J. Aquat. Plant Manage. 29: 109-112

Effects of Waterhyacinth on Water Transportation in Nigeria

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ABSTRACT

The economics of the boat transportation business in waterhyacinth infested areas (WHIA) compared to waterhyacinth free areas (WHFA) highlight the effect of waterhyacinth infestations on commercial boat enterprises in Nigeria. All identified characteristics of commercial boats excluding average size and age of boats in the WHIA were significantly adversely affected by waterhyacinth infestations. Waterhyacinth infestation and high cost of component parts of boats individually and collectively accounted for the rise in transport fare that was borne by the consumers (commuters) in the WHIA. Considering profitability, boat enterprises in the WHIA performed worse than those in the WHFA, thus boat enterprises in WHIA bore part of the additional costs imposed by waterhyacinth infestations. The water transport business in the WHIA managed to cover its variable costs in the short run, but loses in the long run will ultimately force operators in the WHIA to quit the industry. Neither the commuter nor the boat enterprise benefits from waterhyacinth infestations and for this reason waterhyacinths should be controlled.

Key words: Economic efficiency, navigation, economic impact.

IINTRODUCTION

Nigeria became aware of the invasion of its coastal waters by waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) in 1984 (Akinyemiju 1987). The weed entered Nigeria through Badagry from the People's Republic of Benin and is spreading rapidly in the coastal waters and to the riverine villages and towns of Nigeria. It is expected that the unabated growth and presence of the weed will have significant effects on the social and economic well being of the people in the towns and villages of the waterhyacinth infested areas. For example, the presence of the weed has posed a serious threat to water borne transportation and thus to the economy of riverine areas as water is the only transportation link between riverine villages and the coastal villages on land.

This study therefore examines the economic impact of waterhyacinth on water borne transportation. The specific objectives were to study and compare the socio-economic characteristics of the commercial boat transportation business in waterhyacinth infested areas (WHIA) with waterhyacinth free areas (WHFA) and to determine and compare levels of operation of commercial boats at pre- and post waterhyacinth infestation periods in the WHIA. In addition, we examined the changes in boat transportation fare over time between the WHIA and the WHFA, and compared the short run revenue, costs and profits of the transportation business in the WHIA and the WHFA to determine the future of the business in each area.

MATERIALS AND METHODS

The study was carried out in Ilaje-Ese Odo Local Government Area (LGA) of Ondo State in Nigeria. This area has been identified from a previous survey to be the worst waterhyacinth infested LGA in Nigeria. The area is characterized by undulating lowlands within which are rivers, streams and canals. About three quarters of the area is covered by water with islands between the water bodies. The vegetation cover includes mangrove forests, fresh water swamps and marshes, and of course rapidly spreading waterhyacinths. At the time of this study waterhyacinth covers an estimated 70 percent of the waterways in the area.

A list of boat drivers was obtained from the chairman of the boat drivers union at Igbokoda (the headquarters of the LGA) and seventy drivers were randomly selected for survey, half of which ply the WHIA and the remaining half the WHFA. Of the thirty five copies of structured questionnaires administered to the drivers plying the WHIA, only thirty were adequately completed and found analyzable. Although thirty two copies of the questionnaire were completed properly by drivers plying the WHFA only

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thirty were analyzed in order to have equal numbers of responses to the questionnaire.

The questionnaire covered the areas of socio-economic characteristics of commercial boat operators (such as age, year of schooling, apprenticeship period and driving experience of the boat drivers, age, size and engine horse power, etc), levels of operations of commercial boat transportation vehicles, intertemporal and inter-spatial behavior of transport fares, and the costs and revenues associated with the boat transportation enterprises in the WHIA and WHFA.

The characteristics identified were quantified and their means computed. The hypothesis of a difference between two sample means (Karmel and Polasek 1977) paired difference test and p-value (Daniel and Terrell 1979) were used to compare parameters of each characteristic in the WHIA with WHFA. Monthly trading, profit and loss account (Wood 1979) and profitability measurement (Kay 1981) were computed for boats plying the WHIA and WHFA to determine the level of profitability in each area.

