WATER HYACINTH INFESTATION: NUISANCE OR NUGGET

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ABSTRACT

Water hyacinth, *Eichhornia crassipes*, is rapidly colonising water bodies in Africa. The plant with a lovely bluish colour and beautiful lavender flower is a mat-forming and free floating aquatic weed that have multiplied rapidly in the coastal, brackish and inland water bodies since it was first noticed in Nigeria in 1984.This paper gives a brief review of the menace and resource utilisation of the weed in some countries of the world.

Although, this water weed can be dangerous if not properly controlled, having biological, socio-cultural, and economic implications on water bodies and riverine communities, it is the author's view that Nigeria can learn from the experiences of some Asiatic countries who suddenly woke to discover the usefulness of the "devil weed". Against this background the paper concludes that in an attempt to control the rapid spread of the weed, efforts should also be made to utilise it for the biological, social, and economic well being of riverine communities in particular and the entire populace in general.

INTRODUCTION

Aquatic plants develop explosively large populations only when the environment is altered either physically or through the introduction of chemical pollutants. Non-endemic plants may also develop large uncontrollable populations when intentionally or accidentally introduced in areas where there are no natural enemies to check their growth.

Water hyacinth, *Eichhornia crassipes*, is considered a serious and one of the most noxious aquatic pest in many parts of the world. Its rapid growth has clogged major waterways and created problems associated with navigation, national security, irrigation and drainage, water supply, hydro electricity and fishing in many countries (Kusemiju 1988). Because of its devastating effects on aquatic ecology and man, it is called "Blue devil" or "Bengal terror" in India, "Florida devil" in South Africa, "German Weed" in

Bangladesh and "Water terror" by fishing communities in creeks and lagoons of South Western Nigeria.

The first surge of the weed in Nigeria was noticed in September 1984 along Badagry creek in Lagos where the weed formed a 'mat' over the surface area. By 1990, the weed has spread through the entire Nigerian Coastlines in the creeks and lagoon. Inland water bodies were not spared - with rapid spread on River Niger, reported cases in Benue River system, the Benin River, River Kaduna, many natural lakes and large dams and reservoir like Lake Kainji.

The spread of water hyacinth in the country is perceived as a major environmental problem (World Bank 1990). This is especially so in the South where many rivers and channels are blocked by denser growths of the weed which impede navigation, block access of artisanal fishermen to fishing grounds and lower primary productivity in pools and lagoons.

Although the spread of water hyacinth cannot be attributed directly to river flow regulation, reduced peak flows exacerbate the problem by reducing the capacity of rivers to seasonally flush out dense packs of weed. Mechanical and manual harvesting have proven expensive and not fully effective due to its expeditious spread. It's proliferation is exacerbated by water contamination from industrial effluent, fertiliser run-off and raw sewage.

In Nigeria, the environmental and ecological reality is that water hyacinth is here to stay with us. For how long, we do not know. Although its complete eradication may not be visible, the control of its spread is possible (though expensive) with achievable utilisation advantages.

In spite of the control measures to combat the menace in Nigerian coastal area, the weed continued to spread such that by 1995, a national survey indicated that over 20 out of the 36 states and FCT had been invested from fresh to brackish water bodies.

CONDUCIVE CONDITIONS TO WATER HYACINTH GROWTH AND DEVELOPMENT

The rush towards economic development by way of resources exploitation, often without regard for the environment, has left numerous ecological systems in a state of disarray. Man in his desire to obtain direct and readily measurable economic gains, has neglected to concern himself with the direct, long term benefits that he stands to lose as a consequence of environmental deterioration. As a result his multitudinous activities on land and water have caused different degrees of interference with the ecosystem. In the water-sheds, his manifold economic and development pursuits have led to habitat deterioration, making man the greatest single biogenic factor affecting water quality, both directly as a result of discharges into rivers and indirectly through his activities on land.

The following is a review of conditions favourable to rapid growth, proliferation and establishment of water hyacinth.

1. Neglect of Environmental Responsibilities

The consequence of environmental neglect is environmental deterioration with serious ecological implications and great economic losses. The environment is the reservoir of all natural resources and is fragile. "Importation" of the water hyacinth into Nigeria through the neighbouring countries (Benin Republic, Niger and Mali) reveals the extent of our weaknesses in environmental protection, conservation and monitoring. Without a technology to match its proliferation, billions of naira has been expended by both governmental and non-governmental organizations to check its spread. In environmental issues protection and prevention are more desirable than redressing and remedy which often drain scarce resources.

