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Blue Nile Health Project

annual report

1982

ministry of health sudan

BLUE NILE HEALTH PROJECT

1982 ANNUAL REPORT

MINISTRY OF HEALTH

SUDAN

WATER AND HEALTH - IN THE IRRIGATED SCHEMES OF THE SUDAN THE HEALTH OF AGRICULTURAL COMMUNITIES IS CLOSELY LINKED TO WATER-THE PRINCIPAL FOCUS OF THE BLUE NILE HEALTH PROJECT.

PREAMBLE FOR 1982 ANNUAL REPORT

The Sudan has colossal opportunities for development of agriculture and livestock, thus several dams have been built for storing and supplying water to irrigation systems. The economic justification for this development of water resources is beyond argument due to the need to meet growing demands for food, export crops, and also energy. However this same development has led to great modifications in the environment which favoured the spread and multiplication of aquatic snails and mosquitos and produced dramatic increases in prevalence of diseases such as schistosomiasis and malaria. In the National Health Programme, malaria, schistosomiasis and diarrhoeal diseases lie at the top of the list of priorities and certainly they are the major public health problems in the Central Region. In addition they are thought to be responsible for lowering the work capacity of the farmers and consequently in lowering agricultural productivity. Thus control of these diseases must accompany development of water resources in the Sudan.

The Blue Nile Health Project, which became operational in the Central Region in 1980 aims at control and prevention of the water associated diseases, malaria, schistosomiasis and diarrhoea, in the Rahad and Gezira schemes. This report indicates that significant advanceshave been made since the Project's establishment both in preventing transmission of schistosomiasis in the newly established Rahad scheme and in keeping malaria under control in both schemes. The Project has also managed to strengthen health services by training malaria and sc[illegible] facilities such as vehi[illegible], the Project is planning f[illegible]mental management, biological control, rehabilitation of water supplies, and sanitation. The final comprehensive strategy will develop from research activities concurrently being conducted in the Study Zone in the northern part of the Gezira scheme.

I am pleased to note that the efforts of the workers in the Project, as shown in this Annual Report, are appreciated by the communities and the authorities in the Central Region. This is clearly reflected in the participation of the communities in the recent malaria campaign. Furthermore the Project is becoming a focus of attention for many scientists throughout the world, several of whom visited the Project this year. Also there has been close collaboration with many local institutions such as the Universities of Gezira and Khartoum, the National Research Council and other Ministries.

I would like to take this opportunity to congratulate the management and the workers in the Project, wishing them all the best.

H.E. DR. MUTAMID AHMED AMIN
REGIONAL MINISTER OF HEALTH
CENTRAL REGION

LOCATION OF BLUE NILE HEALTH PROJECT

IN AFRICA

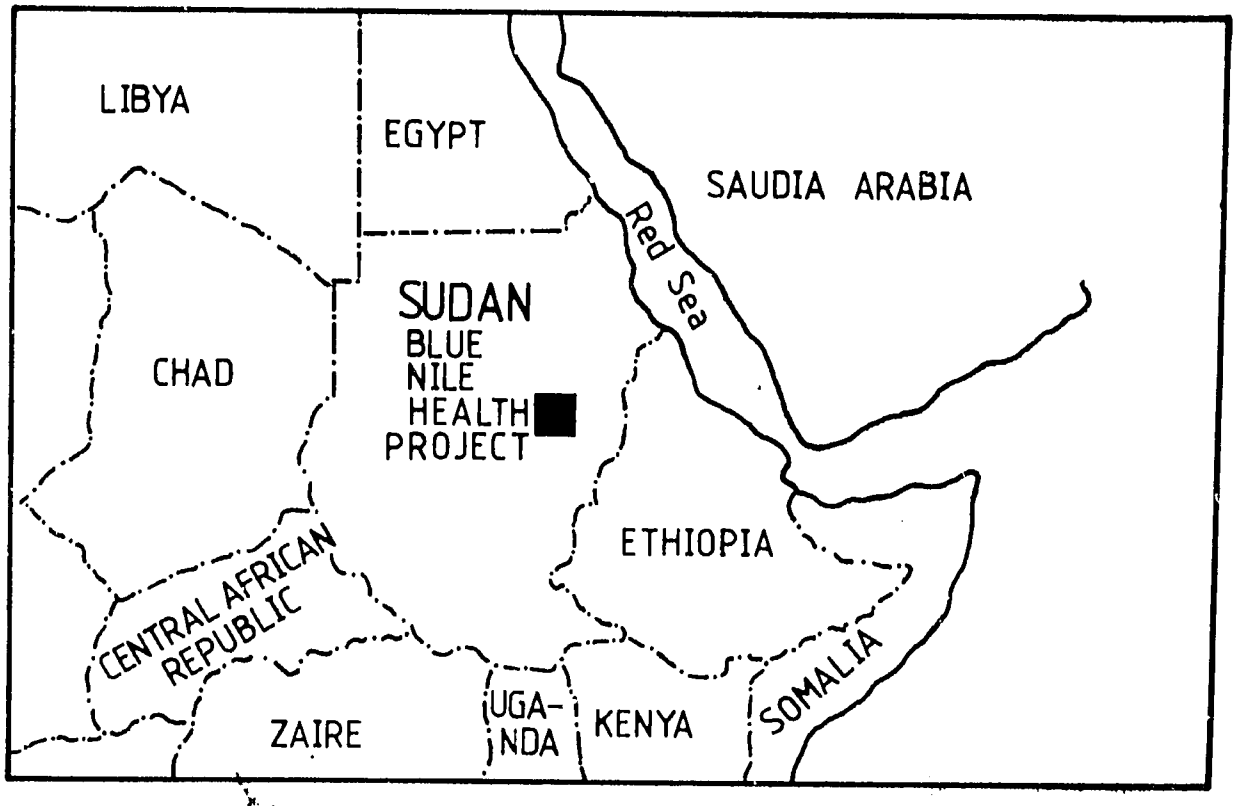

Figure (1)

DEDICATION

This Annual Report is dedicated to our two esteemed colleagues, Osman Bakri El Gammaz and Rashed Bahar, who helped us establish the Blue Nile Health Project and have now been promoted to other posts. Sayed Osman established and managed the original Administration Unit until he was named Commissioner of the Northern Province by the President of the Republic. Engineer Rashed Bahar was one of the original promoters of the Project for the Eastern Mediterranean Regional Office of the World Health Organization and has continued his support in many ways even after his transfer to the WHO Office in Geneva, Switzerland. We are especially grateful to both of them for their patience and constant good humour.

We note with deep regret the recent deaths of three companions closely connected with the project, Dr. A.H. Taba, who had been Director of the Eastern Mediterranean Regional Office for more than twenty years and who established the Project, and also Mr. Salah Younis, and Mr. Marhoum Rahmatalla of Wad Medani.

DR. AHMED AYOUB EL GADDAL
PROJECT MANAGER

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CHAPTER I

HIGHLIGHTS

The following highlights were summarized from this 1982 Annual Report. The report is organized into chapters on administration, on each of the three operational Zones, on research findings, on an overview of the project status, and on future plans:

1. The Project became fully operational with senior staff in all units, and adequate financial support for current activities.

2. The Trial Strategy for control of all three water-associated diseases was initiated in the Study Zone in June, after more than a year of observations on transmission patterns.

3. Prevalence of schistosomiasis in the Rahad Zone was maintained below 10% but there were indications of transmission in 2 of the 46 villages.

4. Malaria was maintained under good control in all three zones. The prevalence was brought below the target level of 1% for the first time since the Project began, partly due to dry weather.

5. Community Participation began on a large scale with formation of 31 village health committees and their active participation in efforts against diarrhoeal diseases, community spraying of houses against mosquitos, and participation in a mass chemotherapy campaign against schistosomiasis.

6. Epidemiological surveys indicated that schistosomiasis transmission in the Managil area is significantly greater than in the rest of the project, with an incidence twice as high as that observed in the Study Zone.

7. Major contributions were received from several donors, including the first distribution of food from the World Food Programme, additional pesticides from the government of Japan, and supplies and equipment from the government of the U.S. of America and from the World Health Organization.

8. A production unit was established in Hasaheisa for concrete latrine slabs to be used in the Study Zone.

9. A major pilot study on mechanical control of aquatic weeds was completed in the Managil area, and the machinery moved to the Study Zone to take part in the Trial Strategy. Economic analysis of the pilot study indicated the cost of the machinery would be quickly repaid through improved crop yields and savings in the current dredging expenses.

10. Large amounts of oral rehydration salts were distributed in the Study Zone and in the Rahad Zone as the first direct attack against diarrhoeal disease.

11. Paramedical and community personnel were trained in the use and promotion of oral rehydration salts as well as in the epidemiology and control of schistosomiasis.

12. Analysis of research activities indicated there has been a concentration on conventional methods, and there is a need to increase research on low-cost control methods.

CHAPTER II

MANAGEMENT, ADMINISTRATION AND FINANCE

The project expansion continued as Sudan government expenditures increased to LS.9.8 million Sudanese pounds in 1982, compared to pre-project expenditures in 1978 of LS.3.3 million (Table 1). Outside contributions in 1982 rose markedly from the previous year to $ 3.3 million, giving a total expenditure of $ 14.1 million using the 1982 official exchange rates.

The second Japanese grant for malaria control in the Gezira was approved. The amount of the grant was 400 million Yen, equivalent to about $ 1,650,000. The entire 200 ton shipment of the insecticide fenitrothion authorized in this second grant was received and placed in protected storage. The remainder of the supplies were expected in early 1983.

The submission for the third malaria control grant has been forwarded to the Government of Japan. This time the submission covered the adjacent Provinces of Khartoum, Blue Nile, and White Nile since the control in these three provinces should provide a barrier zone around the Gezira (Figure 2). Funds for the improvement of the malaria Training Centre in Sennar were also requested under this grant.

Regular food distribution under the first World Food Programme quick-grant began in June to about 1,000 Project employees. The major W.F.P./B.N.H.P agreement to cover the next four years was finalized by both parties, and the documents prepared for signature during the first week of January 1983. The total value of the Grant is about $ 6,625,000.

There were several major personnel developments. Mr. Osman Bakri El Gammaz, Director of Administration and Finance was appointed by the President of the Republic as Commissioner for the Northern Province of the Sudan. Prof. M.S. Rao was appointed by USAID as Biostatistician to the Project in July 1982. He arrived in Khartoum the 31st of August 1982 on a two year contract. Dr. Abdel Rahman Kheiri was appointed as Director of the Statistics Unit, and as counterpart to Dr. Rao. The

TABLE 1

PROJECT EXPENDITURES FOR 1982

(see appendix C for details)

I. Government Expenditures in Sudanese Pounds

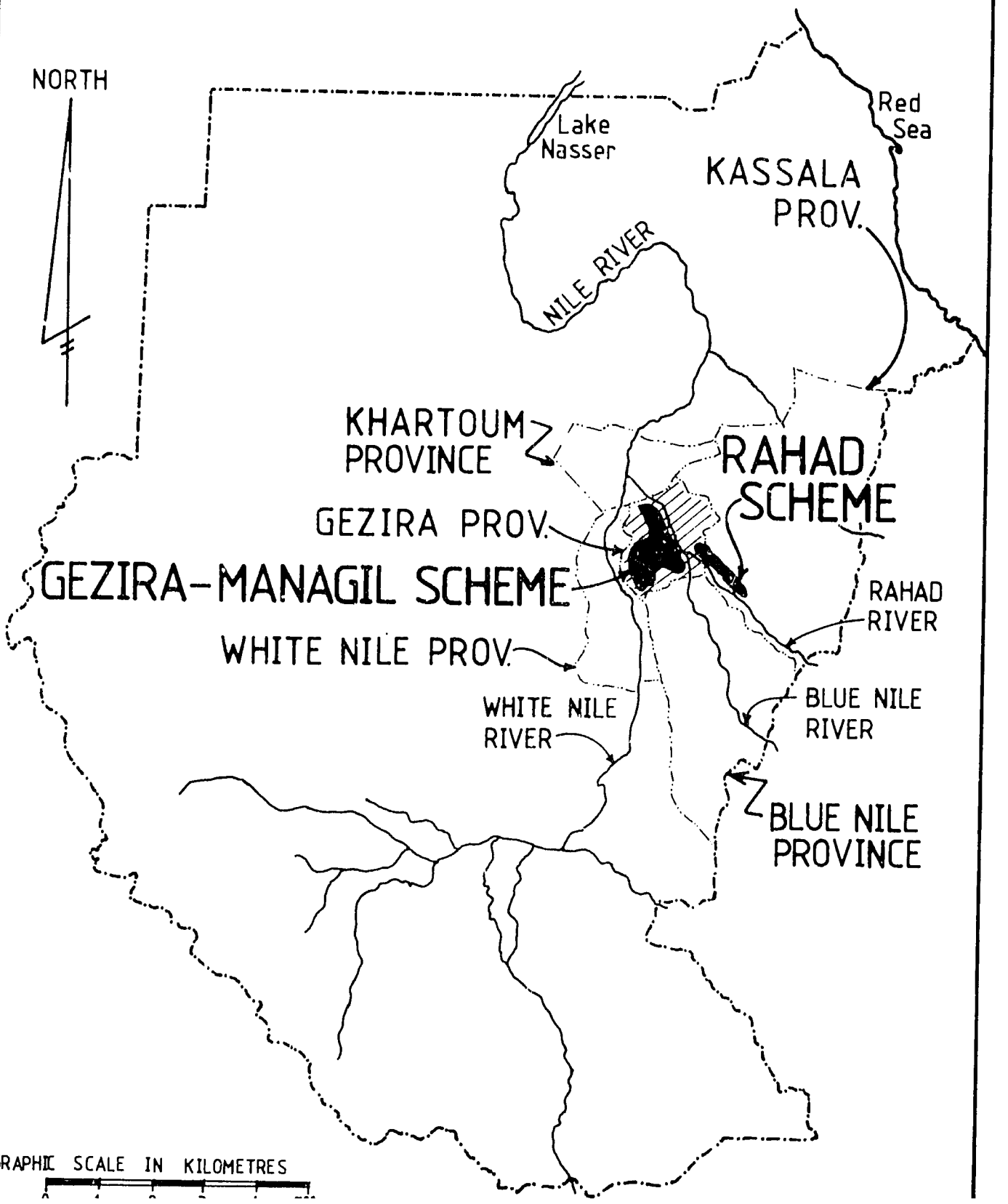
MINISTRY OF HEALTH	£ 1,165,608
REGIONAL WATER ADMINISTRATION	£ 2,411,828
MINISTRY OF IRRIGATION	£ 5,900,000
RAHAD CORPORATION	£ 314,691
NATIONAL COUNCIL FOR RESEARCH	£ 12,960
GOVERNMENT SUBTOTAL in pounds	£ 9,805,087
At official exchange rate in Dollars	$10,894,541
one US dollar equal 0.9 Sudanese Pounds	

II. Outside Sources in U.S. Dollars:

Japan	$ 1,650,000
U.S. of America	$ 746,667
World Food Programme	$ 345,000
Kuwait	$ 261,452
Great Britain	$ 100,000
World Health Organization (EMRO)	$ 100,000
(TDR)	$ 15,000
E.M. Clark Foundation	$ 30,000
U.N. Environment Programme	$ 6,589
Outside sources subtotal	$ 3,254,708
GRAND TOTAL IN US DOLLARS	$14,149,249

Figure (2) MAP OF THE SUDAN

SHOWING THE PROVINCES & IRRIGATION SYSTEMS OF THE BLUE NILE HEALTH PROJECT



Overseas Development Administration of the British Government agreed to extend the contract for Dr. Alan Fenwick, parasitologist, to work with the Research and Training Unit for two more years, from 1983.

Considerable progress was made in terms of buildings and major items of equipment:

1. Buildings
   a. The stores for insecticides, equipment and vehicle spare parts were completed.
   b. A fourth senior house in Barakat was nearly complete.
   c. The construction of two more senior houses and two rest houses was approved.

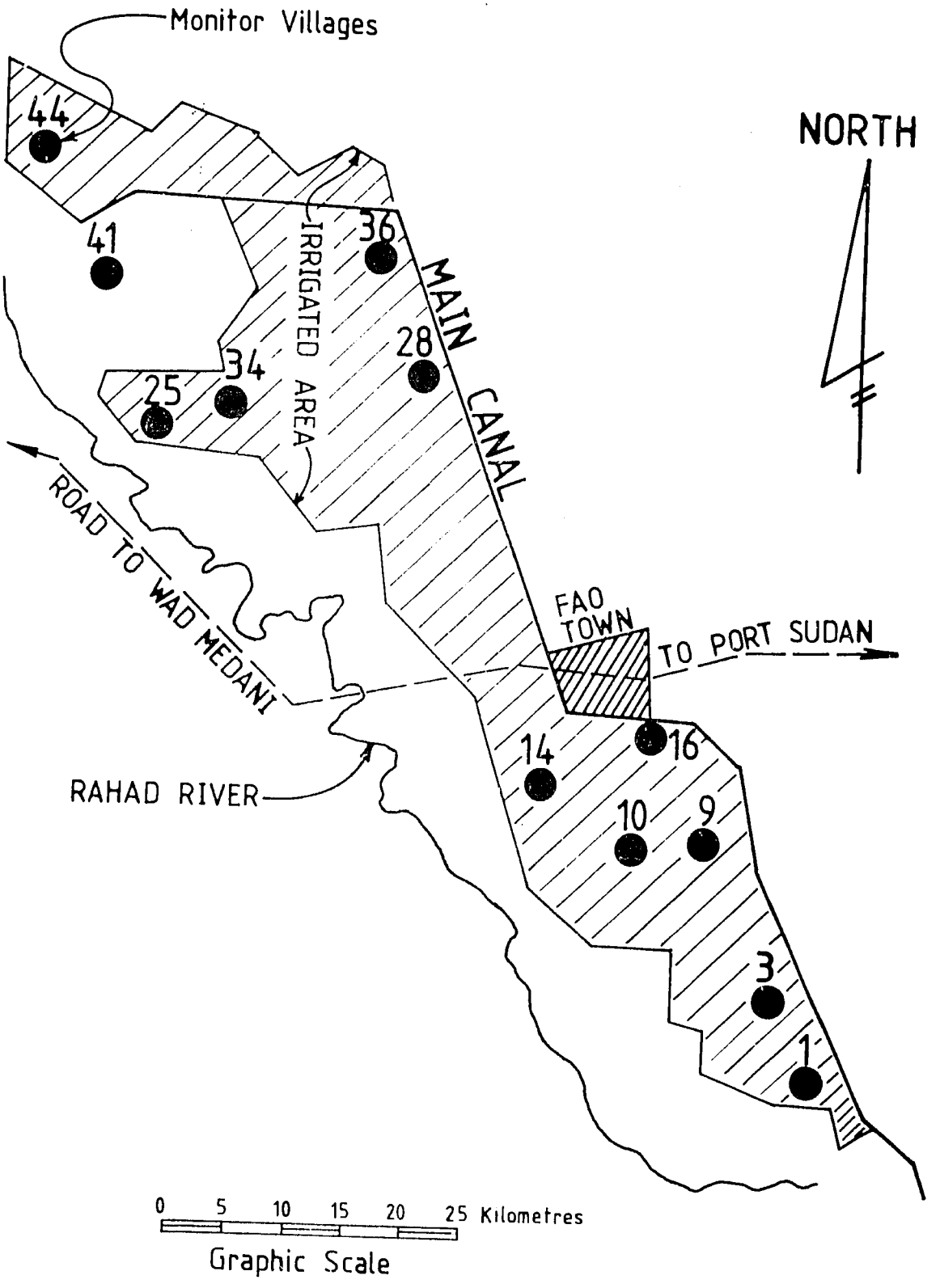
2. Transport
   Thirty Suzuki Jeeps and 6 Station Wagon Land Cruisers were received from WHO.

3. Equipment and Supplies (See Appendix D)
   We received by the end of December 1982, the first shipment of supplies and equipment from the USAID Grant, and numerous consignments from WHO and UNEP.

Monthly staff meetings have become an integral and important part of the management system, regularly attended by 20 to 30 staff. They allow the staff to contribute to decisions, ensure that programmes and activities are well understood, and contribute to staff cooperation and morale.

Five hundred copies of the 1981 Annual Report were distributed in August 1982 to interested persons and agencies. Since the report is the primary source of information and reporting for the various donor agencies and scientific supporters of the Project, the demand has risen each year and it is anticipated that 700 copies of this 1982 Report will be distributed.

CHAPTER III THE RAHAD ZONE



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THE RAHAD ZONE

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CHAPTER III
THE RAHAD ZONE

The Rahad Zone of the Blue Nile Health Project is the new Rahad Irrigation Scheme East of Wad Medani, on the eastern bank of the Rahad River (Figure 2). Activities were initiated in the Rahad Zone in 1978 as soon as the new irrigation system began operating, and in 1980 an extra emergency effort was mounted to prevent any transmission of schistosomiasis. This activity continued through 1982.

In 1982 the Rahad Zone population was about 80,000 people, living in 46 registered villages and Fau Town. Expansion of some villages took place during the year as new settlements of immigrants were established, particularly in the Northern Division (Villages 23 to 46). Apparently the prosperity and economic activity following inception of the scheme attracted the new settlers, but as the villages increased in size, expansion was towards the nearby canals, until houses were being built only a few meters from the water. Meanwhile communal latrines broke down in all villages and were demolished leaving the nearby canal banks as the direct alternatives for defecation and urination.

Project activities in the Rahad Zone continued as in 1981 with emphasis on suppression of schistosomiasis transmission, training of paramedical staff in the use of Oralyte Rehydration Salts (ORS) for controlling diarrhoeal diseases among children, and distribution of ORS in Fau Town hospital and in the newly constructed hospitals in Villages 23 and 40. Training was given to new microscopists in schistosomiasis and malaria diagnosis to run the laboratories in these new hospitals and to establish a schistosomiasis surveilance programme. The malaria control programme continued and more microscopists were trained. Designs were completed for improvement of village water supplies and partial funding was obtained.

Health Services

Curative health services were delivered by the following institutions:

- 3 hospitals; one in Fau Town with 70 beds, run by 3 Medical Officers, the other two in villages 23 and 40 respectively each with 20 beds and one Medical Officer.

- One health centre

- 7 dispensaries

- 30 dressing stations

- 8 Primary Health Care Units

Man-power: 5 doctors, 11 medical assistants and 41 nurses.

A. EPIDEMIOLOGY

1. Diarrhoeal Diseases:

Due to the expansion of villages with continuing immigration and new settlements distributed mainly near canal banks, the environmental sanitation deteriorated. A second social survey was carried out in the monitor villages for compiling diarrhoeal disease data from health centres and to assess the possibility of training educated people in the use of ORS. Unfortunately illiteracy was still dominant, mainly due to the nomadic nature of the population and so it was decided to train only paramedical staff until an intensive health education and community participation programme can be organized in the near future. Therefore 50 paramedical staff of different categories including medical assistants, nurses, midwives, and traditional birth attendants were trained in the use of ORS, and a total of 50,000 ORS sachets were distributed to them.

Considerably more effort must be exerted in the fields of health education and community participation to encourage installation

of latrines which are nearly non-existent in most of the villages. Training of females in maternal and child care practices, with involvement of adult education social workers, and medical students from the Faculty of Community Medicine, University of Gezira, improvement of environmental sanitation and water supply and intensive oral rehydration therapy programme for the control of diarrhoeal diseases are going to be intensified.

2. Schistosomiasis:

The epidemiological activities covered the following aspects of schistosomiasis prevention:-

a. Training of more microscopists in schistosomiasis diagnosis to establish a surveillance system.

b. Establishment of schistosomiasis laboratories in the new hospitals in village 23 and 40.

c. Supplying praziquantel to the 3 hospitals in the Rahad Zone for prompt treatment of newly discovered cases with a proper reporting system of cases by place of migration, age, sex, occupation and permanent residence by villages.

d. The third annual survey in the schools surveyed in 1980, and the second annual survey in 8 schools established in 1981, plus first annual survey in newly established schools and additional classes.

e. A third annual survey in the original 8 villages selected in 1980, and the second annual survey in the 4 monitor villages randomly selected in 1981, in the northern division (dropped this year due to very poor response).

f. Special epidemiological survey in villages 27 and 30.

RESULTS

a. Improved Diagnosis

To strengthen the laboratory services in the Rahad Zone 5 microscopists were recruited and trained in the diagnosis of schistosomiasis

FIGURE 3

An important component of project activities is orientation for health personnel from nearby countries with similar problems. The government of the Kingdom of Saudia Arabia sent Mr. Abdullah Hazan to learn of the schistosomiasis programme. He spent considerable time in the Rahad Zone surveying snail populations in the irrigation canals.

and malaria. Two of them were stationed in the new hospitals in villages 23 and 40 where new laboratories have been established.

In the 3 hospitals in the Rahad Scheme a system was developed for recording schistosomiasis cases and their treatment, with a copy sent to the Epidemiology Unit in Wad Medani. In its turn the Project ensured that the 3 hospitals maintained adequate supplies of praziquantel for treatment (Table 2).

In fact the availability of the praziquantel drug in the three hospitals of the Rahad Zone, the only health facility in the whole country having this drug, attracted many patients from different parts of the Sudan to the area seeking treatment.

b. School Children:

The Rahad Scheme has been divided administratively into northern and southern divisions. The prevalence of schistosome infection in children from the northern division was higher (10.5%) compared with the southern division which was 9.4% (Tables 3 and 4).

The highest prevalence was also found in school children aged 12 years in both divisions as it was in the previous two years (Figure 4, Table 5). The predominant infections in children were *S. mansoni*. (Details in Appendix L).

The incidence of infection among school children was calculated from a cohort analysis of 2458 children who were found uninfected in 1981. New school children examined for the first time were not included. Out of the 1981 cohort 238 children were found to be infected in 1982, an incidence of 9.7% (Table 6). The incidence was higher than last year (1.4%), probably due to huge movements of children during the school vacation to villages in the Gezira or Managil area, known to be endemic for schistosomiasis. Out of 269 who were positive in 1981 and

TABLE 2

MONTHLY EXAMINATIONS FOR SCHISTOSOME INFECTIONS IN PATIENTS ATTENDING FAU HOSPITAL IN THE RAHAD ZONE, 1982

MONTH	EXAMINED	POSITIVE			POSITIVE
		S. MANSONI	S. HAEM.	TOTAL	
January	53	16	12	28	52.8%
February	13	6	4	10	76.9
March	55	20	8	28	50.1
April	132	21	31	52	39.4
M a y	313	65	34	99	31.6
June	151	35	18	53	35.1
July	100	22	7	29	29.0
August	168	52	22	74	44.1
September	110	13	8	21	19.1
October	116	20	21	41	35.4
November	163	15	20	35	21.5
December	158	44	16	60	38.0
T O T A L	1532	329	201	530	34.6%

TABLE 3

PREVALENCE OF SCHISTOSOMA MANSONI IN SCHOOLS, NORTHERN DIVISION VILLAGES, RAHAD ZONE, 1982

VILLAGE	EXAMINED			POSITIVE			PREVALENCE
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
23	181	77	258	31	18	49	20.0%
24	122	34	156	22	7	29	18.6
25	55	19	74	4	0	4	5.4
27	222	65	287	91	19	110	38.0
33	176	57	233	41	15	56	24.0
37	72	19	91	17	2	19	2.0
40	84	34	118	12	3	15	12.7
41	93	39	132	0	0	0	0.0
42	85	11	96	1	0	1	1.0
44	416	301	717	3	1	4	0.6
45	99	61	160	0	0	0	0.0
46	249	273	522	7	6	13	2.5
TOTAL	1854	990	2844	229	71	300	10.5%

TABLE 4

PREVALENCE OF SCHISTOSOME INFECTION AMONG SCHOOL CHILDREN BY SCHOOL NO, SOUTHERN DIVISION VILLAGES, RAHAD ZONE, 1982

SCHOOLS	EXAMINED			POSITIVE			PREVALENCE
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
EL FAU	240	263	503	47	16	63	12.5%
1	161	78	239	2	0	2	0.8
2	206	111	317	1	0	1	0.3
3	213	138	351	6	6	12	3.4
4	87	22	109	3	0	3	2.8
5	65	20	85	0	0	0	0.0
6	91	24	115	2	0	2	1.7
7	122	18	140	0	0	0	0.0
8	74	20	94	20	2	22	23.4
9	99	17	116	3	0	3	2.6
10	460	235	695	27	5	32	4.6
11	79	20	99	28	5	33	33.3
12	57	10	67	5	1	6	9.0
13	211	119	330	23	13	36	10.9
14	87	12	99	0	0	0	0.0
15	112	2	114	12	0	12	10.5
16	100	56	156	10	5	15	9.6
18	198	153	351	69	32	101	28.8
19	158	53	211	38	13	51	24.2
TOTAL	2820	1371	4191	296	98	394	9.4%

Figure 4 Age Specific Prevalence Of Schistosomiasis In School Children Of Rahad Zone (1980, 1981 & 1982)

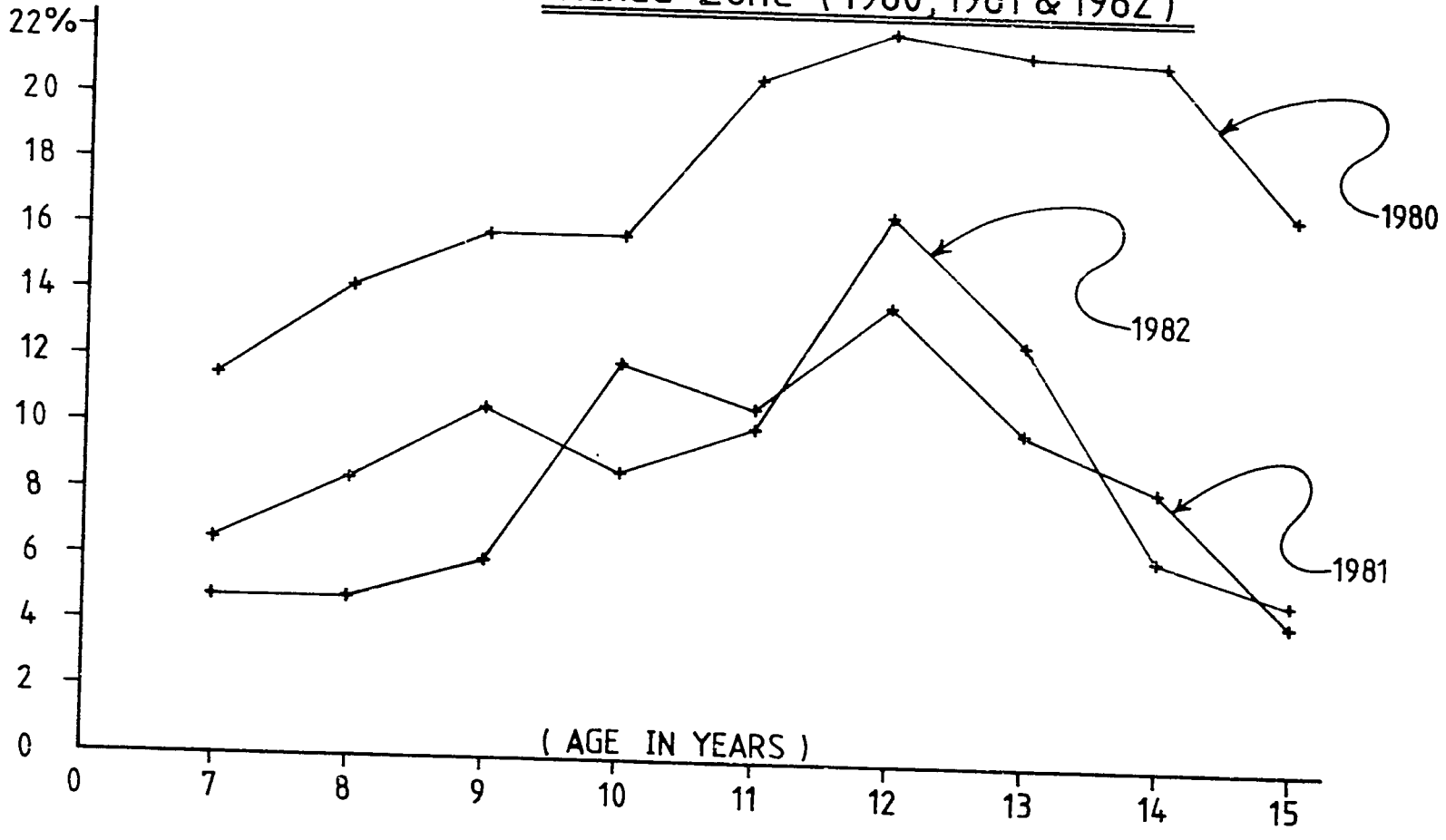


TABLE 5

PREVALENCE OF SCHISTOSOME INFECTION AMONG ALL SCHOOL CHILDREN BY AGE AND SEX, RAHAD ZONE, 1982

AGE	EXAMINED			POSITIVE			PREVALENCE
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
7	562	336	898	36	22	58	6.5%
8	864	429	1293	66	42	108	8.4
9	636	471	1107	83	34	117	10.6
10	463	297	760	51	15	66	8.7
11	554	221	775	65	13	78	10.1
12	609	245	854	120	22	142	16.6
13	549	136	685	73	15	88	12.8
14	191	61	252	13	3	16	6.3
15	246	165	411	18	3	21	5.1
TOTAL	4674	2361	7035	525	169	694	9.9%

TABLE 6

RESULTS OF SCHISTOSOMIASIS SURVEY IN 1980, 1981 AND 1982 ON CHILDREN FROM ORIGINAL GROUP OF SCHOOLS IN FIFTEEN VILLAGES OF THE RAHAD ZONE

PREVALENCE BY SEX

YEAR	SEX	CHILDREN EXAMINED	NUMBER INFECTED	POSITIVE
1980	Male	1978	365	18.5%
1980	Female	922	112	12.1%
1980	Total	2900	477	16.4%
1981	Male	1940	180	9.3%
1981	Female	1194	70	5.9%
1981	Total	3134	250	8.0%
1982	Male	2660	354	13.3%
1982	Female	1428	127	8.9%
1982	Total	4088	481	11.8%

INCIDENCE

1980	Cohort	2430	0	0
1981	Cohort	2430	33	1.4%
1981	Cohort	2458	0	0
1982	Cohort	2458	18	0.7%

received treatment, 44 of them were again positive in 1982 with no significant reduction in intensity of infection. This was either due to reinfection or to children only taking the first dose of the drug (sub-curative dose).

c. Monitor Villages:

During the third annual survey, most of the people selected from the 12 monitor villages refused to cooperate. The response of the persons in the sample was less than 5% compared with 71% and 32% in the years 1980 and 1981 respectively. This poor response was mainly ascribed to the availability of praziquantel and microscopists in the Rahad Zone hospitals which made things easy for complaining individuals to report to hospitals at their own convenience. The poor rate for returned stool containers from the cohort is disappointing, not only as some infected persons would not be detected but also in terms of cost. A trial was initiated to find out whether there is a positive correlation of infection between villagers (adults) and school children so that in the future only school children will be monitored, because the response rate in schools is almost 100%.