RESULTS AND DISCUSSION

Two types of vehicles for water transport in the area of study were boats and canoes. The boats were used mainly for commercial purposes and were power driven (petrol engine). Canoes were pulled with paddles and at least one canoe was owned by each household as it was the only private means of transportation.

About 40 percent of boat drivers were owner-drivers and were either from Ilaje-Ese Odo or Ikale (an adjacent local government area). All of them had knowledge of life in riverine areas and could swim. This indicated that investment in the commercial boat transport business was exclusively that of those who had knowledge and experience of living in riverine areas.

Examination of the personal characteristics of boat drivers (Table 1) showed their mean age to be 33.2 and 31.3 years in the WHIA and WHFA respectively. They were poorly educated with about 45 percent being illiterate and the average years of schooling of those literate was 6.1 and 6.9 in the WHIA and WHFA, respectively. All of them trained for the job, were driver mechanics with driving experience of 8.4 and 7.3 years in the WHIA and WHFA, respectively, and claimed to be experts in swimming. All these attributes are necessary to face the rigours of driving engine boats on water.

The average age of boat and boat size plying the WHIA and WHFA were not significantly different, but boat engine capacity was higher in the WHIA as higher powered engines were needed to move through waterhyacinth infested waters. The driving crew size and wages were higher in the WHIA than the WHFA because apart from the driver, an additional person was required to raise and clear the engine of waterhyacinth clogging. This second person did not undergo any technical training and earned less than the driver. Fuel consumption rates of boats plying the WHIA was higher than in the WHFA because waterhyacinth reduced boat speed and increased the working duration of engine per unit distance traveled. Frequency of boat repairs per period and cost per repair were also higher for boats plying the WHIA because waterhyacinth frequently damaged engine parts. The engine spare parts commonly damaged and replaced were gear-boxes, crank-shaft, connecting rod, propeller, piston cup and gaskets, all of which were imported into the country and have undergone dramatic price increases as a result of the weak exchange rate of the Naira (Nigeria's currency) relative to other more stable foreign currencies. Both the boat engine and structure of boats plying the WHIA had shorter lifespans compared to boats in the WHFA because waterhyacinth damaged the engine and collisions with hidden logs and other hidden submerged objects damaged boat hulls.

It is evident from the foregoing analysis (Table 1), that apart from the identified personnel characteristics of boat drivers, average size and age of boats were not significantly different at the 5 percent level for the two areas (WHIA and WHFA). However, all other characteristics were significantly different with the WHIA being more expensive in which to operate with respect to the water transportation business.

TABLE 1. CHARACTERISTICS OF BOAT OPERATORS AND OPERATIONAL DATA IN THE WATERHYACINTH INFESTED AREA (WHIA) AND WATERHYACINTH FREE AREA (WHFA). MEANS AND STANDARD DEVIATIONS OF THE CHARACTERISTICS ARE PRESENTED. (SOURCE: SURVEY DATA, 1989).

Resources and Management Factors	WHIA		WHFA			
	Mean	S.D.	Mean	S.D.	t_c	p-value
Age of drivers	33.2	4.3	31.3	5.2	1.61	0.05<p<0.10
Drivers years of schooling	6.1	1.5	6.9	2.3	1.91	0.25<p<0.05
Apprenticeship period (months)	18.5	3.5	17.8	5.1	0.62	p<0.10
Driving experience (years)	8.4	3.8	7.3	4.2	1.06	p>0.10
Age of boat	9.8	4.3	10.2	3.9	0.38	p>0.10
Boat size (number of passengers)	12.0	3.5	13.0	2.6	1.26	p>0.10
Boat engine horse power	92.5	17.1	53.2	24.4	7.30	p<0.0005
Driving crew size	2.0	0.4	1.1	0.3	9.86	p<0.0005
Driving crew wages Naira (monthly)	480.0	30.0	300.0	50.0	16.90	p<0.0005
Fuel consumption (litres/100km)	75.3	12.2	28.4	5.2	19.4	p<0.0005
Frequency of boat repairs per month	6.1	2.2	2.0	0.7	7.20	p<0.0005
Cost per repair	436.0	42.4	274.1	27.7	17.52	p<0.0005
Drivers estimated boats useful life	5.5	1.4	12.9	2.9	12.59	p<0.0005

TABLE 2. EFFECT OF WATERHYACINTH INFESTATION ON BOAT OPERATIONS IN THE WATERHYACINTH INFESTED AREAS. (SOURCE: SURVEY DATA, 1989).

