WATER QUALITY

Water hyacinth: Adding value to a noxious weed

Water hyacinth has been dubbed a scourge on South African water systems for decades. But what if this noxious weed held some value?
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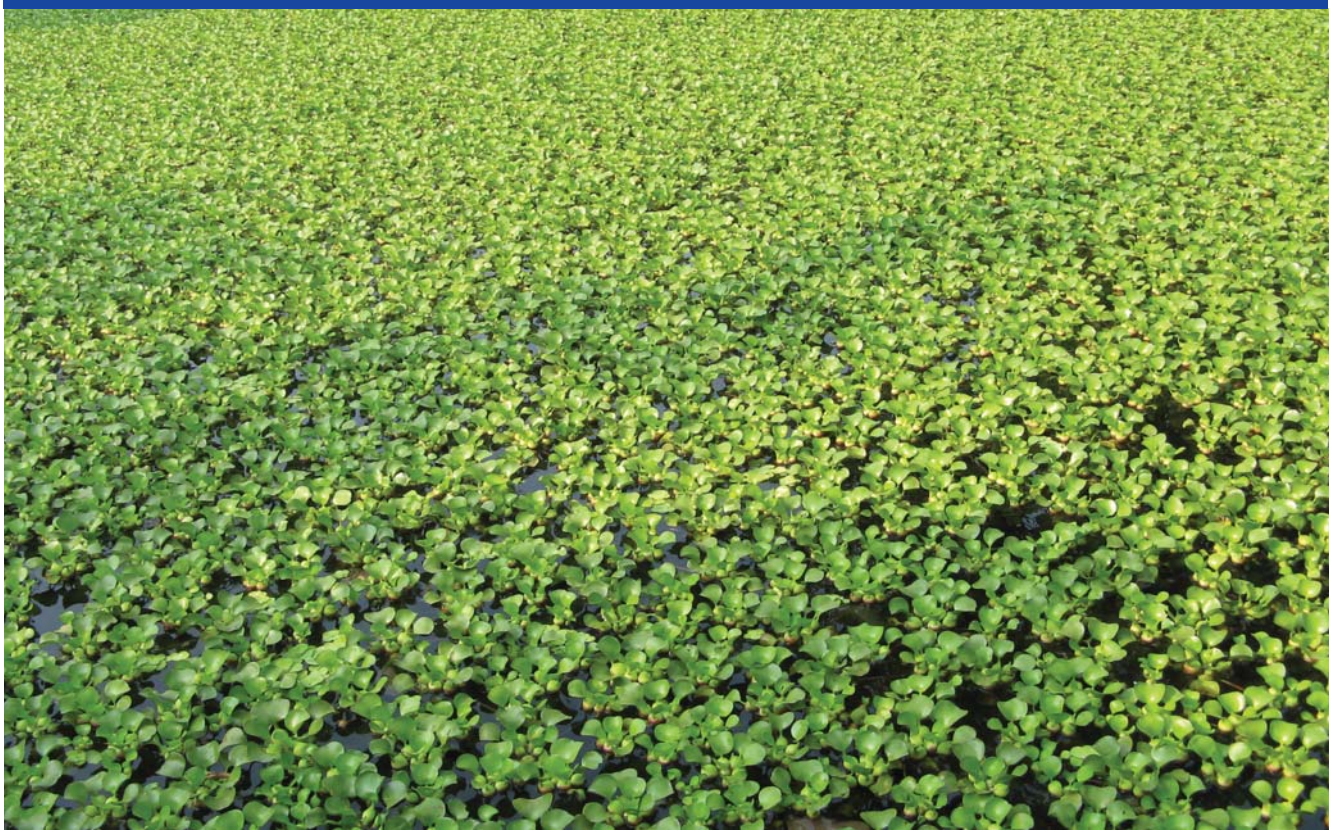
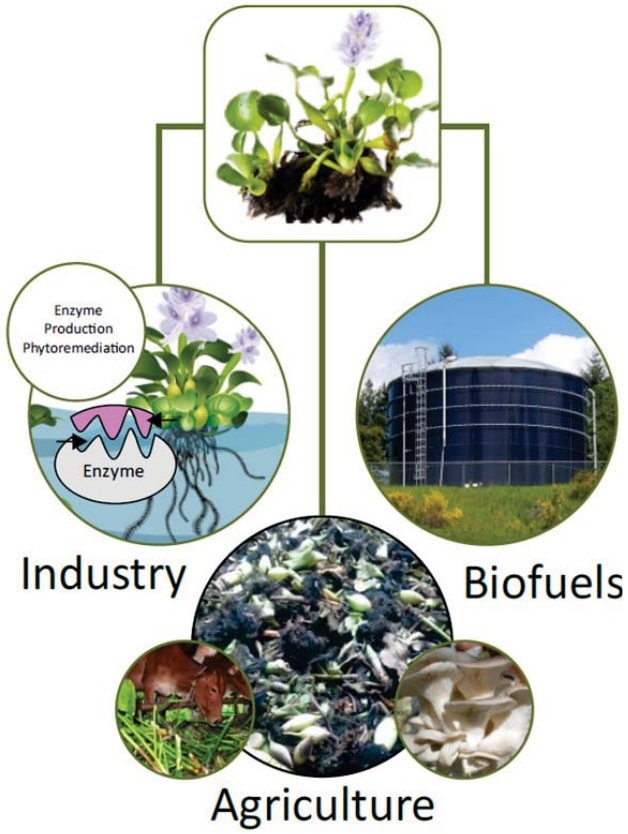