This trial is now being carried out in villages 18 and 27, selected from the southern and northern divisions because their water bodies constitute highly potent transmission sites. All school children were submitted to parasitological examination, and a 20% sample was selected at random from the local inhabitants of the village and also 20% from immigrant labourers coming from different parts of the country. These results will be published in the 1983 report.

In view of suspected local transmission in village 27 and the rise of incidence and prevalence among all school children, it is recommended that an overall revision of the original strategy of the Rahad Zone be undertaken to suppress future transmission which might appear in the area due to the following factors:

- Total lack of sanitary facilities
- The huge population movements which makes the zone highly vulnerable to schistosomiasis transmission.
- High concentration of labourers with settlement close to the canals.
- Initial modest chemotherapy policy for residents who were assumed to have generally low prevalences. In some northern villages this turned out to be incorrect.
- The Bayluscide had lost some of its potency after 5 years of storage.

d. Special Epidemiological Survey:

Owing to the reported occurence of new S. haematobium cases in village 30, screening of symptomatic patients was carried out. Thus 282 people claiming to be suffering from haematuria were examined and 153 (54%) were found infected. An intensive epidemiological and social survey was carried out to trace the source of the infections, followed by a health education programme and a mass chemotherapy campaign which covered 355 individuals. It was apparent that most of the individuals found infected in previous surveys had not taken their second dose of praziquantel which was found inside their huts during our house to house survey. Some of them confessed not taking the second dose after the relief of symptoms following the first dose. Intensive snail sampling, conducted along all water bodies, and laboratory examination of collected Bulinus truncatus by crushing under a compound microscope revealed no infected snails.

Another report indicated an increase in schistosomiasis cases in village 27, mainly among school children. The project malacologist was asked to carry out an intensive snail survey. The survey in the village water bodies revealed the presence of infected snails and cercariae after crushing (see snail control). This focal transmission might be attributed to the new expansion and settlements in the village of immigrants from known endemic areas not included in previous surveys, to improper use of focal mollusciciding by the village mollusciciders

in both dosage and application, and to newly identified and therefore untreated contact sites. However the majority of positive persons were proved to have visited known infected areas so the exact source of infection was not determined.

e. Chemotherapy:

An oral dose of praziquantel was given in 2 doses 5 hours apart to all infected school children, with the first dose taken after breakfast in the presence of the project paramedical staff. The chemotherapy covered 694 school children, 355 individuals of different ages in village 30, and 535 individuals at Fau Town hospital.

3. Malaria

Two more malaria diagnostic labs were opened to increase the total number of laboratories to six, and this greatly improved the situation of malaria case detection in the area. A high positivity rate of 5.7% and 6.6% was reported during the months of March and April respectively (Table 7), which corresponded with the end of the cultivation season and cotton picking. However the rate was kept low during the major transmission season, August to December, as a result of house spraying.

Two child parasite surveys were conducted in the monitor villages in January and October. The results again confirmed a low malaria prevalence, 0.5% in January (4/779) and 0.95% in October (11/1157).

B. B I O L O G Y

1. Snail Control

Snail control was greatly intensified this year, since Biomphalaria and Bulinus snails appeared all over the area except in Block 1. A new agricultural area, Block 7 which represents the last block of phase I, was added this year. This area also had high population movement and intensive flow of labourers.

During this year two major operations were carried out, namely

TABLE 7

MALARIA SLIDE POSITIVITY IN RAHAD 1982

MONTH	NO. OF SLIDES EXAMINED	POSITIVE SLIDES	PERCENT POSITIVE
January	559	22	3.9%
February	648	17	2.6
March	1095	63	5.7
April	780	52	6.6
M a y	860	12	1.4
June	828	11	1.3
July	548	6	1.0
August	652	10	1.5
September	561	12	2.1
October	798	41	5.1
November	896	5	0.6
December	355	2	0.5
T O T A L	8580	253	2.9%

blanket mollusciciding during January and February and focal mollusciciding over the rest of the period.

a. Blanket mollusciciding

Blanket mollusciciding was used in canals with heavy snail infestations. Frescon was applied by the drip-feed method, using two drum dispensers and five Hudson sprayers during January. Seven major canals mostly in Block 4 received blanket coverage. An amount of 15,000 litres of Frescon were used in this operation. The total volume of water treated was estimated to be about 10,500,000 cubic meters.

b. Focal mollusciciding

Focal mollusciciding was applied throughout the area, except in Block 1, which has remained free of the intermediate host up to date. Focal application was carried out by two methods, (i) using a mobile team (ii) using resident spray men to cover a specific area.

Mollusciciding was applied to the water contact sites where snails were found during routine monthly snail surveys (Table 8).

Below is a summary of this operation:

Total number of water bodies treated	5099
Amount of Bayluscide used	1133 litres
Normal rate of application	1 litre/750m^3
Volume of water treated	712,300m^3
Actual mean concentration in mg/l	0.4 mg/l

c. Evaluation and snail survey

Block 1 continued to be free of *B. pfeifferi* and *B. truncatus*, for the sixth year since the start of irrigation (Table 9). *B. truncatus* was reported in Block 2 for the first time this year. In the new extension area, Block 7, both *B. truncatus* and *B. pfeifferi* appeared in the canals, but *B. truncatus* was the predominant species and appeared in the ratio of about 3:1 to *B. pfeifferi*.

TABLE 8

FOCAL MOLLUSCICIDING OPERATIONS IN RAHAD WITH BAYLUSCIDE

MONTHS	TOTAL NUMBER OF WATER BODIES TREATED	SCOOPS TAKEN	FOCI WITH SNAILS	AMOUNT OF BAYLUSCIDE IN LITRES	VOLUME OF WATER TREATED IN CUBIC METERS
Jan/Feb/March	1184	33,487	880	402	301,500
April	600	10,427	200	90	67,500
May	136	2,785	66	18	1,350
June/July	815	34,755	386	156	11,700
August	561	13,870	381	92	69,000
September	355	11,030	266	98	63,500
October	533	15,140	275	101	75,750
November	499	12,540	201	82	51,500
December	416	10,750	209	94	70,500
T O T A L	5099	144,784	2864	1133	712,300

TABLE 9

SNAIL SURVEYS CONDUCTED DURING 1982 - RAHAD

BLOCK NO.	BIOMPHALARIA PF.	BULINUS TRUNC.	BULINUS FORSKALLI	MELANOIDES	OTHERS	REMARKS	
						SCOOPS	BAYLUSCIDE IN LITRES
1	0	0	10	2923	270	6,620	15
2	975	868	1279	2023	0	28,330	50
3	1220	106	15164	28461	9641	15,840	32
4	2259	6401	2080	6023	5629	42,027	376
5	278	10853	0	0	0	13,462	185
6	1808	5538	1617	591	481	28,525	333
7	1524	5833	511	54	5	9,980	142
TOTAL	8064	29599	20661	40075	16026	144,784	1133

FIGURE 5

A visitor from the Ministry of Health of the Kingdom of Saudia Arabia inspects snails taken from one of the irrigation canals in the Rahad Zone.

Post treatment evaluations, made a few days after every molluscicide application were generally negative for live snails, but repopulation usually took place within one month. This was expected as mollusciciding was applied focally, only to the water contact sites. Inspections for snails, and mollusciciding was maintained on a regular basis throughout the year.

d. Snail Examination

Snails collected alive were examined for infection and no positives were found among the snails examined from January to October. During December, more emphasis was given to snail examination, particularly from villages 27 and 30 since there were indications of local transmission. In village 27, 96 snails of B. pfeifferi were examined and 9 were found positive, giving a high positivity of 9%. In village 30 where a high incidence of S. haematobium was reported, 69 snails of B. truncatus and 10 B. pfeifferi were examined but found negative (Table 10). Snails from neighbouring villages 33, 34 and 36 were also negative.

Both the epidemiological and snail surveys suggested focal transmission in village 27. Although there was some epidemiological evidence of local transmission in village 30, this was not confirmed by snail examination.

This first incident of local transmission in the Rahad Zone, in spite of the control efforts, is a warning sign. The Rahad Zone, due to the high influx of agricultural labourers and population movement coupled with the absence of sanitary facilities, is highly vulnerable to schistosomiasis transmission. Under the present conditions any relaxation or negligence in the mollusciciding operation will definitely lead to an outbreak of transmission. The requirements of mollusciciding operation in terms of chemical, labour and supervision must always be secured, and efforts should be made to initiate construction of household pit latrines in order to reduce water contamination.

TABLE 10

SNAILS EXAMINED FOR INFECTION IN RAHAD

DATE	NO. OF SNAILS EXAMINED				AREA
	L. nf.	INFECTED	L. tr.	INFECTED	
January	162	0	88	0	Block 2 + 3
February	490	0	530	0	" 4 + 5
March	92	0	71	0	" 4 + 5
April	0	0	0	0	
May	33	0	41	0	" 4 + 5
June	153	0	0	0	" 4
July	35	0	41	0	" 4 + 5
August	3	0	27	0	" 4 + 5
September	0	0	33	0	" 4 + 5
October	28	0	41	0	" 4 + 5
November	0	0	19	0	" 5
December	129	9	73	0	" 5
TOTAL	1125	9	964	0	

2. Mosquito Control

House spraying with DDT started on 8 June and was completed by 23 June. Sixty one villages were sprayed and about 65,000 inhabitants were protected, amounting to 90% of the total population inhabiting the area. About 2.7 metric tons of DDT 75% WDP were used, giving an average applied dosage of 1.9gm/m^2. (See Annex 1). Larviciding was carried out during the dry season with abate, as usual.

In addition to the regular house spraying, the cotton pickers were protected during January and February 1982. A total of 26,161 labourers were protected using about 589 kgs of DDT 75% WDP. The cotton pickers also received a single dose chloroquine treatment , and a total of 62,000 tablets of chloroquine were distributed.

C. WATER SUPPLY

Water supply systems were completed for all 46 villages and for Fau Town in the Rahad Zone by the beginning of 1982, but performance was unsatisfactory in many villages.

1. Slow Sand Filter

The performance of the village water supply systems was reviewed, especially the slow sand filters. An evaluation of both quality and availability of the water revealed that :

a. The sources of raw water for the slow sand filters (the irrigation canals)have very high turbidity for slow sand filtration. For most of the year turbidity remains in the range of 200 - 300 NTU. It falls down to less than 50 NTU for only one month, January. The sedimentation tanks (Area 38m^2) proved ineffective in plain sedimentation for this high turbidity.

b. At 14 villages in the Southern Group, it was discovered that the filters are too small for the populations. There is one filter (Area 21m^2) giving 50m^3 of treated water per day for a population of 2,500. This resulted in frequent clogging of bed and frequent scraping.

The filter was often short-circuited intentionally, due to inadequate supply for the village (Figure 6).

c. By recording the daily output of adequate plants, the per capita consumption of the Rahad population was found to be around 100 litres per day including losses.

d. The original design of the filters caused difficulties in operation. It was difficult to remove supernatant water and dry the filter bed surface, and it was difficult to control the filtration rate.

2. Improved Designs

Design alterations were made to improve the capacity of the systems but preserve the quality to conform to the Internation Standards of drinking water.

The design proposals covered :

a. Sedimentation Problems

Tests in plain sedimentation were carried out at El Fau water treatment works. The source of the raw water was the Rahad main canal. (Turbidity of the minors feeding the village filters is normally 10 - 20 NTU lower). From the experiments the turbidity fell to less than 50 NTU, sometimes even to 10 NTU, in 100 hours. Thus an area of 1500m^2 would be required for plain sedimentation.

For improvement it was proposed to excavate an earthen Hafir of 1500m^2 surface area and one meter deep; divided in two sections to provide for emptying, drying and cleaning of weeds, snails and silt deposits without interrupting the system flow. The cost of the Hafir was estimated at LS.10,000 including inlet and outlet structures and pipe work from canal.

b. Capacity Problem:

The existing sedimentation tank is to be changed into a filter after

FIGURE 6

The original slow sand filters in many of the Rahad villages were found to be inadequate because of extremely high turbidity of water from the irrigation canals. The Engineering Unit proposed improvements which were funded by the Rahad Corporation in [illegible] for some of the affected villages.

installation of an underdrain system and joining it to the clearwater tank. Another filter (Area $50m^2$) was proposed to be constructed for each of 14 villages in the Southern Group of the scheme.

These additions will make a total filter area of $90m^2$ in each village, comprising a minimum of 3 filters. This facilitates scraping of the filters without interrupting the continuity of water production.

c. Operational Difficulties:

In the improved design, the former difficulties will be overcome by:

(i) Construction of a V-notch weir prior to the clearwater tank, calibrated to control the filter rate.

(ii) A lower drain pipe - level with the underdrain - with a shut off valve will be constructed to connect the underdrain to the clearwater tank, in addition to the existing effluent pipe. This is for lowering the water level in the sand bed below the surface after shutting off the flow from the sedimentation Hafir.

(iii) Dividing the clearwater tank into two parts will facilitate the drainage of clogged filters into the empty compartment.

(iv) All valves, valve chambers and covers will be designed for water tightness.

Cost Estimates:

- Sedimentation Hafir	LS.10,000
- Additional filter	30,000
- Turning sedimentation tank in to a filter	5,000
- Plumbing arrangements	2,000
- Valves and valve chambers	5,000
- Alterations in clearwater tank	3,000
T O T A L	LS.55,000

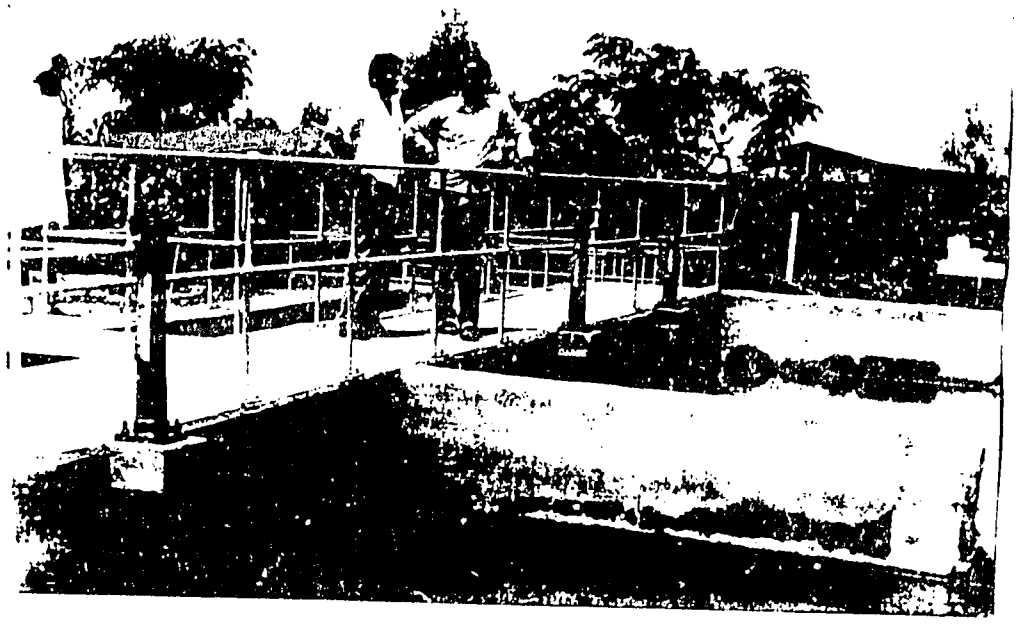


FIGURE 7

In village 10 of the Rahad Zone, a group Headquarters, the drinking water is treated in large slow sand filters.

Thus to reclaim a filter in the Southern Group village, LS.55,000 will be needed; and for one in other Groups LS.25,000 will be required.

The Rahad Corporation allotted LS.200,000 for the improvements in 1982, and work started on improvement of filters of 3 villages in the Southern Group, villages 3, 13 and 18. The remaining money will be utilized in digging bore-holes in villages of the Northern Group.

Also LS.75,000 were approved for construction of a complete slow sand filtration yard in village 15, after investigations confirmed that its bore-hole aquifer had dried out. Construction started in 1982 on this yard.

3. Operation

A system of information collection and record keeping for each filter unit was developed for the Rahad village water supplies. Forms are collected from operators including the following information:

(i) Water quantity produced each day
(ii) Water loss from pipe bursts, tank leakages, etc.
(iii) Raw water quality
(iv) Finished water quality
v) Frequencies of filter cloggings & scrapings
(vi) Chlorine dose and chlorine residual
(vii) Engine, pump, and chlorinator condition
(viii) Consumption of gas oil, etc.

The practice so far gained from running of rural slow sand filters in Rahad Zone for five years showed that the onsite training of operators in only mechanical running is not enough. Operators should be motivated and given adequate training to understand the logic of water treatment, the health aspects of slow sand filtration and the hazards of water contamination. The training, necessarily, must include:

- How the slow sand filter works mechanically and how it treats the raw water.

- How to measure and control the filter rate and why is it so controlled.

- How to know that a filter is clogging and how to scrape it.

- The signifience of chlorination and how the hypochlorite solution is prepared to a required strength.

- How to conduct a chlorine residual test.

Above all the operator must gain the feeling that he is the authority for the village water supply: treatment, storage and distribution. A programme will be arranged this year to train all operators to assimilate these guide lines.

The mean annual budget for operation and maintenance of all village water systems in 1982-83 was £5,730 per village (Table 11).

TABLE 11

RAHAD IRRIGATION PROJECT

THE MEAN ANNUAL OPERATIONAL BUDGET FOR ONE VILLAGE

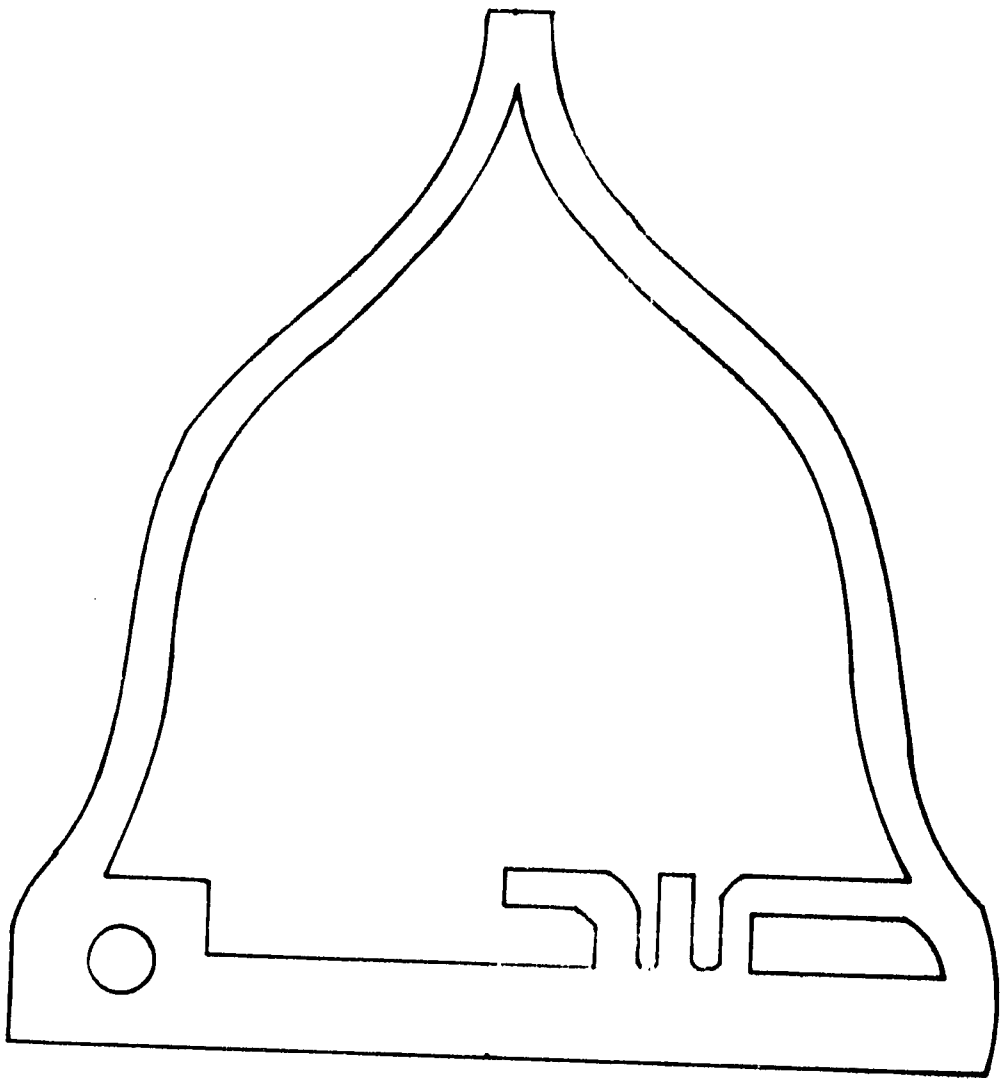
WATER SYSTEM 1982 - 1983 FISCAL YEAR

SALARIES						FUEL		MAINTENANCE					
OPERATOR			GUARD					Engine and pump		Filter cleaning or Bore-hole		Tank and tower	Distribution system
Salary	Allowances	Overtime	Salary	Allowance	Overtime	Gas/oil	Lub. & oil grease	Local	foreign	Local	foreign		
450	180	225	384	180	78	938	78	100	150	1100	580	200	1038

Total local LS 4951

Total Foreign LS 730

CHAPTER IV. THE GEZIRA MANAGIL ZONE



The symbol above represents the Gezira-Managil Irrigated Area, the largest zone of the Blue Nile Health Project, in the triangle between the two Nile Rivers which join at the Apex near Khartoum. The Arabic word for health is the base of the triangle. Design by Taha Yousif Obeid.

CHAPTER IV

GEZIRA-MANAGIL ZONE

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CHAPTER IV

THE GEZIRA-MANAGIL ZONE

A. INTRODUCTION:

The Gezira-Managil Zone covers the large irrigated scheme West of the Blue Nile River, and is generally referred to as "the Gezira". It is located entirely in Gezira Province, one of three provinces forming the Central Region.

The permanent population is over two million, but the irrigated scheme receives an additional half-million migrant workers during the picking season for cotton.

1. Health Services

Health Services are administered by the Deputy Director for Health, assisted by three medical officers in charge of :

a. Preventive health services unit, with the following main activities:

- school health
- health education
- maternal and child health
- immunization

b. Environmental sanitation and endemic disease control unit, covering:

- Sewage disposal
- daily inspection of foodstuff production
- water supply
- control of endemic diseases

c. Curative health services unit, responsible for administrative supervision of all curative health institutions.

2. Health Institutions

The following health institutions provide health care to the population of the Gezira-Managil Zone.

- one provincial teaching hospital in Wad Medani with 784 beds and nearly all medical specialities.

- 3 district hospitals in Hasaheisa, Rufaa and Managil towns, with a total number of 410 beds. They provide some specialist services.
- 23 rural hospitals (single doctor hospitals) with a total of 1,160 beds.
- 8 town health centres (run by doctors) seven of them in Wad Medani town and one in Rufaa town.
- 36 rural health centres (run by medical assistants and lady health visitors).
- 153 dispensaries
- 503 dressing stations
- 119 P.H.C.U's

The following new health units were opened during 1982 in the Gezira-Managil Zone:

- 52 P.H.C.U's
- 5 rural hospitals, each with 30 beds
- 8 rural health centres

3. Health Manpower

a. Doctors

The number of doctors working in the Gezira-Managil Zone is 121 (about one doctor per 22 thousand inhabitants), 83 of them in Wad Medani hospital.

b. Medical Assistants

The number available is 196 (1 per 14,000)

c. Lady Health Visitors

Their number is 55, most of them work in health centres.

d. Nurse Midwives

Their number is 92, 44 of them in Wad Medani town.

e. Village Midwives

They are selected from the villages where they live and are trained in the Wad Medani School. To date 691 of the 1515 registered villages have trained midwives (45.6% coverage).

f. Nurses

These are trained in 13 nursing schools attached to different hospitals. The total number of qualified nurses is 562.

g. Community Health Workers

The community worker should be at least a primary school leaver and is selected by the village community. He is responsible for improvement of village environmental sanitation, safe water supply, and health education especially on child nutrition. He also provides curative services for some 10-12 locally important diseases such as malaria, diarrhoeal diseases, and chest infections.

P.H.C.W's are trained in 4 localities (Rufaa, Hasaheisa, El Hosh and Managil). The duration of the course is 9 months. The total number of P.H.C.W's now in service is 188.

4. Budget for Health Services

The funds budgeted for Gezira Province during 1982/83 in Sudanese pounds were :

Salaries	£5,199,130
Allowances	£ 621,535
Current expenditure	£ 396,380
Development Budget	£1,500,000

B. MALARIA CONTROL

1. Spraying Operations:

Malaria control in the Gezira was faced with a serious financial problem this year. The operational budget which is normally covered by the Sudan Gezira Board was dropped due to the adoption of the new relationship between the tenants and the Sudan Gezira Board and the Individual Account Policy. The malaria budget was dropped at the end of the fiscal year, too late to allocate it to any other source.

a. Residual spraying of houses

The shortage of funds triggered a sense of self-help to carry

out spraying which was exploited to promote self-help in the area for vector control. The Regional Government provided part of the budget for the annual spraying of houses which was only adequate to spray 40% of the area. The Rural Council of Bahri El Gezira took the initiative and provided funds from its own resources to spray the northern part of Gezira (Figure 8).

The area was sprayed with fenitrothion at the rate of 1 gm/m^2. Spraying started in August and was completed in some parts in November or December. The spraying period was greatly extended, due to the shortage of funds. Insecticide toxicity was negligible this year, since the spraymen followed the precautionary measures very closely. About 41 metric tons of fenitrothion were used and 6 councils out of 12 were sprayed (Appendix M page A40)

The budget included components from regional, rural council and town governments as follows:

Central Region	
1. Preparatory phase	£ 20,000
2. Spraying	91,000
Rural Council	
3. Bahri El Gezira	20,000
Town	
4. Hasaheisa	2,000
Total Expenditures in 1982	£133,000

The personnel utilized for spraying were :

1 Chief of Operations
7 Public Health Officers
7 Sanitary Overseers
86 Squad Leaders
86 Mixers
258 Spraymen

Vehicles utilized during the campaign included 2 Landrovers, 5 Suzukis and 4 lorries.

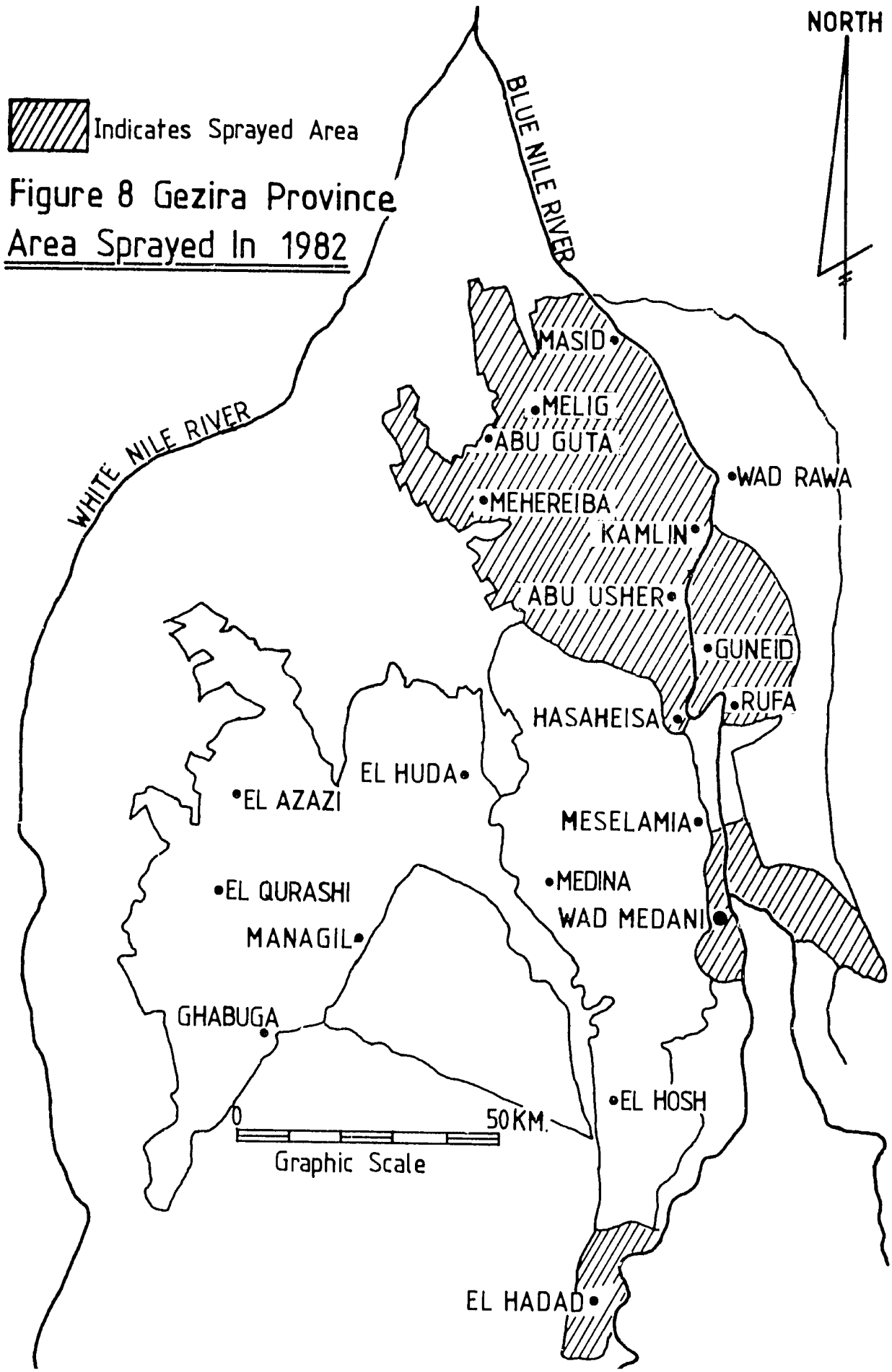


Figure 8 Gezira Province
Area Sprayed In 1982

b. Larviciding Operations

Larviciding was not carried out according to the usual plan, due to lack of the chemical abate, and to the dismissal of the larviciders by the Sudan Gezira Board because of shortage of funds.

2. Impact of Agricultural Spraying on Vector Population

It has been repeatedly observed in the Gezira during the past few years that immediately after the start of aerial control operations against agricultural pests in October, the malaria vector density tends to drop and generally remains low during the following months (Table 12). It was usually difficult to measure precisely the impact of the agricultural spraying. However, as some areas were not covered by house spraying this year, it was possible in these areas to evaluate the impact of aerial spraying alone on vector density.

