Biologicalutilization Of Water Hyacinth (*Eichhornia crassipes*) FOR Production Of Value Added Products

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Abstract

Water hyacinth (*Eichhornia crassipes*) is an invasive variety of free - buoyant plant, its suffocate water bodies in tropical areas. In the river, Water hyacinth causes an effect on human health so, as to prevent or reduce this plant build up in the river, we have to overcome this issue in a commercial and economic means. So, we have to maintain the clean India movement and Green India dogma one step ahead to clean Rivers and make them free from Water hyacinth. This also helps to conserve the river ecosystem. And for that, we should also have an idea about the characteristics and constituents of Water hyacinth. Its capacity for growth and dissemination provokes major protection of the problems and is an emerging environmental issue Water hyacinth motivated this article. The assessment of this review study is to recycle the Waterhyacinth biomass for the production of biogas, biofertilizer, biostimulants etc., by using feasible technologies to promoting 'eco-friendly organic farming practices for the betterment of our farmers. At the outset, the potential impact of this review is to shed new light on the better use of feebly studied Water hyacinth for the enhancement of agriculture production through organic farming. This gives invaluable products like biogas, biofertilizers, and uses like biostimulants, phyto-remediation and medicinal uses as discussed in this study.

Key words:*Eichhornia crassipes; Water hyacinth; Biogas; Biofertilizer; Biostimulants; Natural wastes*

Introduction

India is one of the most important countries in the world, with a diverse crop growing in water segments such as lakes, ponds, rivers, and traces of water bodies. As a result, cleaning and altering excess herb is necessary to protect aquatic life [1]. Water hyacinth (WH-*Eichhornia crassipes*) is free-afloat perpetual hydrophytes that belong to the family *Pontederiaceae*. The tidy is recognized as Akasa or *Vengaya Tamara* in Tamil, Kola vazha in Malayalam *Pisachitha tamara* in Telugu, and Jal khumbe in Hindi. In the Asian subcontinent, WH is named as “Terror of Bengal”. The plants are thick, broad, ovate, and glossy and float beyond the water exterior. They contain spongy, long and bulbous stalks. It has a quick development pace, extreme green mat over inert water bodies like as lakes, waterways, streams, ponds, and backwater and is recognized by its purple-coloured flowers and shinning strong leaves [2]. The plant euryhaline, which tolerates both clean and aquatic water; therefore it spreads at a startling high quality of biomass production [3, 4].

The plant WH required a minimum 120°C temperatures and a maximum 350°C of growth and its pH tolerance lies between 5 and 7.5. The ecological hazards allied with these plant life are despoiled water value, and radical changes in the plant and animal community, radiance and oxygen diffusion are cruelly partial diminution in water faction etc., Other ecological hazard take in congestion of irrigation, hydropower, and water supply ways, the difficulty of water convey, obstruction of canal and rivers cause flood [5, 6].

The influence of mechanical and economic progress on the natural environment may lead to deterioration of the social and cultural environment. As a result, the environment must be examined in a larger sense, taking into account the surrounding parts as well as their interconnections [7]. The impact of mechanical and electrical systems The Environment (Protection) Act of 1986 defines environment as all of an organism's physical and natural environmental components, as well as their interactions [8]. Other than live organisms and materials, the environment is defined as "the sum of all water, terrestrial, and air and interconnections that persist surrounded by them and with human people." Fig. 1.0 effectively illustrates the concept of environment.

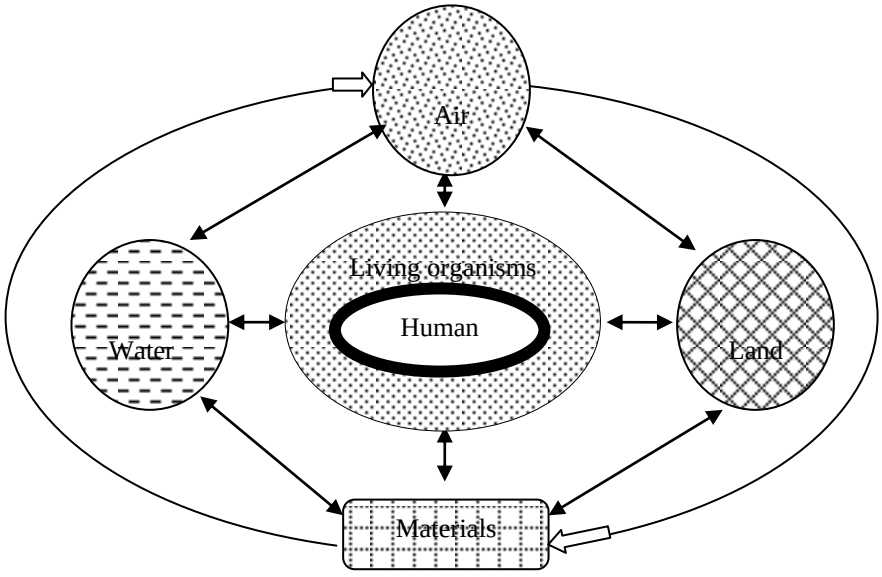

Figure1. Environments are made up of water, air, land, living beings, and materials, as well as their interactions [9].

