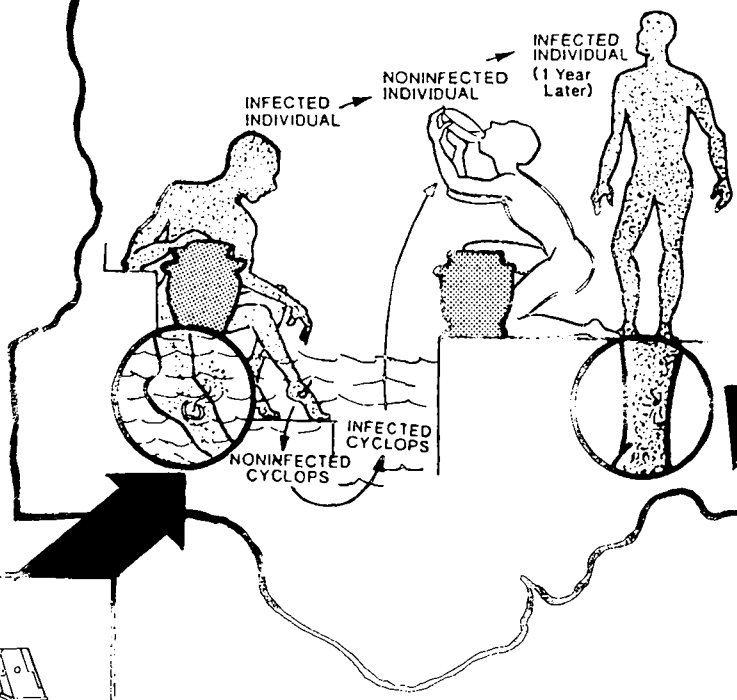
GUINEA WORM CONTROL AS A MAJOR CONTRIBUTOR TO SELF-SUFFICIENCY IN RICE PRODUCTION IN NIGERIA



December 1987

EXECUTIVE SUMMARY

This document focuses on the relationship between Guinea worm morbidity and rice production in selected Local Government Areas of Eastern Nigeria, it spells out how and at what cost Guinea worm disease could be controlled, and what are the minimum economic benefits to be expected.

A study was undertaken in 9 LGA's in Anambra, Cross River, Imo and Benue States during which 723 people in 87 households were interviewed using a structured questionaire with 40 questions. Similarly, 12 Government rice institutions and 36 rice millers were interviewed with a different questionaire consisting of 35 questions.

This data base was extrapolated to 195,000 households (1.6 million people) of 7 LGA's in Anambra (4), Cross River (2) and Imo States (1). It was thus established that at a cost of US$36.2 million, 4 different intervention strategies could simultaneously be used to eradicate Guinea worm in the area over a period of 5 years. These strategies are: water supply, health education & distribution of nylon monofilament, chemical treatment of ponds and community education & mobilization, additionally sanitation could be included. The economic benefits of Guinea worm eradication in the area are estimated at US$20 million profit per annum in additional rice sales alone.

The existence of UNICEF - assisted Water and Sanitation Projects in Imo and Cross River States at present, and the initiation of a similar Project in Anambra State in early 1988, provide the institutional capacity and experience for the absorption of the additional funding herein proposed.

ACKNOWLEDGEMENTS

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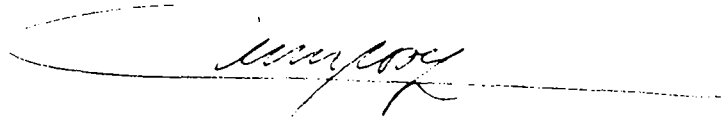
Dr. E.I. Braide,	University of Calabar
Dr. A.B. Nwosu,	Nigeria Institute for Social and Economic Research, Ibadan
Mr. B. Arikpo,	University of Calabar
Mr. E.I.I. Genmade,	University of Calabar
Mr. K.S. Adeyemi,	University of Ilorin

This document could not have been produced without the support of the UNICEF Representative, Mr. R.R.N. Tuluhungwa who's keen interest in UNICEF co-operation with Nigerian Institutes and Universities, as well as for Guinea worm eradication and rural development paved the way to its undertaking. Mr. Tuluhungwa additionally put his personal touch to the document. For these contributions we are most thankful.



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GUINEA WORM CONTROL AS A MAJOR CONTRIBUTOR TO SELF-SUFFICIENCY IN RICE PRODUCTION IN NIGERIA

1. Introduction

A pilot study was undertaken between September and December, 1987 by a team composed of University Lecturers/Researchers, with funding and technical direction by UNICEF, to investigate the relationship between Guinea worm morbidity and rice production in selected Local Government Areas of Nigeria.

The general objective of the study is to solicit for financial support towards the elimination of Guinea Worm disease (dracunculiasis), one of the major constraints to agricultural production, in the main rice growing belt of Nigeria. The study was to:

(i) Establish the relationship between Guinea Worm morbidity and rice production.

(ii) Illustrate the benefits of Guinea Worm Control and relate these to increase in rice production.

(iii) Identify and cost four different intervention strategies for the control of Guinea worm infection for a population of 1.6 million people.

(iv) Present a five year financial plan for the implementation of the proposed intervention strategies.

2. Facts About Guinea Worm

2.1 What is Guinea Worm?

Guinea worm infection (medically known as dracunculiasis or dracontiasis) is a water associated communicable disease. It is a very painful and debilitating disease with multiple adverse consequences on health, agriculture, school attendance and the overall quality of life of the affected communities.

Characteristically, it is found in remote rural communities where:

a) Good quality water for drinking purposes is not available;

b) People are ignorant of its mode of transmission and prevention and;

c) The necessary initiatives, resources, priority and commitment to tackle the problem are either lacking or unexplored.

It is not uncommon to find cases of dracunculiasis in towns and cities. These are the infections which are acquired when the urban victims visit their village homes to see their relations, hold community meetings or to celebrate local festivals [1].

2.2 What Causes Guinea Worm?

Dracunculiasis is caused by a long thread-like round worm measuring approximately 80mm by 2mm. The female worm is responsible for the actual

disease. Before a victim knows that he/she has the infection, the worms have remained hidden in the person's body for about one year from the day its larvae were was first ingested with contaminated drinking water. A victim knows he/she has the disease when the female worm emerges as a partly exposed worm through the painful ulcer which she has caused in the skin.

2.3 How is Guinea Worm Transmitted?

As a rule, Guinea worm infection is acquired by drinking untreated surface water which has previously been contaminated by an infected person. The infection is **never directly** transmissable from person to person. The adult female worm emerging from the human skin contains thousands of young Guinea worm (larvae) in her uterus. Most of the emerging adult female worms are located on the legs of the victim [2, 4], but they can emerge from any other part, including the eyes, trunk, breasts and genital organs.