In the area under observation aerial spraying for agriculture started at the end of September and ended at the end of November. An average of four spraying cycles were carried out. Insecticides used in agricultural spraying were mainly dimethoate, endosulphan, dursban and decamethran. In most situations a mixture of two chemicals was sprayed.

In six villages where no malaria spraying occurred, during the four months from September to December there was a gradual drop in indoor density of mosquitos instead of a build up. The density dropped from 8.6 mosquitos per room in September to 5.2, 2.3 and 0.1 in October, November and December respectively (Figure 9). In the absence of aerial spraying the vector population density should have built up to a much higher level in October, November and December, since the climatic and breeding conditions were favourable.

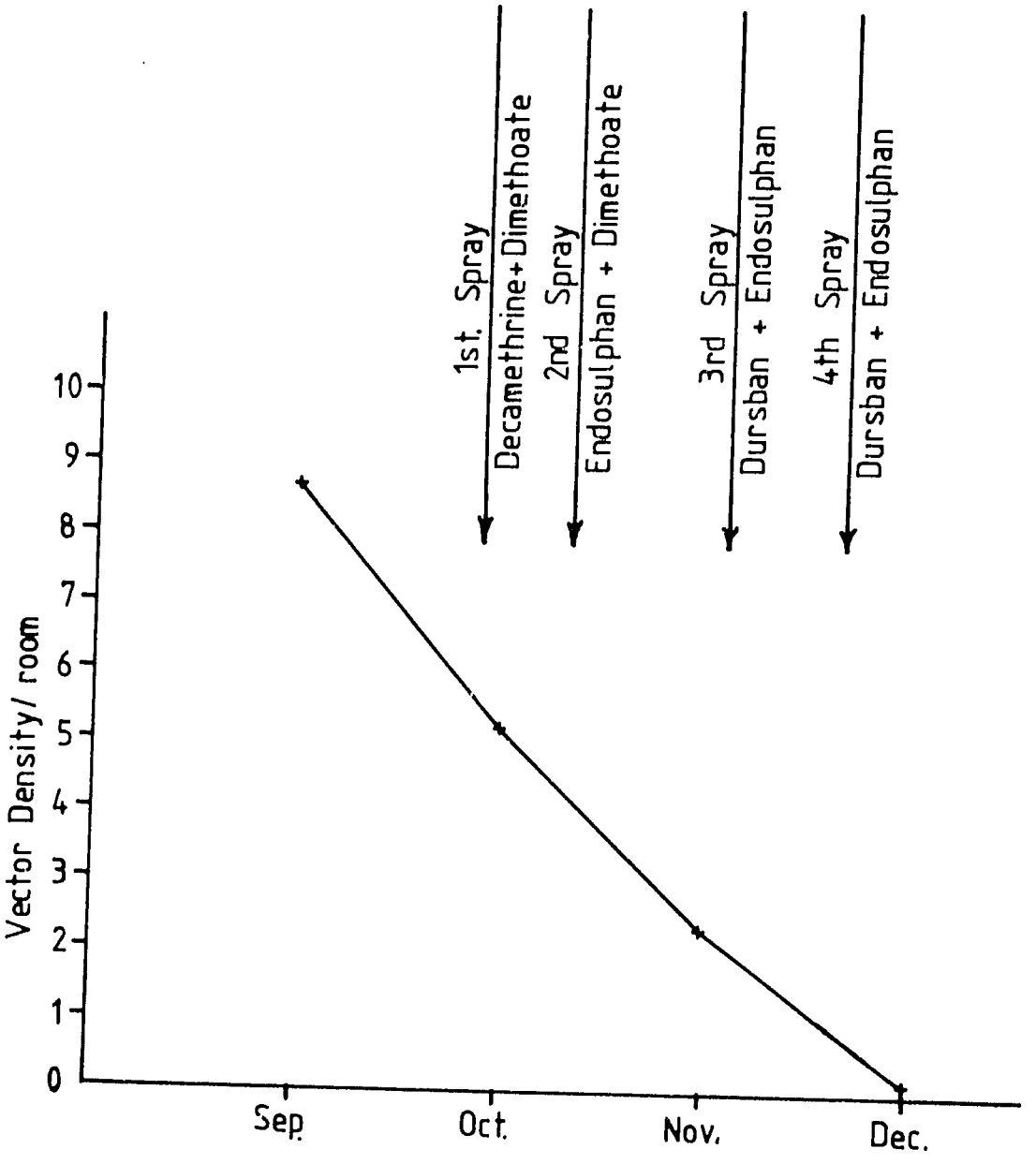
The start and timing of aerial spraying for agriculture corresponded with the peak vector mosquito density and malaria transmission. Aerial spraying produced an appreciable impact on the vector mosquito population, and subsequently on malaria transmission. Aerial spraying for agriculture, supported by the antimalaria drug coverage probably

TABLE 12

INDOOR RESTING DENSITY OF ANOPHELES ARABIENSIS IN INDICATOR LOCALITIES IN GEZIRA 1982

MONTH	ROOMS SEARCHED	MOSQUITOS COLLECTED	MOSQUITOS PER ROOM
January	-	-	-
February	48	134	2.79
March	80	1	0.01
April	80	29	0.36
May	38	0	0.00
June	56	0	0.00
July	0	0	0.00
August	70	126	1.80
September	140	877	6.26
October	341	719	2.11
November	50	27	0.54
December	70	4	0.06

Figure 9 Impact Of Aerial Spraying On Malaria Vector Population Gezira 1982



prevented the malaria epidemic that was expected where houses were not sprayed for malaria control.

Although agricultural aerial spraying produces undesired hazards, such as death of fish and other natural predators from the irrigation canals and development of insecticide resistance, yet its impact on the vector population was a positive effect which should be fully utilized in our Integrated Vector Control Programme.

3. Chemotherapy

In view of the poor spraying coverage and the delay in spraying operations, extra efforts were made to cover the rural health establishments with sufficient drugs. About 3 million tablets of chloroquine and 300,000 tablets of primaquine were distributed during 1982. In addition 600,000 tablets were distributed to the seasonal cotton pickers in collaboration with the Field Inspectors of the Sudan Gezira Board.

The drug was made available to the Health Units throughout the year. Availability of the anti-malaria drug must have played an important role in the suppression of malaria transmission in the area.

4. Malaria Laboratories

Thirty two microscopists received training in microscopical diagnosis of malaria in the Malaria Training Centre at Sennar. The new microscopists were distributed to new laboratories, six in the Study Zone and the rest in the new hospitals and health units. This is in line with the project strategy to expand malaria laboratories in order to have wider coverage, and to improve the diagnostic facilities in the project area.

In view of the expansion of malaria laboratories, the supervisory staff need to be increased in order to improve the quality of examination and to have regular and timely reports from these laboratories. Quality control over the microscopists should be greatly improved and substained in the future.

5. Epidemiological Evaluation

Epidemiological evaluation of the malaria control activities came from two major sources. One source was the passive surveillance mechanism, as reported monthly by the malaria diagnostic laboratories. The highest level of slide positivity was 2.2%, in January and November only (Table 13). During the whole year a total of 123,307 slides were examined, of which only 1.16% were positive. *P. falciparum* was the dominant species.

Comparing the transmission period of August - December 1981 with that of 1982, the positivity rate ranged from 1% to 2% and there was not a big difference between the two years although most of the area was not sprayed in 1982 (Table 14). The low prevalence occurred in 1982 even though the spraying was conducted late, after the major transmission season of August to October.

Three factors contributed to the control of malaria in the absence of house spraying in the area : (i) availability of drugs in the health units for rapid treatment of fever cases (ii) fortunate timing of aerial agricultural spraying of the area which produced an appreciable impact on the vector mosquito population and (iii) a light rainy season (annual rainfall in Wad Medani in 1982 was 168mm compared to 315mm in both 1981 and 1980). The above elements should be considered when implementing the integrated malaria control strategy in the Gezira.

The second source of epidemiological evaluation was the parasite rate in children from surveys conducted in the indicator localities in the area. Three surveys were conducted, the regular survey in the 53 indicator villages of Gezira-Managil Zone in January 1982 and two surveys in March and October in the Study Zone. The average parasite rate in January 1982 was 0.8% compared to 1.3% and 1.7% in 1981 and 1980 respectively (Table 15). Results of the surveys in the Study Zone are in Chapter V.

TABLE 13

SLIDE POSITIVITY RATE FOR MALARIA IN THE GEZIRA MANAGIL ZONE, 1982

MONTH	SLIDES EXAMINED	POSITIVE SLIDES	
		NUMBER	PERCENTAGE
January	8,012	178	2.22%
February	7,183	56	0.77
March	11,238	84	0.75
April	10,213	83	0.81
M a y	10,380	125	1.20
June	10,822	61	0.56
July	8,801	44	0.50
August	11,801	111	0.94
September	8,870	83	0.94
October	14,644	234	1.60
November	10,634	242	2.28
December	10,709	135	1.26
T O T A L	123,307	1,436	1.16%

TABLE 14

COMPARISON OF RATES OF MALARIA SLIDE POSITIVITY IN SPRAYED AND UNSPRAYED AREAS OF THE GEZIRA-MANAGIL ZONE, FOR PERIOD FROM AUGUST TO DECEMBER, 1981 AND 1982

A. AREAS SPRAYED BOTH YEARS

A R E A	SLIDE POSITIVITY RATES	
	1981	1982
1. El Shukria (Rufaa)	-	0.45%
2. Meheiriba	-	2.50%
3. Abu Guta	-	-
4. Wad Medani	1.30%	1.43%
5. El Hosh (Partial)	2.35%	1.14%
6. El Meilig	1.80%	1.50%

B. AREAS SPRAYED ONLY IN 1981

A R E A	SLIDE POSITIVITY RATES	
	SPRAYED 1981	NOT SPRAYED 1982
1. El Medina Arab	1.50%	1.86%
2. El Hasaheisa (Partial)	4.80%	1.20%
3. El Managil	-	1.78%
4. El Huda	1.10%	0.53%
5. El Gorashi	-	1.70%
6. Jaboga	-	-

TABLE 15

MALARIA PREVALENCE IN CHILDREN 2 - 9 YEARS OLD FROM MONITOR VILLAGES OF THE GEZIRA-MANAGIL ZONE DURING JANUARY SURVEYS, 1980 - 1982

YEAR	NUMBER OF MONITOR VILLAGES SURVEYED	SLIDES EXAMINED	POSITIVE FOR MALARIA	
			NUMBER	PER CENT
1980	27	2,816	47	1.7%
1981	53	9,240	121	1.3%
1982	53	6,996	17	0.8%

6. Entomological Evaluation

a. Indoor Density

Indoor resting density of anopheline mosquitos was determined by space-spray catches in indicator localities. Regular catches were made at least once a month. The work was sometimes interrupted due to shortage of petrol. In the favourable transmission season the highest density was recorded in September, being 6.3 mosquitos/room (Table 12). The density dropped after house spraying and aerial spraying for cotton pests to 2.11, 0.54 and 0.06 mosquitos per room in October, November and December respectively (Table 12).

b. Susceptibility Tests

Susceptibility tests conducted during February 1982 in El Basatna locality of Medina Arab area, which has been under fenitrothion spraying for the past three years produced 100% mortality on 1.0 gm/m^2 fenitrothion after one hour exposure. Tests conducted on mosquitos collected from the same area on 5.0% malathion produced 94% and 95% mortality during February and October respectively (Appendix M). The results indicated susceptibility to fenitrothion and only a slight level of resistance to malathion.

C. SCHISTOSOMIASIS

The second epidemiological survey was conducted in December 1982 to determine incidence, prevalence and intensity of schistosome infections in people of the 28 monitor villages of the Gezira-Managil Zone. Only prevalence and incidence of *S. mansoni* infections are summarized herein. Two of these villages were surveyed for the first time, and a third was also included among the monitor villages of the Study Zone (Managaza). The survey was carried out simultaneously by 3 mobile teams, each with 1 sanitary overseer, 3 microscopists and 2 laboratory attendants. The 3 teams covered the northern, western and southern portions of the Gezira-Managil Zone (Figure 10).

All individuals found positive during the first survey in 1981 were treated in 1982 with praziquantel tablets in a split dosage of

BLUE NILE HEALTH PROJECT IN SUDAN

LOCATION OF 28 MONITOR VILLAGES IN THE GEZIRA-MANAGIL ZONE

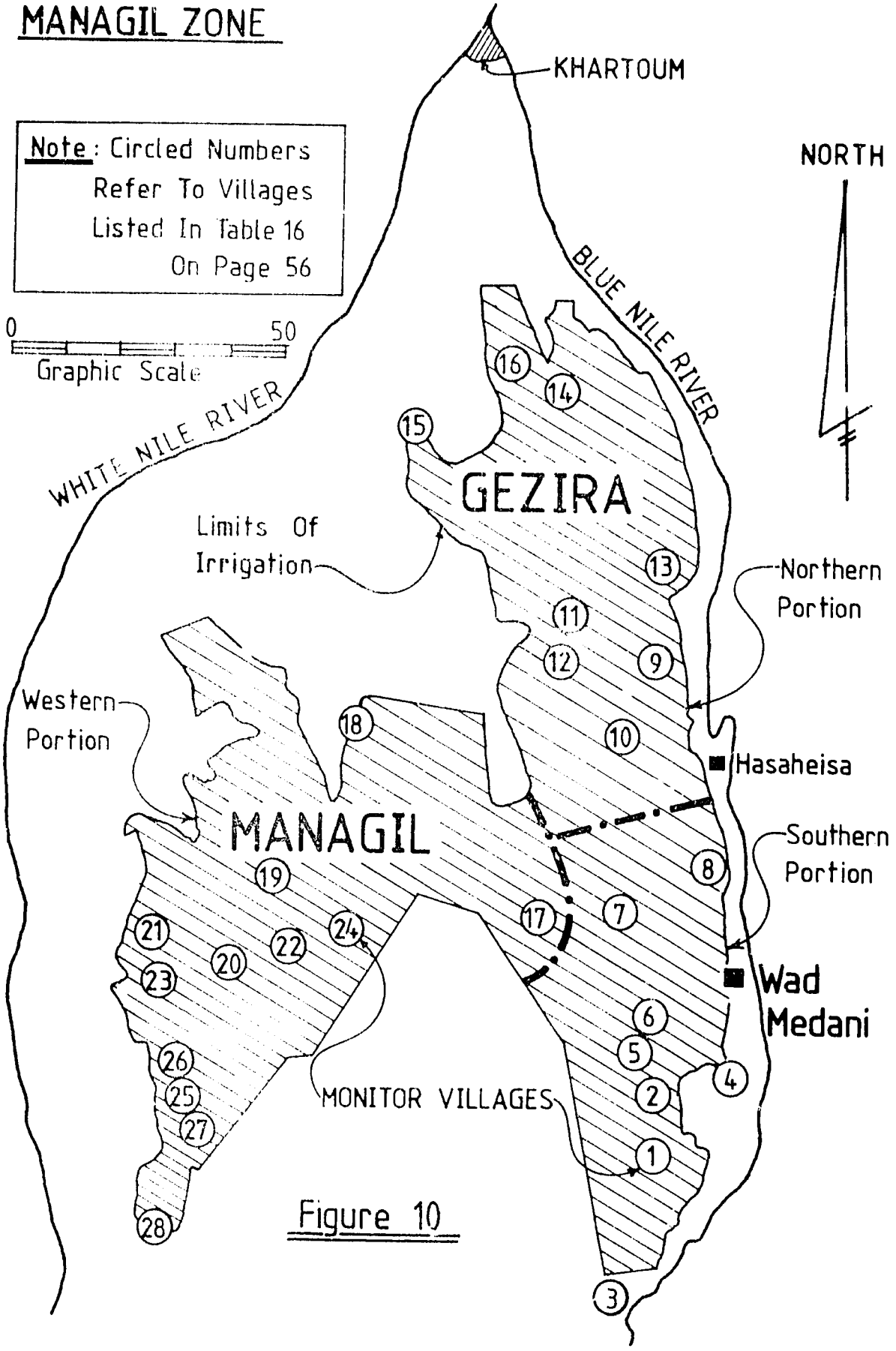


Figure 10

40 mg per kg of bodyweight, after giving stool and urine samples for laboratory diagnosis. Due to the chemotherapy the response rate was 70%, higher than in the 1981 survey.

In the 1982 survey 3,521 people were examined and 2,155 were found infected, a prevalence of 61% (Table 16 and Figure 11). All those found negative at the first survey in 1981 were submitted to parasitological examination to determine the incidence of new infections which was 43%, 36% and 21% in the western, southern and northern portions respectively, with an overall incidence of 29% (Tables 17, 18 and 19 and Figure 12). Newly diagnosed cases were treated immediately after this incidence survey.

It is also important to note that :

1. The overall prevalence of 62% and incidence of 29% S. mansoni infections in the Gezira-Managil Zone were higher than those in the Study Zone and Rahad Zone (Figure 13).

2. The western portion which is the somewhat isolated Managil Zone is comprised of small villages with low socio-economic standards, poor water supplies and less access to health facilities, and showed higher prevalence (67%) and incidence (43%) of S. mansoni infection than the other two portions (Figure 12).

3. The prevalence of S. mansoni infection varied from one village to the other, but 21 villages had a prevalence above 60% (Table 16).

4. There was no significant difference in prevalence or incidence of infection between sexes.

5. By age the infection was highest among 10-19 year olds with possibly another peak in incidence among 55 year olds (Figure 11)

6. Since 1981 there was a slight increase in prevalence in almost all age groups, of about 10% (Figure 11).

TABLE 16

PREVALENCE OF SCHISTOSOMA MANSONI BY SEX, IN MONITOR VILLAGES OF GEZIRA-MANAGIL ZONE, 1982

VILLAGES	EXAMINED			INFECTED			OVERALL PREV.
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
1. Hassan Mohamed Ali	22	32	54	15	22	37	68.5%
2. Wadi El Aros	14	14	28	10	14	24	85.4
3. Shendi Foug	32	20	52	27	13	40	76.9
4. Mayo Abbas	56	64	120	14	4	18	15.0
5. El Shalaikha	53	55	108	41	31	72	66.7
6. El Batahein	53	55	108	33	35	68	63.0
7. Wad El Bur	43	25	68	30	15	45	66.2
8. Wad Soliman	97	111	208	75	71	146	70.2
9. Managaza *	-	-	-	-	-	-	-
10. Habeiballa Burgo	36	23	59	17	10	27	45.8
11. Saleem	263	326	589	175	208	383	65.0
12. Ayan	37	44	81	20	22	42	51.9
13. Tayba El Naeim	40	46	86	8	6	14	16.3
14. F o u r	30	45	75	23	26	49	65.3
15. El Laota	160	161	321	112	101	213	66.4
16. Habeiba	224	191	415	123	82	205	49.4
17. Cambo Wad El Howeir	10	16	26	8	12	20	76.9
18. Cambo Salama	1	0	1	1	0	1	100.0
19. El Amara A/alla	8	27	35	6	19	25	71.4
20. El Amara Karamalla	77	65	142	59	37	96	67.6
21. Um Dakat El Dar	44	49	93	33	27	60	64.5
22. Cambo Wad El Daly	9	6	15	8	4	12	80.0
23. Matoug H.Q.	60	67	127	22	18	40	31.5
24. Cambo David	21	24	45	19	15	34	75.6
25. Cambo Mamoun	20	16	36	12	11	23	63.9
26. Um Sinaita	168	184	352	132	126	258	73.3
27. El Radi	79	79	158	67	60	127	80.4
28. Tayba Gabir	61	58	119	38	38	76	63.9
T O T A L	1718	1803	3521	1128	1027	2155	61.2%

* See Study Zone, Chapter 5.

Figure 11 Age Specific Prevalence Of Schistosomiasis In Gezira Managil Zone

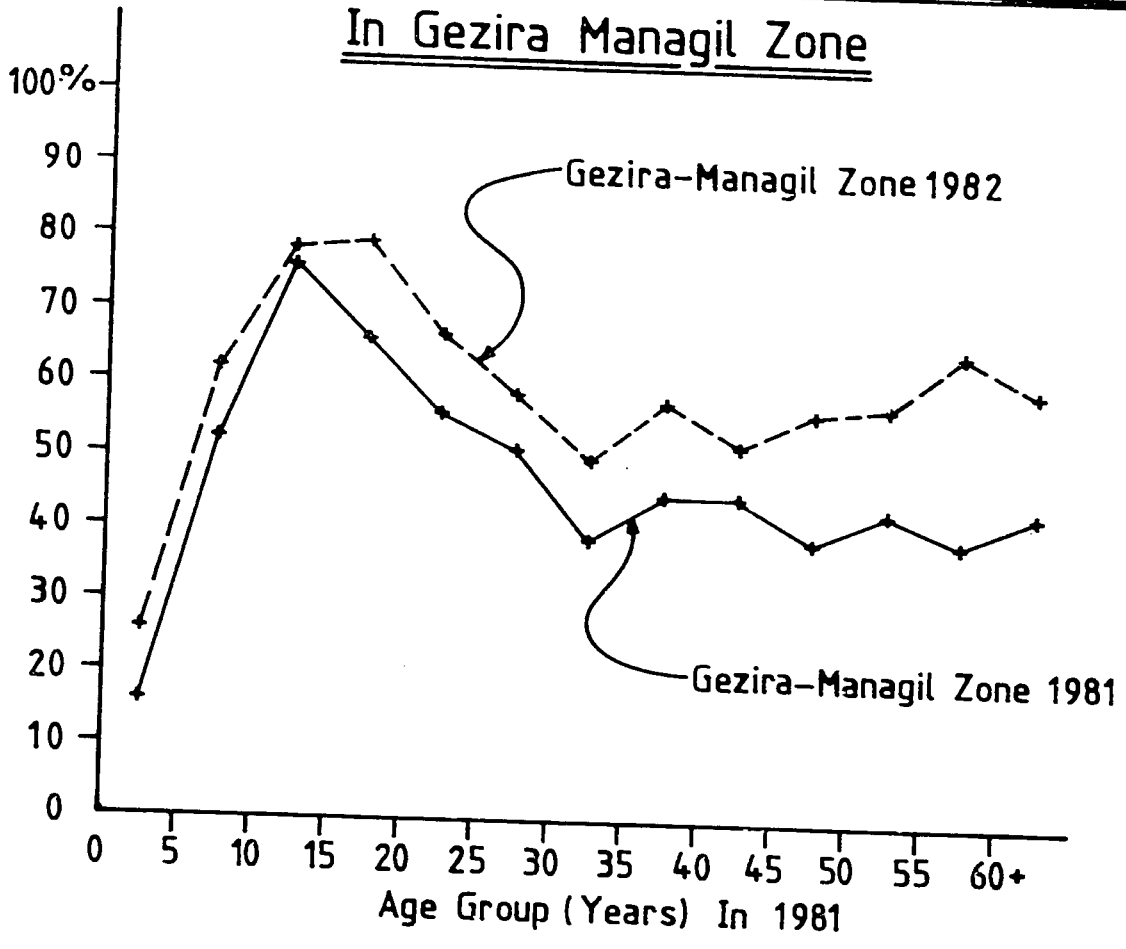


TABLE 17

INCIDENCE OF S. MANSONI INFECTION IN WESTERN PORTION BY VILLAGES, GEZIRA-MANAGIL ZONE, 1982

VILLAGE	NEGATIVES RE-EXAMINED	INFECTED	INCIDENCE
17. Cambo Wad Howeir	5	2	40.0%
18. Cambo Salama	1	1	100.0
19. El Amara A/alla	14	8	57.1
20. El Amara Haramalla	54	28	51.9
21. Um Dakat El Dar	34	16	47.1
22. Cambo Wad El Daly	4	4	100.0
23. Hatoug [illegible]	75	11	14.7
24. Cambo David	7	3	42.9
25. Cambo Hamoun	First examinations	-	-
26. Um Senaita	111	63	56.8
27. El Radi	First examinations	-	-
28. Tayba Gabir	32	9	28.1
T O T A L	337	145	43.0%

TABLE 18

INCIDENCE OF S. MANSONI INFECTION IN NORTHERN VILLAGES, GEZIRA-MANAGIL ZONE, 1982

	NEGATIVES RE-EXAMINED	INFECTED			OVERALL INCIDENCE
		MALE	FEMALE	TOTAL	
10. Habiballa Burgo	33	3	4	7	21.2%
11. Saleem	230	23	38	61	26.5
12. A g a n	36	6	3	9	25.0
13. Tayba El Naeim	73	4	2	6	8.2
14. F o u r	33	4	3	7	21.2
15. El Laota	132	15	20	35	26.5
16. Habeeba	270	25	21	46	17.0
T O T A L	807	80	91	171	21.2%

TABLE 19

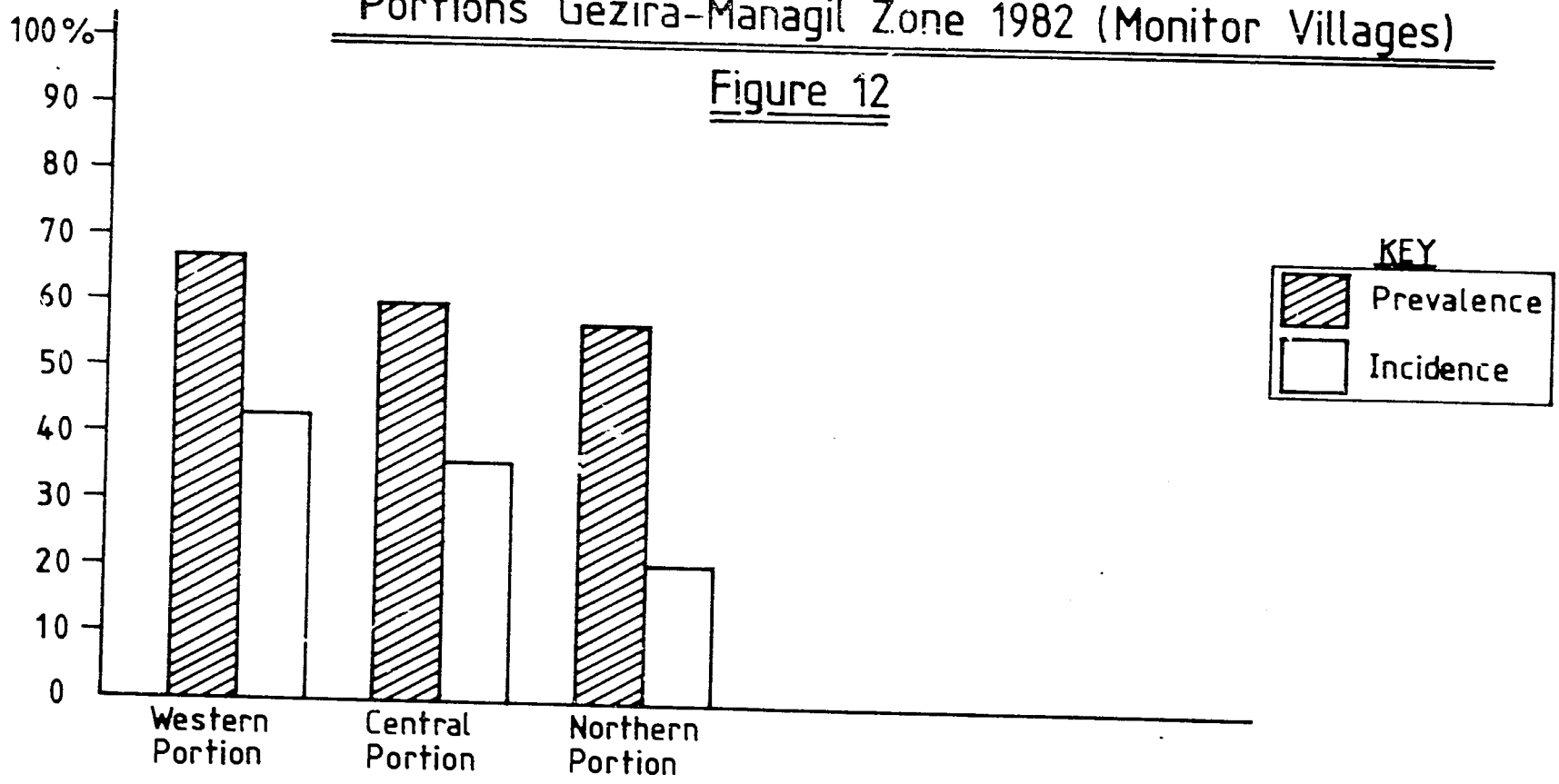
INCIDENCE OF S. MANSONI INFECTION IN SOUTHERN PORTION BY VILLAGES, GEZIRA-MANAGIL ZONE, 1982

VILLAGE	NEGATIVES RE-EXAMINED	INFECTED			OVERALL INCIDENCE
		MALE	FEMALE	TOTAL	
1. Hassan Mohamed Ali	14	1	4	5	35.7%
2. Wadi El Aros	0	-	-	-	-
3. Shendi Foug	16	5	1	6	37.5
4. Mayo Abbas	93	8	2	10	10.8
5. El Shalaikha	32	5	8	13	40.6
6. El Batahein	38	9	11	20	52.6
7. Wad El Bur	28	8	9	17	60.7
8. Wad Soliman	70	12	22	34	48.6
9. Managaza *	73	5	9	14	19.2
T O T A L	364	53	66	119	32.7%

* In Study Zone

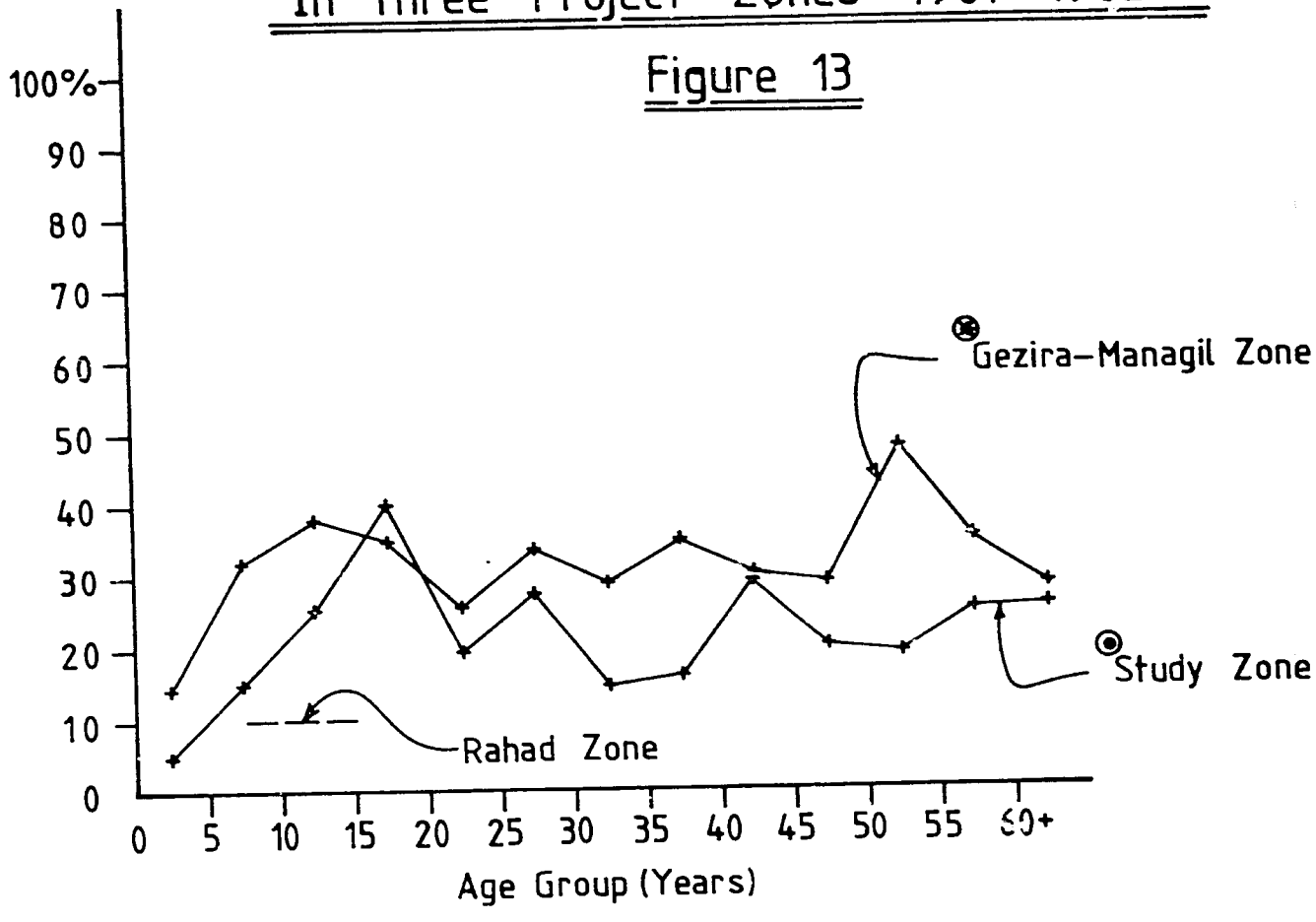
Prevalence & Incidence Of S. Mansoni Infection In The Three Portions Gezira-Managil Zone 1982 (Monitor Villages)

Figure 12



Incidence Of S. Mansoni Infection By Age Group In Three Project Zones 1981–1982

Figure 13



⊗ Before Intervention Phase

⊗ Before Chemotherapy Compaign

D. DIARRHOEAL DISEASES

The monitoring of diarrhoeal diseases in the large Gezira-Managil Zone will be gradually developed before the expansion phase of the Integrated Strategy. At present no systematic monitoring is conducted in this Zone.

