SUSTAINABLE MANAGEMENT OF WATER BODIES FOR SMALL-SCALE FISHERIES RESOURCES-RESEARCH AND DEVELOPMENT

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ABSTRACT

Practical day-do-day management of water resources requires some guiding policy statements. As an example, a guiding policy is that water quality shall be maintained such that the water resources are fit for certain designed uses on a sustained basis. The policy is fairly straight forward to apply when it is focused on human centred uses (agriculture i.e. irrigation/fisheries, industry, domestic supply or recreation). Presently water quality management relies solely on administrative and legal regulations for mandatory compliance with set standards and guidelines. Legal enforcement is necessary where regulations are flouted but counterproductive where appropriate technology are lacking or prohibitive and inimical to rapid development. The current legal position has its origins in times when neither sustainable development nor other truly environmental norms were clearly recognised. Attempts at introducing this type of value more specifically results in additional discordant notes in an already uncoordinated and patchy system.

The rapid growth of both formal and informal high density urban settlements around major water resources has led to increased pollution of streams, rivers, lakes and estuaries, due to contaminated runoff from these developments. There has been several scattered studies which have examined pollutants from such sources. The major contaminants being organic waste (sewage), industrial effluent, pesticides and litter. Pollutant loads vary depending on the hydrology of the urban area, local topography and soil conditions. In some instances, severe pollution of neighbouring and downstream water courses have been observed.

The practice world-wide is towards active management of aquatic ecosystems in a holistic manner. The management of catchment land uses, riparian zones, instream habitat, as well as instream water flow patterns and quality are necessary in order to sustain the integrity and "health" of water resources, for fisheries and other developments. As such, attempts to ensure a certain level of water quality without attention to other aspects, will not automatically ensure a "healthy" ecosystem even as fish habitat. Proper management leads to better water quality and conducive environment for increased fish production.

1.0 INTRODUCTION

The parlanche of sustainability is perhaps today, the most vibrant of environmental concepts acknowledged globally as the way forward for most human activities and interrelations in a finite world. Not surprisingly, the role of water as a natural resource can be examined for the purpose of managing and conserving ecosystems for sustainable production and development. Whereas the rate and type of use of natural resources are dictated by the cultural, social and economic demands of society, it must be accepted that ecological factors set the limits to which the process of renewal can be manipulated.

In this regard, management of water resources requires some guiding policy statement. As an example, a guiding policy is that water quality shall be maintained such that the water resources are fit for certain designated uses on a sustained basis. Water quality criteria have been developed for most major uses such as for drinking waters (WHO, 1984), irrigation waters (FAO-UNESCO, 1973) and for aquatic life (Alabaster and Lloyd, 1980). The policy is fairly straight-forward to apply when it is focused on human centred uses as mentioned including industry and recreation. When these criteria are applied to natural waters it becomes obvious that some uses are greatly impaired. There is evidence of anthropogenic water quality deterioration.

The response to such conditions invariably has been reliance on administrative and legal regulations for mandatory compliance with set standards and guidelines. Legal enforcement is necessary where regulations are recklessly flouted. However, it could be counterproductive where appropriate technology are lacking or prohibitive and inimical to rapid development.

2.0 THE SCOPE OF WATER LEGISLATION

The current legal position has its origins in times when neither sustainable development nor other truly environmental norms were clearly recognised. Nigeria has provisions in a good number of statutes (Olisa, 1981; 1995) designed to protect or control impairment of water, air and land. Although the provisions are not captioned as environmental pollution, they are designed to safeguard the health of our water resources. However, Olisa (1995) recently remarked that our laws are obsolete. We are more than 40 years behind the international community. We have done precious little to keep pace with the international tide, and our municipal laws, where they exist, lack proper coordination and focus. He noted that far too many agencies are saddled with overlapping responsibilities. There must be a focused and coordinated development pattern if any meaningful progress will be made. Greater clarity for legal purposes must be given if the concept of sustainable developement has an important place at the interface between law and the environment.

3.0 FACTORS AGAINST SUSTAINABLE MANAGEMENT

A number of factors militate against sustainable management of water bodies for small-scale freshwater and brackishwater fisheries resources. These are:

3.1 Climatic instability:

Climatic effects arising from unpredictable seasonal fluctuations have major impacts on the size of water resources and flow of rivers for small-scale fisheries. Rainfall fluctuations could easily result in the drying up completely and reduction in area of lakes e.g. Lake Chad. The sahelian drought often takes its toll by diminishing flooding. Failure of the floods restrict artisanal fisheries activities and contribute to decline in fishery for small water bodies e.g. loss of the Yaeres fishery (Cameroon) and loss of production and potential in Lake Chad. Desertification further leads to reduced perennial aquatic potentials and their fisheries resources.