2 Human Activities

The consequences of unplanned, uncoordinated industrialization by man, is environmental deterioration.

The increased use of fertilizers in agriculture and tremendous upsurge in manufacturing activities provide fertile ground for water hyacinth growth and multiplication. High nutrient level discharges from upland and industrial effluent discharges promote proliferation of the water weed. The high nutrient loads from such discharges are fertile grounds for hyacinth growth.

3. Flooding

Floods contribute large amount of suspended solids and debris, and encourage the abundance of phytoplankton and aquatic macrophytes. Siltation and inundation of lake or reservoir can be a source of transporting water weed seeds or whole plant to a new territory for colonization. Tidal waves must have been responsible for the introduction of Water hyacinth into Nigerian coastal water in 1984 through Benin Republic territorial waters and Kainji Lake in 1989 through annual flooding of River Niger. In the Bengal region of India, it has been established that higher flood frequency enhance the colonization of streams and rivers with flood plains by water hyacinth (FNI, 1987).

4. Water Pollution

Acute water pollution is the resultant effect (gradual and cumulative) of industrial discharges, heavy domestic waste and excessive chemical application in agricultural activities. Pollution imposes cost to a society (either in removing or bearing up with it) and consequently lowers the standard of living (Bolorunduro, 1988)

Mysteriously, water hyacinth is known to tolerate a reasonable degree of pollutants that causes fish kills and impair fishing activities. In fact water pollution encourages the spread of the "Bengal devil" in India (FNI, 1998).

5. Favourable Tropical Environment

The tropical environment, with its high solar energy is known to encourage the fast growth and spreading of water hyacinth. Its lovely bluish colour and beautiful lavender flower are known to blossom in tropical, than temperate environment.

6. High Photosynthetic Fixation Efficiency

The water hyacinth is known to have a high photosynthetic fixation efficiency of 1.52% and rapid growth tendency compared with maize (1%), cocoa (0.5%) elephant grass (o.48%) and ground-nut (0.29%) (Edewor, 1988). Photosynthetic fixation efficiency is a yardstick for measuring the productivity of plants. In South America, annual productivity of the hyacinth is estimated to be 350 - 1700 tons per hectare of wet vegetation. Studies by scientists in India had shown the alarming rate of growth and multiplication of this weed. A seven fold increase in surface area occurs in 50 days, a plant multiplies to 1200 in 120 days, a 450km^2 area of weed expands to 14,928km^2 in 200 days, an 8% increase in surface area covered. This implies additional daily amount of weed produced at 1600ha, or 4000 tonnes of fresh weeds.

7. Water transportation and current velocity

Areas with active boat transporters and timberlog pullers in water bodies promote the spread of this weed. High velocity currents of water bodies rapidly favour the translocation of water hyacinth to new colony.

8. The Hardness of Water hyacinth

Abilities of water hyacinth that makes its control difficult include ability to cross from a freshwater body through salt water to another freshwater bodies while retaining its viability. Also its ability of cut pieces of the weed to re-colonize areas previously cleared, ability of the weed to reduce in size to enable it tides over unfavourable conditions. Water hyacinth has a dominating ability of competitive advantage over most other aquatic weeds (Oso, 1988) even when it is exotic to that ecology.

9. Prolific Growth and Multiplication:

In most countries where water hyacinth has invaded aquatic ecology, efforts to adequately control or eradicate the weed have often been frustrated by its prolific spreading. Despite the application of manual, mechanical, chemical, biological control methods, the "clearing rate" is far below "multiplication rate", a situation that makes Water hyacinth a "triumphant competitor" of the state of technologies of weed control in most countries.

THE NUISANCE WEED

Aquatic plants are biologically productive. The complex "mechanics" of their habitats, the wetland ecosystem,

enhances the productivity of aquatic plants.

Most wetland soils are alternately watered and dried. This increases the release of nutrients and speeds the turnover of organic matter. Water moving past plants provides a steady pulsed supply of nutrients often enhances the productivity of aquatic plants, especially floating littoral macrophytes, like water hyacinth, becomes so large that they become a nuisance and are regarded as weeds.