Water hyacinth (***Eichhornia crassipes***) is a perennial, free-floating aquatic weed which is notorious for its rapid reproduction. The plant is indigenous to the Amazon River basin in South America, but is now found in lakes, dams, rivers and swamps in tropical and subtropical countries worldwide. The plant comprises dark green, thick, glossy leaves attached to spongy petioles containing air-filled sacs that enable it to float on water.

Water hyacinth can tolerate a wide range of environmental conditions and successfully out-competes other aquatic plants. Water hyacinth growth is directly correlated to the nutrient concentration in water bodies, especially nitrogen and phosphorus levels. In nutrient-rich water bodies the proliferation rate of the plant can cause various negative effects that are detrimental to aquatic life and human activities. These include blocking light penetration for other submerged aquatic plants, decreasing dissolved oxygen thus affecting water quality, and preventing activities related to navigation, recreation, irrigation and hydropower generation.

Control methods

The negative effects of water hyacinth have motivated research and development activities to manage its proliferation. Several chemical, physical and biological control methods have been tested but none of them provide a permanent solution for the water hyacinth problem.



Value-added applications of hyacinth

These strategies also have high labour and cost implications. The complete elimination of water hyacinth from waterways is almost impossible due to the production of hardy seeds by the plant that remain viable for up to 20 years. Of the control methods tested, the physical removal approach is seen as the most efficient. It is environmentally friendly in comparison to chemical approaches and does not require the introduction of exotic species (e.g. weevils) as with biological control methods.

Problems related to the physical removal method are the cost implications and the fact that the removal is usually only temporary. Strategies need to be in place to offset the costs involved in the physical removal of the weed from waterways in order to ensure its economic viability. The removal of water hyacinth plants results in the generation of a sustainable source of organic matter which has numerous applications.

Value-added applications/products of water hyacinth

Industrial uses of water hyacinth

Water hyacinth is composed primarily of water (95%) but it has fibrous tissue with an elevated energy and protein content, hence it can be utilised for numerous applications. One such application is the production of enzymes from water hyacinth residues. These enzymes include cellulases, xylanases and beta glucosidases, which have potential applications in the food, textile and paper industries. The cost of enzyme production is generally prohibitive due to the choice of carbon source used in the process. Water hyacinth is a low-cost carbon source which motivates its utilisation as a substrate in industrial applications such as enzyme production.

Water hyacinth has long been known for its phytoremediation properties. Its function in ecological systems has been likened to that of the kidneys in the human body, i.e. the removal of toxic compounds. However, proper management of the plant is imperative for water hyacinth to retain its advantages as 'nature's kidney'. The phytoremediation properties of water hyacinth have been exploited for the treatment of industrial effluent rich in heavy metals and pigments. The utilisation of the plant in phytoremediation is both eco-friendly and cost-effective.

Applications in agriculture

Agricultural applications of water hyacinth range from compost to animal feed production. Water hyacinth has a low carbon to nitrogen ratio and low lignin content, making it suitable for use as an organic fertilizer. Furthermore, it actively takes up important plant nutrients such as nitrogen, phosphorus and potassium from nutrient-rich waterways which are stored in the leaves and will be released when the organic fertilizer is applied to soil. Water hyacinth derived compost has a high organic matter content which aids in the improvement of soil structure, improving ventilation and facilitating water percolation through the soil.

Water hyacinth has been investigated as a supplementary feed in fish farming. Furthermore, the elevated protein content in the leaves of the plant together with its rapid growth rate has motivated the utilisation of the plant as fodder for farm animals. Studies have also been conducted on the utilisation of water hyacinth in mushroom cultivation.

Biofuels from water hyacinth

Much attention has been drawn to water hyacinth as a potential renewable energy source. The rapid growth of the plant ensures continual availability which is key when selecting a biomass source for sustainable energy production. Water hyacinth has been successfully utilised for biogas, bioethanol, biohydrogen and biobutanol production.

The numerous applications for water hyacinth motivate the need for more research to evaluate the plant from an energy, environmental and engineering perspective. There is definite potential for the conversion of this noxious weed into precious commodities. The Agricultural Research Council is currently undertaking research on the feasibility of using water hyacinth as a feed for anaerobic digestion. This research is funded by the Water Research Commission and is aimed at maximising biogas production from water hyacinth plants. The feasibility of the use of the effluent from the system as an organic fertilizer is also being evaluated.