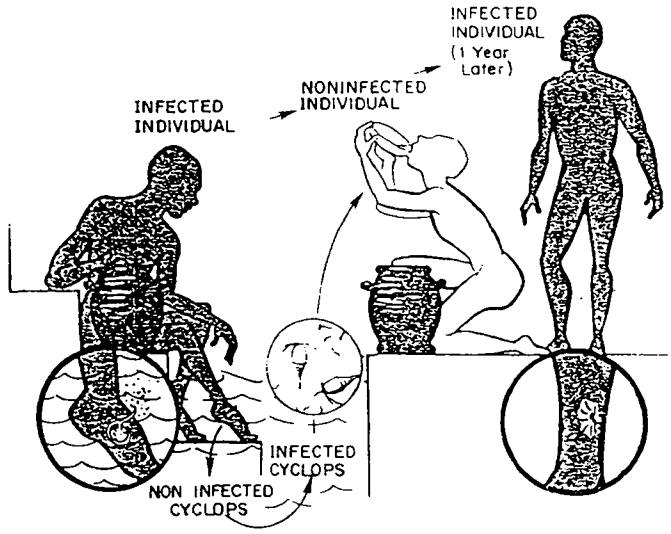
When the affected limb of the Guinea worm victim is imersed into a pond, such as during collection of water for domestic purposes or bathing, numerous young Guinea worm larvae are discharged into the water by exposing the adult female to it. These larvae are not directly infective to man. They must first be transformed into a stage which is infective, this can not occur in the uterus of their mother or directly in the water into which she discharged them. The transformation of Guinea worm larvae into the stage which is infective to man can only occur in water fleas, also known as cyclops. These are small creatures, invisible to the human eye, which are naturally found in most ponds. The ecological conditions of ponds are conducive for the existence, growth and multiplication of these cyclops. After approximately 2 weeks inside the cyclops, the larvae are transformed into a stage which is infective to man. Man becomes infected by ingesting cyclops harbouring infective Guinea worm larvae by drinking these with untreated pond water. The consumption of contaminated drinking water just once is sufficient to cause an infection. Many consumptions increase the risk. In the alimentary tract (gut), the Guinea worm larvae are liberated from the cyclops, migrate into the tissues, grow and become reproductively mature in about 3 months. In another 3 months the male has fertilised the female before he dies: having completed his natural assignment. Approximately 12 months after ingestion the female worm, with thousands of larvae in her uterus, emerges through the ulcer she has caused in the skin. More than one worm can emerge from the same person at the same time and emergence of as many as over 13 worms has been reported in Nigeria [4]. The emerging adult lives for about 3 weeks before she is extracted or, when retained dead in the body, absorbed or calcified.

2.4 What Determines the Severity and Complication of Guinea Worm?

The severity and complication of the disease is related to:

- the number of worms emerging;
- the anatomical location of the emerging worms;
- secondary bacterial infection resulting from negligence, ignorance and poor personal hygiene worsened by unsanitary methods of locally used treatments.

Figure 1: Life Cycle of Guinea Worm



- The mature female worm pierces the skin of the lower leg causing an ulcer
- When the ulcer is in contact with water, larvae are discharged into the water
- The larvae infect Cyclops, a small crustacean
- The water, contaminated with the infected Cyclops, is consumed.
- The ingested larvae mature in humans in one year.

- **Guinea worm disease is transmitted entirely by drinking water.**
- **The contaminated water is typically from open surface sources such as stagnant ponds or "step wells."**

2.5 Implications of Guinea Worm Disease in Nigeria

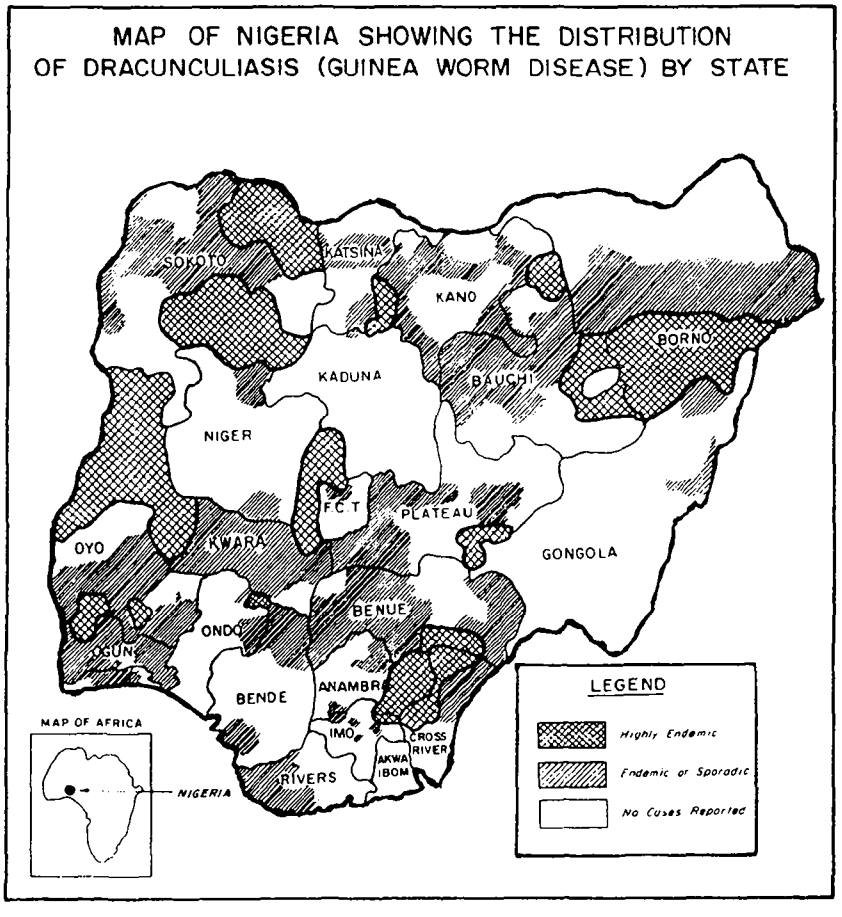
Guinea worm infection is wide-spread in Nigeria. The first National Conference on Dracunculiasis held in Ilorin (March 1985) under the sponsorship of UNICEF showed that it exists in all the 21 States and the Federal Capital Territory of Abuja [5] (Map 1).

At present, about 2.5 million Nigerians are infected every year, of which 1 million are essentially farmers and school children. The infected persons are temporarily incapacitated for periods of 1 to 3 months, but an estimated 12,000 suffer irreversible disablement annually.

Annually the infection is responsible for a substantial amount of lost man-days which translate into the loss of millions of dollars to the nation. Guinea worm infection becomes a cause of death when accompanied secondarily by tetanus bacteria. A report from the University College Hospital - Ibadan in Nigeria [6], where tetanus was the leading cause of death, showed that Guinea worm ulcer was the third most important portal of entry of tetanus spores. In spite of this, the infection is increasing in prevalence, distribution, intensity and public health importance. The latter has prompted the National Council of Health in Nigeria to adopt a resolution (March 1986), identifying dracunculiasis as a leading Nigerian health problem that should receive a high priority for control. In May 1986, the 39th World Health Assembly viewed with grave concern, the implications and geographical distribution of Guinea worm disease, and consequently passed a resolution for its global eradication. In response to this decision, specialists from 14 of the 19 seriously affected African countries met in Niamey, Niger Republic in July 1986, to explore ways and means by which the elimination of Guinea worm disease can be achieved in the continent. India has already an ongoing agressive programme for the eradication of Guinea worm disease in that country.

The disease has multiple adverse effects on health, education, social, religious, political and economic activities of the rural population in Nigeria. Since the overwhelming majority of the rural dwellers relies on agriculture for their subsistence and income, it is this sector which is most affected. This is particularly so because the peak of Guinea worm infection overlaps with the critical period of labour demand for harvesting or planting. Subsistence agriculture is the dominant form of agricultural practice. Additionally the Federal Government is placing a high priority on food self sufficiency, as indicated by the ban on rice importation in October 1985. The production of cash crops has therefore become financially attractive.

The preceding factors have caused the emergence of rice (jointly with maize) as an important cash crop as well as food item. Consequently an attempt was made to relate it to Guinea worm morbidity, as control of the latter could potentially boost local production.