E. COMMUNITY UNIT

The activities of the Community Participation Unit in the Gezira-Managil Zone have been limited to a survey and educational programme in the registered village Adeid Abu Usher near the Study Zone, and a survey of cotton pickers in Darwish Block near Wad Medani. Both of these surveys were intended to collect information for comparison with the Study Zone. The work in Adeid Abu Usher was a way of developing skills and techniques prior to intervention in the Study Zone.

1. Survey of Cotton Pickers in Darwish Block

This survey indicated the following characteristics of the cotton pickers who work in Darwish Block:

a. There were 12 permanent residential camps in the area composed of Nigerians, Bargou and Barnu people, and 500 of them were involved in cotton picking. In addition a total of 900 seasonal people came, 800 from White Nile Province and 100 from West Sennar. The seasonal pickers lived in the harvested dura fields, using the dura stalks for making huts.

b. In the previous season (1980/81) there had been 160 seasonal pickers, 100 from west of White Nile and 60 from West Sennar.

c. For the 1982/83 season a total of 3,575 pickers participated, comprised of the following groups:

- Imported cotton pickers
- Laborers already living in residential camps
- Farmers and their families

d. The seasonal pickers were recruited by Sudan Gezira Board offices West of White Nile Province which recruited laborers from

Kordofan and Darfur Provinces. Also pickers came from West Sennar such as the Kenana and Hassania tribes, who also brought their animals. They were not provided with health care.

2. Survey of Adeid Abu Usher

A survey questionnaire on health, social and economic characteristics was developed in 1981 and used for interviewing residents of Adeid Abu Usher in 1982 prior to organizing our intervention in the Study Zone. Adeid Abu Usher is 6 miles northwest of Abu Usher and probably fairly similar to the villages in the Study Zone. We did not conduct the survey in the Study Zone as it would inevitably involve an educational impact and we did not want this to occur in advance of the planned date of June 1982. After the survey we organized a health committee and began improvements.

The general survey of the community indicated the following:

a. Population

The population was 2000 people, members of the Kawahla and Hausa tribes. The village was established in 1700. The average family size was 5 and 20% of the population was under 5 years of age (Table 20).

b. Health Services

The community health facility was a dressing station established in 1964. The building was located in a low area which floods during the rainy season, causing structural damage. It should be relocated. It had no drugs, the equipment needed to be replaced and there was no furniture.

About 320 patients visited the health facility each month for malaria, and diarrhoeal diseases. Persons with schistosomiasis went to Abu Usher hospital. The village midwife reported a birth rate of 2.1% and death rate of 1.3%. Most deaths of children were due to diarrhoea and malaria.

The village also had a sweeper but the poor environmental sanitation indicated that he was ineffective. There were many flies, dead

TABLE 20

NUMBER OF FAMILIES, SEX, AGE, EDUCATION AND SOCIAL STATUS OF POPULATION IN ADEID ABU USHER, 1982

No. of families	399
Average size of family	5
S e x	
Male	54%
Female	46%
Ages	
0 - 4 years	20%
5 - 19 "	59%
20 - 40 "	17%
41 and more	4%
Occupation	
Under working age	28%
Students	37%
Official	4%
Private work	12%
Tenants	2%
Merchant	1%
House wives	13%
Without work	3%
Education	
Under age	29%
Illiterate	10%
Khalwa	1%
Elementary	40%
Junior Secondary School	12%
High secondary	7%
High Institute and University	1%

FIGURE 14

Adeid Abu Ushar had drainage problems typical of Gezira villages in the rainy season

animals were left near the houses, the butcher left carcasses and offal near his shop, and there was considerable defecation by children near the houses.

c. Educational Services

There was a Junior secondary school attended by 135 girls, a boys elementary school with 375 students and girls elementary school with 342 students. None of the schools had latrines or water supplies.

d. Village Water Supply

A typical deep-well water supply system served the village with a rudimentary pipe distribution system. Pressure on the West side of the village was very low, and many of the pipes leaked. The pump engine stopped frequently because of shortages of fuel, and its operation was limited by severe leaking in the overhead storage tank. Thus people often went to the canal for water.

e. Other Community Services

The village was served by public transport, shops, a bakery, a butcher, a mosque and a social club.

f. Falata Population

The south-western corner of the village was occupied by poorer people of Nigerian origin (called falata) in very crowded houses without bathrooms, kitchens or latrines. The children all went into the canal to swim and fish. The area was surrounded by water in the rainy season.

After the general survey, household interviews were collected in a 10% random sample of the houses, interviewing the head of the household (usually the father) and the mother, separately. General population and housing characteristics were obtained from the interview with the father. Of the 80 households interviewed, 80% were headed by tenant farmers or farm workers (Table 21). 39% of the men were illiterate and only 6% had completed high secondary school. The dependents had a higher rate of education than their fathers, and only 10% were illiterate (Table 20).

Most of the houses had only one or two rooms, and about half were

TABLE 21

OCCUPATIONS AND EDUCATION OF EIGHTY MALE HEADS OF FAMILIES IN ADEID ABU USHER, 1982

OCCUPATION	PERCENTAGE	EDUCATION	PERCENTAGE
Tenant farmers	46%	Illiterate	40%
Farm labourers	34%	Khoran School	22%
Government employees	10%	Elementary	26%
Privately employed	10%	Secondary	6%
		High Secondary	6%

mud brick and half red brick. Housing was not very clean and where they existed the latrines were in poor condition. Garbage disposal was primarily by throwing it outside the house (Table 22).

About half of the houses had window screens and 12 out of 80 (15%) used mosquito nets for sleeping (Table 23). People said that they preferred injections rather than pills for the treatment of malaria. About 2/3 of the households had animals, and most of the animals were kept inside at night (Table 24).

Traditional medicine was quite popular in the village, primarily because commercial drugs were expensive or unavailable (Table 25).

Mothers in Adeid Abu Usher had less education than fathers (Table 26). Most of them breast-fed their babies but did not wash themselves before nursing (Table 27).

TABLE 22

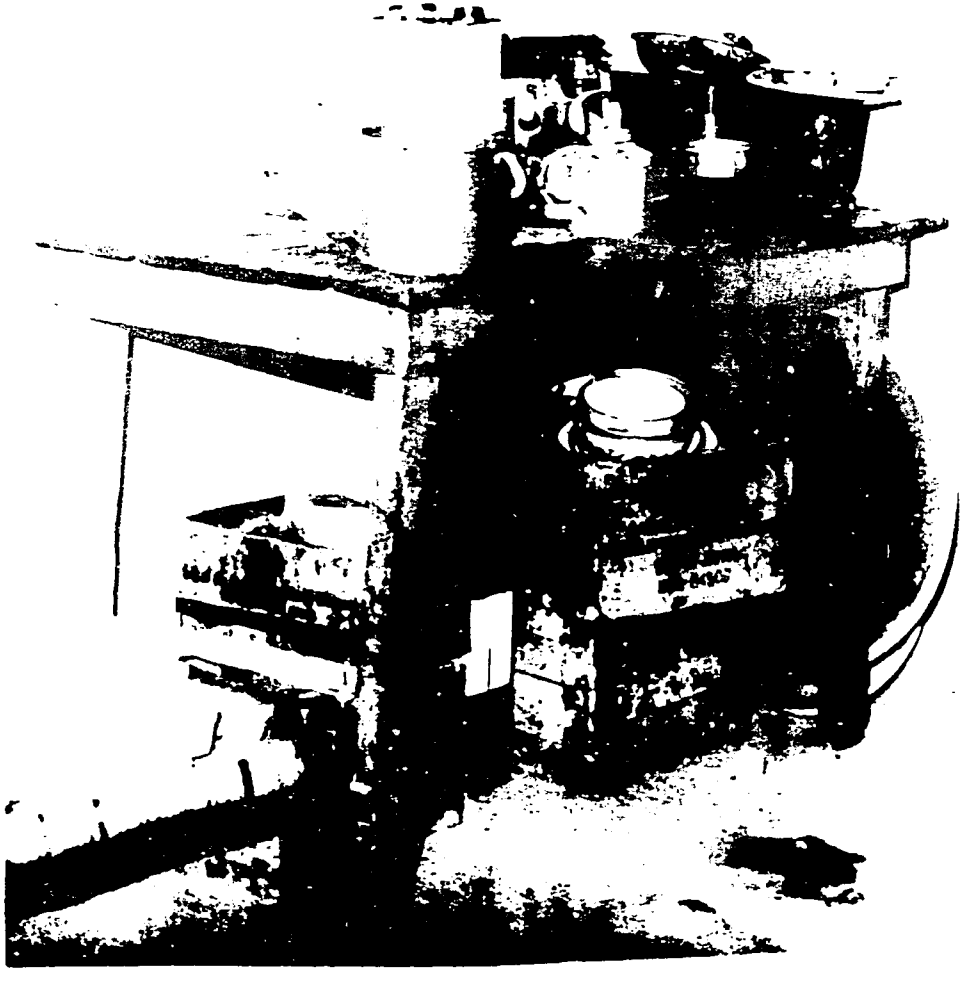
SANITATION CONDITIONS IN EIGHTY HOUSEHOLDS OF ADEID ABU USHER, 1982

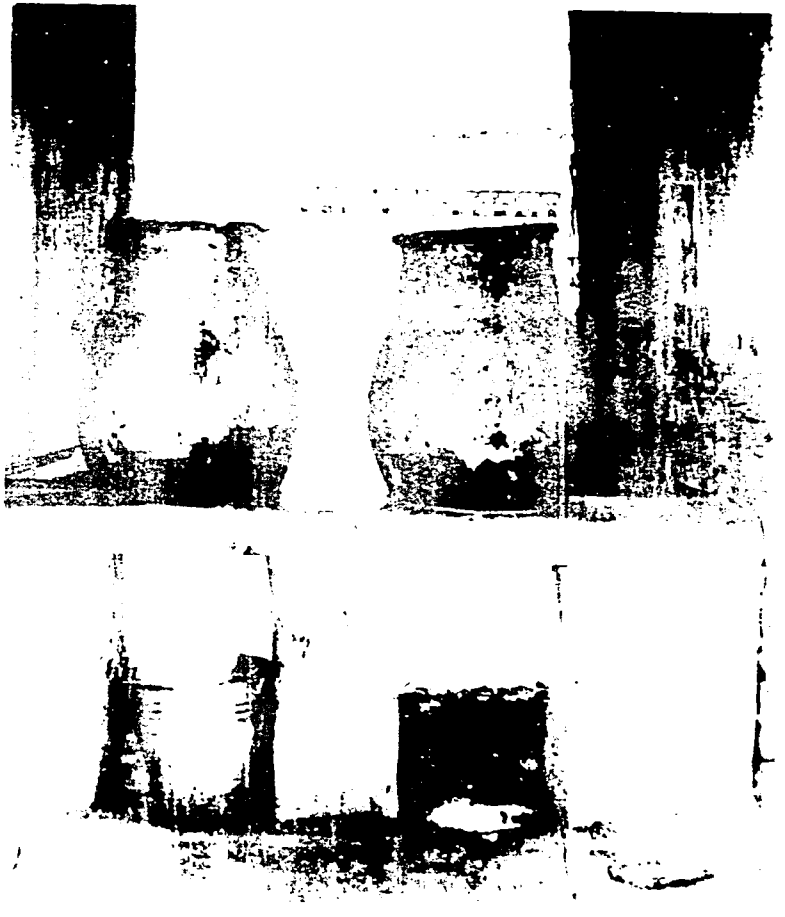
I. METHODS OF GARBAGE DISPOSAL

Garbage left in proper place	16%
Thrown out near house	74%
Buried	10%

II. USE OF CLAY ZEERS FOR STORING DRINKING WATER

Households with no zeer	55%
Households with zeers	45%
Households with zeers:-	
On stands	51%
On floor	41%
On stands and on floor ..	8%





[illegible] [illegible] kitchens and
[illegible] for water in [illegible]
village

TABLE 23

CONDITIONS AND PRACTICES OF EIGHTY HOUSEHOLDS IN ADEID ABU USHER VILLAGE RELATED TO MALARIA, 1982

I. SCREENING	HOUSEHOLDS	
	WITH	WITHOUT
Window screens	56%	44%
Mosquito nets	15%	85%

II. PREFERRED TREATMENT

Tablets	19%
Injections	51%
No preference	30%

TABLE 24

ANIMAL POPULATION RELATED TO 80 HOUSEHOLDS IN ADEID ABU USHER VILLAGE, 1982

Households with no animals	36%
Households with animals	64%

Sheep	224
Goats	159
Cows	165
Donkeys	42
Camels	7
Birds	42

Place of Lodging for Animals:

Inside house	78%
Outside house	22%

Source of Water for Animals:

Canals	86%
Other	14%

TABLE 25

TRADITIONAL MEDICINE PRACTICES IN 80 HOUSEHOLDS OF ADEID ABU USHER, 1982

Users of traditional medicine	72%
Non-users	28%

Reasons for use:

Drugs not available	47%
Quick relief	25%
Doctors unsuccessful	21%
No money for drugs	7%

TABLE 26

AGE AND EDUCATION OF MOTHERS IN EIGHTY HOUSEHOLDS OF ADEID ABU USHER, 1982

A G E S:

Less than 20 years old	6%
20 to 29 years	42%
30 to 39 "	30%
40 and over	22%

EDUCATION:

Illiterate	67%
Khoran school	0
Elementary	30%
Secondary	3%
High Secondary	0

TABLE 27

NURSING PRACTICES OF MOTHERS IN 80 HOUSEHOLDS OF ADEID ABU USHER, 1982

I. INFANT POPULATION

Mothers without infants	35%
Mothers with infants	65%

II. NURSING PRACTICES FOR INFANTS

Bottle fed (Bazaza)	22%
Breast fed	78%

III. WASHING PRACTICES OF NURSING MOTHERS BEFORE BREAST FEEDING

Wash hands and breast	24%
Wash hands	8%
Do nothing	68%

Chapter V

Study Zone

CHAPTER V

THE STUDY ZONE

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CHAPTER V

THE STUDY ZONE

A. INTRODUCTION

The Gezira and the Managil Extension are divided for agricultural administrative purposes into 107 numbered blocks each comprising approximately 20,000 acres of irrigated land. Two adjacent blocks, numbers 26 (Dolga) and 27 (Istarihna) were selected by the Blue Nile Health Project for detailed evaluation of the comprehensive strategy for disease control. These two blocks lie on the eastern side of the Gezira to the north-west of Masaheisa and the south-west of Abu Usher. They include 31 village areas of which 15 "core" villages lie inside the irrigated area, 7 "road" villages lie on the eastern edge adjacent to the main Khartoum-Wad Medani road and 9 "fringe" villages lie to the West on the fringe of Block 27 (Figure 16 and Table 28). Each village area is a basic social, agricultural and epidemiological unit comprising one registered village (or a cluster if 2 or 3 registered villages are situated very closely together) plus the surrounding tenancies worked by the villagers and any hamlets or camps housing any other labour force and their families. At the end of 1981 there were 24 of these small hamlets in the Study Zone.

For detailed study, 3 of the core village areas were selected representing a range of village sizes, economic conditions and geographical locations (Intensive Study Village Areas: Tayeba Sheikh Qurashi; Dolga; Gad El Ain/Awlad Yusif).

A further 18 villages were selected from the remaining 28 as monitor villages in which a less detailed annual monitoring of progress was scheduled for 5 years (Table 28).

Existing Health Services

The total population of the Study Zone is approximately 50,000, served by the following health structure:-

- A rural hospital in Abu Usher with 242 beds, served by 3 Sudanese Medical officers and 106 nurses. This hospital is also served by a team of 8 Chinese expatriate doctors.

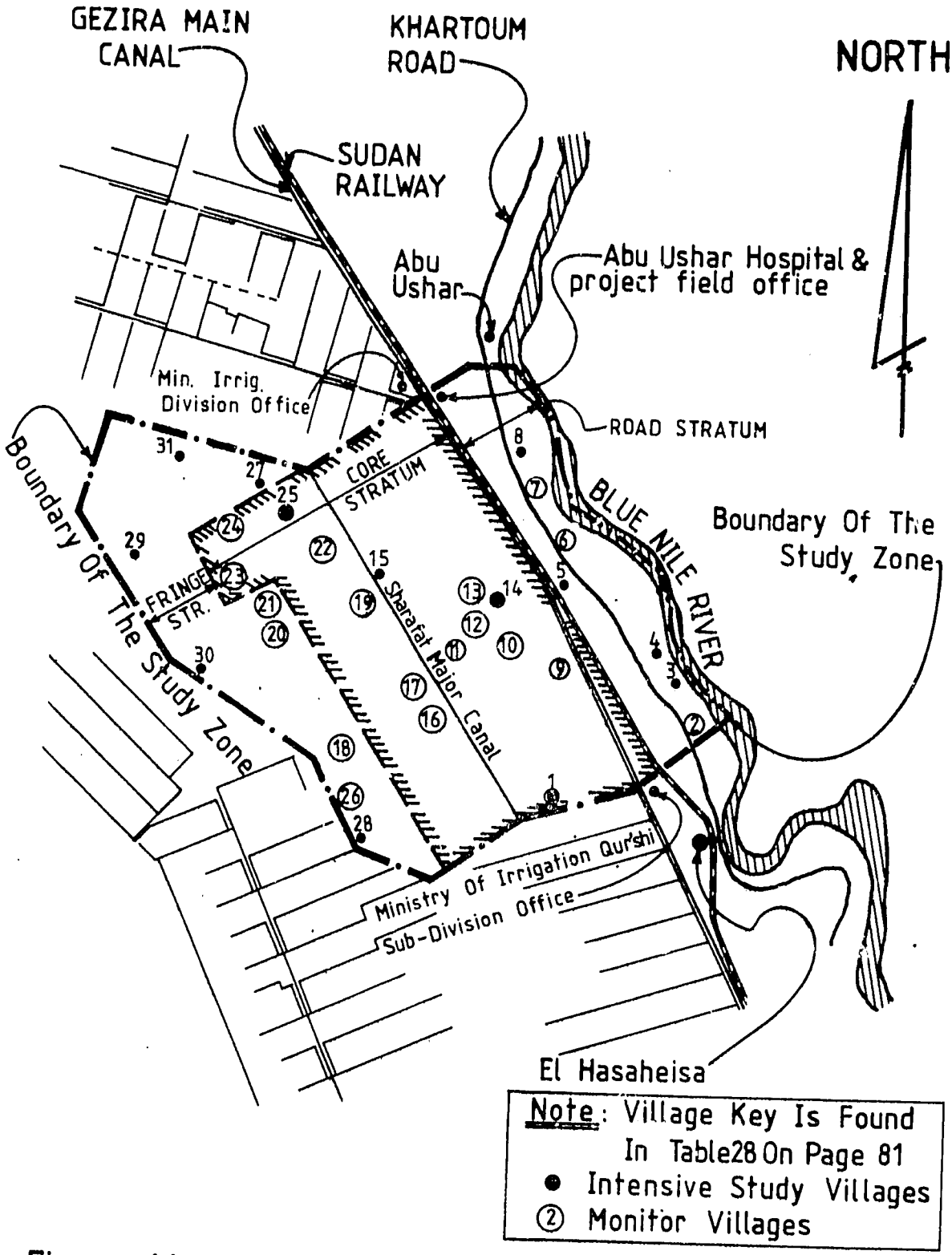


Figure 16 MAP OF THE STUDY ZONE

Kilo. 5 4 3 2 1 0 5 10 15 20 25 Kilometres

Graphic Scale

TABLE 28

The 31 village areas in the Study Zone, their strata and monitoring categories

Village Area	Stratum	Sampling Group
1. Tayeba	Core (C)	Intensive
2. Saddaga	Road (R)	Monitor
3. Abu Frua	R	-
4. Batahein	R	-
5. Ganneb	R	-
6. Shawrab	R	Monitor
7. Al Kua	R	Monitor
8. Talbab	R	-
9. Mustafa Qurashi	C	Monitor
10. Timeid	C	Monitor
11. Takala Qurashi	C	Monitor
12. Sheikh Basir	C	Monitor
13. Huleila	C	Monitor
14. Dolga	C	Intensive
15. Angado	C	-
16. Sharafat	C	Monitor
17. Managaza	C	Monitor
18. Abu Seirs	Fringe(F)	Monitor
19. Istarihna	C	Monitor
20. Turush	F	Monitor
21. Katfia/Safia	F	Monitor
22. Toba	C	Monitor
23. Wad Battaro	C	Monitor
24. Wad El Amin	C	Monitor
25. Gad El Ain/Awlad Yusif	C	Intensive
26. Takala Gubara	F	Monitor
27. Messelemia	F	-
28. Medina	F	-
29. Wad Sheneina	F	-
30. Goz Abdel Salam	F	-
31. Megarab	F	-

- A district hospital at Hasaheisa with about 100 beds.
- Two rural health centres run by medical assistants and female health visitors.
- There are six dispensaries run by medical assistants and nurses.
- Nine dressing stations run by nurses.

The total trained manpower is therefore 11 doctors, 6 medical assistants, 2 health visitors and 140 nurses of which 106 are stationed at Abu Usher. There are 9 trained midwives in the villages.

Those villages in the southern part of the Study Zone find that transportation to Hasaheisa is easier than to Abu Usher, and would therefore not use Abu Usher hospital.

B. COLLECTION OF BASELINE DATA

The collection of baseline data in the Study Zone continued from 1981 until June 1st 1982 which was the designated intervention date.

1. A Second S. mansoni prevalence survey in the 3 Intensive Study Villages.

The first prevalence survey in the three intensive study village areas was carried out in early 1981 in conjunction with the village census. Stool and urine samples were collected from approximately 72% of the population with the promise that mass chemotherapy would take place at the end of the baseline data collection phase. Thus when the intervention date arrived treatment was offered, but on re-registration of all residents and provision of a stool sample. This allowed a second pretreatment prevalence survey some 18 months after the first.

The results of the 1981 census and the 1981 prevalence survey, taken from the 1981 Annual Report are combined in (Table 29) with the results of the 1982 prevalence survey. In the 3 large villages - Tayeba, Dolga and Gad El Ain - the S. mansoni prevalence had increased from 47% in 1981 to 52% in 1982, while in the 3 smaller residential units, which have no piped water supplies, the prevalence has increased from 71% to 85% (Table 29). Both of these increases are significant ($P < 0.01$).

TABLE 29

PREVALENCE OF S. MANSONI IN THE 3 INTENSIVE STUDY VILLAGE AREAS IN 1981 and 18 MONTHS LATER IN 1982, PRIOR TO INTERVENTION

VILLAGE	JANUARY 1981					JUNE 1982			
	TOTAL CENSUS	EXAMINED	RESPONSE	POSITIVE	PREVA-LENCE	EXAMINED	RESPO-NSE	POSI-TIVE	PREVA-LENCE
Tayeba Village	2805	2039	73%	916	45%	1941	69%	968	50%
Dolga Village	1087	792	73	363	46	724	67	357	49
Gad El Ain Village	946	702	74	376	54	569	60	345	61
Awlad Yusif	187	101	54	76	75	115	61	100	87
Shajara Camp	190	117	62	87	74	85	45	76	89
Hababna Camp	181	138	76	91	66	121	67	98	81
Total 3 Villages	4838	3533	73	1655	47	3234	67	1670	52 *
Total 3 Camps	558	356	64	254	71	321	58	274	85 *
T O T A L	5396	3889	72	1909	49	3555	66	1944	55

* Significantly higher than prevalence in January 1981 ($P < 0.01$)

The age specific prevalence of schistosome infections and a more detailed analysis of these results in terms of other parameters will be available after computer analysis of the data.

2. Schistosomiasis Incidence in 18 Monitor Villages

In addition to the 3 intensive study villages, 18 villages were selected for monitoring purposes, 11 of these in the core stratum, 4 on the western fringe and 3 on the eastern fringe situated on the main Khartoum-Wad Medani road. In early 1981 these villages were surveyed by examining all residents in a randomly selected 20% of all households. Only those who had been negative in the 1981 survey were re-examined in 1982 to produce baseline data on incidence (Figure 17). Peak incidence occurred in the 15 year old children in the core stratum villages.

The results in the 15 core and fringe villages (Table 30) show that of 836 people re-examined in 1982, 192 were then positive for S. mansoni (23.0%). In the intensive study villages of Tayeba and Dolga, 256 (21%) of 1217 negative persons converted to positive.

These figures overstate the incidence of S. mansoni because many of the conversions were probably due to false negatives in the 1981 survey. In Tayeba village where the figures are available, from 698 people who were positive in 1981, 617 were still positive in 1982 but 81 (11.6%) had apparently reverted to negative (Table 30). Some of these would be false negatives in 1982, but some would be true reversions and others the result of chemotherapy. In Dolga village 78 people were positive in 1981 and negative in 1982, more than converted the other way. Thus the true incidence level in the Study Zone is probably about half the apparent incidence suggested by the simple analysis.

In the three road villages, the incidence was low in two (Saddage 2.5% and El Kua 6.3%) but high in the third (El Shaurab 17.6%) in which the population are more involved with the Gezira agricultural activities (Table 31).

Figure 17 Incidence Of S. Mansoni By Age In The Core, Fringe & Road Strata Villages

Study Zone 1981 — 1982

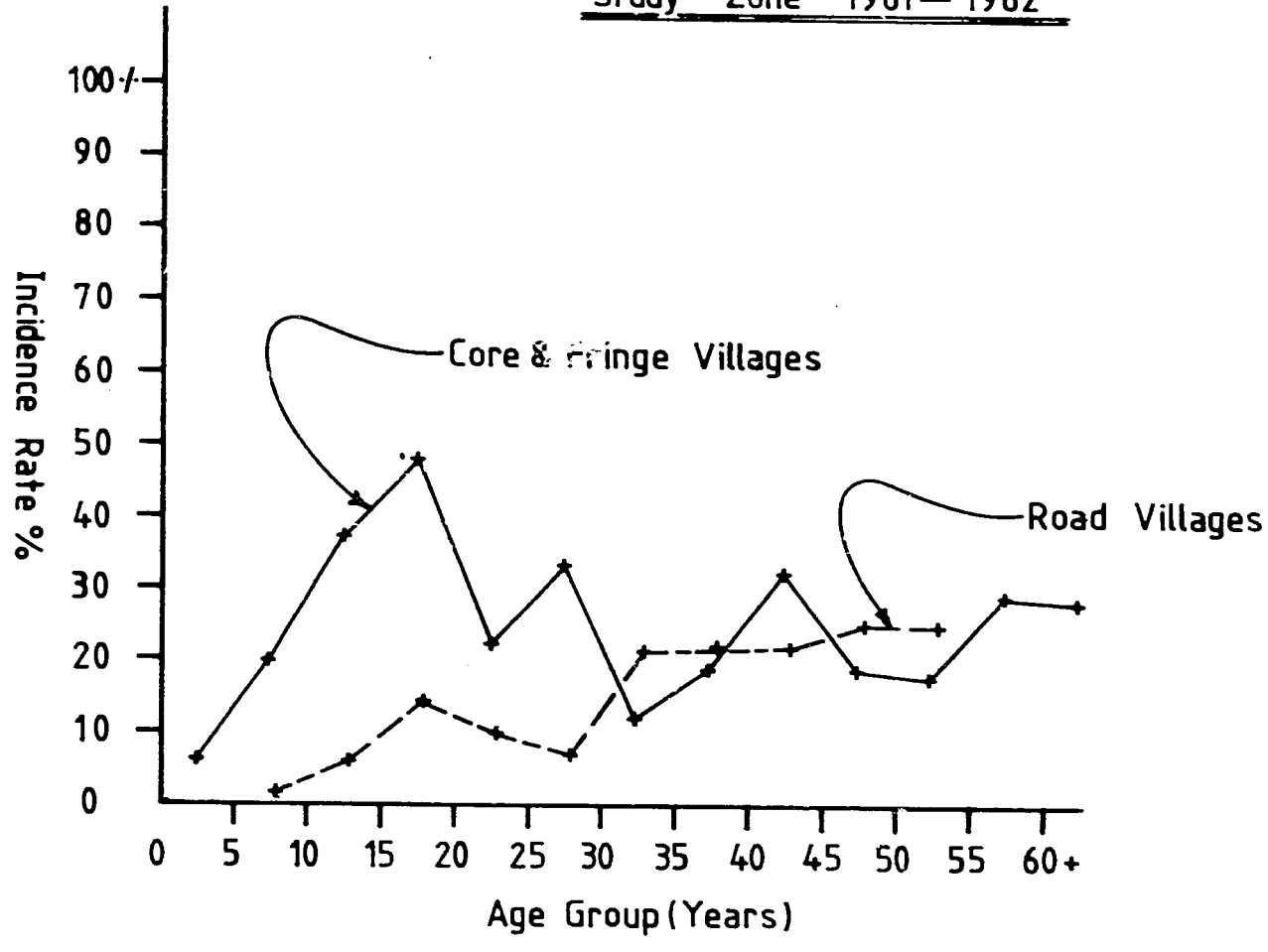


TABLE 30

INCIDENCE OF SCHISTOSOMA MANSONI IN THE STUDY ZONE MEASURED BY RE-EXAMINATION IN 1982 OF NEGATIVES FROM THE 1981 PREVALENCE SURVEY IN 15 CORE & FRINGE MONITOR VILLAGES, PRIOR TO INTERVENTION

MONITOR VILLAGE	MALES			FEMALES			TOTAL		
	EXAMINED	POSITIVE	INCIDENCE	EXAMINED	POSITIVE	INCIDENCE	EXAMINED	POSITIVE	INCIDENCE
Sharafat	39	13	33%	59	9	15%	98	22	22.4%
Managaza	38	5	13	35	9	26	73	14	19.2
Istarihna	4	1	25	12	3	25	16	4	25.0
Wad El Amin	10	2	20	12	2	17	22	4	18.2
Wad Battaro	8	0	0	20	6	30	28	6	21.4
Toba	11	1	9	26	5	19	37	6	16.2
Mustafa Gorashi	28	8	29	37	6	16	65	14	21.5
Timeid	6	2	33	8	3	38	14	5	35.7
Takala Gorashi	1	1	100	12	7	58	13	8	61.5
Sheikh Basir	47	12	26	65	11	17	112	23	20.5
Hulaila	16	5	31	22	9	41	38	14	36.8
Takala Gubara	38	8	21	76	14	18	108	22	20.4
Abu Seir	45	17	38	60	7	12	105	24	22.9
Safia/Katfia	17	6	35	39	9	23	56	15	26.8
Turush	19	5	26	32	6	19	51	11	21.6
T o t a l	321	86	27%	515	106	21%	836	192	23.0%
Intensive Study Villages									
Tayeba	412	82	20	502	100	20	914	182	19.9%
Dolga							313	74	23.6
Total I.S.V.							1227	256	20.9%
Tayeba (Reversions)	350	41	12%	348	40	12%	698	81	11.6%

TABLE 31

INCIDENCE OF SCHISTOSOMA MANSONI IN THE 3 MONITOR ROAD VILAGES 1981 - 1982, PRIOR TO INTERVENTION

VILLAGE	MALES			FEMALES			Total		
	Examined	Positive	Incidence	Examined	Positive	Incidence	Examined	Positive	Incidence
Gaddaga	66	3	5%	94	1	1%	160	4	2.5%
El Shaurab	31	8	26	37	4	11	68	12	17.6
El Rua	14	2	14	18	0	0	32	2	6.3
Total	111	13	12%	149	5	3.4%	260	18	6.9%

3. Schistosomiasis Prevalence in 9 Study Zone Villages Surveyed for the First Time in 1982

The epidemiology unit extended its baseline data in the Study Zone villages by taking samples from a randomly selected 20% of households in 9 villages. These villages, 4 in the road stratum and 5 in the fringe stratum, were being examined for the first time.

In the road villages overall S. mansoni prevalence was 16.2%, but one of the four villages, Batahein, had a 37.3% prevalence which is unusually high for a road stratum village (Table 32). The probable reason for this high prevalence is that Batahein has no clean water supply. In the fringe villages the overall prevalence was 47.9% but two villages - Wad Sheneina and Goz Abdel Salam - had 28% and 29% prevalence while the other 3 village prevalences were high (65.9%, 69.7% and 79.3%) (Table 32).

