INDICATION OF POLLUTION IN A TEACHING AND RESEARCH FARM RESERVOIR

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ABSTRACT

The production and productivity of a water body is largely dependent on its quality. One major source of water pollution is from the agrochemicals from near by farmlands.
The quality of water in the Obafemi Awolowo University Teaching and Research Farm Reservoir was monitored between October, 1993 and March, 1994. Structured questionnaires were administered to obtain information on the types of agrochemicals in use on the farm. Water samples were collected fortnightly for analyses of the physico-chemical parameters and ionic content of the water.
Investigation revealed that 21 agrochemicals had been in use on the farm. The physico-chemical parameters of the water showed that the water was very poor in nutrient. The high concentration of ammonium ion contents of the water shows an indication that the residues of certain agrochemicals got into the water to pollute it.
Agrochemicals should be used with great caution on farmlands especially in areas close to water bodies from which man obtains fish and other proteinous foods. This paper also suggests a regular monitoring of water quality of reservoirs in order to pick the earliest signs of pollution.

INTRODUCTION

The lotic environment (i.e. lakes and reservoirs) are important sources of fish because of their longer resident time. Hence, the development of this environment is ultimately the development of fish production. The heritage of nutrient available to an aquatic habitat via weathering of soils within its drainage area is one major factor that affects its productivity.
Agrochemicals such as fertilizers and pesticides have contributed immensely to the enhancement of food production througout the world. Past gains in food production however have been associated with environmental problems; yet global demand for cereals is projected to increase by 56% and for meat by 74% between 1990 and 2020 (Andersen and Lorch, 1996). The rapidly increasing need for food in the human population has led to much overcropping of many fragile and unsuitable soils, considerable soil erosion and water pollution (Edwards and Wali, 1993).

The WHO (1968) reported that agrochemicals enter aquatic environment directly during agricultural operations and deliberate chemical disposal. Akobundu (1987) and Logan (1993) observed that agrochemicals enter aquatic ecosystems indirectly through run-offs from agriculture lands, leaching and deposition of these chemicals which escape into the air.

Changes in the physico-chemical characteristics of reservoirs are often used as measures in determining their potential productivity (Chidobem and Ejike, 1983). Alterations in water quality has been reported by Wedemeyer and Goodyear (1984) to affect aquatic species composition, growth, development and physiological processes of the organisms.

Agrochemical usage in Africa is insignificant when compared to the level of use in North America, Europe and India (WHO, 1979). Inspite of the low level of usage in Nigeria however, their effects on the aquatic environment needs close monitoring. This will help to prevent serious pollution problems which may otherwise come up in the future.

The Obafemi Awolowo University Teaching and Research farm reservoir, located at an latitude of 122.4m above sea level was formed by the impoundment of Elerin and Omifunfun streams in 1967. Though pre-impoundment data are not available, Adeniyi (1971) reported that factors which favoured flourishing fishery in the reservoir include its relative shallowness, dissolved oxygen content of 7.6mg/l; organic matter content between 2 and 4.7mg/l. This study was carried out to document the types of agrochemicals in use on the farm and also to monitor some physico-chemical parameters of the water which are susceptibe to changes and are indicators of pollution in the reservoir.

MATERIALS AND METHODS

The study was carried out between October, 1993 and March, 1994. Information on the qualitative and quantitative usage of agrochemicals were collected through questionnaire administration.

Sample Collection

Water samples were collected fortnightly from who locations (A and B) within the reservoir (Figure. 1). Sampling point A was characterised by sandy bottom; while the sampling point B was characterised by marshy bottom. Water samples were collected into 2-litre plastic bottles and transferred to the laboratory for further analyses. The pH was determined on the samples ast the locations *in situ.*

Laboratory Determinations

The determinations of the physico-chemical parameters as well as the ionic contents of the water samples were made by the methods of the American Public Health Association (A.P.H.A. *et al* 1985). The physico-chemical parameters determined were the pH, dissolved oxygen content, biochemical oxygen demand, alkalinity and total hardness. The anions analysed included the chloride, silicate, sulphate, phosphate, nitrate and ammonium ions. The cation determined were sodium, pottasium, calcium, magnem and zinc.