2.6 Can Guinea Worm Disease be Treated and Prevented?

At present, there is no effective drug or vaccine for the treatment or prevention of Guinea worm disease. However, there are various intervention options that can be used to control and even eradicate the disease. These include:

a) Chemical treatment of pond water to kill the cyclops;

b) Health education (including boiling and filtering of untreated pond water) and;

c) Provision of clean drinking water

Of these options, the latter is the most effective and permanent alternative. It tackles the problem at its root and reduces morbidity due to other water borne diseases as well.

2.7 Is Guinea Worm Disease Eradicable?

Theoretically, Guinea worm is an easily eradicable disease. The adult worm has a relatively short life span of only one year. There is no important reservoir host other than man and the infection is transmitted exclusively through the drinking of raw contaminated water.

Introduction of clean water supply in an affected community produces a dramatic and permanent impact on prevalence of Guinea worm. The UNICEF assisted Water and Sanitation Project in Kwara State, for example, commissioned two handpump equipped boreholes in Kankan (population 500) which was previously known as "the village of Guinea worm" [7] and has a history of long-standing hyperendemicity of dracunculiasis. The prevalence of the disease dropped from 62% before intervention in 1983 to 0% after intervention in 1987 [8]. Likewise, the same project, in the Asa Local Government Area of Kwara State, caused 81% Guinea worm reduction among the intervention population of 35,000 people within 3 years.

This dramatic reduction of Guinea worm morbidity was accompanied by an incredible improvement in socio-economic activities in the area. Thus school absenteeism dropped from 33% before intervention to less than 3% after intervention. Many farmers who had suffered "Guinea worm attacks" in the past commented on improvement in size, variety and yield of their farms. Hence they produced more food to feed their dependants and even make some profits to meet their financial obligations, including the payment of their children's school fees, community levies, costs of agricultural inputs and services, pilgrimage to Mecca and even the purchase of motor cycles and radios. As money and enthusiasm for community self-initiated and self-supported projects increased, villagers also cited the building of new religious houses, health clinics and additional classrooms for the village schools. In contrast, some of the neighbouring villages where no such interventions occurred, still suffer from high prevalence of Guinea worm infections and the associated morbidity and poverty.

3. Investigation

3.1 Selection of Study Area

The areas presenting a congruency of highly endemic Guinea worm disease (Map 1) were superimposed on that of major rice producing zones (Maps 5.8 & 5.9 [2]).

The greatest overlap was observed to be in the south eastern part of Nigeria (Map 2) which was consequently selected for the pilot study.

The study was designed to assess the impact of Guinea worm morbidity on rice production in 9 Local Government Areas (LGAs) of Anambra (4), Benue (1), Cross-River (2) and Imo States (2). During the survey, 89 households, consisting of 723 people, were interviewed using a structured questionnaire of 40 questions. Similarly, 12 Government rice institutions and 36 rice millers were interviewed, using a different questionnaire, consisting of 35 questions.

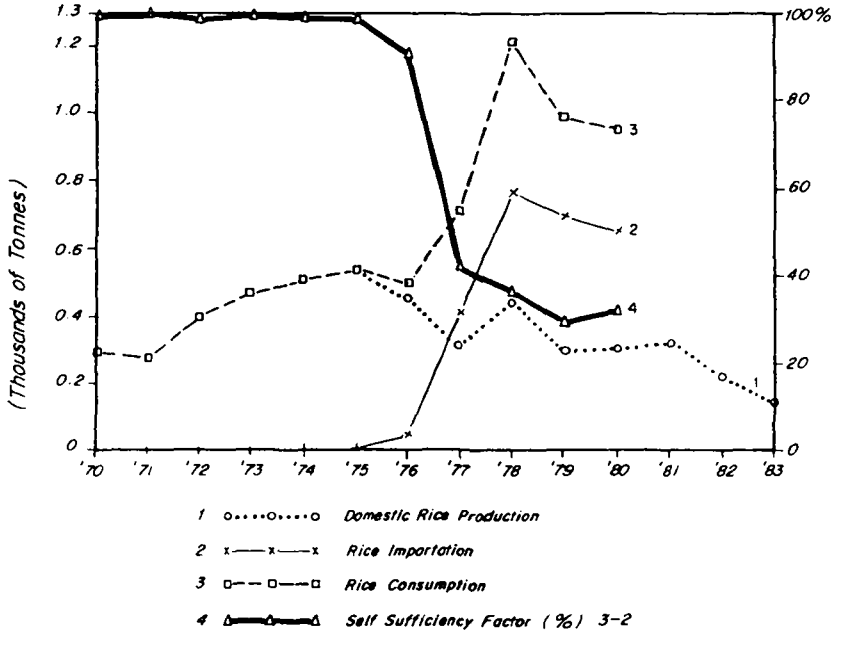
A team of 12 people undertook the field survey over a period of two weeks at a cost of roughly US$2,500. Analysis, compilation of data, and literature research took an additional 3 weeks at an extra ost of US$2,500.

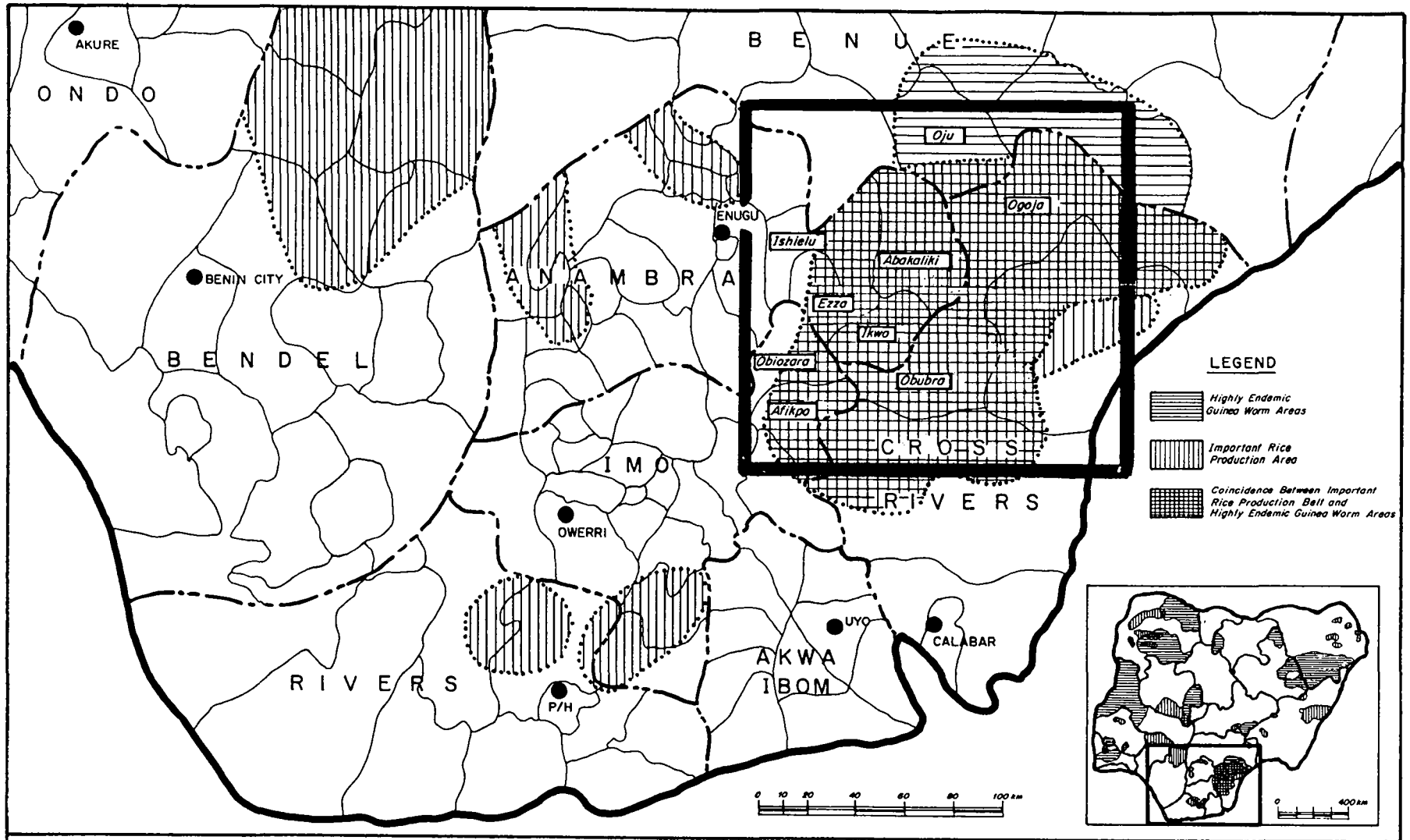
Extrapolation of data was made from 87 of the surveyed households to 195,000 rice-farming households in 7 Local Government Areas (LGAs) of Anambra (4), Cross River (2) and Imo States (1). The findings form the basis of this presentation and discussion.

