Sustainability of the Aquatic Environment: The Menace of Water Hyacinth Plant in Nigeria

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What this Unit is about

This chapter examines environmental sustainability with focus on water as an indispensable resource, and the menace of a plant called Water hyacinth as the worst aquatic weed that has the fastest proliferation rate. The plant hinders water transport; clogs major water ways; acts as a microhabitat for disease vectors; increases evapotranspiration; reduces biodiversity in aquatic environment and causes problems related to fishing. The paper is a demonstration that is activity oriented. The topic demonstrated is "Effects of water hyacinth in aquatic environments (artificial ponds). Participants are expected to record their observations and relate them to the menace of the plant.

What you will learn

After studying this unit, you will be able to:

- Understand the place of water as the most precious natural resource
- Describe the characteristics of water hyacinth
- Discuss the various menace caused by water hyacinth to the aquatic habitat.

Comprising over 70% of the Earth's surface, water which is the aquatic environment is undoubtedly the most precious natural resource that exists on our planet. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on Earth

would be non-existent as it is essential for everything on our planet to grow and prosper.

Water hyacinth, is the world's most noxious aquatic weed (Holm et. al, 1977); being ahead of the eight worst water weeds (Oso, 1996). This plant is an erect, free-floating, monocotydenous, stoloniferous, perennial herb of order Lilliales and family Pontederiaceae that grows up to 1 meter tall (Akinyemiju, 1995). It is a pleustophytic hydrophyte, which tolerates a wide range of environmental conditions such as temperature, illumination, pH; salinity, wind current and drought. It thrives in fresh water and brackish environments; grows luxuriantly in rivers, lakes, ponds, canals, drains, dams, ditches, channels, creeks, lagoons, estuaries and reservoirs (Oso, 1996). The plant is a cosmopolitan in distribution as it has proliferated many areas and found in all continents except Europe; spread to more than 50 countries (Barrett, 1989; Mansor, 1996), and it is particularly suited to tropical and subtropical climates (Cook, 1990). The plant was first reported in West Africa in 1977 in Benin (L. Fagbohoun, in Van Thielen et. al, 1994). The plant was reported to infest Nigeria's freshwater lagoons through Ogun and Lagos states (Badagry creeks) in 1984 from the neighboring republic of Benin (Akinyemiju, 1987).

Diagnostically, the mature plant consists of long pendant fibrous roots, short leafy stems, rhizomes, stolons, leaves, inflorescences and fruit clusters. In shallow waters, it roots in the mud and produces long stolons which grow into separate plants. They are distinctive –looking plants with round to oval, shiny green leaves. The leaf stalk is thick and spongy and helps to keep the plant buoyant. The flowers are large and attractive, blue-purple or lilac-colored with a yellow spot. The fruit is a three-celled capsule containing many minute, ribbed seeds. The inflorescence bears 6-10 lily-like flowers. The stems and leaves contain air-filled tissue which give the plant its considerable buoyancy.

The plant is morphologically very plastic with a rapid mode of vegetative propagation which makes it well adapted to long distance dispersal and successful colonization of diverse ecological niches (Holm et. al., 1977); doubles its number within four weeks under favorable conditions (Akinyemiju and Imevbore, 1990); and is capable of producing 3, 3000 tons per hectare (Oso, 1996) annually as ten plants can Produce 600,000 others covering 0.4 hectares within months. The individual plant has a potential of producing at least, 140 million others, (Botanouny and El-fiky, 1975). Its rapid growth has clogged major water ways and created problems associated with navigation, national security, irrigation and drainage, water supply, hydroelectricity, fishing and recreation in many countries (Kusemiju, - 1988). An important characteristic of the plant is that it is extremely gregarious in habit and its rate of

growth is said to be the highest of any angiosperm on Earth (Julien and Griffiths, 1998).

The Menace of Water Hyacinth

Water hyacinth's diagnostic features and its rate of proliferation makes it a menace to the aquatic environment. Adekoya (2000) revealed that the plant infestation have a significantly adverse effect on the aquatic and terrestrial biodiversity of the affected location. Unmanaged populations of this plant create serious impacts that ripple through infested areas. Effects of infestations worldwide are varied and well documented (Mitchell, 1996; Haller, 1996; Denny, 2001; Harley, 1991; Mailu, Ocheil, and others, 1998). These impacts include:

- **Hindrance to water transport**:
  Impeding transport of irrigation and drainage water in canals and ditches and hindering navigation by preventing free movement of boats and other navigation vessels. Access to harbors and dockling areas can be seriously hindered by mats of water hyacinth. Canals and freshwater rivers can become impassable as they clog up with densely interwined carpets of the weed. It is also a serious hazard to lake transport as large floating islands of water hyacinth clogs up free waterways, sometimes leading to many of the inland waterways being abandoned. This can have negative economic impact on the host community.

- **Clogging of intakes of irrigation canals, hydropower and water supply systems.**
  The plant interferes with hydroelectric power generation schemes by blocking water intakes of dams. In addition, it clogs pipes and inlets of pumping stations which in most cases lead to the shutting down of power generation.