Operations	Pre-waterhyacinth Mean	Pre-waterhyacinth S.D.	Post-waterhyacinth Mean	Post-waterhyacinth S.D.	t_c	p-value
Number of trips made per day	5.3	1.4	2.1	0.9	10.54	p<0.0005
Number of days worked per week	6.0	0.3	3.9	1.5	7.53	p<0.0005
Number of weeks worked per month	3.8	0.4	2.7	1.4	6.04	p<0.0005
Number of months of work per year	10.1	1.0	6.3	1.4	1.52	p<0.0005
Number of hours of work per day	7.2	1.4	10.3	2.4	6.23	p<0.0005

Table 2 shows the effect of waterhyacinth infestations on boat operations. The number of trips made daily after waterhyacinth infestion declined 60 percent. Following the infestation, the number of days boats worked per week decreased 35 percent, the number of weeks worked per month decreased 30 percent, and the number of months of work by boats per year decreased 38 percent compared to pre-waterhyacinth infestation data. The number of hours boat operators worked per day increased by 30 percent post infestation, however, operators were also frequently stranded by waterhyacinth for longer periods and could be bitten by snakes and insects hiding under and within the plants. The relative inefficiency of operations in the WHIA is a direct result of the rapid expansion and growth of the waterhyacinth.

The relative inefficiency, and the additional cost of operation incurred by commercial boats in the WHIA leading to higher total cost is expected to be borne by either or both of the relevant economic units (boat enterprise and commuter) involved in the economic activity. The commuters bear at least part of the cost if transport fare rises with the presence of waterhyacinth.

Table 3 compares the behavior of commercial boat transport fares per 100km distance over time in the two locations. The increase in transport fare was less rapid before 1985 prior to waterhyacinth infestation in the WHIA. The drivers in the WHIA identified the physical presence of waterhyacinth and the high cost of boat repair as being primarily responsible for the increased transport fares since 1985.

The average transport fare before 1985 (1980 to 1984) in the WHIA was 5.62 Niara[2] and rose to an average of 36.21 Niara after 1984 (1985 to 1989). This rise in transport fare *ceteris paribus* (other things being equal) indicates that at least part of the additional cost caused by the two factors noted above is borne by commuters. The difference

[2]The average Naira currency exchange rate was 1.4957± 0.2406 US dollars per Naira in 1980 to 1985 and 0.1914 ± 0.0495 US dollars per Naira in 1986 to 1989.

TABLE 3. IMPACT OF WATERHYACINTH ON BOAT FARES IN THE WHIA AND WHFA IN NAIRA PER 100KM. (SOURCE: SURVEY DATA; 1989)

Year	WHIA Mean	WHIA S.D.	WHFA Mean	WHFA S.D.	t_c	p-value	dj $(\bar{X}, -\bar{X}_2)$
1980	5.3	0.5	5.2	0.7	0.55	p>0.10	0.09
1981	5.4	5.4	5.4	0.6	0.47	p>0.10	0.08
1982	5.5	1.0	5.5	0.7	0.14	p>0.10	–0.03
1983	5.6	0.6	5.7	0.7	0.61	p>0.10	–0.10
1984	6.2	1.0	6.6	1.0	0.13	p>0.10	–0.35
1985[1]	16.0	1.7	10.0	2.3	11.76	p<0.0005	0.06
1986	20.7	2.7	15.1	1.3	10.14	p<0.0005	–5.60
1987	36.1	3.5	25.0	2.1	14.82	p<0.0005	11.09
1988	45.0	3.7	28.1	2.0	21.90	p<0.0005	16.91
1989	63.2	3.2	35.1	3.1	34.41	p<0.0005	28.09

[1]There were no waterhyacinths in any of the two areas prior to 1985. Also, the Naira was devalued in 1986 (see footnote 2).