3.2 Intensive exploitation

A number of water bodies have a history of long and intensive exploitation. Over exploitation is expressed as a drop in catch and disappearance of larger species of fish and decline in mean size of fish caught. Heavily populated and fished coastal lagoons and rivers seem to be close to the limit of overfishing. Welcomme (1979), observed that there is little hope of any great increase in production from the natural waters of the country as development for other purposes proceeds. Some decline in catch from capture fisheries is already experienced. However, opportunities exist for expansion of aquaculture into the very large areas available especially in the residual pools of the floodplain and in the delta.

3.3 Extensive stocking of small reservoirs

In culture systems, the water body could be overexploited by extensive stocking of small reservoirs (<50ha) and of rice culture ponds. Although floodplains increasingly used for rice culture and the drain-in fish ponds initially contributed to fisheries in Queme (Benin), the fisheries was later abandoned. It is one of the classical examples of past mismanagement of various types in Benin fisheries

3.4 Changes in Salinity

Salt-water intrusion could be real in coastal environment where changes in salinity of the lower reaches of rivers easily lead to collapse of fishery e.g. Benin Republic Nokoue lagoon with a permanent opening to the sea. The invasion of the lagoon by teredo worms and greater fishing pressure on other fish stocks resulted in a collapse of the fishery. The ingress of seawater was eventually controlled by the installation of a weir across the mouth of a channel at Cotonou.

3.5 Changes in fishing gear and Poor formation

The fall in catch in Aheme lagoon (Benin) from 9000t in 1959 to 500t in 1976 coincided with the removal of Acadjas from that lagoon for political reasons. Extensive areas of brush parks were used. However the reintroduction of acadja in a planned fashion resulted in increased production.

3.6 Presence of diseases

The presence of river diseases e.g. Onchocercosis, tryanosomiasis, bilharzia and malaria in water courses has consequent effect on the development of small-scale inland fisheries. These hazards require intensive effort to control and could easily lead to isolation of many fisheries.

3.7 Invasion of swamp Vegetation

Swamp vegetation constitutes a physical barrier to navigation and fishing in waters. It also enhances the breeding of vectors of human and animal diseases. The most disturbing aquatic weed is the water hyacinth, various labelled Florida devil or Bengal terror. Management strategies have included mechanical removal, chemical control, some utilisation and biological control.

3.8 Mangrove conversion activities

Acid-sulphate soils of the coastal mangrove swampland and excessive water seepage limit fish yield in brackishwater fish farming in the southwest and southeast zones. Acid sulfate soils, are acidic soils with high concentrations of soluble acid Aluminium and ferric sulfates. The acidity is due to the release of sulphuric acid on oxidation. These soils are derived from sediments high in sulfidic materials (e.g. Iron sulfides-pyriters). When submerged and anaerobic, they are nearly neutral in reaction but when the land is drained and exposed, the sulfidic materials are oxidised to sulphates and sulphuric acid resulting in extremely acidic conditions. The exchangeable aluminium and iron usually at the very low pH values of the soils increase to toxic levels (Brinkman and Pons, 1972). Despite the high acidity and associated effects, acid sulphate soils have characteristics which are conditioned by topographic and hydrologic parameters that are favourable for establishing fish cultivation. The potential can be realized through the provision of relevant soil data for appropriate soil management.

3.9 Increasing pollution levels.

Although water in its natural state is usually fit for most human uses, there is evidence of anthropogenic water quality deterioration to which water resources are highly sensitive and responsive. There has been several scattered studies which have examined water bodies in the country. The major contaminants are organic waste (sewage), industrial effluents, pesticides and litter. Pollutant loads vary depending on the hydrology of urban areas, local topography and soil conditions. The rapid growth of both formal and informal high density urban settlements around major water resources has led to increased pollution of streams, rivers, lakes and estuaries, due to contaminated run-off from these developments. In some instances, severe pollution of neighbouring and downstream water courses have been observed. The ultimate pollution prevention and control must incorporate the management of catchment land uses, riparian zones, instream habitat as well as instream water flow patterns and quality in order to sustain the integrity and "health" of water resources for fisheries and other developments.