3.2 Importance of Rice in Nigeria

Between 1976 and 1978, the consumption of rice in Nigeria increased by approximately 40% as a result of rice importation which reached the peak of about 800,000 tonnes in 1978. Domestic production declined between 1975 and 1983 by approximately 300,000 tonnes (37.5%). As a result the self-sufficiency factor for rice had been reduced to 32% by 1980 (figure 2).

Figure 2: Rice Production, Importation and Self Sufficiency Factor (1970 - 1983) in Nigeria





PILOT STUDY AREA

(9 Local Government Areas of 4 States)

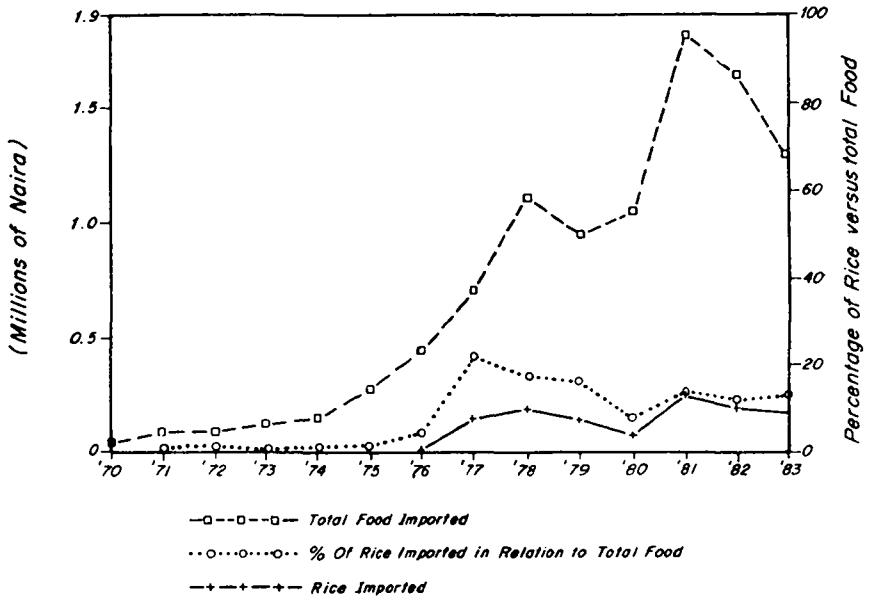
MAP 2

UNITED NATIONS CHILDREN'S FUND
Nigeria Country Office
11a Osborne Road, Ikoyi
Lagos - Nigeria.

Drawn: *Olumide Beckleys .*

Date: *December 1987*

Figure 3: Rice Imports Versus Total Food Imports
(1970 - 1983) in Nigeria



In the past rice has been a major imported food item in Nigeria. Between 1977 and 1983 it comprised of 15% to 20% of the total food imports. The ban on rice importation in October 1985 has apparently encouraged local production.

3.3 Prevalence of Guinea Worm in the Study Area

At least one out of every five persons interviewed were suffering from Guinea worm at the time of the survey as indicated in figure 4. This is an annually recurring problem.

Figure 4: Prevalence of Guinea Worm
Based on 89 Households* in Anambra, Benue, C. River & Imo States
(1983 - 1986)

*Household (HH) in the context of this document stands for "those individuals who are held together in the same house under a headship and sharing a common source of feeding as a family".

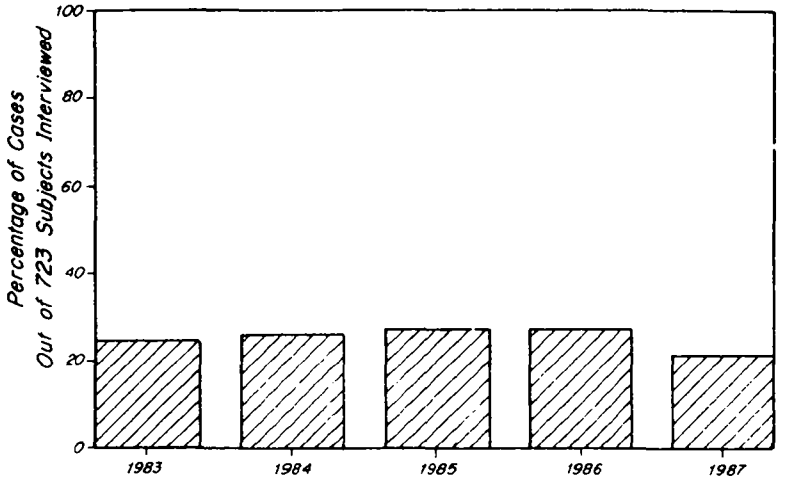
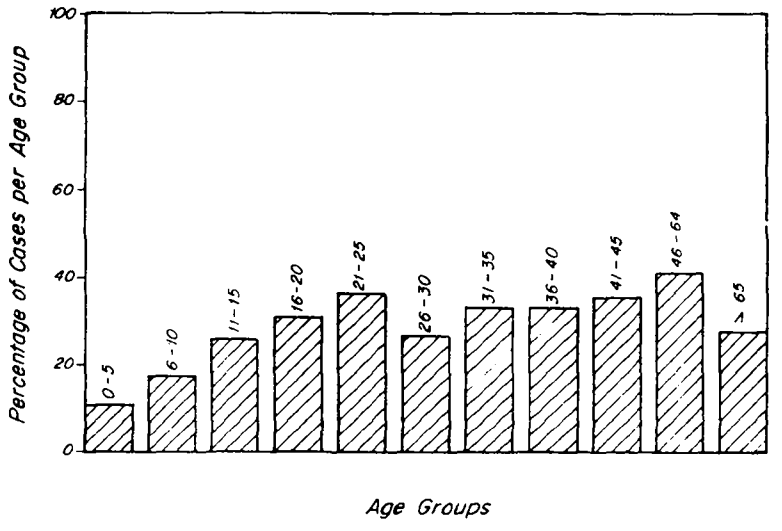
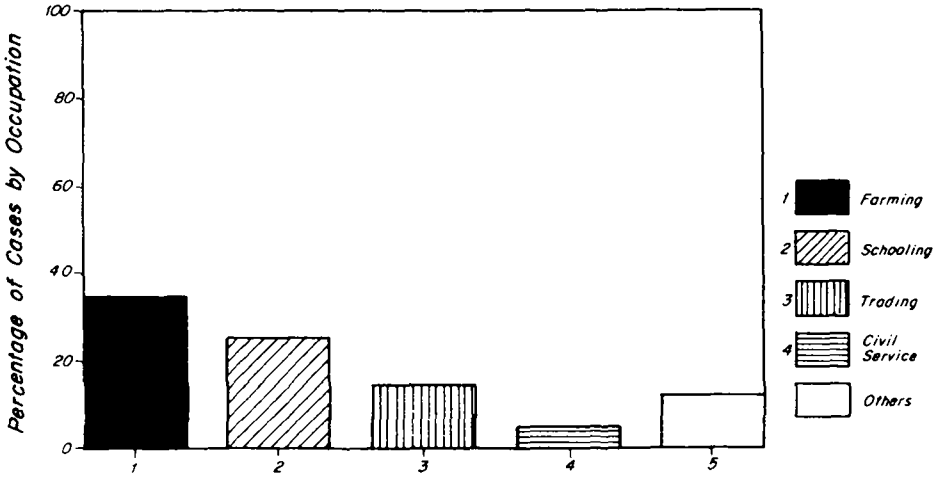


