (Pon), the international patent classification is chemical (C11), the serial number is 3, and the patent code for the preparation of bio-oil of Phyllostachys edulis is DP2 - F-Pon-C11-0003.

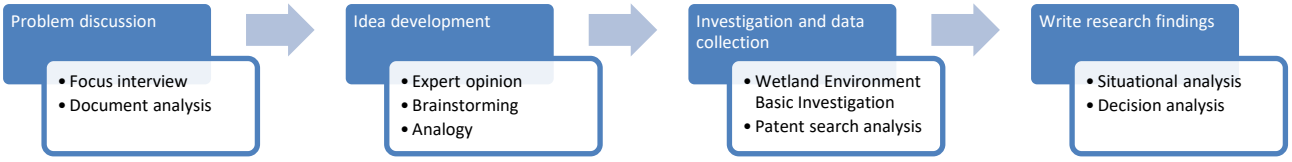

Fig. 1 Research process architecture.

4. Process and Discussion

The wetland in this case is located on the outskirts of the city. After the first phase of focus interviews with randomly selected community residents, wetland maintainers, and nearby environmental conservationists, the initial opinions collected from the industry and academia are mostly linked to environmental education or natural recreation. As for the concept of the wetland agricultural and fishery products, even if the toxicological test results are similar to those of general commercial products, it is generally difficult for the public to remove the indirect pollutants caused by sewage. Therefore, in the concept development stage of the second stage, the sales of agricultural and fish farming are excluded, and it is decided to take the aquatic plants in the densely planted area or the surrounding planting as the target of production and academic development and use non-food such as biochemical, construction, electricity or manufacturing. Commodities are the main development products.

In the third stage, in addition to conducting wetland environmental surveys, the researchers also searched for patents in the Global Patent Search System (GPSS) using aquatic plants commonly used in decontamination constructed wetlands as keywords, and set the non-food industry to be the Republic of China Announced patents, obtained 702 strokes of root floating leaf plants > 634 strokes of emergent plants > 83 strokes of floating plants > 49 strokes of submerged plants, after the manual deletion function or narration error term, I got 406 strokes of emergent plants > roots 181 of floating leaf plants > 44 of floating plants > 18 of submerged plants can be coded with data. Among them, emergent plants are widely used in board, textile, papermaking, furniture, etc. due to their wide variety and their fibrous characteristics. Secondly, the aquatic plant fermentation broth is used for fertilization or insecticide and other biological nutrient solutions, or its extracts are used for medical or cosmetic purposes and are also used for renewable energy production.

5. Conclusion

Some artificial wetlands in Taiwan are affected by exotic aquatic plants with high fertility, and some water areas are covered with hyacinths or water hibiscus,

which affects the survival of aquatic organisms and forms river siltation, and there is a phenomenon of water quality optimization. The wetland in this case is taken as an example. Emergent plants are planted in dense planting area I, while the ecological pond is planted with ornamental root and floating-leaf plants. However, in dense planting area II and some areas of the ecological pond, exotic aquatic plants such as hibiscus are flourishing. It needs to be removed manually. If we can cooperate with the industry to process or extract the eliminated aquatic plants for medical purposes, it will help to deal with exotic aquatic plants and carry out effective management.

Constructed wetlands currently operating with wastewater treatment as their main purpose are mostly outsourced for their operation mode. Take the constructed wetland in this paper as an example, and its associated environmental education program is also promoting activities for public compulsory education. As an attribute, the income line of the cost and income statement is mostly in deficit. As for the outsourced private management companies, under the strict supervision and supervision of various implementation items and the operation and development constraints of conservation laws and regulations, even in the face of waste resources that can be developed and processed in a circular economy, if they fail to contribute to a sustainable economy. In the wise utilization plan of recycling and upgrading, the enthusiasm tends to be moderate. Therefore, this paper attempts to obtain the process of regularly replacing aquatic plants in decontamination constructed wetlands to ensure water quality from the perspective of circular economy development. The utilization and development of innovative products can form a common good possibility, and there are patents of the Republic of China available for inquiries. The relevant wise utilization practices provide a reference for the sustainable management of decontamination constructed wetlands.

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