Table 1: **List of some of the agrochemical in was in the Teaching and Research Farm during the last 4 years**

{PRIVATE }Type of Agrochemical	Trade Name	Common Name	major Chemical Constituents	Source of Constituent
Fertilizers	Urea Sulphate of Ammonia NPK 15:15:15 C.A.N.	Urea Ammonium sulphate NPK 15:15:15 Calcium ammonium nitrate	$CO(11_2N)_2$ $(N11_4)_2SO_4$ Nitrogen, phosphorous and potassium $CaNH4(NO_3)_3$	+ + + +
Herbicides	Atrazine Lasso Lasso-atrazine Dual Primextra Velpa Gramoxone Gramorone Basamase Round up Rilof	Atrazine Alachlor Lasso-atrazin Metachlor Primextra Hexazinone Paraquat dichloride Paraquat dichloride Basamase Glyphounto Piperophos	2-chloro-4-ethylamino--6-isopropylaamino-,3,5,triazine 2-chloro-2'6`--diethyl-N-methoxymethyl accetanilide mixture of lasso and atrazine 2-chloro-6'-ethyl-N-(2-methoxy-l-methyethyl) acet-o-tohidiole Mixture of atrazine and metachlor 3-cyclohexyl-6-dimethylamino-1-methyl-1,3,5-triane-2,4(1H,3H)-dione 1,1'-dimethyl-4,4'bipyridimium dichloride 1,1,-dimethyl-4,4`bipyridinium dichloride 2-chloroN-(1mehyprop-2-ynyl) acetanilide mono (isopropyl ammonium) salt 3-2-methyl piperidinocarbonyl methyl o,o - dipropyl phosphorodithioate	++ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++
Incacticidon	Cymbunh 10EC Gammalin 20 Nuvacron Adrex 40	Cyprmothrin Gamma-BHC Atropine Aldrine	(RS)-eyano-3phnonxylonzyl (1RS, 3RS, 3SR)-3-(2,2-dichlorovingl)-2,2-dimethy cyclopropane carboxylate 1,2,3,4,5,6 hexachlorocyclohexane 1-methyl-2-methyl carbamonlvinyl phosphate 1,2,3,4,10,10-hexachloro-1,4,4`,5,8,8` hexahydro-exo-A1,4, endo-5,8, dimetha-nonaphthalene.	++ +++ + +
Fungicides	Caocobre Sandoz Apron plus	Caocobre sandoz Apron (methlaxyl)	56% cuprous oxide (equivalent of 50% pure copper metal) methyl N-(2-methoxyacetyl)-N-(2,6-xy/yl)-DL-alaninate	+ ++

Source of information chemical constituents: + - Roberts (1980)
++ - Worthing and Walker (1983)
+++ - Femhurst (1970)
+ - Container of the chemical

Results

Agrochemicals

Information gathered through the questionnaire administered revealed the usage of 21 agrochemicals in the Teaching and Research Farm. The agrochemicals which could be classified into four broad categories consisted of 4 fertilizers, 11 herbiicides 4 insecticides and 2 fungiicides (Table 1). The result also showed that no direct application of any agrochemical occured on the reservoir within the last five years.

Water Quality

The pH and total hardness of water samples collected from site A during the period of study were lower than those of Site B (Table 2).

Table 2: Some physico-chemical parameters of water samples collected from the two sampling sites during the period of study.

{PRIVATE }Physico-chemical parameters	SITE A				SITE B			
			Range				Range	
	Mean	S.E.	Low	High	Mean	S.E.	Low	High
PH	6.78	0.45	5.05	7.28	7.20	0.21	6.60	7.90
Alkalinity (mg/l)	32.67	0.87	30.00	36.00	32.08	1.16	28.00	36.50
Total hardness (mg/l)	19.81	2.89	7.47	26.84	20.64	2.57	9.56	28.74
Dissolved oxygen (mg/l)	8.18	0.96	5.30	11.30	6.72	0.66	5.30	9.40
Biochemical oxygen demand (mg/l)	5.62	0.96	3.00	8.50	3.98	0.85	1.80	7.90

The result also showed that the dissolved oxygen and alkalinity content coupled with the biochemical oxygen demand of water samples from Site A were higher than those of Site B. The recorded differences between the 2 sites were however, not statistically significant $P > 0.05$.