4. Malaria Prevalence

Parasite surveys were conducted in children of the three intensive study villages and 18 monitor villages during March and October 1982. In March the prevalence was extremely low, approaching zero. In October the prevalence was also low (0.36%) in spite of the delay in spraying which took place in October instead of the normal time in July (Tables 33 and 34).

5. Diarrhoeal Diseases Baseline Data

The three intensive study villages and two other villages were used for the collection of data on the prevalence and importance of diarrhoeal diseases in the children under 5 years old. Trained observers using a standard questionnaire asked mothers about their children's health, and particularly about diarrhoeal attacks. In the 3 villages all children were covered by the survey, but in the two other villages a 20% household sample was used. The record sheets were checked by the sociologist and passed to the epidemiologist where they await computer analysis.

TABLE 32

PREVALENCE OF S. MANSONI IN A 20% HOUSEHOLD SAMPLE OF 4 NEWLY ADDED ROAD VILLAGES AND 5 NEWLY ADDED FRINGE VILLAGES IN THE STUDY ZONE, IN 1982

VILLAGE	EXAMINED	POSITIVE	PREVALENCE
(1) Road Villages			
Talbab	1067	142	13.3%
Ganneb	621	116	18.7
Batahein	142	53	37.3
Abu Frua	1119	166	14.8
(2) Fringe Villages			
Wad Shaneina	164	46	28.0
El Medina	88	58	65.9
El Nagarabi	58	46	79.3
Goz Abdel Salam	45	13	28.9
El Masalamia	33	23	69.7
Total Road	2949	477	16.2
Total Fringe	388	186	47.9
Total	3337	663	19.9%

TABLE 33

MALARIA PREVALENCE SURVEYS IN CHILDREN OF THE 21 MONITOR VILLAGES IN THE STUDY ZONE, 1981 & 1982

YEAR	MONTH	EXAMINED	POSITIVE	PREVALENCE
1981	March	0	-	-
	October	6691	21	0.31%
1982	March	3737	1	0.03%
	October	3562	13	0.36%

TABLE 34

PREVALENCE OF MALARIA IN CHILDREN OF STUDY ZONE, BY VILLAGE, 1982

	MARCH			OCTOBER		
	EXAMINED	POSITIVE	PREVALENCE	EXAMINED	POSITIVE	PREVALENCE
1. Tayeba Gurashi	217	0	0%	254	0	0%
2. Dulga	178	0	0	253	0	0
3. Gad El Ein	169	0	0	181	0	0
4. El Hua	92	0	0	55	5	9.1
5. El Shawrab	164	0	0	218	0	0
6. El Sadaga	304	0	0	287	3	1.04
7. El Hulaila	185	0	0	135	0	0
8. Sheikh El Basir	236	0	0	155	0	0
9. Takala Gurashi	74	0	0	50	1	0.2
10. El Timeid	97	0	0	78	0	0
11. Mustafa Gurashi	298	0	0	282	0	0
12. Sharafat	299	1	0.33	239	0	0
13. Managaza	242	0	0	297	0	0
14. Wad El Amin	75	0	0	50	0	0
15. Safia	203	0	0	248	0	0
16. El Turush	80	0	0	90	0	0
17. Wad Batro	75	0	0	86	0	0
18. Toba	162	0	0	121	0	0
19. Istarihna	48	0	0	42	4	9.5
20. Abu Seir	293	0	0	241	0	0
21. Takala Gubara	246	0	0	200	0	0
TOTAL	3737	1	0.026	3562	13	0.36

6. Snail Population Sampling and Infection Rates

a) Snail sampling - Tayeba village area

The 12 designated sampling sites in the Tayeba village area were visited on a weekly basis until June 1 to complete the baseline data collection, and from June to December to check on the focal molluscicide efficacy.

From January to June almost 22,000 B. pfeifferi snails were collected of which 749 (3.4%) were infected and shedding cercaria presumed to be S. mansoni (Table 35). Thanks to intervention using the focal molluscicide application technique and Bayluscide, no snails were found from August to December. Whereas infected snails were found in 7 of the 12 contact sites, 722 (96%) were found in the composite site 12, a canal at the northern fringe of the Tayeba village (Table 36).

Eight minor canals were examined for snails and infected snails on a monthly basis and over 60,000 snails were collected from 61 sites. In all 24 (0.04%) individuals were shedding S. mansoni cercaria and these were found over several sites in 3 canals in March, April and May (Table 37).

b) Snail sampling Gad El Ain village Area

In the Gad El Ain village area, snail sampling was carried out on a regular basis throughout 1982; before intervention to complete baseline data collection and after intervention as an indicator for mollusciciding and as an assessment of the control programme. The same 11 sites - all near dwellings and therefore proven or potential transmission sites - were sampled. The snails collected from each site were screened for mature infection with Schistosoma mansoni. In the 6-month period from January to June a total of 14,872 snails were collected of which 521 (3.5%) were shedding S. mansoni type cercariae (Table 38). From July to December no live B. pfeifferi snails were found in any site. Whereas in the Tayeba village area 96% of the infected snails were found in one canal stretch, in Gad El Ain all 11 sites were infective during the early part of 1982. No single site produced

TABLE 35 SEASONAL DISTRIBUTION OF BIOMPHALARIA PFEIFFERI AND THEIR INFECTIONS WITH SCHISTOSOMA MANSONI IN TWELVE TRANSMISSION SITES AROUND TAYEBA VILLAGE IN 1982

Month	Jan	Feb	March	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Snails collected	4483	5593	4380	4215	2655	480	0	0	0	0	0	0	21,806
Monthly snail collection as percentage of total collected in year	20.6%	25.6%	20.1%	19.3%	12.2%	2.2%	0	0	0	0	0	0	100%
Number of infected snails	222	173	123	180	51	0	0	0	0	0	0	0	749
Prevalence of infected snails	5.0%	3.1%	2.8%	4.3%	1.9%	0%	0	0	0	0	0	0	3.4%
Monthly infected snails as percentage of total infected snails for year	29.6%	23.1%	16.4%	24.0%	6.8%	0	0	0	0	0	0	0	100%

TABLE 36 GEOGRAPHICAL DISTRIBUTION OF BIOMPHALARIA PFEIFFERI AND THEIR INFECTIONS WITH SCHISTOSOMA MANSONI IN TWELVE TRANSMISSION SITES AROUND TAYEBA VILLAGE IN 1982

Site Number	1	2	3	4	5	6	7	8	9	10	11	12a	12b	12c	Total
Snails Collected at Site	0	608	550	1434	2352	1771	0	1637	1343	357	2003	3169	4154	2428	21806
Snails Collected at Site as Percentage of Total Snails Collected at all Sites	0	2.8%	2.5%	6.6%	10.8%	8.1%	0%	7.5%	6.2%	1.6%	9.2%	14.5%	19.0%	11.1%	100%
Number of Infected Snails	0	1	5	2	8	1	0	0	0	0	10	295	235	192	749
Prevalence of Infected Snails %	0	0.2%	0.9%	0.1%	0.3%	0.1%	0%	0%	0%	0%	0.5%	9.3%	5.7%	7.9%	3.4%
Infected Snails at Site as Percentage of Total Infected Snails at all Sites	0%	0.1%	0.7%	0.3%	1.1%	0.1%	0%	0%	0%	0%	1.3%	39.4%	31.4%	25.6%	100%

Note : All the snails were found only from January to June, 1982.
From July 1982 - December 1982 all sites were snail free.

TABLE 37

GEOGRAPHICAL DISTRIBUTION OF SNAILS IN THE MINOR CANALS IN TAYEBA VILLAGE AREA, AND INFECTIONS WITH S. MANSONI, IN 1982

MINOR CANAL	SNAILS COLLECTED	INFECTED	PREVALENCE OF INFECTIONS
Gubara (4 sites)	2980	0	0
Karabi (4 sites)	10561	0	0
Debba (3 sites)	5195	0	0
Wad El Kamil (4 sites)	2815	0	0
Gannabia (9 sites)	3611	2	0.06%
Tayeba (7 sites)	7264	0	0
Gorashi (17 sites)	18401	8	0.04
Abu Gweili (13 sites)	10043	14	0.14
T O T A L	60870	24	0.04%

TABLE 38 GEOGRAPHICAL DISTRIBUTION OF BIOMPHALARIA PFEIFFERI AND THEIR INFECTIONS WITH SCHISTOSOMA MANSONI IN ELEVEN TRANSMISSION SITES IN THE GAD EL AIN VILLAGE AREA IN 1982

Site Number	1	2	3	4	5	6	7	8	9	10	11	Totals
Snails collected at site	2099	824	3032	1234	705	627	1157	1019	689	563	2923	14872
Snails from site as percentage of total snails collected at all sites	14.1%	5.5%	20.4%	8.3%	4.7%	4.2%	7.8%	6.9%	4.6%	3.8%	19.7%	100%
Number of infected snails	44	110	34	16	35	36	50	77	81	25	13	521
Prevalence of infected snails	2.1%	13.3%	1.1%	1.3%	5.0%	5.7%	4.3%	7.6%	11.8%	4.4%	0.4%	3.5%
Infected snails from site as percentage of total infected snails from all sites	8.4%	21.1%	6.5%	3.1%	6.7%	6.9%	9.6%	14.8%	15.6%	4.8%	2.5%	100%

N o t e : All these snails were collected from January to June
After June 1982 no snails were found

a majority of the infections although site 2 opposite Awlad Yusif village was the most heavily infected.

The lack of snails in all sites from June to December reflects the successful molluscicide campaign.

7. Mosquito and Larval Surveys

A team of mosquito and larval searchers from the Biology Unit carried out routine fortnightly surveys in six villages, viz. Tayeba, Dolga, Gad El Ain, Hag El Said, Safia and Batahein, representing the different areas of the Study Zone. The purpose was to monitor the prevalence of all mosquitoes and larvae and to correlate the existence of the insects with seasonal and local conditions.

a) Adult mosquitoes (Table 39)

The *Anopheles arabiensis* survey consisted of a pyrethrum spray and collection in 10 rooms in each of the six villages. The mosquito density was virtually zero until September, and then large numbers were collected in 4 of the 6 villages in October, due to the delay in house spraying and the accumulation of rainpool breeding sites (Table 39). In the other 2 villages there were no mosquitoes to be collected because early in the month the villagers had themselves sprayed their houses. The rest of the Study Zone was treated with fenitrothion in late October.

b) Larvae

All potential breeding places in and around the same six villages were searched using standard dipping techniques. The only species found in large numbers was *Anopheles pharoensis* which is exophilic, and even in October when *An. arabiensis* were found, the larvae were found only near Dolga village (Table 40).

c) Potential breeding places for mosquitoes

Eighteen villages have been surveyed to determine potential breeding sites in and around Study Zone villages.

In the months of August and October - and presumably September, though no surveillance was possible because of rain - large numbers of

TABLE 39 ADULT ANOPHELINE MOSQUITOS COLLECTED PER ROOM IN SIX VILLAGES OF THE STUDY ZONE, ADULT MOSQUITO SURVEY IN 10 ROOMS PER VILLAGE, IN 1982

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov *	Dec
Total *An. arabiensis* collected from 10 rooms in each village		0	10	0	0	0	0	0	4	6014	-	-
Village	Mean count of mosquitos collected per room											
Tayeba		0	0	0	0	-	0	0	0.4	0.44	-	-
Dolga		0	0.1	0	0	0	0	0	0	32.70	-	-
Gad El Ain		0	0	0	-	0	0	0	0	13.30	-	-
Hag El Said		0	0	0	-	0	-	0	0	4.90	-	-
Safia		0	0	0	-	0	0	0	0	0	-	-
Batahein		0	0	0	0	0	-	0	0	0.80	-	-

* House spraying was completed in October.

TABLE 40 AVERAGE DENSITY OF MOSQUITO LARVAE PER DIP IN THE BREEDING SITES IN 6 VILLAGES OF THE STUDY ZONE, 1982

Village	Average NUMBER OF LARVAE FOUND PER 10 DIPS																										
	Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct		
	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C	AA	AP	C
Tageba	3.5	1.2	0	0.3	14.2	0	0	110.2	0	0	8.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolga	0.6	1.4	0	0	4.5	0	0.1	4.4	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0	1.7	2.8	1.4
Bad El Ain	0	0	0	0	4.4	0	0	0	0	0	1.4	2.2	0.1	0	0	0	0	0	6.0	0	0	0	0	0	0	0	0
Hag El Saeid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Safia	0	0	0	0.1	3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Batah-een	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key : AA *Anopheles arabiensis*

AP *Anopheles pharoensis*

C *Culex spp*

An. arabiensis larvae were found in pools from leaking water pipes, in Abueshreens and Abusitta (Table 41). Earlier in the year very small numbers of larvae were found in the same habitats. In drains An. arabiensis were not common, but An. pharoensis appeared to prefer these habitats.

8. Village Water Supply Systems

a) Methodology

Monitoring of the 24 village water supply systems was continued until the end of May 1982, providing one year of operational history prior to implementation of the Comprehensive Strategy. The monitoring was based on daily written records kept by the pump operators regarding hours of operation, amount of water pumped, amount of fuel or electricity used and operational problems. The collected data:

1. Provided a baseline on the rate of consumptiom of safe water against which the effect of engineering improvements could be assessed.

2. Provided design information for construction of new systems and expansion of existing systems, and

3. indicated a strong relation between consumption of safe water and prevalence of diarrhoeal diseases and schistosomiasis.

The monitoring system was extremely simple but relied heavily on cooperation and judgement of the pump operators. The amount of water pumped each day was estimated from changes of water level in the overhead storage tanks, not from meters. Records of operational failures were assessed from those months during which the operator had kept a complete record for both the previous and the following month, to minimise reporting errors. In cases where long sets of identical records were submitted they were disregarded. As a result of this selectivity, the values presented can be considered as a reliable sample of the operating records which gives a good indication of performance throughout the Study Zone. However there were many individual villages

TABLE 41

ANNUAL DENSITY PER DIP IN DIFFERENT KINDS OF BREEDING SITES IN THE STUDY ZONE, 1982

Month of 1982	BREEDING SITES											
	Leakage of Water Pipes			Drains			Abu-eshreen			Abu Sitta		
	An. arab.	An. phar.	Culex	An. arab.	An. phar.	Culex	An. arab.	An. phar.	Culex	An. arab.	An. phar.	Culex
Jan.	0.2	0.4	44.1	0	5.1	3.3	0.68	0.1	0.22	1.1	0	0
Feb.	1.0	2.8	6.5	0	8.5	4.9	0.1	0.1	0.2	1.4	4.1	0
Mar.	2.5	0	0.1	0.1	2.0	3.3	2.4	0	0	3.1	0	0
Apr.												
May												
Jun.	0	0.9	1.3	0	0.5	3.0	5.1	3.8	0	2.8	0.9	0
Jul.	0	0	0.5	0	0	0	2.1	4.7	1.5	0	3.2	0
Aug.	18.2	3.6	0.9	1.7	6.5	3.4	20.3	0.2	5.1	9.5	5.4	1.0
Sep.												
Oct.	19.5	5.6	7.0	5.1	3.2	4.1	15.6	6.8	2.7	21.3	0.5	0
Nov.												
Dec.												

from which unreliable records were obtained (Table 42). In all it was a relatively inexpensive way of monitoring the large variety of water supply systems in the Study Zone, and gave valuable information.

After the improvements to the water supply systems are completed a similar monitoring should be conducted for one full year to measure the impact of the improvements.

b) Performance of village water supply systems

1. For periods when systems were operating normally. Operating records were obtained from 20 of the 24 village water supply systems, all of which were deep well systems providing water to household taps without chlorination. The remaining 7 village areas in the Study Zone did not have community systems. Only 11 of the 20 villages provided records which were reliable enough for detailed analysis (Table 42). These 11 villages were included in calculating a selected mean as a reliable estimate of the consumption for all villages. The per capita consumption of water in the 11 selected villages ranged from 49 litres per day in Gad El Ain to 162 litres per day in Sharafat, with a mean of 100 litres per day.

Diesel engines were used to power 13 of the systems in the 20 villages reporting and the fuel consumption for 5 selected villages with diesel engines was 1.7 litres of diesel fuel per hour of operation (Table 43). The mean operating time was 6.5 hours per day, usually half in the morning and half in the afternoon. The engines showed a large variance in pumping efficiency with a range from 6 cubic meters of water pumped per litre of fuel consumed in Gad El Ain to 19 cubic meters in Angado, with a mean for the 5 selected villages of 11 cubic meters of water pumped per litre of fuel. Most of the diesel engines in the selected villages were 15 horsepower Bukh engines driving Grundfos pumps, one of the standard equipment sets in the Gezira.

Of the 7 electrically powered pumps the motors in 6 selected villages had a mean operating time of 10.5 hours per day, usually half in the early morning and half in the afternoon. However some of the pumps

TABLE 42

NORMAL DAILY CONSUMPTION OF WATER IN VILLAGES OF THE STUDY ZONE, JULY 1981 TO MAY 1982 BEFORE INTERVENTION WITH THE COMPREHENSIVE DISEASE CONTROL STRATEGY

Village	Days of recorded operation	Cubic meters pumped per day	Estimated 1982 Population	Estimated daily consumption in litres per capita **
1. Tayeba Sheikh El Gurashi	159 *	214.5	2800	73
2. Saddaga	159 *	229.5	2700	68
3. Abu Frua	156 *	568.8	3500	130
4. Ganneb	71 *	196.5	1400	133
5. Shaurab	118	169.3	1000	160
6. Mustafa Gurashi	92 *	171.9	3000	54
7. Timeid	27	99.5	450	177
8. Takala Gurashi	71	175.3	350	476
9. Sheikh Basir	108	111.3	1200	88
10. Huleila	30	177.0	900	187
11. Dolga	86 *	104.8	1100	76
12. Angado	204 *	171.1	1000	162
13. Sharafat	146 *	184.6	2600	67
14. Katfia Safia	41	103.6	2000	49
15. T o b a	139 *	95.1	600	150
16. Wad Battaro	29	187.0	1000	178
17. Wad El Amin	40	137.7	700	187
18. Gad El Ein/ Awlad Yousif	168 *	54.5	1200	49
19. Takala Gubara	33	85.9	2300	35
20. Wad Sheneina	52 *	135.8	900	143
T O T A L S				2642
M E A N S				132
* Selected total of villages				1105
* Select Mean				100

** Corrected for system leakage.

TABLE 43

SUMMARY OF OPERATION FOR 13 VILLAGES WITH DIESEL ENGINES IN STUDY ZONE

JULY 1981

VILLAGE	Days of Record	Hours/Day Operation	Horse Power of Diesel Engine	Litres fuel Consumed	Litres/Hour Operation	M^3 Water Pumped/ litre fuel
Wad Battaro	29	11.9	Lister	528	1.5	10
Sheikh Basir	108	4.0	25 Lister	738	1.7	16
T o b a	139 *	5.4	15 Bukh	834	1.1	16
Wad Shaneina	52 *	6.3		838	2.6	8
Gad El Ein	168 *	4.8	15 Bukh	1724	2.1	6
Katfia	41	6.4		542	2.1	8
Takala Gurashi	71	7.5	15 Bukh	485	0.9	26
D o l g a	86 *	7.1	15 Bukh	1062	1.7	8
Takala Gubara	33	11.2		443	1.2	6
Huleila	30	7.7	12 Lister	270	1.2	20
Angado	204 *	8.8	15 Bukh	1805	1.0	19
Shaurab	118	10.0	Delta	917	0.8	21
Wad El Amin	40	5.8	Bukh	695	3.0	8
Totals	1124	96.9		10881	20.9	172
Means		7.4			1.6	13
*Selected totals from 5 villages	649	32.4			8.5	57
*Select Means		6.5			1.7	11

ran continually for up to 14 hours a day in the larger villages such as Saddaga and Abu Frua. Mean power consumption was at the rate of 3.4 kilowatts and the efficiency of the pump was fairly uniform, about 8.2 cubic meters of water pumped for every kilowatt-hour of electricity used (Table 44).

There were small seasonal variations in the amount of water consumed, generally correlated with air temperature and humidity. For the 9 villages which had adequate records over the entire year of observations, the mean consumption was 90 litres per capita per day with two peaks of 104 litres in November and 101 litres in April (Table 45). Lowest consumption was 80 litres in the coldest month of February, with normal rates during the rainy season from July to October.

2. Periods when the systems were not operating

For the 9 villages which had sufficient continuity of records to determine operating experience, the mean time of operation was only 72% because of serious problems due to lack of fuel, electricity failures, lack of spare parts and leaking storage tanks (Table 46). The poorest operating record was in Abu Frua which was running only about half of the time, 52%. In Toba village however the system ran continuously for the period of complete records. The systems with the poorest records of continuous running were the electrically powered units, the main reason being electric power interruptions.

c) Impact of the Water Supply Systems on Health

The parameter one would expect to correlate most precisely with improvements in health would be the annual mean rate of water consumption, composed of two factors, the daily per capita consumption when the system was running properly (Table 42), and the proportion of the time the system was in operation (Table 46). Multiplying these two factors together would indicate the mean annual experience of consumption of safe water in a village. This annual mean can then be compared with prevalence of water-associated diseases to determine if they are affected by safe water supply (Table 47).

TABLE 44

SUMMARY OF OPERATION FOR 7 VILLAGES WITH ELECTRICALLY POWERED WATER SUPPLY SYSTEMS IN THE STUDY ZONE JULY 1981 TO MAY 1982

Village	Days of Record	Hours per day of operation	Power consumption when operating in kilowatts	M^3 Water Pumped per KWhr.	Remarks
Tayeba	159 *	9.3	4.1	5.6	
Saddaga	159 *	13.7	-	-	No meter
Abu Frua	156 *	14.5	4.9	8.0	
Ganneb	71 *	10.3	2.0	9.8	
Timeid	27	4.4	-	-	No meter
Sharafat	146 *	7.4	2.7	9.2	
Mustafa Gurashi	92 *	11.4	-	-	No meter
Totals	810	71.0	13.7	32.6	
Means		10.1	3.4	8.2	
* Select totals from 6 villages	783	63.2	13.7	32.6	
* Select means		10.5	3.4	8.2	

TABLE 45

ESTIMATED SEASONAL VARIATION IN DAILY WATER CONSUMPTION IN 9 VILLAGES OF THE STUDY ZONE ON DAYS WHEN SYSTEMS WERE OPERATING PROPERLY. ANNUAL MEAN RATE OF WATER CONSUMPTION WAS 90 LITRES/CAP/DAY

MONTH	RATIO OF MONTHLY CONSUMPTION TO ANNUAL MEAN	ESTIMATED DAILY CONSUMPTION IN LITRES/PERSON/DAY
1981		
7	0.92	83
8	1.05	94
9	0.97	87
10	0.92	83
11	1.15	104
12	1.02	92
1982		
1	1.00	90
2	0.89	80
3	1.08	97
4	1.12	101
5	1.06	95
Mean	1.00	90

TABLE 46

OPERATING TIME OF 9 VILLAGE WATER SUPPLY SYSTEMS IN STUDY ZONE FROM JULY 1981 TO MAY 1982

VILLAGE	DAYS OF OPERATION DURING MONTHS OF COMPLETE RECORDS	TOTAL DAYS IN MONTHS OF COMPLETE RECORDS	OPERATING TIME IN PER CENT
Tayeba	142	181	78%
Abu Frua	110	212	52%
Ganneb	38	61	62%
Sheikh Basir	79	122	65%
D o l g a	66	92	72%
Angado	164	183	90%
Sharafat	93	153	61%
T o b a	91	91	100%
Gad El Ain	120	153	78%
T O T A L S	903	1248	72%

TABLE 47

PREVALENCE OF SCHISTOSOMIASIS AND ESTIMATED ANNUAL RATE OF CONSUMPTION OF SAFE WATER FOR 9 VILLAGES IN STUDY ZONE FROM JULY 1981 TO MAY 1982

VILLAGE	FULLY OPERATING DAILY CONSUMPTION LITRES/CAP/DAY	PERCENTAGE OF TIME AT FULL OPERATION	ANNUAL MEAN RATE IN LITRES/CAP	PREVALENCE *S. MANSONI* 1981
Tayeba	73	78%	57	47.7
Abu Frua	130	52%	68	-
Ganneb	133	62%	82	-
Sheikh Basir	88	65%	57	38.4
D o l g a	76	72%	55	49.1
Angadc	162	90%	144	
Sharafat	67	61%	41	49.3
T o b a	150	100%	150	39.6
Gad El Ain	49	78%	38	56.2

1. Diarrhoeal Diseases

In 1981 the prevalence of diarrhoeal diseases in children under 5 years old was measured in three intensive study villages(BNHP Annual Report page 89). Annual mean rates of safe water consumption for these villages in litres per capita per day were 57 for Tayeba, 55 for Dolga and 38 for Gad El Ain. These show a precise correlation with the prevalence of diarrhoeal disease (Figure 18). It appears that diarrhoeal disease rates could be reduced significantly by raising either the normal daily consumption rate or by improving the operating experience. Additional data points would be helpful to make the correlation more meaningful.

2. Schistosomiasis

During the 1981 epidemiological surveys the schistosomiasis prevalence was determined for 6 of the villages in the core and fringe strata for which there were adequate records of safe water consumption. A comparison of the prevalence of infection with the annual experience of safe water consumption indicates two important facts about the relation:

a. Prevalence decreased with increasing consumption.

b. The most likely curve to fit the data would include two logical constraints. Firstly it would pass near 100% prevalence if the consumption rate of safe water were zero, and secondly as the consumption rate exceeded some value representing adequate domestic supply, the prevalence rate would no longer fall, being reduced to the prevalence incurred in agricultural or recreational activities (Figure 19).

It appears that an adequate domestic supply is about 80 L/cap/day and below that level there is a sharp rise in prevalence with decreasing availability of water (Figure 19). Although this may be adequate for engineering design, it would be helpful to have more data points to insure the reliability of the curve. These could be obtained by a separate study in areas of the Gezira-Managil Zone where no treatment has taken place.

Figure 18 RELATION OF PREVALENCE OF DIARRHEAL DISEASES AND SAFE WATER CONSUMPTION FOR INTENSIVE STUDY VILLAGES 1981

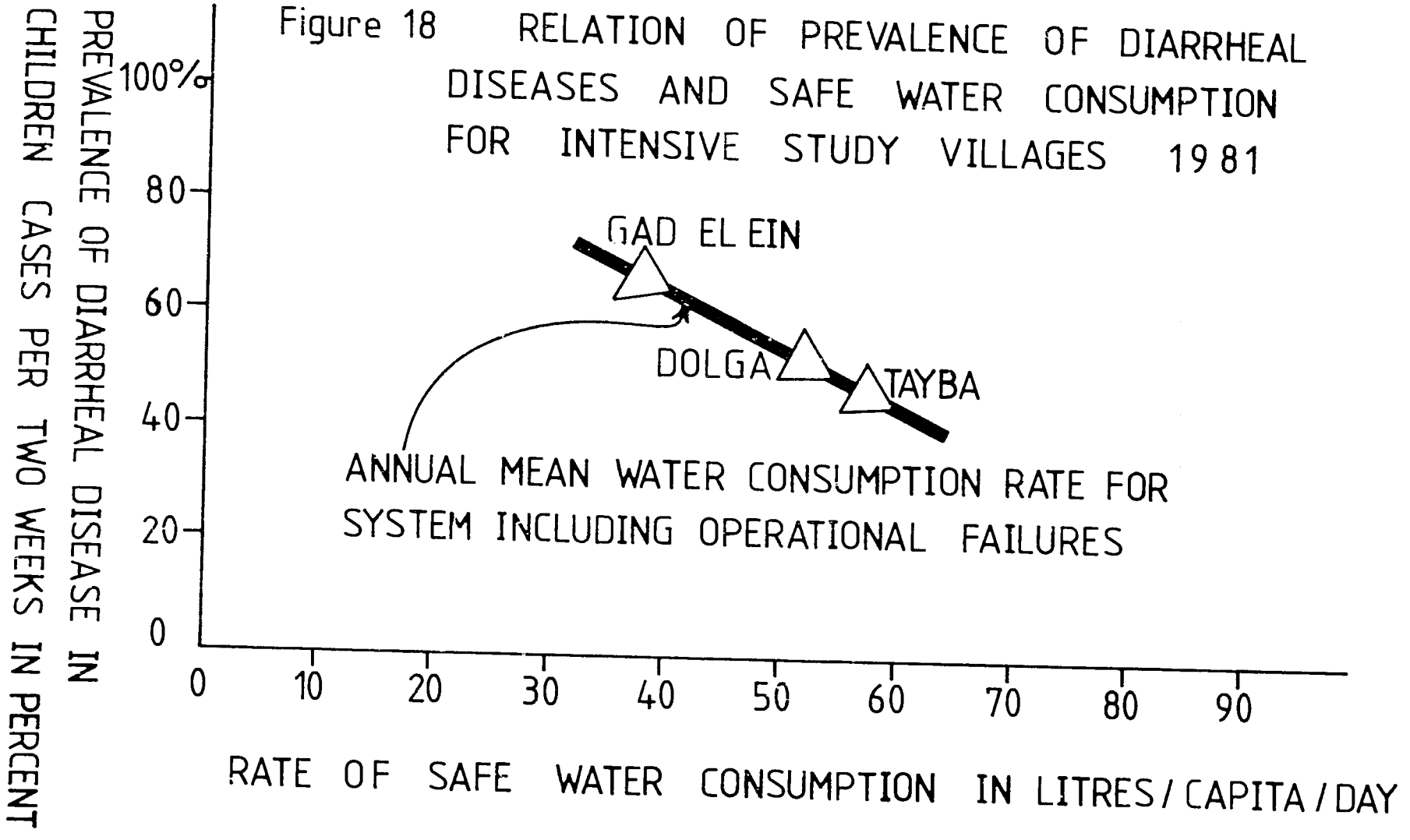
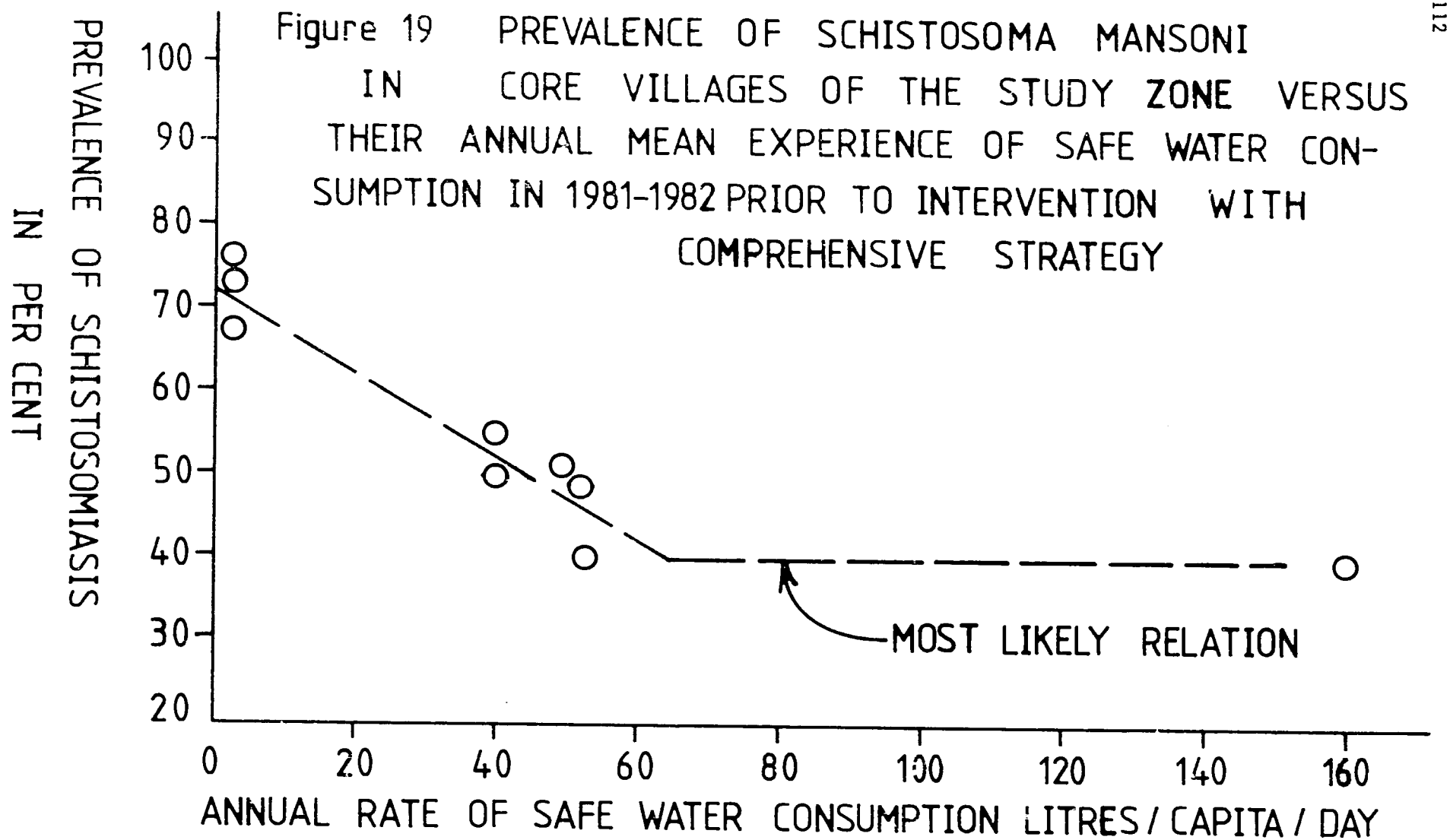


Figure 19 PREVALENCE OF SCHISTOSOMA MANSONI IN CORE VILLAGES OF THE STUDY ZONE VERSUS THEIR ANNUAL MEAN EXPERIENCE OF SAFE WATER CONSUMPTION IN 1981-1982 PRIOR TO INTERVENTION WITH COMPREHENSIVE STRATEGY



Based on figure 19 there seems to be little value for schistosomiasis control in raising consumption above 80 L/cap/day annual experience in individual villages. However about 8 villages in the Study Zone were below that rate and thus required improvements. The recommended design value, to include some safety factor, is a normal operating rate of 90 L/cap/day with a system reliability of 90%, giving annual experience of 81 L/cap/day for prevention of schistosomiasis.