Figure 5: Yearly Average of Guinea Worm Cases by Age
Based on 89 Households in Anambra, Benue, C. River & Imo States
(1983 - 1986)



Although, all age-groups are affected, the productive population (ages 16 - 64) suffer the most (figure 5). As earlier stated, the predominant economic activity among the rural dwellers is agriculture. Strickingly, this is the occupational group that suffers most from the disease morbidity as indicated in figure 5.

Figure 6: Guinea Worm Cases by Occupation
Based on 89 Households in Anambra, Benue, C. River & Imo States
(1983 - 1986)



3.4 Link Between Guinea Worm Morbidity and Rice Production

Figure 7 indicates that apart from finance, Guinea worm is the leading constraint to rice production. It may be speculated that this is interwoven with finance since Guinea worm affects agricultural output which is the major source of income in rural areas. The eradication of the disease would therefore improve the income generation in these areas and enable the people to better deal with other problems, such as health and education.

Figure 7: Leading Constraints in Rice Production
Based on 89 Households in Anambra, Benue, C. River & Imo States
(1983 - 1986)

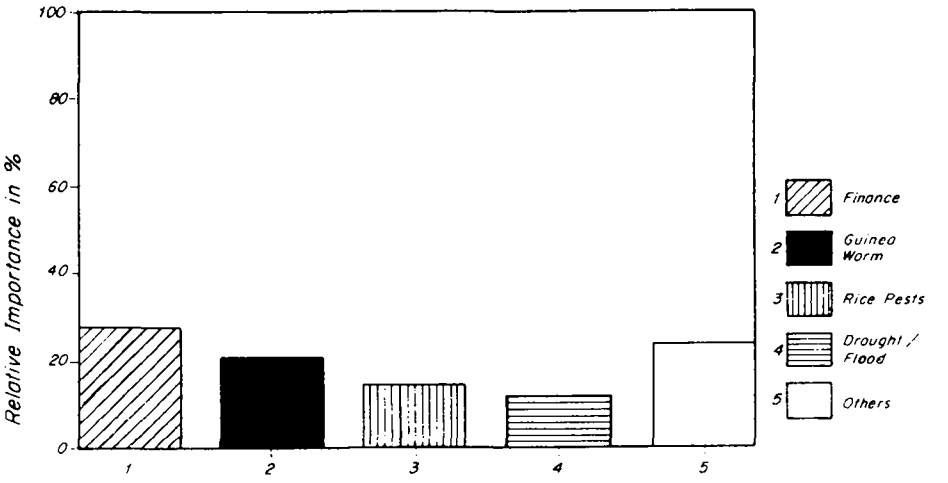


Table 1: Average Number of Man-days Employed and Lost in Rice Production and their Financial Impact
(Based on 87 households in 4 States - 1983 to 1986)

State	Number of HH's Surveyed	Man-days Employed in Rice Product.	Rice Produced (tons)	Value of Rice Produced (N800/t) (Naira)	Value of Rice Output per Man-day (Naira)	Man-days Lost to G.worm	Value of Rice Output Lost (Naira)
[1]	[2]	[3]	[4]	[5] [4]x800	[6] [5]/[3]	[7]	[8] [6]x[7]
ANAMBRA	7	18,300	74.3	59,440	3.25	777	2,525
BENUE	20	28,272	69.7	55,760	1.97	6,094	12,005
C.RIVER	29	62,188	300.3	240,240	3.86	10,140	39,140
IMO	31	78,392	582.1	465,680	5.94	2,843	16,887
TOTAL	87	170,682	1,026.3	821,040	4.81	19,854	95,498

The relevant information derived from Table 1 is that "1 man-day of rice cultivation is equivalent to approximately Naira 4.8". Considering the December 1987 United Nations Naira/US$ rate of 4.24, this translates into US$1.13.

Table 2: Economic Effect of Guinea Worm on Rice Production in 7 LGA's of Anambra, Cross River and Imo States

Base Data & Extrapolation Sampled	Number Household	Productive Man-Days	Lost Man-Days	% Man-Days Lost	Cost of Man-Days Lost (US$)
Households	87	170,682	19,854	11.6	22,523
Extrapolated Households**	195,000	382,563,103	44,500,345	11.6	50,482,703

* See Table 1

** Derived from Federal Office of Statistics - FOS, National Integrated Survey of Households 1983/84, Rural Economic Survey and Supplemented with survey data.

3.5 Rice Production, Income, Expenditure and Profits

Table 3: Rice Currently Produced in Weight and US$ Value in 9 LGA's of Anambra, Benue, Cross River and Imo States
(Data extrapolated from 87 households in 4 States to 195,000 households in 3 States)

Data Base & Extrapolation	Number of Household	Hectares with Rice (9.1ha/HH)	Tonnes of Rice/year (11.8t/HH)	Annual Value of Rice (US$) (at US$190/ton)
Sampled Households avrge 4 States	87	792	1,026.3	194,997
Extrapolated Households*	195,000	1,775,172	2,300,327.6	437,062,244

* Derived from FOS, National Integrated Survey of Households 1983/84, Rural Economic Survey and Supplemented with survey data.

The total value of rice produced converted to US$ would be equivalent to US$437,062,244. This amounts to US$2,241 per household.

The survey additionally indicated the following breakdown of production, sales, expenditures and profit relating to rice.