- **Micro-habitat for a variety of disease vectors.**
  While providing shelter for predator reptiles of fish and other aquatic wild life, the plant harbors insect vectors of human and animal diseases. The diseases associated with the presence of the aquatic weed in tropical developing countries are among those that cause the major public health problems: malaria, schistosomiasis and lymphatic filariasis. Some species of mosquito larvae thrive on the environment created by the presence of aquatic weeds, while the link between schistosomiasis (bilharzias) and aquatic weed presence is well known (Pieterse et. al, 1990).

- **Increased evapotranspiration.**
  It increases the surface areas of the river or lake and increases water loss to the atmosphere by three to five times through accelerated evapotranspiration. The

weed promotes greater evapotranspiration through its many leaves thus accelerating the drying up of rivers, lakes reservoirs, canals and river basins. Sutton (1983) suggested that the rate of water loss due to evapotranspiration can be as 1.8 times that of evaporation from the same surface area but free of plants. This has great implications where water is already scarce.

- **Problems related to fishing.**
  The plant presents many problems for fisherman. Access to sites becomes difficult when weed infestation is present. Loss of fishing equipment often results when nets or lives become tangled in the root systems of the weed and the result of these problems is more often than not a reduction in catch and subsequent loss of livelihood. In areas where fishermen get a meager living from their trade, this presents serious socio-economic problems. According to Gopal and Sharma (1981), in West Bengal about 45 million kg of fish were annually lost due to water hyacinth infestation.

- **Reduction in biodiversity.**
  A further long term threat is, if the weed infestation continues unabated, it would spread over large areas and much of the water body could be eventually lost to land as other plants also begin to grow because of the new conditions created by the presence of water hyacinth. Of even greater relevance in terms of the ecology and life in

  Water bodies is that the water hyacinth blots out light, endangers oxygen supply, slow down water flow and suppresses phytoplankton and algae growth with serious repercussions on biological productivity and diversity. The weed infestation produces an obnoxious smell that affects the colour and tasteof the water, thereby impairing its quality and changing its chemistry, thus making it unfit for human consumption. Where the plant is prolific, other aquatic plants have difficulty in surviving. This causes an imbalance in the aquatic micro-ecosystem and often means that a range of fauna that relies on a diversity of plant life for its existence will become extinct.

  The socio-economic structure, Food supply and health of up to several million people are seriously disrupted [Johnson 1993, Harley 1997, Thielen Van et. al. 1994]. In all countries, but to varying degrees, water hyacinth threatens provision of adequate supplies of fresh water that is essential for human, agricultural and industrial activities.

Topic: The effects of water hyacinth in aquatic environments (artificial ponds).

Class: X

Materials Required

- Ponds- real or improvised
- Collecting bottles for sampling;
- Disposable plastic gloves;
- Microscopes for looking for living material;
- Light meter
- Oxygen meter
- Weighted string
- Fishing net
- guides/keys for identification

Learning Outcome

By the end of this workshop participants should gain:

- Awareness that proliferation of the plant is very fast;
- An appreciation of some effects of the menace of water hyacinth on the aquatic environment;

Procedure

- Set up two different ponds containing equal depths of water in the school environment.
- Introduce water hyacinth to one of the ponds and leave the other as a control variable.
- Allow the set ups to remain for at least a period of one month.
- Take different samples of water from time to time and observe under the microscope.
- Identify different species using guides or keys.
- Measure the intensity of light using the light meter.
- Measure the amount of oxygen dissolved in both ponds using the oxygen meter.
- Use the fishing net to catch fish in the two different ponds.
- Use the weighted string to measure the depth of water in the two different ponds.
- Record/ write your observations

Results

	Light intensity	Availability of Dissolved Oxygen	Water depth	Quantity of Fish	Quantity of other living organism
Pond 1 (without water hyacinth)					
Pond 2 (with water hyacinth)					

Analysis

- The amount of light that reaches the bottom of the pond in pond 1 is higher than that of pond 2.
- The amount of dissolved Oxygen in pond 1 is higher than the amount in pond 2 as the Oxygen supply is endangered by the presence of the plant.
- The amount of water loss by evapotranspiration in pond 1 which is free of the plant is less than that of pond 2 because of increased loss of water through the many leaves of the plant, so the depth of water will be more in pond 1 than 2.
- The quantity of fish in pond 1 will be much higher than in pond 2 where there will be little or no fish at all.
- The amount of phytoplankton, algae as other organisms will be more in pond 1 than 2 because the presence of water hyacinth affects biodiversity.

Interpretation of Analysis

Participants have learnt much about the aquatic Environment with focus on the menace of Water hyacinth through the following:

- The fast proliferation of the plant.
- An appreciation of some effects of the menace of the plant on the aquatic environment.

Suggested Activities

The following activities are suggested:

i) Intensify public awareness campaign against water hyacinth to educate people through out the country about the problem caused by the weed and how to identify it.

ii) Encourage the government of Nigeria to put in place a mechanism to stop or limit the spread of water hyacinth especially as ornamental plant.

iii) The use of water hyacinth for waste water treatment by some agencies.

Conclusion

The threat of this plant to aquatic ecosystems is real. The infestation of our water bodies by this aquatic weed is a scourge that must be tackled with all amount of seriousness. However, the current drive towards the total eradication of the weed may not be the most viable option, for the reason of high cost, resourcefulness of the plant and the fact that some of the eradication methods may do further harm to the environment. In spite of problems caused by this weed, a critical study of the plant physiology indicated that it could have potential agricultural, medicinal and economic applications.

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