9. Rainfall and Irrigation Data

a. Rainfall

The 1982 rainfall in the Study Zone was 221mm. The total rainfall for 1982 was similar to 1981, but just over half of the extremely wet season of 1978 (Figure 20 and Table 48).

b. Minor Canal flow Rates

The daily mean flow by month for the 18 month period June 1981 - December 1982 in the Study Zone Minor Canals was significantly below the design flow (Table 49). The peak period for irrigation water demand was September, October and November with April, May and June being the canal closure months (Figure 20).

c. Incidence of Breakage and Overflows

The canal breakages, water wasted and area flooded during 1982 were much lower than in 1981 (Table 50). A total of 26 incidents were reported during the year involving 145 days and an estimated 225,500 cubic metres of wasted water, compared to 800,000 cubic metres in 1981.

d. Distribution of Aquatic Weeds and Snails

The second survey of aquatic weeds in the area was carried out at the end of April 1982 repeating the one carried out during October 1981 when all canals were full of turbid water. Except for the summer canals, the other minor canals were either completely dry or drying out, containing only pools of water or shallow water. The same types

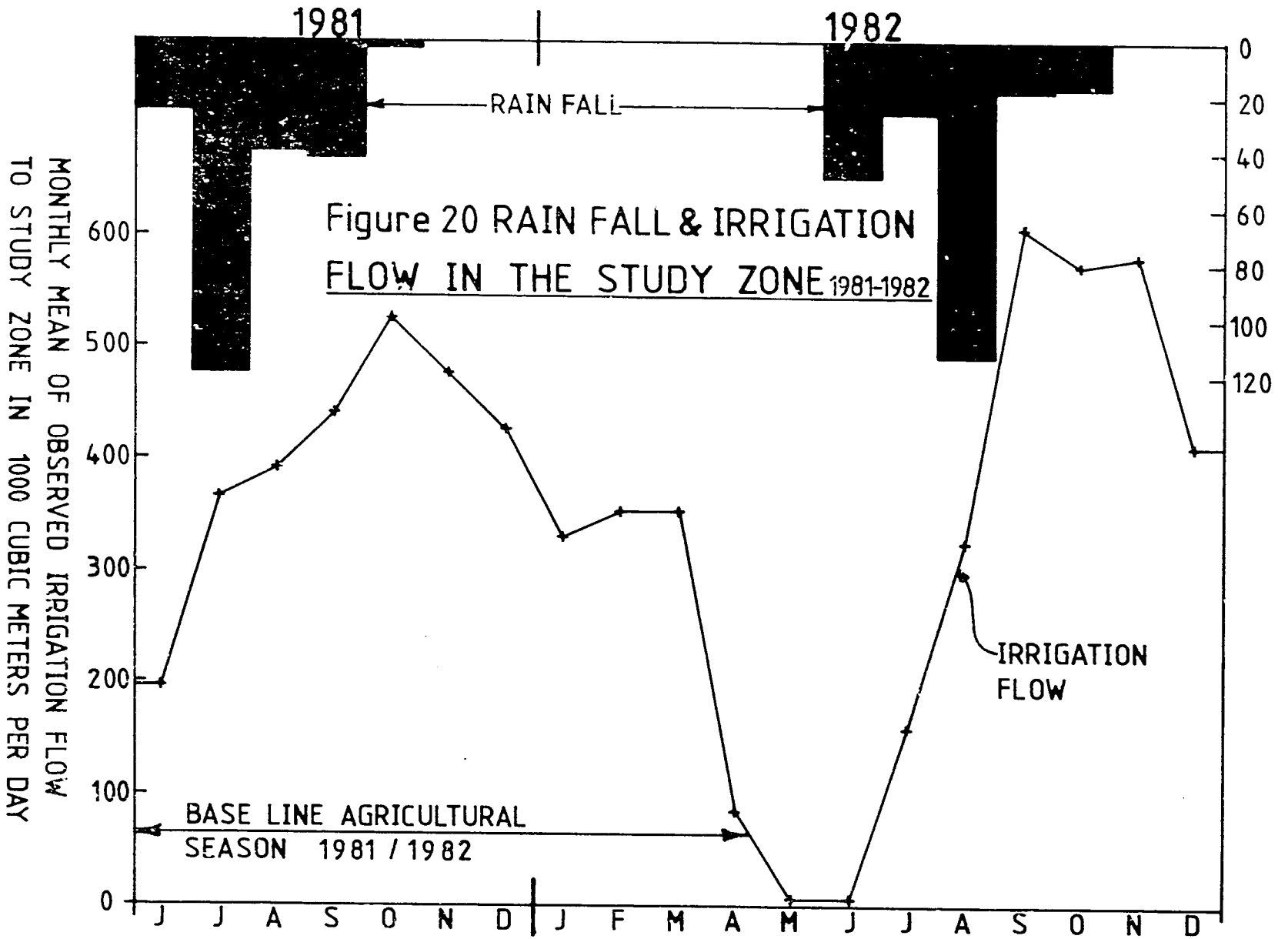


Figure 20 RAIN FALL & IRRIGATION FLOW IN THE STUDY ZONE 1981-1982

TABLE 48

RECORD OF RAINFALL GAUGES IN STUDY ZONE FOR 1982/83 AGRICULTURAL SEASON, PRECIPITATION IN MILLIMETERS

DATE 1982	DOLGA BLOCK	ISTARIHNA BLOCK	MEAN
June			
1 - 15	0	82	41
16 - 30	16	0	8
July			
1 - 15	0	0	0
16 - 31	35	27	31
August			
1 - 15	76	90	83
16 - 31	23	28	25
Sept.			
1 - 15	2	0	1
16 - 30	33	0	16
October			
1 - 15	20	0	10
16 - 30	11	0	6

MONTHLY TOTAL OF MEANS	
May	0
June	49
July	31
Aug.	108
Sept.	17
Oct.	16
Nov.	0
1982 total	221

Previous years:

1981 225
1980 346
1979 262
1978 426
1977 182

TABLE 49

TOTAL OBSERVED FLOWS IN MINOR CANALS OF THE STUDY ZONE, 1981 AND 1982. DESIGN FLOW IS 739,000M^3/DAY

DATE	DAILY MEAN FOR MONTH
1981	in 1,000M^3/day
June	198.5
July	368.4
August	393.6
September	444.2
October	528.6
November	479.2
December	427.7
1982	
January	330.4
February	356.5
March	355.8
April	89.4
M a y	6.3
June	6.5
July	160.3
August	326.8
September	609.7
October	578.9
November	584.1
December	411.1

TABLE 50

INCIDENTS OF BREAKAGE AND OVERFLOWS IN MINOR CANALS OF STUDY ZONE DURING 1982

INCI-DENT	MINOR CANAL	DATE STARTED 1982	DURATION IN DAYS	WATER WASTED IN 1000 CUBIC METRES	AREA FLOODED IN FEDDANS	AREA FLOODED IN HECTARES *
1	Koa	30 Dec (81)	20	120	80	32.0
2	Gad El Ain	2 Jan	20	70	130	52.0
3	Dolga	1 July	3	1	3	1.2
4	Gann El Sheikh	5 Aug	7	5	10	4.0
5	Mustafa	5 Aug	3	1	3	1.2
6	Gad El Ain	10 Aug	2	1	1	0.4
7	Gann Wastani	10 Aug	3	1	3	1.2
8	Umm Sayiala	9 Aug	5	0.3	5	2.0
9	Wad Battaro	11 Aug	6	2	180	72.0
10	El Wali	20 Aug	8	0.7	30	12.0
11	Karabi	1 Sept	2	1	3	1.2
12	Abu Sin	4 Sept	5	5	10	4.0
13	Timeid	14 Sept	7	5	2	0.8
14	Istarihna	15 Sept	1	Trace	-	Trace
15	Abu Seir	20 Sept	1	Trace	-	Trace
16	Hogozab	20 Sept	1	Trace	-	Trace
17	Abu Seir	20 Sept	1	Trace	-	Trace
18	Tayeba	10 Oct	7	2	5	2.0
19	Managaza	20 Oct	1	Trace	-	Trace
20	Goz Babbaro	14 Oct	6	1	20	8.0
21	Safia	10 Oct	11	6	20	8.0
22	Istarihna	20 Oct	1	Trace	-	Trace
23	Debba	5 Nov	1	1	3	1.2
24	Wad Bahai	11 Nov	10	1	25	10.0
25	Goz Kabbaro	3 Dec	7	0.5	10	4.0
26	Katfia	5 Dec	6	1	80	32.0
		TOTALS	145	225.5	623	249.2
		MEANS	5.6	8.7	24.0	9.6

* 1 feddan = 0.4 Hectares

of weeds that had been found during the October survey had grown denser during the season, especially in those canals with low water levels or just water pools. In the dry canals dried weeds were observed covering the bed. The weeds growing on banks were also mostly dried up. These included :-

Cynodon dactylon
Cyperus rotundus
Dichanthium annulatum
Graminae spp.
Panicum spp.
Echinochloa stagnina

The other types of weeds were less affected by the drying. These included weeds either having stems and roots extending inside the canals, or weeds actually growing submerged, emergent or floating. So they were observed growing densely in canals with very low water level. These were :-

1. Emergent Weeds	*Potomogeton nodosus* *Potomogeton crispus* *Potomogeton perfoliatus* *Typha spp.*
2. Submerged	*Ottelia spp.*
3. Floating	*Ceratophyllum spp.* Filamentous Algae
4. Extending from Banks	*Vossia cuspidata* *Ipomea aquatica* *Jussiaea spp.*

e. Snail Collections

Snails were collected in large numbers mainly from the sites where there were emergent, submerged and floating weeds and either a low water level or pools of water.

The stagnant, clear, low water levels prevailing at the time provided suitable conditions for both snails and weeds to grow densely.

C. INTERVENTION

1. The Trial Strategy

The Second Scientific Advisory Group meeting held in August 1981 (WHO Publication EM/VBC/32) recommended that the intervention date in the Study Zone should be June 1, 1982, and as much as possible of the Comprehensive Trial Strategy should be implemented at that time, including :

Chemotherapy

a. Malaria

The strategy for malaria should be at two levels:-

i. The replacement of presumptive treatment by radical treatment of cases presenting positive blood slides.

ii. Presumptive treatment of immigrant seasonal labour.

b. Schistosomiasis

There should be mass chemotherapy of all inhabitants over 5 years of age in any village where a sample reveals a prevalence of over 50%. Further rounds of chemotherapy may be carried out if indicated.

c. Diarrhoeal Diseases

There should be a decrease in the use of antibiotics in favour of Oral Rehydration Salts.

Vector Control

a. House Spraying

In 1982/83 spraying with fenitrothion should continue at a target dose of 1 g/m^2, but spraying in future years should be gradually reduced as alternative measures are implemented.

b. Molluscicidng and Larviciding

One man should be responsible for both focal molluscicidng and

larviciding in each village area under the supervision of the senior biologists.

Community Participation

The Community Participation Unit should form village health committees and then hold village meetings to ensure cooperation, give an awareness of health problems, encourage self-help projects and change certain behaviour.

Engineering Unit

The Engineering Unit was given 4 objectives:-

a) to decrease mosquitoes and snails in the irrigation canals
b) to decrease mosquito habitats by improved drainage
c) to improve domestic water supplies
d) to improve general sanitation

2. Community Participation and Health Education

Meetings in Hasaheisa

In March, before starting intervention in the Study Zone in June as part of the Trial Strategy, a preparatory meeting was held in Hasaheisa, attended by community leaders from each village in the Study Zone, political and administrative officials, Project staff and participants from a WHO/TDR course on socio-economic research.

The senior staff, Dr. Wafik Hassouna from the TDR course and several of the community leaders addressed the meeting to explain the project and invite participation by the communities. After considerable discussion the participants agreed to assist in mobilising their own communities. The chairman of the North Gezira Government Council also promised to give more attention to health problems in the area, especially at the time of budget consideration.

The community leaders were asked to assist with the formation of Village Health Committees in each of the 31 villages in the Study Zone.

Health Committees

Health Committees were formed in each of the 31 Study Zone villages in order to form a unit at village level, to look at the health problems and to serve as a link between the communities and the Project. Each committee was composed of 10 male and female volunteers selected in an open meeting of the village, plus the nurse or medical assistant from the community health post, a midwife and a teacher from each school in the village (Figure 21).

To assist the committees, forms were prepared to summarize their committee meetings, the public educational meetings and to explain the function of the committees and the requirements for membership. Joint meetings were held in which the committees selected their Chairman, Secretary and Treasurer and their roles and responsibilities and means to carry them out were discussed. The Health Committees were formed in May 1982 and began the following activities in June as part of the Trial Strategy:-

a) Cooperation with the schistosomiasis mass treatment campaign by preparing a centre and by encouraging the people to come for treatment. The committees prepared a list of the village population, and those persons who could not come for treatment on the allotted day were sent with a letter to the hospital at Abu Usher when they were located.

b) In 6 villages the committees prepared laboratories for a newly trained microscopist who established a unit for diagnosis and treatment of malaria and schistosomiasis. The villages are Tayeba, Safia/Katfia, Angado, Sharafat, Mustafa Qurashi and Sheikh El Basir.

c) In 2 villages the committees assisted in conducting the annual spraying of houses for malaria. In Tayeba the committee recruited 23 volunteers who were trained for 2 days and then sprayed 465 houses in 4 days. In Safia/Katfia the committee recruited 18 villagers and collected money to pay them for the spraying. They were trained in 2 days and sprayed 300 houses in 2 days.

Evaluation of the spraying operations showed that 99% of the houses

FIGURE 21 Village Health Committees encouraged local music and folk dances as part of educational meetings in the Study Zone.

in the 2 villages had been sprayed. The villagers and spraymen were very enthusiastic and interested in repeating the work next year. The high degree of cooperation was because of the positive attitude of the spraymen and because the villagers trusted them to enter houses and remove the furniture.

d) When Tayeba village was flooded with rainwater on the western side, the health committee obtained a pump from the local authorities and assigned an operator to run it, reducing the potential for mosquito breeding.

e) The committees in 5 villages contacted the Regional Water Administration to repair their water supply unit.

f) The committees in 3 villages organized clean-up campaigns to collect and burn trash and dead animals.

Health Education Meetings in Villages

Meetings were convened in each of the Study Zone villages to educate people and to prepare them for the schistosomiasis treatment campaign. Before the public meetings we prepared the programme in cooperation with the village health committee who introduced local materials and contributions such as folklore, songs and poetry. The meetings also explained the water-associated diseases and how the villagers could prevent them. Instructions were given regarding each disease and for general sanitation (Appendix I). The rate of attendance for the villages in the core and fringe strata was 70% but for the large villages in the roadside stratum it was only 40% (Figure 22).

Training

A short course was arranged for the members of some of the health committees and attended by 50 members from 8 villages; Gad El Ain, Wad Sheneina, Wad El Amin, Safia/Katfia, Turush, Masalamia and Awlad Yusif. The course was held in Gad El Ain village for 3 days and consisted of lectures and films about the 3 diseases, environmental sanitation and community participation. Discussion periods indicated that the participants understood the information and their role in their villages.

FIGURE 22

Both elders and children had a chance to participate in the community meetings in the Study Zone.

Similar courses are planned to cover the remaining Study Zone villages.

The Adult Education Section from Meilig helped to organize the training course and the women teachers have begun to assist on a regular basis, conducting interviews on health knowledge, attitudes and practices and also educating mothers. They are also evaluating sanitary conditions inside the houses.

3. Mass Chemotherapy against Schistosomiasis

a) Tayeba, Dolga and Gad El Ain

In the 3 intensive study villages the mass chemotherapy campaign against schistosomiasis was used to persuade villagers to provide a stool sample for the 1982 pretreatment prevalence survey, and to provide clinical data at the time of treatment. Thus the morning after the health education visit, a team of clinicians and technicians arrived. The villagers reported to the centre, were registered and given a plastic container. When they brought a sample they immediately were admitted to the clinicians for examination, advice or treatment for any current illness, and treatment with Praziquantel unless contra-indicated.

After examination, patients were weighed, the total dosage at 40 mg/kg calculated, then half that dose was swallowed on the spot. The second half of the dose was taken home by the patient to be swallowed after lunch. Almost 70% of the villagers were examined in this way, but more were treated without examination on the last day in each village, and subsequently in Abu Usher.

b) The Fringe and Core Villages

The staff of the epidemiology unit were responsible for the mass chemotherapy campaign in the Study Zone excluding the 3 intensive study villages. A manual covering treatment with Praziquantel, dosage, side effects, and precautions was circulated to paramedical staff involved with the campaign. They were then taken for a short course covering prevention and control of schistosomiasis with special emphasis placed

on mass chemotherapy, weighing of patients, calculation of dosage and drug distribution.

It was decided that mass chemotherapy should apply to all fringe and core villages if the sample prevalence was 40% or above, rather than the 50% suggested by the Scientific Advisory Group. Contra-indications were pregnancy, lactating mothers whose children were too young to leave the breast milk for 3 days and children aged 5 and below.

As in the intensive study villages, the treatment team visited the village the day after the Health Education Team had conducted their sessions with film slides and lectures. There were 4 teams in all each headed by a nurse, and the treatment programme was supervised by the epidemiologist.

The response rate was excellent with approximately 15,000 persons (about 90% of those qualified) accepting the treatment. Those absent from the village on the day of the treatment were referred later by the Health Committee to the Study Zone HQ for treatment.

The 31 Study Zone villages and labourers camps were covered in 3 weeks in June 1982.

c) The Road Villages

With the prevalence of S. mansoni in the road villages generally between 10-20% there was no mass chemotherapy in these villages. Microscopists were posted to the villages and people encouraged to attend for diagnosis and treatment of proven positive cases.

d) Improved Diagnostic Services

In recent years diagnostic facilities for malaria and schistosomiasis have not been available except in the hospital laboratories and larger health centres. This has resulted in presumptive treatment of all fevers against malaria, usually with sublethal doses thereby risking the development of resistance, and virtually no treatment against schistosomiasis.

The intervention strategy is to move away from presumptive treatment for malaria and offer instead a speedy, accurate diagnostic service. Six microscopists were trained in the Sennar Malaria training Centre for malaria diagnosis and in Abu Usher for schistosomiasis diagnosis. They were established in laboratories in 6 villages with arrangements made for transporting people and specimens to and from surrounding villages (Table 51). Malaria positives receive treatment from nurses, schistosomiasis positives take the examination result to Abu Usher and are treated on the spot.

e) Post Intervention follow up

The 3 Intensive Study Villages (Table 52)

In December 1982, 6 months after the mass chemotherapy campaign, the first indication of the efficacy of intervention was given by the prevalence surveys carried out in the 3 villages. At first there was resistance to the request for a third round of stool samples but a team of volunteers from the villages was recruited and they persuaded the people to cooperate. The reduction in prevalence in the 3 villages was from 52% to 14% and in the camps from 85% to 35% (Table 52). The reduction in Awlad Yusif (to 24%) was significantly greater than the reduction in Shajara (to 61%).

A closer look at the positive cases found in December 1982 revealed that of the 337 who were positive in the 3 villages only 49% had received the treatment in June, a total of 172 having missed the drug. In the 3 camps 70/106 had been treated (67%) and 36 had not.

4. Diarrhoeal Diseases

The intervention in the Study Zone aimed at diarrhoeal diseases was based on prevention by health education and treatment of cases with Oral Rehydration Salts.

To prepare for intervention in the Zone a simplified course in the epidemiology of diarrhoeal diseases with emphasis on nutrition and oral

TABLE 51

STOOL EXAMINATION FOR S. MANSONI BY THE 6 BILHARZIA/MALARIA MICROSCOPISTS POSTED TO THE STUDY ZONE FROM AUGUST 1982

VILLAGE	AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		TOTAL	
	EXAM-INED	POSI-TIVE	EXAM-INED	POSI-TIVE	EXAM-INED	POSI-TIVE	EXAM-INED	POSI-TIVE	EXAM-INED	POSI-TIVE	EXAM-INED	POSI-TIVE
Tayeba	21	0	8	0	*		5	0	7	0	41	0
Sharafat	32	13	12	2			10	1	8	1	62	17
Safia	33	1	24	0			12	0	14	0	83	1
El Sheikh El Basir	-	-	3	1			6	0	11	1	20	2
Mustafa Qurashi	-	-	-	-			9	2	31	4	40	6
Angado	-	-	6	0			8	0	7	0	21	0
T o t a l s	86	14	53	3			50	3	78	6	267	26

* In October the microscopists attended a refresher course.

TABLE 52

PREVALENCE OF S. MANSONI IN THE 3 INTENSIVE STUDY VILLAGES IN JUNE 1982 (PRETREATMENT) AND IN DECEMBER 1982 (POST TREATMENT)

VILLAGE	TOTAL CENSUS	JUNE 1982				DECEMBER 1982			
		EXAM-INED	RESPONSE IN %	POSI-TIVE	PREVA-LENCE	EXAM-INED	RESPONSE IN %	POSI-TIVE	PREVALENCE
Tayeba	2805	1941	69	968	50%	1461	52	211	14%
Dolga	1087	724	67	357	49%	639	59	74	12%
Gad El Ain	946	569	60	345	61%	379	40	52	14%
Awlad Yusif	187	115	61	100	87%	80	43	19	24%
Shajara Camp	190	85	45	76	89%	75	39	46	61%
Hababna Camp	181	121	67	98	81%	137	76	42	31%
Total 3 villages	4838	3234	67	1670	52%	2479	51	337	14%
Total 3 camps	558	321	58	274	85%	292	52	106	36%
T o t a l	5396	3553	66	1944	55%	2771	51	443	16%

rehydration was held in Abu Usher with a refresher course held just prior to intervention. In all, 46 people attended the course, comprising 5 medical assistants, 11 nurses, 18 midwives, 5 adult education social workers, 2 community participation social workers and the 5 observers employed in the diarrhoeal diseases work. Each of these people then trained mothers in the Study Zone to recognise signs of dehydration and how to use the ORS.

Also covered in the course was improved dietetic management, the promotion of breast feeding, the motivation of mothers to vaccinate their children, the improvement of hygiene and the discouragement of the use of antidiarrhoeal drugs.

The BNHP responsibility outside this health education programme is to make sure that supplies of ORS are available, and to carry out epidemiological surveillance.

Thus a recording and delivery system has been established in Abu Usher for ORS and recording of diarrhoea and deaths in the 3 area hospitals in Hasaheisa, Abu Usher and Mehereiba has been instigated.

Bi-weekly follow-up sheets to include well-defined and easily recognisable infectious diseases such as diarrhoea, measles, whooping cough, mumps, fever, otitis, conjunctivitis, bronchitis and skin diseases will be completed in a sample of children under 5 to determine relative morbidity.

5. Vector Control

a) Focal Molluscicidings

The field staff available and employed for routine snail control operations after intervention in the Study Zone consisted of 1 Public Health Inspector based in Hasaheisa, 3 sanitary overseers, 5 manual labourers and a driver.

Routine operations began at the intervention date of June 1st 1982, and consisted of a monthly inspection of all sites near villages or

camps which are potentially transmission sites, and molluscicide application if snails were found.

The Study Zone was divided into 3 geographical areas and one sanitary overseer was given responsibility for each area together with labourers, snail scoops, chemical, knapsack sprayers and the transport (Suzukis) to cover the area. At each village 10 scoops were taken in each defined water contact site and the number of live and dead Biomphalaria pfeifferi and Bulinus truncatus snails were counted. If snails were found and molluscicide applied, a return visit was made one week after treatment to ensure that adequate snail kill had been achieved.

The routine application method adopted stems from the trials reported in the 1981 Annual Report. 3 litres of Bayluscide (niclosamide 25% E.C.) are applied by dripfeed into the nearest sluice gate upstream from the application site. Two Hudson sprayers are used each filled with 1.5 litres chemical and 8.5 litres water. The sprayers are discharged into the turbulent water at the sluice over a period of 30-45 minutes, and this has proved to be an efficient method of killing snails for about 1 km downstream, even in slow flow and densely weeded canals.

The monthly snail counts in the minor canal and village sites declined markedly by the end of the year (Table 53). During September 1982 no surveillance was possible because of shortage of fuel, and most roads were impassable due to heavy rains.

In all the 7-day post-treatment surveys only a total of 394 Biomphalaria and 148 Bulinus were found alive (not in table). The finding of these snails and the finding of snails 4 weeks post treatment in some canals did not necessarily indicate failure of the treatment but more likely represents reinvasion by drifting snails. The aim of the molluscicide programme is to keep contact sites free from infected snails at optimum cost, and the figures suggest that this was achieved. Over the 7 months of 1982 when molluscicides were in use a total of 486 litres were applied (Table 54). In October, 8 sites did not qualify for treatment and in November and December, 8 and 14 sites were snail free and therefore untreated.

TABLE 53

MONTHLY PRE-SPRAY SNAIL COUNTS IN CONTACT SITES OF MONITOR VILLAGES IN THE STUDY ZONE, JUNE-DECEMBER 1982

Canal	NUMBERS OF SNAIL COLLECTED													
	June		July		Aug		Oct		Nov		Dec		Total	
	Bio	Bul	Bio	Bul	Bio	Bul	Bio	Bul	Bio	Bul	Bio	Bul	Bio	Bul
Wad Zaroug	-	-	125	113	174	70	0	0	0	0	0	0	299	183
Timeid	601	100	412	74	ND	ND	219	150	96	16	0	0	1328	340
Hileila	30	14	0	0	226	143	17	5	2	2	0	0	275	164
Ganneb	0	0	0	0	207	27	37	10	0	0	15	5	259	42
Hogozab	38	49	78	55	33	11	0	0	14	5	0	0	163	120
Abu Sein	30	15	0	0	13	4	124	0	0	0	0	0	167	19
Istarihna	30	16	122	106	145	115	11	22	6	5	0	0	314	264
Safia	80	3	130	16	123	61	3	3	0	0	0	0	336	83
Katfia	15	0	82	45	10	6	0	0	0	0	0	0	107	51
Wad Battro	38	13	110	54	98	75	31	5	0	0	0	0	277	147
Wad Battro	35	6	120	54	132	115	19	32	0	0	7	3	313	210
Tayeba	780	100	725	30	220	52	47	7	10	0	0	0	1782	189
Managaza	290	210	120	132	34	116	0	0	0	0	0	0	444	458
Hag El Saied	56	5	125	132	208	84	0	5	0	0	0	0	389	226
Wad El Amin	121	6	86	3	105	58	0	0	0	0	0	0	312	67
Totals	2144	537	2235	814	1728	937	508	239	128	28	22	8	6765	2563

In Sept. no surveys were possible due to rains and fuel shortages

Bio = *Biomphalaria pfeifferi* Bul = *Bulinus truncatus*

TABLE 54

THE CONSUMPTION OF BAYLUSCIDE (IN LITRES) BY FOCAL MOLLUSCICIDING IN THE STUDY ZONE, JUNE-DECEMBER 1982

Village	LITRES USED							
	June	July	Aug	Sept	Oct	Nov	Dec	Total
AWlad Yusif	3	6	3	No activities because of the heavy rains and shortage of fuel	-	-	-	12
Gad El Ain	3	3	3		-	3	-	12
Wad El Amin	6	3	6		3	-	-	18
Wad Battro	6	6	6		3	-	3	24
T o b a	3	6	6		-	3	-	18
Safia/Katfia	6	12	9		3	3	3	36
El Turush	3	3	3		-	-	-	9
Istarihna	6	9	9		3	3	3	33
Managaza	3	3	6		-	-	-	12
Sharafat	6	3	3		-	3	-	15
Abu Seir	3	3	3		3	-	-	12
Tayeba	6	6	3		3	3	-	21
Mustafa Qurashi	3	3	-		3	3	-	12
Takala Qurashi	3	3	3		-	-	3	12
Hag El Said	3	3	6		-	3	-	15
Dolga	6	6	3		6	3	-	24
Timeid	-	3	3		6	-	3	15
Hileila	6	3	3		3	3	-	18
Sheikh El Basir	3	3	3		3	3	-	15
Camps (2)	30	30	36		15	27	15	153
Total (litres)	108	117	117		54	60	30	486

N o t e: 1. The dose is 3 litres for every contact site

2. Camps indicates all the dwellings other than villages where there is man-water contact

3. Application is carried out with Hudson Xpert pumps

b) House Spraying against Mosquitoes

Houses in all villages in the Study Zone were sprayed with fenitrothion at 1 gram per square meter. Two villages were sprayed by people of the community and the rest of the villages were sprayed by our mobile teams during October (Figure 23).

6. Engineering Unit Activities

a) Improvements to the Water Supply System

Improvements to the existing water supply systems were initiated gradually after the baseline observation period finished in June 1982 The next month 5 of the leaking water storage tanks were cleaned, welded and painted in the villages of Saddaga, Sharafat, Dolga, Abu Frua and Timeid.

The installation of a new second water yard with 45,000 litre storage tank was completed in Managaza village but not yet connected to the existing water yard or into the distribution system (Figure 24). It is expected that this will be done as a community work project in early 1983. Almost £500,000 worth of new construction and improvements in village systems are planned as part of the Trial Strategy but have not yet been implemented.

A new water supply maintenance centre was established at Hasaheisa to serve the Study Zone. Fifty thousand dollars worth of spare parts for Bukh diesel engines were delivered to the centre in August, as well as to other maintenance centres in the rest of Gezira Province.

b) Drainage System Designed for Study Zone

In order to improve water control and drainage in the Study Zone as a means of reducing anopheline mosquito breeding places, a joint panel of engineers from the Ministry of Irrigation and senior staff of the project developed a plan with an estimated construction cost of £1.4 million, 1982 prices. The plan includes:

1. Al Kua collector drain including road crossings and a permanent pumping station (Figure 25). The drains were designed to remove

FIGURE 23. In Katfia village local volunteers received training and supplies from Blue Nile Health Project staff, then sprayed their own village against malaria mosquitos.