In most countries with the water hyacinth menace, the following are some of its attributes that negatively impair on the ecology and economic activities of man when the infestation is heavy.

i). Blockade of Canals. The Panama Canal was almost rendered useless following its blockade by water hyacinth. Success of its control was not without cost - a whopping one million U.S. dollar (FNI 1987).

ii). Blocking of suction lines of irrigation pumps, reducing efficiency and increasing maintenance cost.

iii). High water loss through evapo-transpiration. In India the loss of water through water hyacinth was 7.8 times that of open water (FNI 1987).

iv). Massive out-break of water hyacinth covered 54% of the total surface hectarage of lake Brokopondo, Surinam in 1966 costing an annual control with chemicals amounting to 250,000 US. dollar (Dasman *et al* 1973). The result was lowering of dissolved oxygen with adverse ecological implications.

v). Interference with and reduction in power supply in hydro-electric project. When infested, dams encourage the spread of aquatic weeds.

vi). Obstruction of boat traffic and navigational difficulties with consequent damage to outboard engines and fishing nets.

vii). Increase in water borne disease; such as schistosomiasis, malaria and river blindness have been associated with the establishment of the weed since the water hyacinth provides suitable breeding environment for snail vectors and mosquitoes.

viii). The high water content (90-95%) of the weed, its bulkiness and low storability combined with non-existing cost saving processing technology in Nigeria and most developing countries make its harvest and processing less lucrative.

ix). Limitations of its control by biological agents raised questions on how best to check its spread. To hold an infestation steady (without further spreading) at 200,000ha, it has been

estimated that 2,000 Chinese Grass carp of 1kg each would be required to consume 1ha of weed, that is, 32 million live fish weighing 32000 tonnes would be needed (Fish and Agboke, 1988). Calculations by these authors showed that 2 million pigs and 8.8 million cattle would be needed to hold same. Considering the enormous cost involved in importation of exotic species like Chinese carp or in maintaining the pigs and cattle are quite enormous, thus developing countries are constrained in trying these options.

x). Heavy infestation of water hyacinth have enormous repercussion for local distribution for riverine populations - reduction in local fish catch due to loss of phytoplankton and physical impediment to fishermen.

xi). The high amide content (toxic matters) of 8-10% on dry weight basis prevent its fresh edibility and some cattle populations have been reported wiped out in India due to over consumption (Farming News, 1998). Similarly in the flood plains of Warra along the Kainji Lake basin cattle death were reported due to excessive grazing on fresh Water hyacinth.

xii). Despite its promising potential utilization, major constraint is in the procurement, handling and storage of the weed as a source of raw materials. Continuity of its supply due to capital/labour intensive harvesting methods is an important consideration.

xiii). Prolific growth rate with ability to regenerate after a long period of dormancy.

THE NUGGET RESOURCE

Until recently, perhaps it is the tendency of aquatic plants to become a nuisance that has discouraged their study and utilization and encourage the tendency to annihilate them. If water hyacinth can be controlled, it can also be kept within safe limits for effective management and utilization. Proliferation of the hyacinth in an ecosystem is a menace. However its controlled growth could turn it to a resourceful plant.

A renown Nigerian parapsychologist Dr. Okunzua on looking into his crystal ball for his yearly predictions for 1985 was quoted by Edewor (1988) as having recovered the following communication from the water hyacinth that have just invaded the Nigerian coastal water. The message was explicit "I am the leaf, the leaf of blessings and fortune. I have brought with me fortune and wealth to Nigeria, I am the leaf, I am full of wealth and blessings". May it be so.

Science however does not dwell on predictions without prove and evidence. Scientists from all over the globe have findings to justify the paraphyscologist's claim.

Indian scientists carried out a comprehensive investigation on growth, control and utilization aspects of water hyacinth with a view of developing an environmentally sound management scheme. Encouraging developments from the investigations include possibility of designing more efficient biogas systems, utilization for making paper, boards and water hyacinth cement boards. Also as a good nutrient in growing mushrooms, waste water treatment, use of root extracts to assist plant growth, preparation of carbon black, preparation and evaluation of activated carbon from the plant.

The potential use of water hyacinth as a means for water pollution abatement was investigated in Malaysia. Waste water investigated include those from electroplating, pig farming, sugar refining, rubber processing and palm oil industries. The results indicated that the weed is particularly useful as an economical and effective method in the advance treatment of palm oil mill effluent and rubber factory effluent that are the two major environmental polluters in Malaysia (Khan and Thyagarajan (1988).

Treatment of waste water from pulp and paper mills and tanneries were studied in Bangladesh and India. These studies yielded useful scientific results for utilizing Water hyacinth for water pollution control.