4.0 REQUIREMENTS FOR SUSTAINABLE MANAGEMENT OF WATER BODIES

The fisheries resources of Nigeria include a variety of both fin and shell fish species whose distribution are dictated by the prevailing ecology of their aquatic environment. The broad habitat with their species diversity include freshwater, brackish water and marine habitats. In addition fish is also produced in aquaculture systems, using different types of ponds, tanks, and other holding facilities. There are varieties of standing water bodies with varying vegetation types, shoreline, soil characteristics, gradients and water depth. The lakes, dams and open freshwaters are more stable environments than rivers. Fish production is largely based on small-scale artisanal system with the use of simple wooden canoes and different fishing nets and traps.

The major constraint facing fisheries development include the inadequate knowledge of indigenous fish stocks and the biological productivity of the complex aquatic environments which are required for efficient exploitation of the resources (NARSP, 1995). The long-term research goals in the fisheries subsector are aimed at increased fish production both in artisanal capture fisheries and in aquaculture with efficient postharvest fish processing technology. These include:

1) Establishment of fisheries resources and their potential yields in the coastal, marine and inland freshwater bodies;

2) Development of fisheries management strategies for optional harvests and fishing gear selectivity to prevent over-exploitation particularly in the inland water bodies;

3) Control of aquatic pollution and degradation to attain sustainable fisheries production, particularly in the south-west and south-east coastal zones;

4) Increased fish production from available aquatic potentials especially in the brackish water, swampland and inland wetland.

On the basis of the long-term goals priority research themes were formulated on zonal basis. Aspects that directly concern water resources include:

1) Conduct stock assessment of fish resources and their potential yield;

2) Determine the effects of climatic cycles on fish production.

3) Culture of fishes in cages, pens, flood ponds and free flowing boreholes;

4) Management of water quality in aquaculture;

5) Determine biological productivity of the system;

6) Determine physico-chemical parameters of the system;

7) Management of floodplains for increased fish production; and

8) Development of cage and Pen culture.

A salient feature of the research goals is the recognition of the need to obtain basic information on water resources which are essential for policy formulation and management strategies. For example, the basic descriptors of water quality for most water bodies are poorly known. The knowledge about water quality therefore requires substantive enhancement at both the research level and the monitoring level at various time and space scales. The present or intended uses to which a water body is subjected play a significant role in determining the parameter set for monitoring in any exercise. This is because water quality standards are usually pre-determined. It is therefore necessary to monitor a water course for the parameters of greatest importance for the intended use of the water (Table 1).

For fisheries, basic water quality descriptors have to be supplemented with polluting parameters associated with industrial groups discharging into different aquatic systems e.g. (BOD, COD, TSS, TDS, DO, Trace heavy metals and organic micropollutants (DDT, DDT residues, organochlorides/pesticides, PCBs, etc.) are frequently monitored. It is very difficult to predict future environmental evolutions unless direct casual linkages are made between socio-economic trends and the resulting environmental quality. The ultimate goal of water quality management is to permit all forms of natural aquatic life and allow for various human uses. This is attainable with reduction of pollution problems to a tolerable level which is sustainable on a long term basis.

TABLE 1: Important Water Quality Parameters for indicated use purpose (after Meybeck & Helmer, 1989)

Use Purpose	PHYS	GWQ	ORG	BACT (PATH)	NON-METALS	OTHERS
Domestic water supply	x	x	x	x	x	Hardness
Fish, Wildlife & Recration	x	x	x	x	x	Nutrient materials
Irrigation				x		Salinity & growth inhibitors
Livestock watering				x		Salinity

Legend

PHYS: Physiological parameters-colours, odour, taste

GWQ: General water quality parameters-temperature, dissolved oxygen, pH, electrical conductivity,

ORG: Organic content as determined by one or more of biochemical or chemical oxygen demand (BOD or COD) and Total Organic Carbon (TOC).

Bact (path): Bacteriological counts, (Pathogenic organisms)

Non-metals: Toxic non-metals e.g. Ammoniacal nitrogen (AN)<cyanides (CN-), phenols (Ph-) Poly-chlorinated biphenyls (PCBs) and other carcinogens.

5.0 CONCLUSION

The National Agricultural Research Strategy Plan recognises that research on resource assessment, management and conservation will form an integral part of future agricultural research plans. The medium-term research plans are organised to clearly exhibit the relationships between production systems, constraints, research objectives and research themes. The plan include research activities necessary to generate appropriate macroeconomic, land use, technological and environmental policies compatible with wholesome agricultural/fisheries sector performance. It is expected that its implementation will provide quality data on which valid scientific judgement should be based for decision-making in the sustainable management of the country's enormous water resources, available for small-scale fisheries development.

6.0 REFERENCES

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