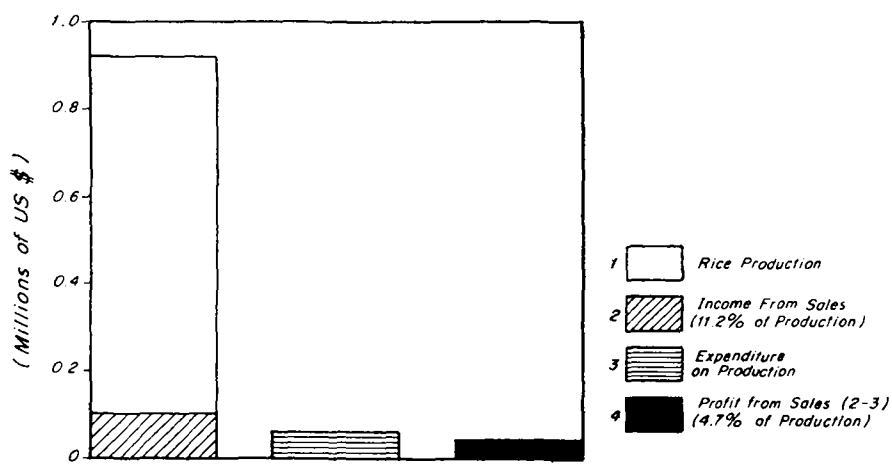
Table 4: Breakdown of Production, Sales, Expenditures and Profit With Rice
(Data extrapolated from 87 households in 4 States to 195,000 households in 3 States)

Activities	(in Millions of US$)
Production [1]	437,062,244
Sales (11.2% of Production) [2]	48,950,971
Expenditures with Production [3] (58% of income from sales)	28,409,046
Profit [2 - 3] (42% of income from sales or 4.7% of rice produced)	20,541,925

Strikingly, as indicated in figure 8 and table 4, only 11.2% of the rice production is sold. Profit from sales amounts to 42% which represents only 4.7% of the value of the total production. It can therefore be assumed that most of the rice produced is consumed. It appears however that the quantity of rice sold is larger than what is indicated, as these statistics were derived from direct questions relating to the quantity of rice harvested and sold, and that the respondents were frequently reluctant to report on the latter, probably for fear of taxation. Therefore, these figures, for practical purposes, could be regarded as the absolute minimum.

Another question relating to the issue was focused on the reasons for the cultivation of rice. The response indicated that consumption and sales of rice are ranked equally. It can therefore be inferred that the sale of rice may amount to 40 - 50% of the total rice production. For this study the minimum figure of 11.2% is used.

Figure 8: Rice: Production, Income, Expenditures and Profit
(Based on extrapolation from 87 households
in Anambra, Benue, C. River & Imo States
to 195,000 households in Anambra, C. River and Imo States)



4. Cost of Interventions

4.1 Target Population

With 195,000 households of rice producers having an average size of 8.1, the target population is in the order of 1.6 million people.

4.2 Water Supply

Water supply is the major strategy which can permanently control and even eradicate Guinea worm because it deals with the "root of the problem". At a borehole/population ratio of 1/500 (handpump equipped boreholes), 3,200 boreholes (BH) would be required. Considering the time frame of 5 years for completion of the project, 640 handpump equipped boreholes per year would have to be implemented. One drilling rig can in average produce 50 BH/year, which means that 13 drilling rigs, with all accessory equipment and vehicles, would be needed to undertake the necessary drilling operations. The "per capita" cost of this intervention amounts to US$19.0 over 5 years.

The geology of the area consists essentially of Cretaceous shales which are relatively impermeable sedimentary deposits bearing little water restricted to relatively shallow fractures. Experience from the UNICEF - assisted Imo State Water and Sanitation Project proves that support of geophysical surveys (resitivity method) is fundamental for a successful drilling operation, and that boreholes in the area should be shallow (maximum 50m) as deeper boreholes do not substantially add to borehole yields and may even strike brackish water.

The foregoing indicates that potentially relatively small drilling equipment could be used. For planning purposes however the cost of conventional drilling equipment has been taken.

CAPITAL

	Units	1989	1990	1991	1992	1993	TOTAL
Workshop	3	300	-	-	-	-	300
Trucks	26	2,210	-	-	-	-	2,210
Drilling Rigs with Compressors and Accessories	13	5,200	-	-	-	-	5,200
L. Vehicles	2 x 30	450	-	-	450	-	900
Handpumps	5 x 60	960	960	960	960	960	4,800
PVC Casing	5x10,880	490	490	490	490	490	2,450
	Subtotal	9,610	1,450	1,450	1,900	1,450	15,860

RECURRENT

	Units	1989	1990	1991	1992	1993	TOTAL
Spare parts	10%/yr.	900	900	900	900	900	4,500
Others (Salaries, Allowances, Fuel, Consumables, etc.)		2,000	2,000	2,000	2,000	2,000	10,000
	Subtotal	2,900	2,900	2,900	2,900	2,900	30,360
TOTAL		12,510	4,350	4,350	4,800	4,350	**30,360**

4.3 Health Education/Distribution of Nylon Monofilament

The use of health education, focussing on the cause, prevention and treatment of Guinea worm concurrently and the distribution of nylon monofilament for household filtration of raw water, until clean water is made available to the community, could be very effective. This type of intervention could, in fact, reduce the incidence of Guinea worm, prior to the provision of water supply to the target population, at a cost of US$2.0/person.

CAPITAL

	Units	1989	1990	1991	1992	1993	TOTAL
L. Vehicles	2 x 3	45	-	-	45	-	90
	Subtotal	45			45		90

RECURRENT

	Units	1989	1990	1991	1992	1993	TOTAL
Monofilament		600	600	600	600	600	3,000
Spare parts	10%/yr.	4	4	4	4	4	20
Others (Salaries, Allowances, Fuel, Consumables, etc.)		4	4	4	4	4	20
	Subtotal	608	608	608	608	608	3,040
TOTAL		653	608	608	653	608	3,130

4.4 Chemical Treatment of Traditional Water Sources (Est. 8000 Ponds)

The use of chemicals to treat contaminated water sources can also be effective as a complimentary control measure in the initial period. The disadvantage of this method is that treatment should be undertaken periodically, it is therefore considered as useful during a limited period of time. At only US$0.3/person this intervention can be very cost effective.

CAPITAL

	Units	1989	1990	1991	1992	1993	TOTAL
L. Vehicles	2 x 3	45	-	-	45	-	90
	Subtotal	45			45		90

RECURRENT

	Units	1989	1990	1991	1992	1993	TOTAL
"Abate type" chemicals		70	70	70	70	70	350
Spare parts	10%/yr.	4	4	4	4	4	20
Others (Salaries, Allowances, Fuel, Consumables, etc.)		4	4	4	4	4	20
	Subtotal	78	78	78	78	78	390
TOTAL		123	78	78	123	78	480

4.5 Community Education and Mobilization

At a cost of US$0.6/person, it would be desireable to use billboards and radio as a means to support health education and the creation of awareness about Guinea worm. Furthermore, this would foster community participation and ultimately prepare the population to possibly contribute, if only partially, to the cost of the programme, notably the maintenance of water supply schemes.

CAPITAL

	Units	1989	1990	1991	1992	1993	TOTAL
L. Vehicles	2 x 3	45	-	-	45	-	90
	Subtotal	45			45		90

RECURRENT

	Units	1989	1990	1991	1992	1993	TOTAL
Billboards (Wood, paper, ink and publishing)	1000	150	150	150	150	150	750
Radio	10	10	10	10	10	10	50
Spare parts	10%/yr.	4	4	4	4	4	20
Others (Salaries, Allowances, Fuel, Consumables, etc.)		4	4	4	4	4	20
	Subtotal	168	168	168	168	168	840
TOTAL		213	168	168	213	168	930

5.6 Sanitation

Although excreta disposal per se has no connection with Guinea worm disease, its inclusion in the programme package is strongly recommended. The justification for this is based on the fact that dehydration caused by diarrhoea, which in turn is strongly linked to poor sanitation, is in Nigeria, the second biggest infant killer after malaria. The integration of sanitation comprising of environmental, household and personal hygiene in addition to excreta disposal, integrated with adequade quality and quantities of water supply can reduce diarrhoea caused morbidity rates among young children by up to 32 % [9].

The sanitation component would involve the construction of demonstration "ventilated improved pit" (VIP) latrines concurrently to the training of village artisans and establishment of slab construction units on a revolving fund basis. The "per capita" cost of this intervention would amount to US$0.8 which represents only 3.5% of the total programme package!