The utilization of water hyacinth leaf protein concentrate (LPC) as poultry feed supplementary protein in diets of growing chicks in India was good. LPC was suggested as a possible replica of first meal in the formulation of poultry feed.

In Uganda scientists of Makarere University have formulated a palatable water hyacinth based poultry feed. Water hyacinth silage are made locally in farm and stored for several years. Of all the additives tried so far, the maize bran and Water hyacinth based feed gave the best flavour and form much to the delights of the birds (poultry planner, 1999). Previous research in other countries had indicated that Water hyacinth could be successfully fed to poultry provided it was supplemented with other weeds.

Utilization of the weed in an integrated scheme involving its suitability as an animal feed supplement, biogas production and pollution control was investigated by scientists in Fiji with encouraging results. Thus illustrating the possible value of water hyacinth in rural development. On dry-weight basis, the hyacinth contains about 25-30% protein related matter, with 17% amino acids.

In Nigeria scientists have indicated the possible utilization of the weed for liquid fertilizers, ceiling boards and medium density fibre board (Udohitinah and Aladeselu, 1988), gaskets, amino acid production, detergents, pulp and paper utilization (Udohitinah and Koleoso, 1988), manufacturing of mat, bag and drug; and for waste water treatment and purification. Technology breakthrough in its utilization in agro-allied industries is bound to create employment opportunities for people.

Potential utilization for stable packages called briquettes or waters when dried and compacted as a source of biofuel useful in rural communities and agro-industries have been documented by Faborode (1988). This can serve (i.e. briquette) as replacement for fuel wood consumption, estimated to meet 70% of total domestic energy consumption in Africa (FAO 1980) with its devastating effect on the forestation. Study by Faborode (1988) essentially confirmed that Water hyacinth either freshly harvested, dried and crushed or utilized further after leaf protein extraction can be successfully briquetted for utilization.

Kusemiju and Akingboju (1988) carried out a study on comparative growth of *Sarotherodon melanotheron* on formulated fish feed and water hyacinth diets. Tilapia fed with NIOMR fish feed gained 49.5% in weight and 5.5% increase in length over eight weeks period; compared with 22.2% in weight and 5.5% increase in length when fed on dried hyacinth diet. The food conversion ratios were 6.61 and 12.90 for NIOMR fish feed and dried water hyacinth diet respectively, (non-conventional). Dried water hyacinth could be used as artificial feed in aquaculture, thereby reducing the heavy cost on fish feeds. Proximate composition of the diets are shown in Table 1 below:

Table 1: Comparative Proximate Composition of NIOMR Fish Feed and dried Water hyacinth.

Components	Composition%	
	NIOMR Feed	Water hyacinth
Crude Protein	38.5	14.2
Crude fibre	9.0	20.4
Lipids/Crude fat	6.8	3.3
Moisture	13.4	10.4
Ash	-	27.2
–Free extract	-	24.6
Others	32.3	-

Source - Kusemiju and Akingboju 1988

Works by Daddy and Ilesanmi (1988) showed that the proximate composition of water hyacinth including the leaf blade, petiole, root, whole plant without root suggests that the aquatic plant would be a good source of protein among other uses for animal supplement especially if the protein could be extracted and concentrated into leaf protein concentration.

Water hyacinth, when present in small quantities serves as source of food for aquatic biophages, purifying turbid water through sedimentation and absorption of minerals including heavy metals. It also provides breeding space and sanctuary for birds, fish, snails, insects and other wildlife.

THE CHALLENGES TO SCIENTISTS

(A) Utilization of water hyacinth may be appropriate in certain circumstances.

(1) The sheer biomass of water hyacinth infestations has prompted formulation of various schemes for its utilization. However utilization is not a method of control for water hyacinth as widely claimed on potential utilization for food and feed, paper and boards, biogas, waste water treatment, water quality management, fertilizer and as a source of carbon. Cost/benefit ratio of these proposals and their practicability into commercial operation should be established. According to Harley (1988), world-wide experience indicates that these proposals are usually neither commercially nor economically viable.

(2) In spite of its various utilization potentials, efforts should be made to check its spread since its economic viability and environmental desirability are still questionable when weighed against the cost/benefits.

(3) The economic disadvantages of the presence of the weed in Nigeria's water bodies far outweigh its advantages, thus necessitating control (Alimi & Akinyemiju 1988).