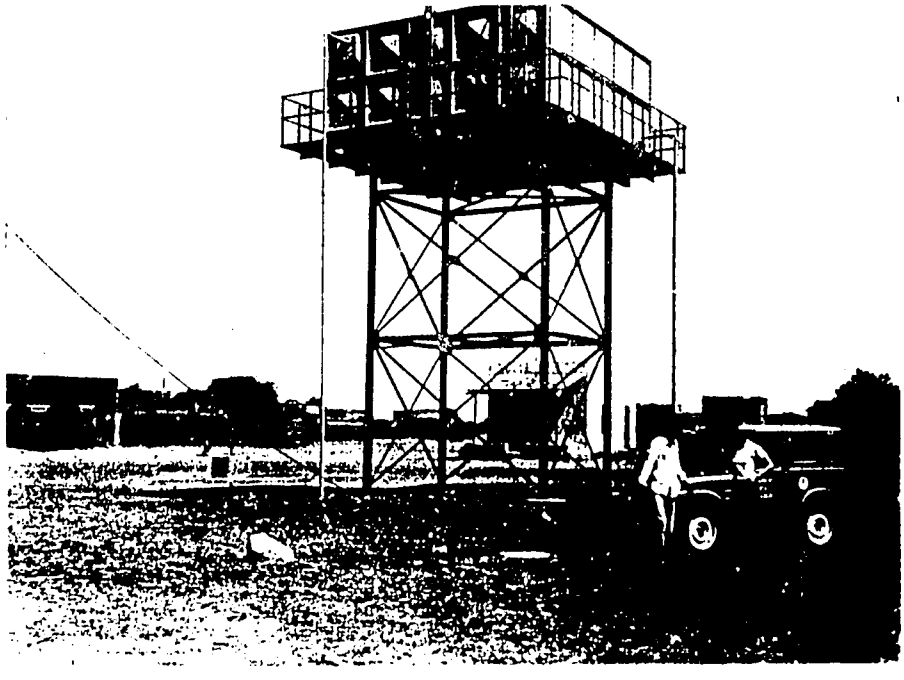


FIGURE 24 New fiberglass water tank constructed in Hanagaza village of the Study Zone to supplement existing inadequate system

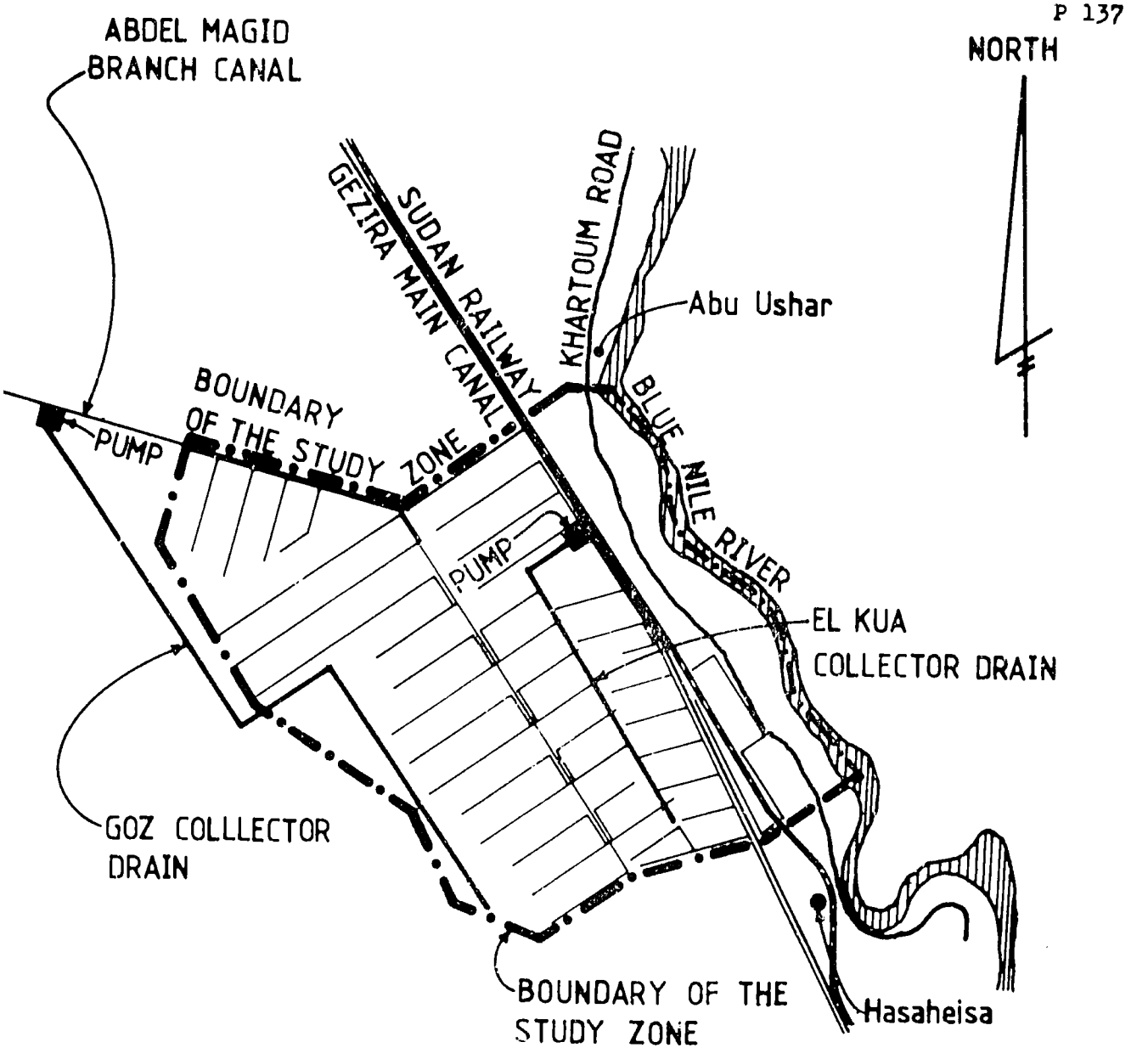


Figure 25 PROPOSED DRAINAGE IMPROVEMENTS FOR MALARIA CONTROL IN STUDY ZONE

Graphic Scale

1 cm of runoff within 6 days, as a way of preventing mosquito breeding.

2. Goz collector drain, including road crossings, pumping station and several minor drains, designed as above.

3. Improved field outlet valves, to avoid leakage and allow for strict control of the water.

The proposal was submitted to the Government for funding in 1982, but not approved. It will be resubmitted in 1983 and hopefully will be constructed in time for the 1983 malaria season in September.

c. Latrine Slab Production

In mid 1982 a small production unit was established in Hasaheisa to make concrete slabs for latrines, to be distributed in the Study Zone. The initial slabs were 8cm thick, 120cm by 95cm with a 10cm hole in the centre and an 8 cm hole for a vent pipe. Later the slab was strengthened by the addition of two beams along the edges, 11cm thick, 20cm wide and 170cm long, cast integrally with the slab. Finally an asbestos elbow with a mechanical flap was added to the centre hole to exclude flies from the latrine pit (Figure 26). Of this final model 75 units were produced by the end of the year. An experimental ferro-cement slab will be produced to decrease the thickness and weight, a decided disadvantage of the present slabs.

7. Canal Dredging and Weeding Operations

a. Dredging and Manual Weeding of Canals

From the first of January 1982 until July, normal dredging and manual weeding of canals was continued as in previous years. During these 6 months 29 kilometers of canal were dredged with draglines, removing 54,105 cubic metres of silt. Thus the total silt removed in the 1981/82 agricultural season was 139,470 cubic metres, compared to 113,050 cubic metres in the 1980/81 season.

Manual weeding operations from January to July 1982 covered 42.2 kilometres of canals, utilizing 597 man days of labour. This gave a total for the agricultural year of only 14,766 man days, compared to

Original model showing standard pit opening

New Model A showing asbestos pipe
mechanical seal for fly and odour control

Figure 26 Production of reinforced concrete slabs for latrines, in Hasheisa

29,160 man days expended in the 1980/81 season.

In September eight weeding machines were brought into the Study Zone to begin weeding operations in the major and minor canals as part of the Trial Strategy. Two machines, a bulldozer and a motor-grader worked on dressing of the canal banks and roads to improve operation of the other machines. Another two machines were excavators which removed silt from those portions of canal with serious deposits. Specifically for weeding operations there were three tractor-mounted machines (one of each type - mowing bucket, rotary disc and worm screw) and one amphibious mower (Figure 27).

The machines worked in a routine sequence after levelling the roads, depending on weed and silt conditions in the canals as determined by a simple bottom survey. First the dressing machines straightened and flattened the canal banks. Then the excavators levelled the canal bottom where necessary. The mowing buckets or amphibious mower were then used to remove weeds in the middle of the larger canals and finally the rotary disc and worm screw machines were used to trim the canal bank to its original slope of 2 horizontal to 1 vertical.The entire process took some time because the canal banks had not had maintenance for many years. However when the process finished it left a clean, well dressed canal and banks which will considerably facilitate future maintenance.

By the end of December 1982 about 30 kilometres of the approximate total of 200 kilometres of canals in the Study Zone had been dressed and weeded (Figure 28). It is expected that the first coverage of all canals in the Study Zone will be completed by March 1983, after which routine maintenance and weeding of canals will continue. Detailed records of operation and costs are being kept by the supervisory personnel of the Ministry of Irrigation (Appendix J).

b. The Impact of Mechanical Weed Control

The biological impact of these weeding operations, aimed at the clearance of vegetation from the canals and the subsequent reduction of

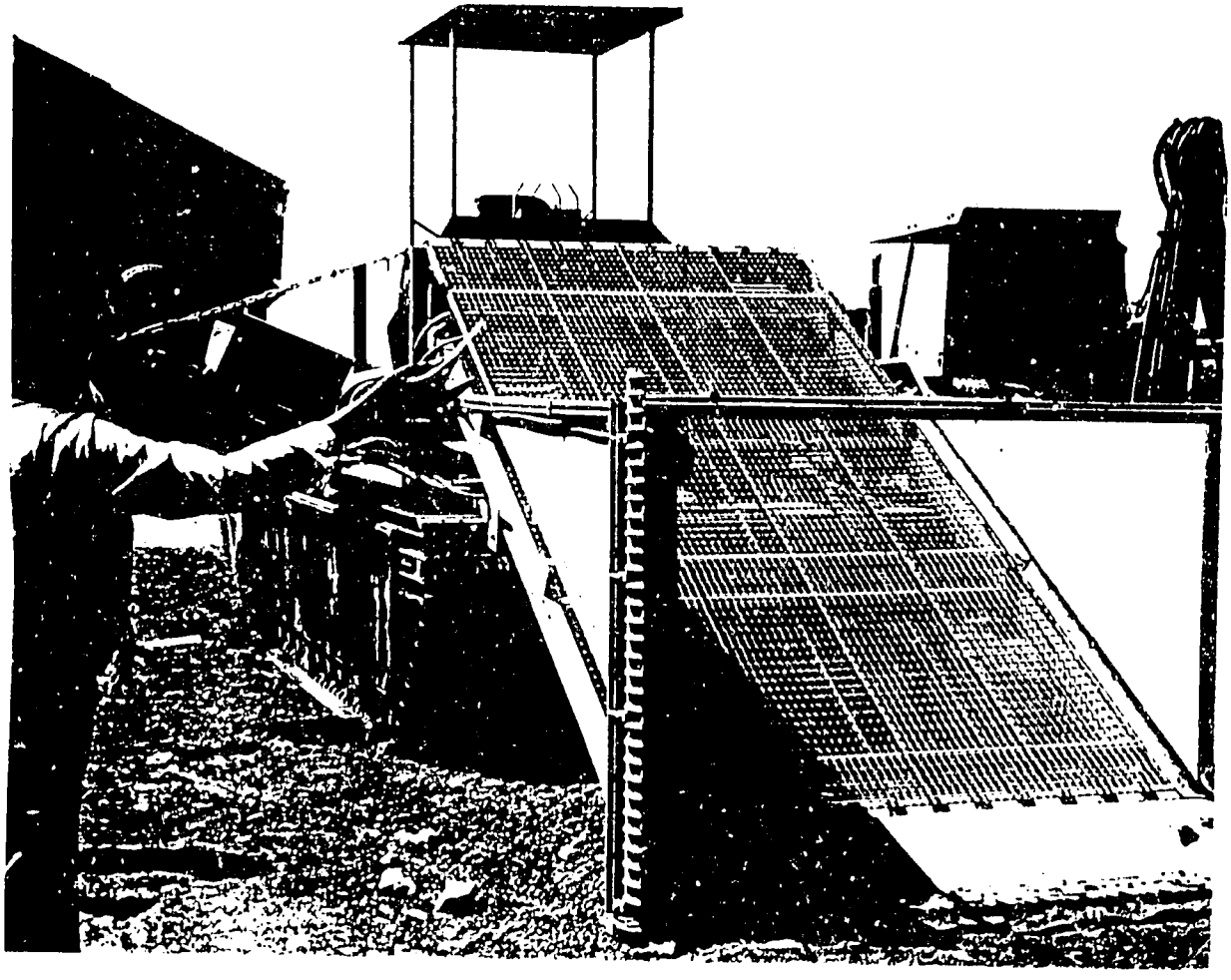


Figure 27

This amphibious weeding machine runs along the canal bottom, removing weeds with a system of conveyor belts. It moves at about 1 kilometer per hour and is used in large minor canals and major canals after the silt has been removed by excavating machine.

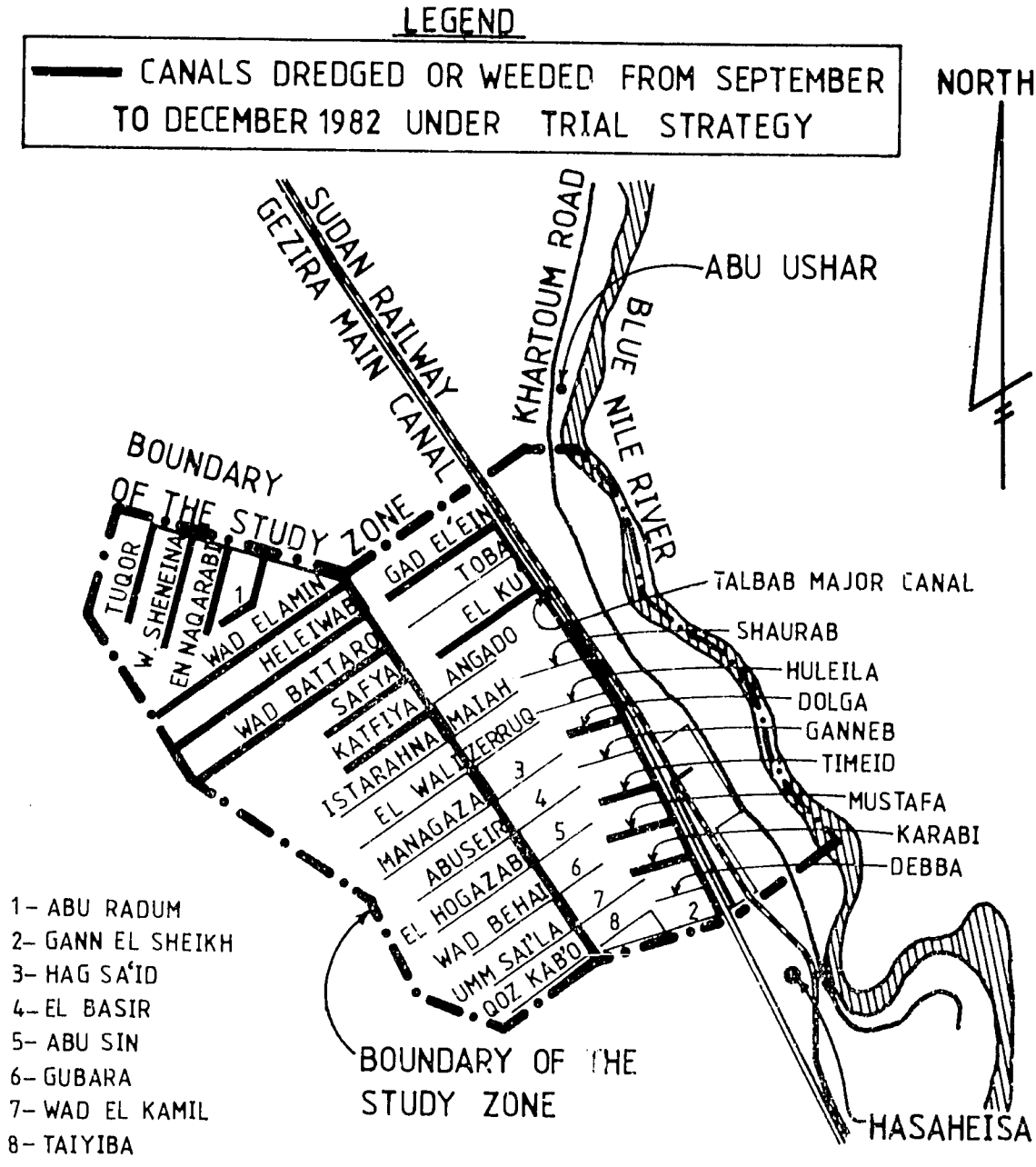


Figure 28 CANALS IN THE STUDY ZONE CLEANED BY WEEDING MACHINES AT END OF 1982

Kilo 5 4 3 2 1 0 5 10 15 20 25 Kilometres

Graphic Scale

snail populations, are being monitored. For this purpose 18 minor canals plus one major were surveyed monthly starting from October 1982. Two minor canals taking their water directly from the main canal were added to the study for comparison with the minor canals fed normally by majors, in case they differ in silt precipitation and weed population.

Preliminary results suggest that after canal clearance by these machines there is marked reduction in snail populations, but some aquatic weeds such as Vossia cuspidata, Potomogeton perfoliatus, Typha spp, and Cynodon dactylon were not completely removed. Snails were collected from sites where pieces of these weeds were found and were observed to be attached both to the floating and cut parts of weeds and to the remaining fixed parts of the weeds. These canals will be inspected monthly to follow the population growth of both weeds and snails after clearance.

CHAPTER VI

RESEARCH AND TRAINING

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CHAPTER 6

RESEARCH AND TRAINING

I. RESEARCH

This section deals with research projects conducted either in laboratories or in the field outside the Study Zone. These projects involve the isolated testing of control methods for possible inclusion in the integrated strategy.

A. Antischistosomal Chemotherapy

1. Praziquantel (Biltricide)

a. Angado Village - a field trial against S. mansoni

In Angado village in March 1980 a field trial was carried out to assess the acceptability and efficacy of Praziquantel against *S. mansoni* in a typical village. Side effects were mild and transitory and the cure rate was excellent, particularly when the drug was delivered in 2X20 mg/kg doses after breakfast and lunch on the same day. These results and the 1,3,6 and 12 month follow up egg counts were reported in the 1981 Annual Report.

During 1982 a further follow up stool examination was carried out in March, 24 months after treatment, to investigate reinfection rates. It was found that of the 246 patients followed in 1982, 57.3% were still cured - i.e. had never presented a positive stool since treatment (Table 55). Reinfection rates were highest in boys, young adult males and girls. Adult females were virtually free of infection presumably due to their lack of water contact.

Table 56 shows the geometric mean egg counts of all persons found positive at each follow up and shows that even after 24 months there was a significant reduction in egg output from pre-treatment levels.

b. Toba 16 and Toba 17 Camps

In two small camps housing labourers from Western Sudan (Toba 16) and Nigeria (Toba 17) a total of 81 patients were treated with Praziquantel (40 mg/kg single dose) in April 1980. Thirty eight of the patients were infected with *S. mansoni* only, 43 were infected with both

TABLE 55

ONE MONTH AND 24 MONTH FOLLOW UP AFTER PRAZIQUANTEL TREATMENT IN ANGADO VILLAGE, 1980 - 1982

	TREATED IN 1980	1 MONTH POST TREATMENT			24 MONTHS POST TREATMENT		
		EXAMINED	NUMBER CURED	% CURED	EXAMINED	NUMBER *CURED	% CURED
Males							
5 - 14	96	82	69	84.1	59	14	23.7
15 - 34	78	54	49	90.7	33	16	48.5
35 +	61	57	56	98.2	36	25	69.5
Total	235	193	174	90.2	128	55	43.0
Females							
5 - 14	71	67	58	86.6	53	30	56.6
15 - 34	70	68	62	91.2	50	41	82.0
35 +	20	18	18	100.0	15	15	100.0
Total	161	153	138	90.2	118	86	72.9
All							
5 - 14	167	149	127	85.2	112	44	39.3
15 - 34	148	122	111	91.0	83	57	68.7
35 +	81	75	74	98.7	51	40	78.4
Total	396	346	312	90.2	246	141	57.3

*Those cured have not presented any positive stool sample since treatment.

TABLE 56

PREVALENCE AND GEOMETRIC MEAN EGG COUNTS OF S. MANSONI POSITIVES IN ANGADO BEFORE AND AFTER CHEMOTHERAPY WITH PRAZIQUANTEL IN 1980

	PRE-TREATMENT IN 1980	POST TREATMENT				
		1 MONTH	3 MONTHS	6 MONTHS	12 MONTHS 1981	24 MONTHS 1982
Number of persons examined	396	346	299	243	221	246
Number of persons positive	396	34	29	59	72	84
Prevalence	100%	9.8%	9.7%	24.3%	32.6%	34.1%
Pre-treatment geometric mean egg count in eggs/gm	253.5	571.2	433.6	389.5	457.5	414.1
Post treatment geometric mean egg count in eggs/gm		30.2	43.4	60.7	43.9	85.9

S. mansoni and S. haematobium. At one month the cure rate was 84.8% in the S. mansoni only group and 43.2% in the mixed infection group. By 24 months when 39 were re-examined only 4 of the 18 S. mansoni group were negative and all 21 mixed infection group were reinfected.

The poor results are presumed to be due to the high pre-treatment egg counts, the single dose which caused vomiting and the heavy water contact with infected canals. By the 24 months follow up, egg counts were virtually at pre-treatment levels (Table 57).

c. Galgala and Wad Lemeid Schools

As a result of the poor results with Praziquantel against children with mixed infections, a new trial was designed with a total of 237 children, all with mixed infection, being treated. The children were drawn from three schools in two villages; Galgala Girls' School, Galgala Boys' School and Wad Lemeid Co-educational School. Half of the children were treated with a single dose of 40 mg/kg administered after breakfast and the rest were given 20 mg/kg after breakfast and a further 20 mg/kg after lunch. Side effects were mild (abdominal discomfort, nausea and some vomiting) and had disappeared within 24 hours.

One month after treatment there were 64% who were negative for both S. mansoni and S. haematobium (Tables 58 and 59). Thereafter the number of S. haematobium positives fell and the number of S. mansoni cases increased. By the six month follow up the cumulative failure rate was almost 70%, but the geometric mean egg count was still lower than pre-treatment (S. mansoni 131 eggs/g compared to 367 eggs/g).

The drug failure rates were higher in the group with the highest pre-treatment egg counts ranging from 10% failure to 60% failure at one month and from 57% to 87% failure at 6 months (Table 59).

Despite the slightly poorer cure rates in heavy mixed infections, excellent egg count reductions have been achieved and Praziquantel was the drug of choice in 1982.

TABLE 57

STOOL AND URINE EXAMINATION RESULTS FROM TOBA 16 AND 17 CAMPS 24 MONTHS AFTER TREATMENT WITH PRAZIQUANTEL, 1980 - 1982

GROUP	PRE-TREATMENT			24 MONTHS POST TREATMENT (1982)					
	NUMBER TREATED IN 1982	GEOMETRIC MEAN EGG COUNT		NUMBER EXAMINED	NUMBER CURED	POSITIVE FOR S.MANSONI		POSITIVE FOR S. HAEMATOBIUM	
		S.M.	S.H.			NUMBER	G.M. IN EGGS/GM	NUMBER	G.M. IN EGGS/10 ML
S.m. only									
5 - 14	11	268	0	5	1	4	919	3	29
15 - 34	14	637	0	7	1	6	197	1	5
35 +	13	487	0	6	2	4	185	0	0
Total	38	452	0	18	4	14	300	4	19
S.m. & S.h.									
5 - 14	34	410	61	17	0	16	374	12	46
15 - 34	5	883	20	3	0	3	121	1	56
35 +	4	204	12	1	0	1	267	0	0
Total	43	420	46	21	0	20	311	13	46

TABLE 58

PREVALENCE AND INTENSITY OF SCHISTOSOME INFECTIONS ONE MONTH, 3 MONTHS AND 6 MONTHS AFTER TREATMENT WITH PRAZIQUANTEL IN GALAGALA AND WAD LEMEID SCHOOLS (MIXED INFECTIONS)

	Males		Females		Total	
No. treated	146		74		220	
S.m. egg count	315.5 e/g		496.3 e/g		367.4 e/g	
S.h. egg count	120.3 e/10ml		119.0 e/10ml		119.8 e/10ml	
1 month follow up						
Examined	138		73		211	
Cured	86	62.3%	49	67.1%	135	64.0%
Not cured:						
S.m. only	14	10.1%	8	11.0%	22	10.4%
S.h. only	16	11.6%	5	6.8%	21	10.0%
S.m. & S.h.	22	15.9%	11	15.1%	33	15.6%
3 months follow up						
Examined	139		63		202	
Cured	67	48.2%	32	50.8%	99	49.0%
Not cured:						
S.m. only	22	15.8%	17	27.0%	39	19.3%
S.h. only	13	9.4%	2	3.2%	15	7.4%
S.m. & S.h.	9	6.[illegible]%	0	0	9	4.5%
6 months follow up						
Examined	133		62		195	
Cured	39	29.3%	21	33.9%	60	30.8%
Not cured:						
S.m. only	65	48.9%	23	37.1%	88	45.1%
S.h. only	5	3.8%	3	4.8%	8	4.1%
S.m. & S.h.	4	3.0%	5	8.1%	9	4.6%

TABLE 59

CUMULATIVE FAILURE RATES AFTER PRAZIQUANTEL TREATMENT AGAINST MIXED INFECTIONS OF S. MANSONI AND S. HAEMATOBIUM IN SCHOOL CHILDREN

STRATA BY EGG COUNTS		POST TREATMENT EXAMINATIONS								
		1 MONTH			3 MONTHS			6 MONTHS		
			CUMULATIVE FAILURES*			CUMULATIVE FAILURES*			CUMULATIVE FAILURES*	
S.m.	S.h.	EXAMINED	NUMBER	PER CENT	EXAMINED	NUMBER	PER CENT	EXAMINED	NUMBER	PER CENT
256-	1-64	21	2	10%	21	5	24%	21	12	57%
256+	1-64	46	10	22%	48	20	42%	46	30	65%
256-	65-256	32	6	19%	28	16	57%	31	18	58%
256+	65-256	53	28	53%	52	32	62%	53	43	81%
256-	256+	21	7	33%	22	10	45%	20	13	65%
256+	256+	38	23	60%	37	26	70%	38	33	87%
Totals		211	76	36.0%	208	109	52.4%	209	149	71.3%

* C.F. means cumulative failures in which schistosome eggs were found in that examination or in the preceding ones.

2. Oltipraz

Oltipraz is a new drug from the Rhône-Poulenc Company which was subjected to hospital based clinical trials in Omdurman before being passed to the Schistosomiasis team for field evaluation.

a) Azrag and Bint El Hag Villages

For this first field trial 61 children in Azrag school and 90 in Bint El Hag were selected because their S. mansoni egg count on two consecutive days was 300 eggs/gm or more. Seventy-eight children were treated with a single dose of 20 mg/kg and 71 were given 2X10 mg/kg, 4 - 7 hours apart. Two children received only 1X10 mg/kg because they did not return for the second dose.

In Azrag the side effects were mild and transitory but in Bint El Hag 20 children complained of pain in the fingertips, two children with severe pain.

The cure rates were most promising except for the single dose in Bint El Hag village where the cure was 41% (Table 60). However the pre-treatment egg counts in this group of children were exceptionally high, and the post treatment egg count reductions were excellent.

b) W.H.O. Multicentre Field Trial

As part of worldwide multicentre field trials, the World Health Organization commissioned a second trial in Gezira to test 3 dosage levels (15 mg/kg, 20 mg/kg and 25 mg/kg) again using single doses and split doses with a 4-6 hour interval. A total of 294 children were treated, all S. mansoni cases with a minimum egg load of 100 eggs/gm. They were drawn from 4 schools, viz, Gemiabi, Rihana and Debeiba primary schools and Rihana intermediate school.

The acceptability of the drug was good. Only a few children complained of fingertip pain, and few complained of transitory blurred vision.

The 5 week follow up results showed no significant difference between the single and split dosages at any treatment level. They are

TABLE 60

CURE RATES AND FECAL EGG COUNTS IN CHILDREN INFECTED WITH SCHISTOSOMA MANSONI, SHOWING EFFICACY OF OLTIPRAZ IN AZRAG AND BINT EL HAG SCHOOLS, USING 20 MG/KG ADMINISTERED IN SINGLE OR SPLIT DOSES

Schools	Post Treatment					
	5 weeks		3 months		6 months	
	Single Dose	Split Dose	Single Dose	Split Dose	Single Dose	Split Dose
Azrag Schools						
Children treated	32	29	32	29	32	29
Children examined	31	29	32	28	25	26
Children negative	22	19	18	21	18	16
Cure rate	71%	66%	56%	75%	72%	62%
Pre-treatment egg count geometric mean in eggs per gram	749	676	749	676	749	676
Post treatment egg count geometric mean in eggs per gram	32.7	30.0	30.3	18.3	62.1	29.1
Bint El Hag Schools						
Children treated	46	42	46	42	46	42
Children examined	44	42	32	41	42	38
Children negative	18	27	13	25	17	20
Cure rate	41%	64%	41%	61%	41%	53%
Pre-treatment egg count geometric mean in eggs per gram	862	1036	862	1036	862	1036
Post treatment egg count geometric mean in eggs per gram	78.7	25.1	41.9	13.7	78.3	23.3

therefore combined in Table 61 which shows three pre-treatment egg load strata against three dosages. The differences in the cure rate by strata are not significant (P=0.08) but the differences by dose regimen are significant, and 25 mg/kg has given a 35% cure rate (Table 61).

3. Oltipraz and Praziquantel against Mixed Infections

In Abu Rus village school in northern Gezira about 120 children were found to have S. mansoni infections and many of them had concomitant S. haematobium infections. After pretreatment examination of stool and urine on 2 consecutive days all the children were treated, half of them using Oltipraz at 30 mg/kg and half with Praziquantel at 40/mg/kg, both drugs administered by split dose, after breakfast and lunch on the same day.

Treatment was on November 29th, 1982 and stool and urine follow up examinations will be carried out on 2 consecutive days after 5 weeks, 3 months, 6 months and 12 months.

The reason for carrying out the trial, in addition to the obvious comparison of acceptability and efficacy in the same population, was to study whether reinfection was independent of drug given. There have been a number of heavy reinfection rates in the period 6 months after treatment, and this trial should show whether this is due to reinfection or belated drug failure.

B. Research on Control of Biomphalaria pfeifferi and Bulinus truncatus Snails

In the short term, the strategy being implemented in the Rahad Zone and the Study Zone has depended for snail control solely on the use of Bayluscide, applied focally around dwellings. However the cost of focal mollusciciding is not low (Bayluscide 25% EC cost approximately $20 per litre in 1982) and therefore any non-chemical methods by which the target snails can be controlled are of interest to the Blue Nile Health Project. The following studies have already been initiated:

TABLE 61

POST-TREATMENT RESULTS FROM WHO MULTICENTRE TRIAL USING OLTIPRAZ AGAINST S. MANSONI INFECTIONS IN SCHOOL-CHILDREN

DOSAGE 15 MG/KG, 20 MG/KG AND 25 MG/KG

PRE-TREATMENT EGG COUNT GROUP		TREATMENT DOSAGE			TOTAL
		15 MG/KG	20 MG/KG	25 MG/KG	
100 - 400 eggs/gm	Children examined	42	51	43	136
	Children negative	35	41	40	116
	Cure	83.3%	80.4%	93.0%	85.3%
401 - 800 eggs/gm	Children examined	30	21	25	76
	Children negative	18	18	24	60
	Cure	60.0%	85.7%	96.0%	78.9%
800 + eggs/gm	Children examined	24	23	27	74
	Children negative	10	16	26	52
	Cure	41.7%	69.6%	96.3%	70.3%
Total	Examined	96	95	95	286
	Negative	63	75	90	228
	Cure	65.6%	78.9%	94.7%	79.7%
Number of positives after treatment		33	20	5	58
Pre-treatment egg counts geometric mean in eggs/gm		722.8	504.7	363.1	601.8
Post treatment egg counts geometric mean in eggs/gm		29.4	27.5	27.4	28.6

1. The Competitor Snail Lanistes carinatus

In the 1981 Annual Report preliminary experimental results suggested a reduction in fecundity of Biomphalaria pfeifferi in the presence of Lanistes in aquaria in the laboratory.

Two further laboratory experiments were completed which suggest that Lanistes limit B. pfeifferi by eating the egg masses. Table 62 shows the results from different ratios of the two snail species, kept together for one month. At similar numbers of Lanistes and Biomphalaria, the mortality of B. pfeifferi increased by 40% and the number of egg masses was reduced to zero.

The second experiment involved adding 10 Lanistes snails to a bowl of water containing some 50 Biomphalaria egg masses attached to polythene. In one bowl the snails were given no food, and within 24 hours 48 of the egg masses had disappeared. The last two were eaten on the second day. In another bowl to which excess green food was added, 25 egg masses were eaten on the first day and six on the second day.

Based on these promising preliminary results there is scope for a study into the distribution of Lanistes in Gezira, the survival rate of Lanistes if added to canals not now infested, and the coexistence if any of Lanistes and Biomphalaria in the field.