CAPITAL

	Units	1989	1990	1991	1992	1993	TOTAL
Vehicles	2 x 8	120	-	-	120	-	240
	Subtotal	120			120		240

RECURRENT

	Units	1989	1990	1991	1992	1993	TOTAL
Building materials	1500 compts/yr.	150	150	150	150	150	750
Training materials	1000 artisans/yr.	10	10	10	10	10	50
Spare parts	10%/yr.	12	12	12	12	12	60
Others (Salaries, Allowances, Fuel, Consumables, etc.)		33	33	33	33	33	165
	Subtotal	205	205	205	205	205	1,025
TOTAL		325	205	205	325	205	1,265

5.7 Total Programme Expenditure

	1989	1990	1991	1992	1993	TOTAL
Water Supply	12,510	4,350	4,350	4,800	4,350	30,360
Health Education/Filament	653	608	608	653	608	3,130
Chemical Treatment	123	78	78	123	78	480
Community Educ. & Mob.	213	168	168	213	168	930
Sanitation	325	205	205	325	205	1,265
GRAND TOTAL	**13,824**	**5,409**	**5,409**	**6,114**	**5,409**	**36,165**

The total "per capita" cost of this proposal amounts to US$22.7 distributed as indicated in Table 5:

Table 5: "Per Capita" Cost of Interventions

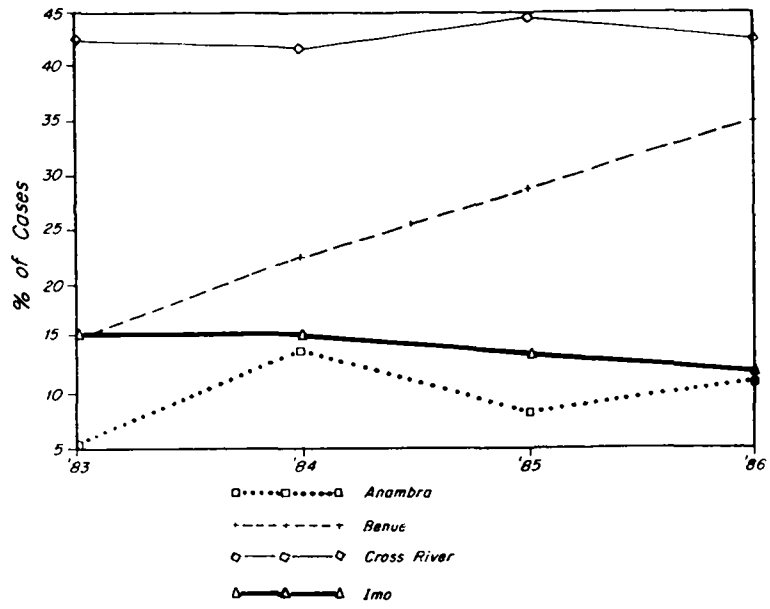
Type of Intervention	US$/capita
Water Supply	19.0
Health Education & Distribution of Monofilament	2.0
Chemical Treatment of Traditional Sources	0.3
Programme Suport Communication	0.6
Sanitation	0.8
TOTAL	22.7

5. Guinea Worm Eradication; Investment and Economic Benefits

5.1 Past Experience in Nigeria

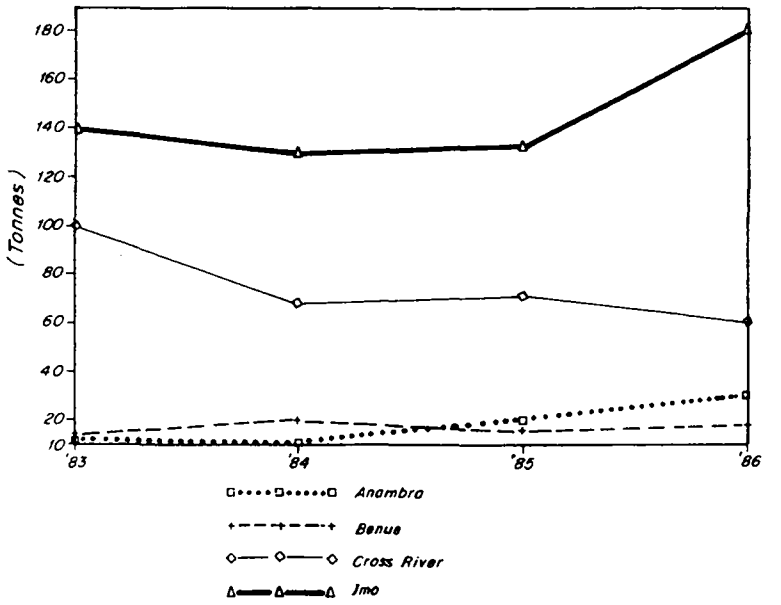
Figures 9 and 10 show, for the 87 households surveyed in 4 States, the number of subjects who admitted previous cases of Guinea worm and the amount of rice harvested per State respectively, over the period of 1983 to 1986.

Figure 9: Admitted Cases of Guinea Worm Infection
(In 87 Households of Anambra, Benue, C. River and Imo States)



From figure 9 it can be seen that there has been a gradual but steady decline of % Guinea Worm Cases reported for Imo State since 1984. Data which is not shown here, indicated a further drop from 12 to 6% for 1987. Meanwhile there is no such clear trend, indicating a gradual Guinea worm reduction for the other States. The most probable explanation for this contrast is that one of the two LGA's surveyed in Imo (Ohaozara) has been served with over 200 handpump equipped boreholes since 1983. Ohaozara was the most highly Guinea worm endemic LGA in Imo State.

Figure 10: Rice Harvested
(In 87 Households of Anambra, Benue, C. River and Imo States)



As a result of the reduction of prevalence of Guinea worm in Imo State (Fig. 9), a significant increase in rice production occurred in 1986 as indicated in figure 10. No such trend is visible in the other states which did not, during this period, similarly benefit from successful rural water supply schemes.

From the foregoing it can be concluded that improved rural water supply reduces the incidence of Guinea worm which in turn has a substantial impact on upon rice production in this area and on agriculture in general.

5.2 Benefits of Guinea Worm Control

The introduction of the various proposed interventions simultaneously could gradually, over a five year period, lead to the reduction of the present 11.6% man-days lost to Guinea worm, which translate into US$50,482,703 worth of rice produced (Table 2). Assuming that:

a) All the additional rice produced is sold;

b) Profit on rice sales is kept at the current 42%;

c) Additional profits increase at a rate of 20%/year until the full recovery of man-days lost to Guinea worm after a period of 5 years.

The additional profits on rice sales could potentially reach 42% of US$50,482,703 which amounts to US$21,202,735, (approximately US$20 million/year). At an annual increment of US$4 million, due to the gradual reduction of man-days lost to Guinea worm from 11.6% to 0%, that level of profits would be reached 5 years after the beginning of intervention, as shown in figure 10.