(4) The choice of any control method(s) to be adopted should be based on a detailed economic analysis to ensure judicious use of resources.

(B) Control methods as poser to scientists:

- Manual harvesting is labour intensive (transportation of labour, removal of the weed from water surface and its haulage, and labour management). Working under water is cumbersome and a tiring task.

- Mechanical harvesting is capital intensive with cost components as acquisition, repairs and maintenance of machine, removal of the weed from water and haulage, and acquisition of skill labour.

- Chemical control is capital intensive with cost components on acquisition, application and equipment.

The economic efficiency of a chemical in controlling the weed is a function of its percent active ingredients, rates of application at which the chemical is effective and its unit price. Mechanical harvesting is more economically efficient than manual harvesting but not as efficient as chemical control (Alimi and Akinyemiju 1988).

(5) Development of efficient technology for its routine cultivation, harvesting, drying, milling and storage in silos and bins for agro-industrial utilization.

RECOMMENDATIONS

I. There is an urgent need to exploit positive uses of the hyacinth while ensuring its control measures.

II. Better control of environment through improved methods of management of wastes generated.

III. Integrated approach in control measures is a cost effective manoeuvre

IV. Management measures to tolerate co-habitation (as in Panama canal) since total eradication might be impossible, is a logical solution implying that water fresh from the weed is watched and kept clear.

REFERENCES

Bolorunduro, P.I. (1988) Implications of ecological changes to the management of fresh water bodies. Post graduate Seminar paper. University of Ibadan, 16 p

Daddy, F. and B.D. Ilesanmi (1998) The nutritive value of water hyacinth of lake Kainji, Nigeria. *National Institute for Freshwater Fisheries Research. Annual Report* pp12 - 13.

Dasman, R.F., J.P. Milton and P.H. Freeman (1973) Ecological Principles for Economic Development. John Willey and Sons Ltd. Lond. 252p.

Edewor, J.O. (1988) Developing water hyacinth from menace status to national profitability level. In Oke, O.L., A.M.A. Imevbore and T.A. Farri, ed. Proceedings of the International Workshop on Water hyacinth. FMST pp.175 - 178.

Faborode, J.O. (1988). Briquetting water hyacinth for domestic and rural agro-industrial fuel application. In, Oke, O.L., A.M.A. Imevbore and T.A. Farri. Op. Cit. Pp179 - 188.

Farming News (1998) Resources of utility. Vol. 2 No. 9. p9

FFI (1998). Fish Farming International. *Obstruction to floodplain aquaculture in India.* Vol.14 No.2. p.16.

Fish, R. A. and K. Agboke (1988) Physical method for the control of water hyacinth infestation. In: Oke, O.L. A.M.A. Imevbore and T.A. Farri op. Cit pp172 - 174.

FNI (1987) Fishing News International.Lakes get another Clean up. Vol.26. No.10 Oct. 1987 pp14 - 15

Khan, M.N.G.A. and G. Thyagarajan (1988). Water hyacinth: Historical Background and CSC initiative. In: Oke, O.L., A.M.A. Imevbore and T.A. Farri, op. Cit pp19 - 25.

Kusemiju, K. (1988) Strategies for effective Management of water hyacinth in the creeks and lagoons of South-Western Nigeria. In. Oke, O.L., A.M.A. Imevbore and T.A. Farri op. Cit, pp.39-45.

Kusemiju, K. and O.S. Akingboju (1988) Comparative growth of *Sarotherodon melanotheron* (Ruppell) on formulated fish feed and Water hyacinth diets. **In**. Oke, O.L. A.M.A. Imevbore and T.A. Farri. O.p. Cit pp. 196 - 203.

Oso, B.A. (1988). Invasion of Nigerian Water Ways by water hyacinth. Ecological and Biological Considerations. In. Oke, O.L; A.M.A. Imevbore and T.A. Farri. *Op.cit* pp.116 - 123.

Udohitinah, J.S. and I. Aladueselu (1988). Production of Medium density fibre board from water hyacinth. In. Oke, O.L.; A.M.A. imevbore and T.A. Farri, op. Cit pp.194 - 195-.

Udohitinah, J.S. and O.A. Koleoso (1988). Utilization of water hyacinth for Pulp and Paper Production. In Oke O.L; A.M.A. Imevbore and T.A., Farri Op. Cit pp 189 - 193.

Poultry Planner (1999) Water hyacinth based Poultry Feed. News and Views vol.1 Nov. - Dec. p9.