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An Economic Analysis of Water Hyacinth Control Methods in Nigeria

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INTRODUCTION

The status of water hyacinth (*Eichhornia crassipes* (Mart.) Solms)) in Nigerian waters was recently reviewed by Akinyemiju (1). Since then, the publicity created by the nation's press resulted in the government initiating manual and mechanical harvesting for control. However, these efforts have not yielded sufficient success and it is necessary to find other control measures.

Some of the measures currently being explored are chemical and biological controls (4). Research on biological control methods is either non-existent or at its infancy in Nigeria and data are not available for evaluation and comparison with other control methods. In a recent study at the Obafemi Awolowo University,[2] several herbicides were screened for their control of water hyacinth. Some of the herbicides have been identified to be capable of achieving acceptable control of water hyacinth and many of these herbicides were reported to have been used successfully in other parts of the world (3).

The choice of any control measure(s) to be adopted should be based on a detailed economic analysis in order to use the nation's scarce resources judiciously, especially when the nation is in a weak economic situation like many developing countries. This paper reports the economic analysis of the different control measures (mechanical, manual, and chemical) that are currently available for control of water hyacinth in Nigerian waters.

MATERIALS AND METHODS

Questionnaires were used to collect information on manual and mechanical water hyacinth control methods from companies that engaged in the aquatic weed clearing business. The questionnaire identified major activities performed in water hyacinth clearing; the proportion of total costs that go into skilled labor, unskilled labor, machinery repairs and maintenance, machinery and equipment depreciation and haulage, effectiveness of control, utilization of water hyacinth, availability of water hyacinth processing equipment and the amount charged per km^2 of water surface cleared of water hyacinth.

Economic data on chemical control methods were obtained from an experiment carried out on control of water hyacinth. The experiment evaluated the effectiveness of the herbicides asulam, glyphosate, ioxynil + 2, 4-D[3] at concentrations of 1.5 and 3.0 kg a.i. per ha, paraquat, terbutryn, and 2,4-D ester at concentrations of 1.0 and 2.0 kg a.i. per ha, and diquat at 2.0 and 4.0 kg a.i./ha. The current

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[2]Akinyemiju, O. A., Bewaji, F. A. and Imevbore, A. M. A. 1988. Chemical control of water hyacinth (*Eichhornia crassipes*). Paper presented at the International Workshop on Water Hyacinth, Ministry of Science and Technology, Lagos, Nigeria, August 7-11, 1988.

[3]Actril, D. S. is a commercial formulation of May and Baker, Dagenham, England, containing 100g/l ioxynil and 600 g/1 2,4-D.

[4]One Nigerian Naira = 4.70 U. S. Dollars.

TABLE 1. ECONOMIC EFFICIENCY OF DIFFERENT WATER HYACINTH CONTROL METHODS IN NIGERIA. ALL COST VALUES ARE EXPRESSED IN NIGERIAN NAIRA (=4.70 U.S. DOLLARS AT TIME OF WRITING).

Control methods	Herbicide application rate (kg a.i./ha)[1]	Number of floating[2] plants at 4 weeks after herbicide application	Price of herbicide (kg. a.i.)	Herbicide cost (km²)	Total costs[3] (km²)
asulam	1.5	160	68.75	10,312	20,912
	3.0	159	"	20,625	31,225
diquat	2.0(8)	38	351.70	70,341	80,941*[4]
	4.0(9)	0	"	140,682	151,228*
glyphostate	1.5	173	125.00	18,750	29,350
	3.0	138	"	37,500	48,100
ioxynil + 2, 4-D	1.5	45	104.76	15,713	26,314
	3.0	7	"	31,427	42,027*
paraquat	1.0(3)	88	150.00	15,000	25,600*
	2.0(6)	40	"	30,000	40,600*
terbutryn	1.0(2)	0	100.00	10,000	20,600*
	2.0(4)	0	"	20,000	30,600*
2,4-D ester	1.0	125	46.88	4,689	14,600
	2.0(1)	25	"	9,378	19,978*
Manual	(7)	0	–	–	45,000*
Mechanical	(5)	0	–	–	38,000*
Control	0.0	220	–	–	–

[1]The numbers in parentheses of 1 to 9 in the herbicide application rate column indicate the economic efficiency rating of control methods; 1 = most economical, 9 = least economical.
[2]Number of floating plants at the beginning of the experiments were 100 for each treatment tank.
[3]Total costs included the assumed uniform herbicide application cost of 10,600 per square km.
[4]Asterisk indicates control methods that could eradicate water hyacinth within 4 weeks.

prices of chemical, labor and equipment (rent) were obtained from the market (Table 1).

Ratio analysis was used to determine the technical and economic efficiency of each control method. The technical efficiency of each chemical is the quantity of the active ingredient (in kg a.i.) required to clear a given area (ha) of water hyacinth. The smaller the quantity of chemical required per unit area, the higher the technical efficiency. The economic efficiency is the amount (Nigerian Naira) to to remove or eliminate water hyacinth from a given area. The smaller the cost per unit area, the higher the economic efficiency. The technical efficiency and the current prices of inputs were used in arriving at the economic efficiency (2).

RESULTS AND DISCUSSION

Analysis of the information obtained from the completed questionnaires showed that the major activities performed in manual harvesting are transportation of labor, removal of water hyacinth from the water surface, haulage of weeds, and labor management. This method is labor intensive because human labor is required to carry out nearly all the activities, and labor costs accounted for about 75% of the total cost involved. The charge for clearing one square kilometer of water hyacinth ranged from 45,000 to 60,000 Nigerian Naira[4] (Table 1).

The major activities identified in mechanical harvesting were machinery repairs and maintenance, removal of water hyacinth from the water surface and haulage. This method is capital intensive and skilled labor is required for repairs and maintenance of the machines. Mechanical harvesting was faster than manual harvesting and required less labor and associated labor management problems. Firms charged between 38,500 and 50,000 Nigerian Naira to clear one square kilometer of water surface. All the firms interviewed claimed that mechanical harvesting was more efficient than manual harvesting. All the firms stated that water hyacinth was not processed for any commercial use and that water hyacinth processing equipment was not available.

The major cost items in the chemical control are chemical cost which is a function of chemical's price, and chemical application cost, which depends on wage rate and equiment cost (rent). The chemical application period and cost may be reduced using aerial application. All the chemicals tested have the ability to suppress the growth of water hyacinth as reflected by the fewer number of floating plants in treated plots compared with control plots (Table 1). Considering the ability to kill all plants within four weeks, the effective herbicides were diquat (2.0 & 4.0 kg a.i./ha), ioxynil + 2,4-D (3.0 kg a.i./ha), paraquat (1.0 & 2.0 kg a.i./ha), terbutryn (1.0 & 2.0 kg a.i./ha) and 2,4-D ester (2.0 kg a.i./ha). The most technically efficient chemicals were paraquat and terbutryn at the rate of 1.0 kg a.i./ha. (Table 1).

The highest economic efficiency is achieved with the herbicide that is able to eliminate the weed within the stipulated time period at the least possible cost. The most economically efficient chemical is 2,4-D (2.0 kg a.i./ha), followed by terbutryn (1.0 kg a.i./ha), paraquat (1.0 kg a.i./ha) and diquat (2.0 kg a.i./ha) in that order (Table 1). The economic efficiency of a herbicide in controlling water hyacinth is a function of its percent active ingredients, rate of application at which the herbicide is effective and its unit price. Mechanical harvesting is more economically efficient than manual harvesting but not as efficient as chemical control.

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