Ionic Concentrations of Water Samples

Anions: The concentrations of anions assayed in the water samples collected from th 2 sites during the period of study is shown in Table 3.

Table 3: Concentrations of some anions assayed in the water samples collected form the two sampling sites during the period of study.

{PRIVATE}	SITE A				SITE B			
Anions	Range Mean (mg/l)	S.E.	Low	High	Range Mean (mg/l)	S.E.	Low	High
Cl-	6.01	1.44	2.61	11.22	5.65	1.05	2.81	8.42
Sio_2=	11.08	1.17	6.50	12.20	11.07	1.22	6.90	12.70
SO_4=	2.83	1.89	0.00	5.00	2.78	0.83	2.00	4.00
PO_4=	0.006	0.004	0.00	0.20	0.043	0.03	0.00	0.22
NO_3-	0.25	0.07	0.15	0.60	0.17	0.04	0.08	0.35
NH_4+	6.37	4.06	0.22	13.00	6.02	3.29	0.16	10.00

The concentration fo silicate, chloride and ammonium ions were higher than 6.0mg/l; while that of sulphate was about 3mg/l at the two sites. Nitrate and phosphate ions occured in trace amounts - their concentrations were less than 0.3mg/l.

Cations: The mean concentration of cations assayed in the water samples is shown in Table 4. The result showed that the concentrations of most of the cations at the 2 sites was more or less homogenous.

Table 4: Concentrations of some cations assayed in the water samples collected from the two sampling sites during the period of study.

{PRIVATE}	SITE A				SITE B			
Cations	Range Mean (mg/l)	S.E.	Low	High	Range Mean (mg/l)	S.E.	Loqw	High
Na+	7.25	0.20	6.63	7.99	7.28	0.24	6.63	8.16
K+	2.83	0.05	2.72	3.04	2.83	0.07	2.72	3.04
Ca++	3.63	0.60	1.48	4.74	3.99	0.80	1.11	6.66
Mg++	2.59	0.76	0.47	5.41	2.59	0.66	0.71	5.41
Zn++	0.0041	0.009	0.0009	0.0125	0.0057	0.0017	0.0010	0.0125

*The concentration of zinc ion is in ug/l

Zinc was the only exception; its concentration was higher at site B. The lead concentration in the water samples was below the detectable level (0.001ug/l) of the equipment used (i.e. Perkin-Elmer AAS model 403).

DISCUSSION

The nutrient content of the water body was higher during this study than it was 15 years after impoundment as reported by Ekpeyong (1982). The results of the analyses of the physico-chemical parameters of water samples from the two sampling sites were not significantly different. This is an indication of the homogeneity of the water body; a condition that will favour high production of phytoplnkton and fish in thee reservoir.

The water body is however relatively poor in nutrients, an indication of its oligotrophic state (Imevbore, 1970). The ionic content of the water samples from the reservoir during the study, were lower in most cases than the estimated world averages reported by Flaten (1991). Based on the classification of Prati *et al* (1971) the quality of water in this reservoir could be classified midway between acceptable and slightly polluted.

The concentration of ammonium ions in the water samples during the period of study was very high. This was probably due to the fact that all nitrogenous fertilizers which are in use on the farm eventually got converted by microbial activities in the soil and ended up in the reservoir (Leeper, 1961). The cationic concentration in the water body also probably emanated from the secondary and trace elements in some of the agrochemicals which escaped with run-offs and sub soil water movement in the impacted areas into the reservoir.

Information obtained on the agrochemical usage on the farm revealed that the selection of the chemicals were based on their availability and research work in progress. No consideration was given to their environmental fate.

There should be a review of this practise, in view of the result of this study. The possibility of a selection criteria for products that are effective, cost efficient and environmentally favourable should be considered. In view of some subtle issues related to agrochemical usage, Hornsby *et al* (1993) suggested a selection criteria which considers the following points:]

i) relative leaching potential index of the soil
ii) relative run-off potential index of the soil and
iii) the aquatic toxicity of the chemicals.

This type of criteria will enable agriculturists to select agrochemicals with less water quality impact. This will in turn be a step in the right direction to having sustainable development of lakes and reservoirs.

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