Figure 11: Proposed Annual Investment and Expected Economic Benefits

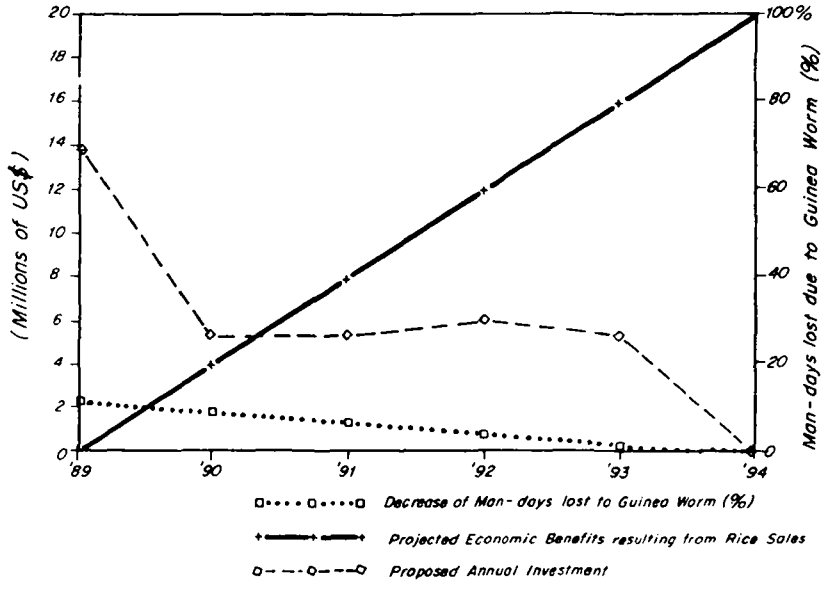
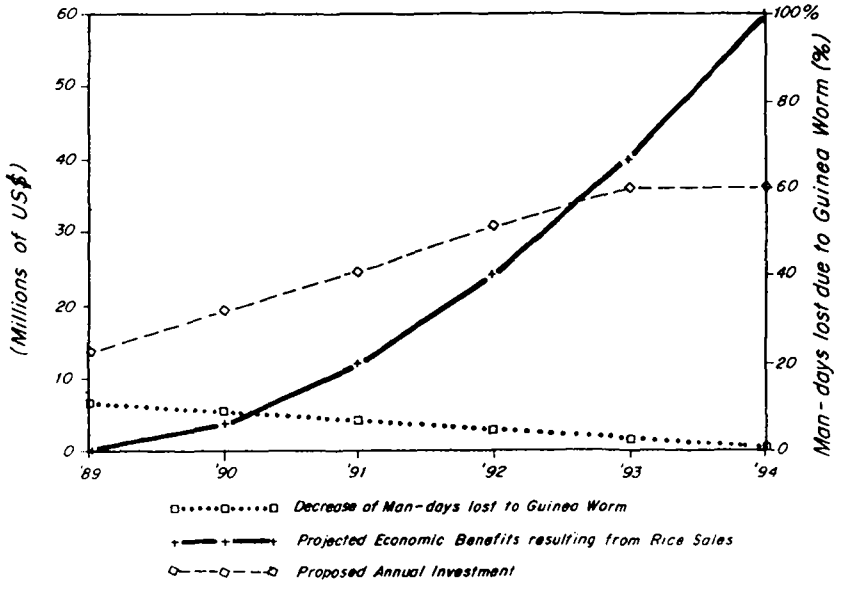


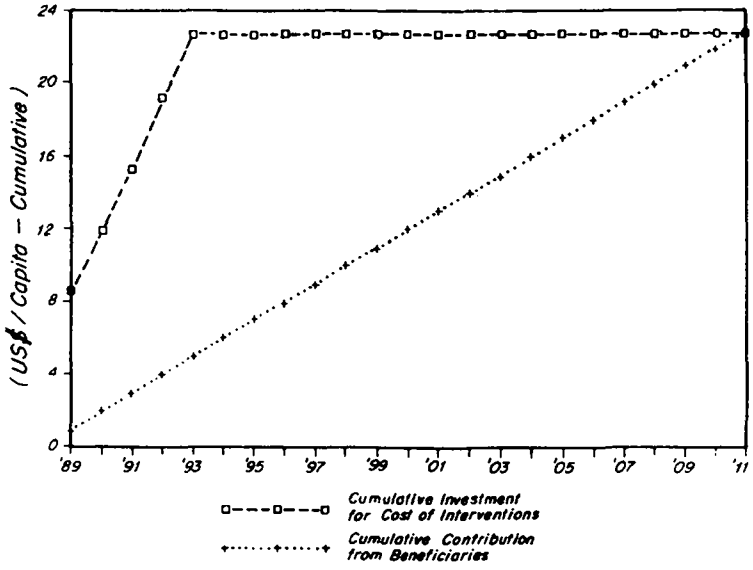
Figure 11 shows that only 4 years after the start of the programme, economic benefits will have superseded the total cost of interventions.

Figure 12: Proposed Cumulative Investment and Expected Economic Benefits



6. Potential for Cost Recovery

Figure 13: Projected Cost Recovery
(At a taxation rate of US$1/capita/year)



The foregoing figures regarding the estimated economic benefits resulting from the introduction of the proposed interventions, make it clear that, at least financially, there is a potential for cost recovery:

> The total cost of interventions is in the order of US$22.7/capita while additional profits resulting from increased sales of rice could amount to US$12.5/capita/year.

At a taxation rate of US$1/capita/year, which would commence at 40% of "additional profits" (20% of US$12.5 = US$2.5) at the end of the first year of implementation but gradually level off to only 8% (US$1 is 8% of US$12.5) after the fifth year, the intervention costs could be recovered in a period of 23 years as shown in figure 13.

7. Conclusion

The data from this study demonstrate that the eradication of Guinea worm can rapidly increase agricultural production. The conclusions from the analysis were deliberately conservative and since it was based on rice alone, it should be even more beneficial if allowance is taken of other crops (yam, cassava, palm produce, soya beans etc.) which are also produced and sold in the area. Furthermore, analysis not detailed in this submission has shown that in Anambra State only 25% of the land suitable for rice production is currently being used. Based on this figure, one can presume that rice production could potentially be expanded by at least 100%. It is estimated, therefore, that an additional 0.5 - 1 million people could become actively involved in rice cultivation - while potentially, 20,000 direct jobs could be generated in the rice processing industry.

In general, this document indicates that:

- Guinea worm is a debilitating disease which imposes adverse effects on the health and economy of rural populations.

- The disease is easily eradicable by a combination of intervention strategies costing an estimated US$22.7/capita of which the provision of clean drinking water is the most effective. This has been demonstrated by the UNICEF-Assisted Kwara State Water and Sanitation Project which has reduced the prevalence of Guinea worm from 60% to 11.3% in Asa LGA (intervention population of 35,000) within a period of three years.

- The eradication of this disease in the proposed intervention area will at least, double agricultural productivity and raise the overall quality of human life. This is substantiated by the experience in Imo State where findings show that there was an increase of US$70 per capita in rice production three years after UNICEF-Assisted Imo State Water and Sanitation Project initiated the provision of potable water supply.

- Potentially, an additional 500,000 to 1,000,000 jobs could be created in the intervention area on rice production alone.

- Given the projected increase of an annual profit of US$20 million as a result of the proposed interventions estimated at US$36.2 million, there is a potential for cost recovery.

Additionally it must be stressed that in Imo and Cross River States, UNICEF - assisted Water and Sanitation Projects already exist, while in Anambra State assistance will initiate in 1988. These projects are multidisciplinary, established with the capacity to undertake community mobilization, health education, sanitation and water supply, covering on average a rural population of 50,000 people per annum. Typically staff strength is in the order of 100 to 150 people with different professional backgrounds seconded from State Ministries, and the Projects are managed by State appointed Project Managers who report directly to the Governor's Office. UNICEF initially provides capital inputs such as vehicles, drilling rigs (2) and workshop equipment, and during a period of 3 to 5 years gives technical support focussed on strengthening of institutional capacity and technology transfer. Given the foregoing, the institutional base and experience already exists to undertake the services proposed in this document. All that is required is expansion of the Projects' capacities.

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