High transport fares became noticeable in WHFA in 1986 and the reason given by boat operators was the increased cost of boat parts. Most boat component parts were imported and with the declining exchange rate of Naira, investment, repair and maintenance costs in Aaira value increased. The average transport fare in the WHFA before 1986 (1980 to 1985) was 6.39 Naira per 100Km and in-

TABLE 4. ECONOMIC ANALYSIS (IN NAIRA) OF THE COMMERCIAL BOAT TRANSPORTATION BUSINESS IN THE WATERHYACINTH INFESTED AREA AND IN THE WATERHYACINTH FREE AREA. (SOURCE: SURVEY DATA, 1989).

	WHIA Mean	WHIA S.D.	WHFA Mean	WHFA S.D.	t_c	p-value
Revenue	5780	1130	6375	598	2.55	0.005<p<0.01
Variable costs						
Driving crew wages	480	30	300	50	16.92	p<0.0005
Fuel and engine oil	2230	398	1522	274	8.03	p<0.0005
Repairs and maintenance	2516	9.13	8.22	115	10.08	p<0.0005
Total variable costs	5225	–	2644	–	–	–
Fixed costs						
Depreciation[1]	758	–	323	–	–	–
Interest on invested capital[2]	500	–	500	–	–	–
Total fixed costs	1258	–	823	–	–	–
Total costs	6484	–	3467	–	–	–
Return to management	(–704)	–	2908	–	–	–

[1]Straight line depreciation method is used and the cost price of a standard size boat is 50,000.00 Naira.
[2]Interest on savings deposit is at 12% p.a., a virtually riskless investment alternative open to an investor.

in transport fares between the two areas (WHIA and WHFA) after 1986 (Table 3) indicates that transport fares were higher over the years in the WHIA than in the WHFA and the difference was significant. This indicated that the presence of waterhyacinth singly affected the transport fare which was passed on to commuters.
creased to 25.84 Naira after 1985 (1986 to 1989). This shows that at least part of these additional costs had been passed on to the commuters. Thus, the increased costs of boat component parts and the presence of waterhyacinth individually and jointly affected the rise in boat transport fares.

An economic analysis of the commercial boat business in the WHIA and WHFA is presented in Table 4. The average monthly revenue in the WHIA was lower than in the WHFA despite the higher transport fare in the WHIA. This finding shows that the degree of inefficiency of the boats plying the WHIA outweighs the relatively higher transport fare when the WHIA is compared with the WHFA. The difference in revenues between the two areas was statistically significant. The identified variable costs such as crew wages, fuel and engine oil cost, repairs and maintenance costs were individually and collectively significantly higher in the WHIA than in the WHFA. The longer lifespan of boats in the WHFA compared with the WHIA enabled depreciation charges per period to be lower for boats in the WHFA. The return to management in the WHIA was negative (-704 Naira), but positive (2,908 Naira) in WHFA. The monthly rate of return on investment in the WHIA was negative (-1.41%) and lower than the monthly interest rate on loans (2.5%), and the rate of return in the WHFA was 5.81%. The higher profitability of boats plying the WHFA when compared with the WHIA indicated that boat enterprises in the WHIA bear part of the additional costs caused by waterhyacinth infestation.

The monthly total revenue earned was higher than the total variable cost, but less than the total cost in the WHIA. This implied that a rational commercial boat firm can stay in business in the short run as it is covering all the short run variable cost and recouping part of the fixed cost. It would quit the industry in the long run by not replacing its fixed assets (boat engine, boat building, etc.) when totally depreciated and beyond normal life. This will have severe consequences on future social and economic activities in the WHIA since all commercial boats and means of water borne transport may disappear completely if this economic loss continues.

LITERATURE CITED

Akinyemiju, O. A. 1987. Invasion of Nigerian waters by waterhyacinth. J. Aquat. Plant Manage. 25:24-26.

Daniel, W. W. and J. C. Terrell. 1979. Business Statistics. 2nd Edn. Houghton Mifflin Company, Boston. pp. 207-214.

Karmel, P. H. and M. Polasek. 1977. Applied Statistics for Economics. Pitman, Australia. pp. 183-193.

Kay, R. D. 1981. Farm Management Planning Control and Implementation. McGraw-Hill, New York. pp. 154-163.

Wood, F. 1979. Business Accounting 1. 3rd Edn. ELBS, London. 483p.