Draw a picture of a human's habitat. The water, air, and land that surround us form our environment and have a direct impact on us. At the same time, we have an influence on the environment due to resource exploitation or misuse, as well as pollution of the water, air, and land. Microorganisms, animals, and flora, as well as manmade constructions in the environment, have all had direct or indirect bidirectional interactions with us [10]. The environment is created by all of these components and their interactions. The threat posed by WH is particularly concerning for water resources that are highly dynamic, such as irrigation water [11, 12].

In the south Asia pacific region, WH encompasses grounds considerable damage to restricted domestic surface water quality and domestic biodiversity [13]. WH proliferation worldwide geo and biological organize scheme is approximately sketchy to have a cost of few million of U.S. dollars [14].WH harvested handling has been put into the valuable negative image for WH in several countries and their demerits following as, Table 1.

Table 1. Demerits and negative image for Water hyacinth

S.No.	Demerits	Description	Reference
1.	Reduction to biodiversity	WH is a floating typed aquatic plant suppressing the development of local plants and some native fishes and prevents the abundance of phytoplankton under huge mats.	[15]
2.	Blocking oxygen depletion and Reduced water quality	In the aquatic ecosystem, WH plays a vital role for block the light and oxygen to the marine organisms, which affect the primary production of planktons and microbes and also it leads to death for fishes. Furthermore, low dissolved oxygen conditions stimulate the release of phosphorus from the silt, hastening eutrophication and perhaps leading to a rise in WH. The world's most epidemic weed, WH, also causes alterations in water chemistry.	[16, 17]
3.	Water pollution	The plant's quick growth and spread into new areas is attributed to its ability to move easily with water flows, winds, or other unintentional techniques such as fishing nets and boats. The plant attacked streams, canals, ponds, lakes, dams, and other bodies of freshwater. Water transit is hampered.	[18]
4.	Plastics debris in water	WH often collects and forms large plant patches, which also contain plastic trash. Plastic transport in such rivers may be predominantly influenced by vegetation dynamics, rather than hydro-meteorological cycles such as outflow, water level, flow speed, or wind velocity.	[19]

5.	Blockage of waterways and streams causing flooding	WH may develop so thickly that a human being can walk on it. When it takes root in streams and canals, it may grow so dense that it creates a herbivorous barrage, causing damage and posing a flood danger. Also, water running to farm fields and hydroelectric turbines is obstructed, causing significant economic and environmental impact.	[18, 15]
6.	Increased evapotranspiration rate	Evapotranspiration rate has been increased from water body with aquatic plants compared to evaporation from an open-surfaced water body	[6]
7.	Effect on human health	WH causes the significant public medical issues like malaria, schistosomiasis and lymphatic filariasis.	[18]

Production of value added products and applications of WH

Production of Biogas

In marine environments, weeds are a basin reservoir of both energy and nutrients [20]. The harvest and anaerobic digestion might permit for both the nutrients and energy that are detained in an unnatural manner which would ensure that they are taken away from the reservoir deposition and value-added reprocess. Organic biogas is a gas mixture that results from the anaerobic fermentation of organic waste by methanogenic bacteria. WH's potential as a raw material for biogas assembly has been the subject of a number of studies. On a laboratory scale, the anaerobic co-digestion of WH in conjunction with particle and elephant grass for biogas invention was calculated. The investigation revealed that co-digestion of WH, cow dunk, and organic leftovers resulted in a greater biogas output [21].WH contains 64% methane and can be used for biogas invention and water decontamination. It has an excellent source of biomass [22].

Production of Biofertilizer

The farmers were willing to employ chemical fertiliser as it yields a great amount of crops. However, scientists eventually realised that chemical fertiliser had an adverse effect on sediment soil fertility and kills beneficial microbes. Chemical fertilisers contaminate the ecosystems of the air, soil, and water. Researchers have discovered that "Biofertilizer" is an excellent alternative to chemical fertilisers for avoiding this problem [23]. The better presentation of the soil approached with WH as for the higher rate of germination due to improve the soil fertility by releasing nutrient content such as nitrogen and phosphorus it had assimilated from its surroundings and preparation oflivingcells or effective microorganism. It would have intensified the proffering of phytohormones like gibberellins and auxins [24]. WH applied to seeds, plants, or to the rhizosphere it refashioned concomitantly, and unquestionably the bacterial pursued of the rhizosphere, propounded urge that they were ideal for organic matter and simperishable farming [25-27].

Biostimulants

The plant biostimulants also called phytochemicals/ insignificant metabolites delineate as an organic material which is consist gatered and the substances along with alkaloids flavonoids, terpenoids, and phenolic compounds ensue spontaneously in plants [28]. The positive characteristic of biostimulants keep popularizes the monetary cultivation of deserted and underutilized domestic leafy vegetables. Numerous undervalued and

underutilised vegetables have the ability to add variety to the human diet and increase food extension levels by educating people about agro-food systems.

WH is more sustainable and resilient [29]. Natural biostimulants derived from sewage muck, chicken feathers, WH condensed distiller's soluble enzymatic hydrolysate, carob germ enzymatic extract, rice grain extract, and other sources have recently been used. The enzymatic hydrolysis approach to natural xenobiotic contamination of sediment soil was a widely used containment method for speeding up and stimulating the breakdown of the stated xenobiotics in sediment soil.The xenobiotics-tolerant microorganisms are fascinated and included by the lower molecular weight proteins found in abundance in these biostimulants, extending their multiplication and the biochemical exercise action of the sediment soil, and thus accelerating the disintegration of the contamination in the soil [30-33].

The biostimulants continue practiced in cramped quantities to the plants enhanced the growth of plants and sediment microorganisms, enhanced the chemical, physical, and microbial aspect of cultivated sediment soil, and condensing the colony on chemical fertilizers. WH yield have been focus into the scared use in various countries and their product applications following as Table 2.

Table 2. Possible applications of Water Hyacinth

S. No.	Applications	Description	Reference
1.	Industrial and Environment applications	Paper making- WH is utilized for cigar covering production by utilizing fibrous tissue of WH mixed with jute. **Yarn rope** - The fibres present in WH can be used to produce ropes. **Water purification** -The roots of WH has been absorbed various types of heavy metals such as Cu, Cd, Ni, Ag, Cr, Zn, Mg, Mn also create a suitable environment for the growth of aerobic microorganisms.	[34]
2.	Charcoal briquetting	The pyrolysis from the WH is used to create charcoal briquetting in small-scale industries.	[15]
3.	Seed adhesion	WH is directly used as green manure for many plants. The root portion has been promoting the growth and yield of the vegetables. Naturally, WH has a moisture-containing capacity and its leads to the higher moisture-holding capacity of the soil.	[35]
4.	Pollution control	Now day pollution is the biggest problem for every country, The waste effluents from the industries, mixed with water, which leads to water pollution. WH is important in the removal of pollutants from the water, including as BOD, phosphorus, and metals.	[36]
5.	Phyto-remediation	Industrial effluent is one of the major sources of water pollution. The effluents contain numerous amounts of dyes. WH can remove the dyes from the water. It has been absorbed the dyes from the water and removes. Also, the phyto-	[37-38]

		remediation process is used to remove some heavy metals from the water.	
6.	Energy production	Recent studies reveal that WH has been used for the production of bio-fuel and ethanol.	[39]
7.	Medicinal uses	In India, WH has long been used to cure skincare and goitre. The WH extracts were converted into a therapeutically acceptable solvent and used in the clinical therapy of lipid dysregulation or the treatment of fatty liver patients. It has been discovered to be a very effective health-care product.	[40-41]
8.	Anti-oxidative properties	The apical oxidative potential was noticed for freeze-dried WH leave extract. The outcomes demonstrated the capability of this plant as another option and advantageous ease crude material for anti-oxidizing agent recovery. The leaf extracts of WH have been set up to have phyto-chemicals with strong antioxidant and hepato protective exercises. The ability of WH extracts to reduce blood lipid levels *in vitro* has been demonstrated, along with the prevention of fatty liver.	[42]
9.	Anti-aging efficacy	Potential of extracts of WH in anti-aging adequacy by DPPH radical scavenging assay and DNA damage inhibition assay. There was an increase in DPPH radical scavenging and DNA damage inhibition capacity.	[43]
10.	Anti-cancer properties	Because of the existence of several cancer-fighting chemicals in WH, it has been reported to have anticancer potential. It is also reported to have antifungal, antibacterial, and anti-inflammatory activities (fungicidal and bactericidal actions). It's commonly used to cure cholera, sore throats, and snake bites, as well as as a hair scent. WH has also been shown to have larvicidal and wound-healing effects.	[44,45]

Conclusion

In this study from the above literature, we come to the following conclusions regarding Water hyacinth. It has been revealed that the assimilation of WH after its autoclave pre-treatment together with cow dung is a resourceful way to augment the biogas/CH_4 yield rather than organic WH. The combination of pre-treated WH the length of using cow dung can be optional during bio-methanation. From that different aspect, the recognition of key microbial commune further spread out our thoughts of the organic microbial metabolic conduit and multi-faceted biological gathering during the Bio-methanation progression.

1. Removing WH promotes cleaning of the river.
2. It reduces harm to the ecosystem.
3. It is also can be used in producing bio-products as discussed.

The cheap bio products produce by this protocol and elimination of risk in handling of chemical biofertilizers and biostimulants. From this study we can conclude that a commercial method should be developed to control and removing of WH. As a result, there is a significant need to adapt agricultural systems by adopting an alternative environmentally pleasant and effective source of soil additives in order to investigate "best out of trash." As a result, exploitation may become a way of life for it.

Declarations

Not applicable

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Conflicts of interest

None

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