2. The Exotic Snail Marisa cornuarietis

In 1982 laboratory and field studies were initiated with the ampullarid snail Marisa cornuarietis which had been imported from Puerto Rico to use as a biological agent in the control of schistosomiasis.

a) Evaluation of International Shipping Methods for Importation of Marisa

A total of 4 separate shipments of Marisa were made from Puerto Rico to Sudan. Three of them were completely successful but in one there was high mortality. The successful shipments were made as follows:

TABLE 62

LABORATORY EXPERIMENTS TO EVALUATE THE POTENTIAL FOR BIOLOGICAL CONTROL OF B. PFEIFFERI USING THE AMPULLARID SNAIL LANISTES CARINATUS

Snails in each tank		Replicate 1		Replicate 2	
		Biomphalaria pfeifferi		Biomphalaria pfeifferi	
Biom.	Lanistes	egg masses laid in one month	number of snails dead after one month	egg masses laid in one month	mortality number of snails dead after one month
10	0	53	1	54	0
10	2	4	1	9	3
10	5	0	2	2	1
10	10	0	4	0	4

i) Snails were taken directly from their habitats in Puerto Rico and immediately wrapped individually in damp paper towels with one complete section of towel for each snail.

ii) They were placed in tin cans with plastic air-tight covers, with approximately 40 snails per can. On one occasion large cans were used with 500 snails per can but there was a mortality of about 98%.

iii) The containers were shipped in ordinary suit-cases or cartons in the hold of the airplane as baggage, with no special handling.

iv) The successful trips lasted less than one week. In the case of one trip that took 18 days there was 95% mortality.

b) Laboratory Studies

Marisa are being maintained and bred in both Khartoum and Wad Medani laboratories. Various kinds of local vegetation were used as food for Marisa in the laboratory but egg production was maximal when the snails were fed Rigla or Girgir (the locally grown greens used in salads). Other foods readily consumed by Marisa included cucumbers and tomatoes, but carrot greens were apparently toxic to the ampullarids and resulted in the loss of a laboratory colony.

i) Effect of Temperature on Egg Laying Rate

Laboratory aquaria containing Marisa were maintained at varying temperatures from 24°C to 31°C and the snails laid eggs over the entire range. There should therefore be no temperature limitation on breeding in Sudan. Snails may well breed at lower or higher temperatures than those tested.

ii) Stimulation of Egg Laying with Artificial Oviposition Sites

The rate of egg laying was apparently increased by placement of floating styrofoam blocks in laboratory aquaria. With 10 blocks, 5cm X 2cm adult Marisa produced several hundred eggs each day, at 30°C.

c) Field Trials to Determine Whether Marisa will Survive in Gezira Habitats

Observations from Puerto Rico indicated that Marisa would probably survive and reproduce very well in large reservoirs like Sennar and Roseires and in the Gezira Main and Major canals. However the periodic drying of Minor canals and Abu eshreens may be a serious problem for this ampullarid as it probably needs a full year in a stable habitat to build up to numbers sufficient to exert a controlling effect on the planorbid snails. The frequent drying of Abu sittas and the irrigated fields would definitely preclude Marisa from those habitats, and the Blue Nile river near Wad Medani also appears highly unsuitable for Marisa because of the continually shifting river bed and lack of stable vegetation.

Beginning in early 1982 Marisa adults and eggs were placed in 4 types of habitat near Wad Medani (Table 63). These were habitats which had no outlets or drains so that it would be practically impossible for the ampullarids to escape to the natural watercourses such as the Blue Nile river. The snails will be monitored for two agricultural seasons to determine whether they can survive the occasional drying of the habitats, the high summer water temperatures, the high turbidity in the rainy season and the general ecological conditions of the Gezira Irrigation Scheme.

The most interesting observations to come from this field study will be related to the survival of the Marisa in the minor canals as these are the most important transmission sites in Gezira Irrigation Systems. Thus in these minor canals observations are being made on the other snails and their schistosome infections prior to introduction of the Marisa, and also in nearby similar canals where no Marisa have been introduced. In this study the effect of the local ampullarid snail Lanistes carinatus is also being observed, as it has been found to have a wide distribution in the Centre Group of the Gezira.

3. The Lungfish Protopterus annectens

A further set of laboratory trials with the lungfish were carried as follows:

TABLE 63

GEZIRA HABITATS IN WHICH MARISA WERE PLACED IN 1982 TO OBSERVE SURVIVAL AND REPRODUCTION

HABITAT TYPE	NUMBER OF SITES	LOCATION	MONTH OF PLACEMENT OF MARISA DURING 1982	NUMBER OF SNAIL EGGS PLACED
1. Abu eshreens	2	Barakat	January	80 adults
2. Small artificial ponds	2	Research Corporation	February	40 adults
3. Small artificial ponds	3	Wad Shafia	September	1000 eggs
4. Minor canals	4	Centre Group	October	4000 eggs
5. Major canal	1	Messelemia South K.114	December	40 adults

a) One fish was offered 100 B. pfeifferi snails and 100 insect larvae every day for 8 days.

b) One fish was offered 50 insect larvae and 50 Tilapia nilotica fry daily for 8 days.

c) One fish was offered 5 T. nilotica larvae and 5 tadpoles.

The fish ate what came their way but when given a choice ate that food which was easier to catch (Table 64).

The fish were being maintained in small tanks or aquaria and prior to these trials had not eaten for weeks or in some cases months. These are hardly realistic experiments and therefore once the fish had demonstrated their ability to consume large quantities of B. pfeifferi snails it was decided to release the remaining six live fish.

They were released on July 9th into the lower 600 metres of Dolga minor canal at a time when the water was at a high level, clear of turbidity and choked with aquatic vegetation. The lengths and weights of the released fish were :-

Wt (gm)	579	342	300	297	286	102
Length (cm)	46	38	36	35	35	28

During each of the 7 days after release the canal stretch was visited and on two occasions a fish was spotted taking air. No dead fish were seen.

4. Pilot Programme for Mechanical Weeding of Canals

This section deals with the results of a two year pilot project on aquatic weed control and silt clearance in canals of the Managil Extension. It is paraphrased from a report to the Ministry of Irrigation submitted in 1982 by the Dutch Consulting Firm DEMAS. The report evaluated performance of the machinery, proposed the optimal combination of mechanical equipment to be employed in the Gezira Managil scheme, and assessed its feasibility by cost-benefit analysis. The original report, based on the work performed by DEMAS, was summarized with their permission, as follows:-

TABLE 64

THE PREFERRED DIET OF LUNGFISH IN THE LABORATORY: SNAILS VERSUS INSECT LARVAE; INSECT LARVAE VERSUS FISH FRY; AND FISH FRY VERSUS TADPOLES

Day	Tank 1 Number eaten		Tank 2 Number eaten		Tank 3 Number eaten	
	B. pfeifferi	Insect larvae	Insect larvae	*T. nilotica* fry	*T. Nilotica* fry	Tadpoles
1	100	32	39	12	0	0
2	100	29	37	7	1	0
3	95	40	32	10	0	0
4	97	18	41	0	0	0
5	91	13	35	2	1	0
6	86	24	29	4	0	0
7	88	11	24	0	0	0
8	84	16	30	1	0	0
Total	541	183	267	36	2	0

There are four methods for controlling aquatic weeds, manual, chemical, biological and mechanical. Mechanical weed control permits maximum control over the weeds in contrast to the indirect and less determinate effects of chemical and biological control. There is a large range of mechanical equipment available and effectively in use in many countries. However, it was necessary to carry out trials with this equipment to adapt it to local conditions and to allow for an optimum equipment choice.

In February 1979 the first lot of equipment arrived on site at Wad El Gorashi in the Managil Extension (Figure 29). From that date onward a number of service engineers visited the site to assist with the assembly of the equipment and to train operators and mechanics. The first equipment was delivered in 1979 and additional items arrived in 1980 and 1981, at a total cost of Dfl 2,298,185 (Appendix J).

One US dollar was worth 2.80 Dfl (Dutch Guilders) at the end of 1982, and also about LS.1.70, on the open market. Thus one Dutch Guilder was worth about £0.60 on the open market at the end of 1982.

With the arrival of the above-mentioned equipment during 1980 and 1981, the project was fully equipped to handle weed-infestation and siltation.

From over 2 years of operation it was determined that the total cost of the programme for a typical year of full operation was Dfl 16.87 per feddan served by the canals being cleaned (Table 65).

Benefits

Increased Production

The production gain to be obtained through the weed control project consists of two parts. Firstly, the continuing decline in yield which was being observed in the Gezira scheme, is averted as a result of the weed control activities and secondly, the project provides its own impetus for yield improvement.

Figure 29 Location Of Original Pilot Project For Evaluating Weeding Machines In Blue Nile Health Project In Sudan

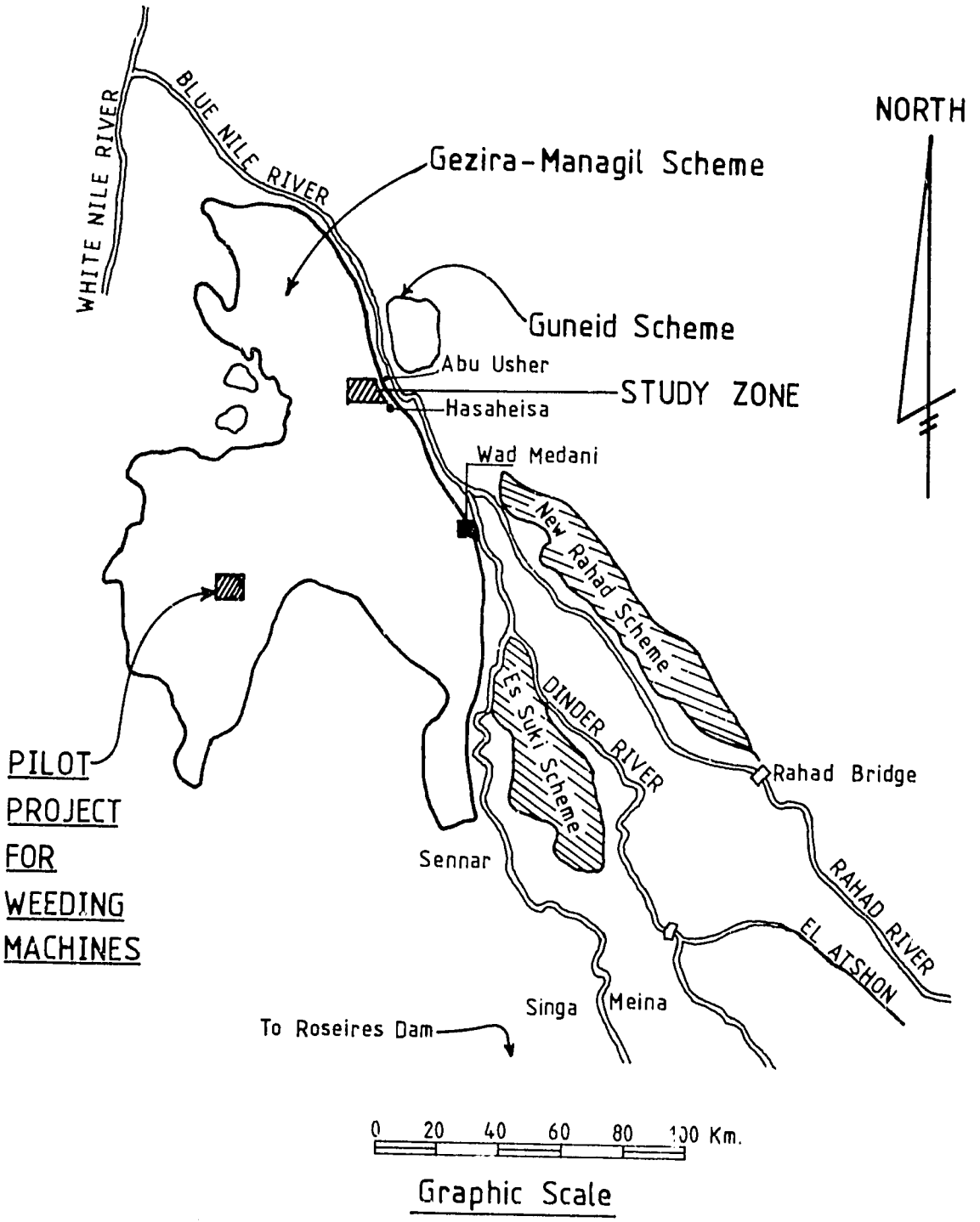


TABLE 65

ANNUAL PROJECT COSTS FOR WEEDING MACHINERY IN MANAGIL PILOT AREA OF 50,000 FEDDANS, IN DUTCH GUILDERS (Dfl), 1982

(One Guilder was equal to 0.60 Sudanese Pounds)

TYPE OF EQUIPMENT	DEPRECIATION	CONSUMPTION SPARES	LABOUR COSTS	FUEL CONSUMPTION	OIL & LUBRICANTS	OTHER COSTS	TOTAL COSTS
A. WEED CONTROL EQUIPMENT	118,410	65,985	110,385	33,895	3,395		Dfl.332,070
B. SILT CLEARANCE EQUIPMENT	40,590	13,440	26,570	14,205	1,420		96,225
C. AUXILIARY EQUIPMENT	145,980	33,265	75,545	39,185	3,135	7,135	304,245
D. OVERHEAD			101,000			10,000	111,000
T O T A L	304,980	112,690	313,500	87,285	7,950	17,135	Dfl.843,540

Data collected in the course of the project during three years support this assumption (Table 66). The data were taken from three blocks (58, 59 and 63) which partially belong to the pilot area. Circumstances must have been as equal for the observed areas as possible; the only difference lay in the weed control activities for half of the observed area.

Considering that the activities in the pilot area were gradually implemented during the period of observation and that a number of equipment units arrived as late as March 1980, and taking into account that the results from the pilot project would be even better if the area had an optimum combination of equipment, the assumption seems quite conservative that the project will yield a 3% improvement in yield over four years after which the yield remains constant. The yield improvement is expected to materialise with a one year lag and reflects the average yield of that particular crop combination.

In a similar project in the New Halfa scheme yield increases over a period of four years were estimated at 17.4%, 16.7%, and 27.7% on the average for cotton, groundnut and wheat respectively. Given the currently low yields in the Gezira/Managil scheme, there is ample scope for yield improvement; actual yields are only half or less of the yields considered as good yields.

Savings on Present Weed Control Method

In the Gezira-Managil Zone, at present, siltation and weed control are undertaken manually and with draglines. If the proposed weeding machines are used, the present costs of dredging and manual labour would be saved.

The present level of dredging and manual weed control is insufficient to prevent yields from further decline. The expenditures on dredging are rather low and amount to around LS.1.00 per feddan according to data from July 1981 for the Fakhakhir subdivision. However, a large backlog exists of at least 12 million cubic meters according to

TABLE 66

COMPARISON OF CROP YIELDS IN AND OUTSIDE MANAGIL PROJECT AREA FOR WEEDING MACHINERY (in % of 1978/1979 YIELDS)

		CROP YIELDS				
		'78/'79	'79/'80	'80/'81	Annual growth	Improvement in growth-rate in weeded area
Cotton	IN	100%	76%	61%	-22%	6%
	OUTSIDE	100	67	52	-28	
Groundnuts	IN	100	117	201	42	21
	OUTSIDE	100	78	147	21	
Wheat	IN	100	159	92	-4	8
	OUTSIDE	100	147	78	-12	
Dura	IN	100	161	189	37.5	14.5
	OUTSIDE	100	117	151	23	

the Ministry of Irrigation. Assuming a continuation of the present, less efficient dredging activities for silt and weed control, then the annual expenditures would amount to at least LS.150,000 for regular maintenance, and an estimated LS.35,000 to clear the backlog over a twelve year period, in a 150,000 feddan area (Table 67).

After applying a standard conversion of 0.6, an amount of Dfl.225,000 can be considered as the annual saving on dredging costs for a Basic Unit Group.

Weed control by manual labour is gradually disappearing, as labourers become aware of the health hazards, and as a result of the labour shortage in general. Therefore this potential saving is not included and the disappearance of manual labour control is seen as a contribution to the continuing decline of yields in the areas where the mechanical approach is not applied.

Health Benefits

A quantification of the effects of malaria and schistosomiasis in terms of economic losses must await an improved data base. However, the existence of a positive, and probably large, benefit from the weed control and silt clearance activities is abundantly clear, and this fact should be taken into account in the ultimate appraisal of the project.

One benefit is easy to identify. If malaria control includes weed control by manual labour, then in order to enable labourers to enter canals, extensive precautions have to be taken in order to protect their health, estimated to cost about Dfl 10 per feddan. It is estimated that the costs of this programme could be cut by 50% in those areas where weed control is already undertaken by mechanical means, saving an estimated Dfl 762,000 annually (Table 67).

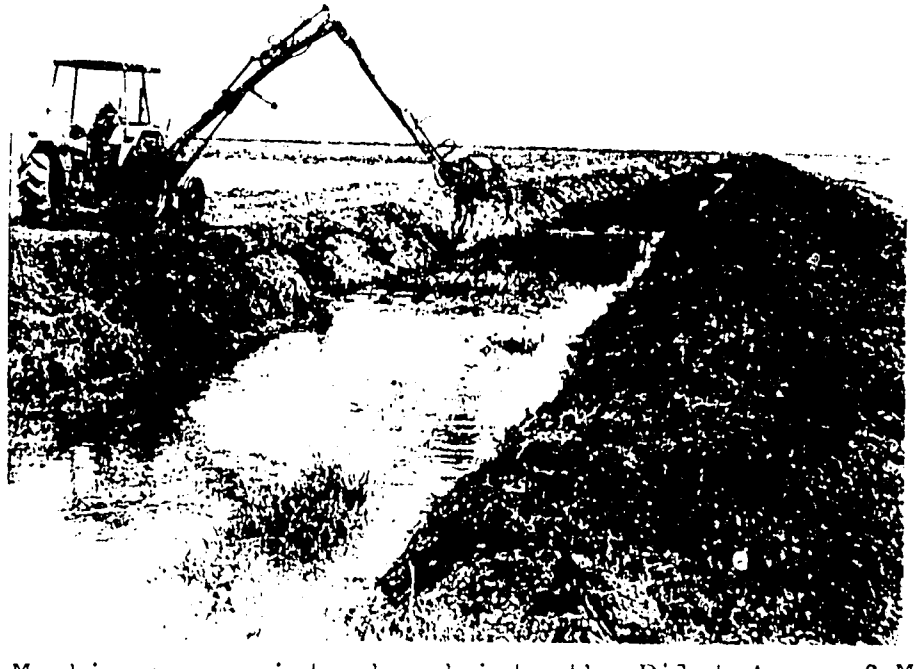
Other Benefits

A project with the general objective of improving irrigation

TABLE 67 ESTIMATION OF ANNUAL BENEFITS FROM WEEDING MACHINERY FOR PROPOSED BASIC UNIT OF 150,000 FEDDANS, IN THOUSANDS OF DUTCH GUILDERS (DFL.), 1982 VALUES (ONE DUTCH GUILDER WAS EQUAL TO 0.60 SUDANESE POUNDS ON THE OPEN MARKET)

	1	2	3	4	5	6	7	8	9	10	11	12
Increased Crop Yields												
1st area, 50,000 feddan	-	483.6	981.6	1,495	2,023	2,023	2,023	2,023	2,023	2,023	2,023	2,023
2nd area, 50,000 feddan	-	-	483.6	981.6	1,495	2,023	2,023	2,023	2,023	2,023	2,023	2,023
3rd area, 50,000 feddan	-	-	-	483.6	981.6	1,495	2,023	2,023	2,023	2,023	2,023	2,023
Sub-total yields	-	483.6	1,465	2,960	4,500	5,541	6,069	6,069	6,069	6,069	6,069	6,069
Savings-dredging	225	225	225	225	225	225	225	225	225	225	225	225
Direct health benefits	254	508	762	762	762	762	762	762	762	762	762	762
T O T A L	479	1,217	2,452	3,947	5,487	6,528	7,056	7,056	7,056	7,056	7,056	7,056

This manual method is the original system for aquatic weed control utilized throughout the Gezira-Managil system, employing 2,000 labourers.



Machinery was introduced into the Pilot Area of Managil and to the Study Zone in 1982 for more effective weed removal, and to avoid exposure of men to schistosome infection. Note canal banks carefully trimmed by machines preceding the weeding bucket.

FIGURE 30 Removal of aquatic weeds from canals

practices through weed control and silt clearance can cause many indirect benefits. Those concerning health have already been mentioned; but the influence on mortality and labour output can at present not be quantified.

Furthermore, the project is bound to have a positive influence on drinking water provisions and thus on health.

It is also known that the ultimate effect of pesticide spraying on crops very much depends upon timely irrigation of the sprayed area; improved aquatic weed control must therefore contribute to more efficient spraying and thus higher crop yields.

Wastage of water from the irrigation systems onto the roads will clearly be diminished in the future, resulting in less loss of water, improved accessibility of the area, and consequently lower costs of transportation.

Summary

Based on a conservative estimate of the benefits - a 3% increase in yield during four years - the International Rate of Return (IRR) from the project amounts to 46.7%. Assuming a 5% increase in yield raises the IRR to 68.8%. Furthermore it appears that the influence of the IRR of benefits other than increases in yield, is limited. Sensitivity analysis shows that important cost factors and prices of agricultural products do not have a decisive impact on the project's feasibility.

Assuming that investments in equipment for a basic unit group are financed entirely by external sources on a permanent basis, the production costs per feddan will amount to about Dfl. 14.35. In order to extend weed control to the entire Gezira-Managil scheme over a period of twelve years as discussed in this report a total investment of Dfl. 101 million is foreseen.

5. Effect of Mechanical Weeding on the Distribution and Abundance of Snails and Aquatic Weeds in the Pilot Project, Managil Extension

The pilot area in the Managil Extension where different machines

have been tested by the Ministry of Irrigation and Dutch consultants for several seasons covers an area of 50,000 feddans and a total minor canal length of 200 kms. Various machine types for weed clearance have been tested to remove emergent, submerged and floating weeds.

The pilot area covers 31 minor canals from which ten minor canals were selected at random. To determine the effect of mechanical removal of weeds, three minor canals outside the pilot area were selected for study as controls and a weed survey was conducted by a biology team from 1-6 April 1982.

For snail population estimates, 5 scoops were taken from each sampling point along the minor canal. Snails collected were then separated by species, counted and reported as snails per scoop. Dates when the canals were cleaned and other relevant information such as side and portion of the canal cleaned were obtained from the Irrigation Department. The vegetation systematics including vegetation density were recorded for each canal.

Results

In the 10 minor canals which had been weeded prior to the survey the numbers of B. pfeifferi snails were very low in comparison to the 3 minor canals which had not been weeded (Table 68). The number of other snails were not significantly different in the two groups of canals.

Five of the weeded canals deserve special mention because B. pfeifferi snails were found:-

a) Bikri minor canal was cleared from fixed side weeds in the period between 11th February and 21st March. However, the canal contained patches of submerged weeds such as Potomogeton perfoliatus 'Um Sufa' along the whole of its length. Other fixed side weeds such as Vossia cuspidata 'Abu Rukab', and Cyprus alopecuroides occurred but sparsely.

TABLE 68

SNAIL DENSITY IN WEEDED AND UNWEEDED CANALS IN THE MANAGIL PILOT PROJECT (APRIL 1982)

Canal	Number of each snail species recovered per scoop					
	B.pfeifferi	B.truncatus	B.forskalii	L.natalensis	C.buliomoides	N.tuberculata
Weeded canals						
Bikri	12.74	7.71	0.00	0.37	8.29	3.74
Wad Shabush	12.70	11.80	1.00	0.00	0.50	0.20
Ramaya	3.96	0.72	0.00	0.48	2.52	0.24
Eleseidi	2.04	1.20	0.00	0.00	1.00	0.28
Mina	0.20	0.50	0.20	0.20	0.60	0.00
Fakhakhir	0.00	0.00	0.00	0.00	0.00	0.00
El Tayef	9.20	2.50	0.00	0.00	1.90	0.50
Um Dakat	0.20	0.20	0.00	0.40	0.20	0.20
Ismailia	1.30	1.70	0.00	2.90	0.20	0.40
Nabiha	19.20	0.20	0.30	0.00	1.20	0.60
Unweeded canals						
Um Shagarat	63.80	6.80	0.60	0.00	0.00	0.00
Abu Igil	272.00	2.40	0.00	0.00	0.20	0.20
El Nur	15.60	0.60	0.00	0.00	1.40	1.20

b) Wad Shabush canal was cleared from Vossia cuspidata only during November 1981 but clearance for all types of Potomogeton spp was done once (24/1/82) but the process was brought to a halt for lack of fuel. However, Potomogeton perfoliatus was still the dominant weed whereas other creeping 'fixed side' weeds such as Vossia cuspidata occurred in patches.

c) Ramaya minor canal was cleared from submerged and floating vegetation from 25th February to 18th March, yet patches of Vossia cuspidata, P. perfoliatus (dense) and patches of Ceratophyllum spp and Filamentous algae were occurring.

d) El Tayef minor canal was cleared from V. cuspidata during the end of November 1981. Clearance being on the first and second reaches of the left and right sides respectively. The canal was densely covered with P. perfoliatus and other submerged weeds due to the fact that it was cleared from fixed side weeds only.

e) Nabiha minor canal was cleared from both submerged and fixed side weeds during the middle of November 1981. However, V. cuspidata, P. perfoliatus, Cyprus alopecuroides occurred all along the canal length because the canal clearance was never repeated.

Snail populations remained low in the rest of the canals in the pilot area due to efficient recent weed clearance or canal dredging.

In the comparison area, outside the pilot project area, three canals were surveyed: Um Shagarat canal contained dense weeds comprising Vossia cuspidata, C. alopecuroides, Filamentous algae and P. perfoliatus. Abu Igil and El Nur minor canals had dense vegetation mainly P. perfoliatus and green algae, while Vossia cuspidata occurred in a few places.

[illegible] numbers of Biomphalaria pfeifferi were found in the three unweeded canals outside the pilot project area, in comparison with the weeded canals, with the average density in the three unweeded canals being 117 per scoop while in the nine weeded canals the density

was 6.8 per scoop. The density of Bulinus truncatus in weeded canals and in the unweeded canals was low at about 3.3 per scoop.

While mechanical weed clearance has a marked effect on the snail population as shown by the results presented above, both fixed and submerged weeds, especially P. perfoliatus were not completely removed allowing regrowth and consequent repopulation of the canals in a short time.

C. Schistosoma haematobium transmission in Gezira

The prevalence of Schistosoma haematobium in the Gezira varies from village to village and tends to be very low in the study area. In the northern group there are several villages in which S. haematobium prevalence in school-children is very high. A project is now under way to determine the dynamics of transmission of S. haematobium in and around three such villages.

A biologist started weekly collections of Bulinus snails from all potential transmission sites near the three villages, screen-ing them all for mature trematode infections. Whenever time permits the snails are crushed to determine the prevalence of immature trematodes. In addition to snail surveys, water contact activities in the three villages are monitored regularly with binoculars.

After 6 weeks study no S. haematobium infections were found in Bulinus snails. Two snails have been found shedding "non-human" forked tail cercariae, and other cercariae have also been found.

D. Pesticide Research

1. Field evaluation of Decamethrine (K-Othrine) against adult mosquitoes in a small-scale trial in Gezira.

Introduction

A village-scale trial was conducted in 1981 to evaluate the impact of Decamethrine on An. arabiensis in the Gezira when two dosages, 0.05 gm/m^2 and 0.025 gm/m^2 showed a residual effect for at least three months.

Following these results the chemical was tested in a 4 village field trial during 1982.

Trial area

Four adjacent villages in Darwish Block of Central Gezira were selected for the trial, two to be sprayed with the dosage 0.025gm/m^2 and the other two villages with 0.05gm/m^2 (Table 69). One village was selected as an untreated control.

Methods

The insecticide was sprayed by Hudson Xpert Spray Pumps. Decamethrine (K-Othrine) 2.5% WDP formulation was used. An amount of 400 gms and 200 gms of the product was diluted in 10 litres of water and sprayed at the normal pattern to give the target dosage of 0.05gm/m^2 and 0.025gm/m^2 respectively.

Entomological evaluation was carried out by fortnightly observations of indoor resting densities, Bioassay tests and exit window traps observations.

Results

The spray suspension was odourless and non-irritant. Spraying was conducted without any signs of toxicity, but slight irrigation in the eyes and hands was reported among some of the spraymen. The chemical was well accepted and tolerated by the residents.

The average room vector density in the four villages was 2 per room one week before spraying, and dropped to zero one week after spraying (Table 70). Subsequent observations made for eleven weeks after spraying up to November continued to record either a zero density or extremely low density (0.2 per room) in the sprayed villages. Parallel observations in the unsprayed control village showed a relatively high density during September of 32/room which dropped gradually to 12/room in October and 9/room in November. There was no obvious difference in

TABLE 69

QUARTERLY REPORT ON HOUSE RESIDUAL SPRAYING USING DECAMETHRINE (K-OTHRINE) AUGUST 1982

Name of Village	Localities		Houses		Rooms			Pop.Protec		Insecticide				Date spraying	
	Plan.Spr.	Spr.	Plan.	Spr.	Plan.	Spr.	% Covr.	Plan.	Prot.	Name & Form	Dose gm/m^2	Used kg	gm capit.	From	To
Darwish	1	1	234	217	1134	1047	92.3%	1246	1232	K-Othrine	0.02	40.6	32.9	22.8	22.8.82
Hilat Soliman	1	1	33	33	276	296	100	290	290	"	0.02	9.2	31.7	23.8	23.8.82
Hilat Hussein	1	1	78	65	504	405	80.3	459	475	"	0.05	29.2	61.4	24.8	24.8.82
A/Daim	1	1	162	146	589	510	86.5	813	632	"	0.05	36.8	58.2	25.8	25.8.82

TABLE 70

SHOWING INDOOR RESTING DENSITY OF AN. ARABIENSIS IN UNSPRAYED VILLAGE AND VILLAGES SPRAYED WITH DECAMETHRINE (K-OTHRINE) AT 0.025 GM/M^2 AND 0.05 GM/M^2

SPRAYING DATE 23-25TH AUGUST 82

Date	Villages sprayed with 0.025 gm/m^2			Villages sprayed with 0.05 gm/m^2			Unsprayed village		
	No. of rooms	Total coll.	Density/ room	No. of rooms	Total coll.	Density/ room	No. of rooms	Total coll.	Density/ room
Before spraying									
19-21.8.82	20	72	3.6	20	14	0.7	10	36	3.6
After spraying									
1-2.9.1982	20	1	0.05	20	0	0	10	35	3.5
12-15.9.82	20	11	0.5	20	0	0	10	324	32.4
10-17.10.82	20	1	0.05	20	1	0.05	10	61	6.1
24-25.10.82	20	1	0.05	20	2	0.1	-	-	-
10-14.11.82	20	0	0	20	0	0	5	90	18
29.11.82	-	-	-	-	-	-	10	7	0.7

indoor resting density between the villages sprayed with 0.05 gm/m^2 and those sprayed with 0.025 gm/m^2. In both situations the density was extremely low.

Window trap observations were negative over the whole observation period.

Bioassay tests conducted on room surfaces sprayed with 0.05 gm/m^2 gave 100% kill on initial tests conducted 2 weeks after spraying. Eleven weeks after spraying there was still a high kill on the three surfaces, cement, mud and wood, the lowest kill being 83% on the cement surface.

Bioassay tests conducted two weeks after spraying rooms with 0.025 gm/m^2 gave a mortality of 83% on cement surfaces, 63% on mud surfaces and 100% on wood. At eleven weeks the kill was again less than with 0.05 gm/m^2 but was still satisfactory with mortality rates of 66%, 72% and 95% on cement, mud and wood-sprayed surfaces respectively.

The results of the bioassay tests indicated a three months residual effect of the two sprayed dosages, and suggest that Decamethrine is a satisfactory product.

2. Field trial of IGR-Dimilin for the control of Anopheles larvae in Gezira

Dimilin, a wettable powder formulation and insect growth regulator was evaluated under field conditions against *Anopheles* larvae in the Gezira area during Feb-March 1982.

Three main sites where a high density of mosquito larvae was found were selected viz. Alam El Huda, Abu Seneina and the seedfarm area. The breeding places were mainly irrigation ditches, 'Abu eshreens' of different lengths, 100-500 m. and of an average width of one metre. The target species at the time was *Anopheles pharoensis* larvae. All searches were negative for *An. arabiensis* larvae, the principal malaria vector in Gezira.

Application Method

Dimilin was applied in the field by Hudson Xpert sprayer at a dose ranging between 25-50 mg a.i./hectare. This was attained by dissolving 7.5 mg Dimilin powder in 10 litres to be sprayed on surface water of $500m^2$.

Each irrigation ditch was divided into two parts by an earthen dam, one part sprayed with Dimilin and the other part left unsprayed as a control. Assessment of effectiveness was done by two methods. In the first method, immature mosquitoes were sampled by taking 10 dips/10 paces throughout the study area prior to treatment and one, 2, 3 and 5 days after treatment. Reduction in larval density was calculated for the last sampling done after treatment, in relation to the density reported before treatment.

The second method consisted of collecting 40 surviving larvae and pupae from each plot 24 hours after treatment, washing them in uncontaminated water and then transferring them to the laboratory for further development observations. Mortality of larvae, pupae and emerged adults in the cups was noted.

Dimilin proved highly effective against Anopheles larvae (mainly An. pharoensis) when treated at the rate of 26 gm/a.i./hectare. At one site, Abu Seneina, where there was a lot of vegetation along the ditch, poor results were obtained. In many plots the reduction rate of immature mosquito stages was highly significant, over 90%. Densities of mosquito larvae started to rise again after the fifth day of treatment (Tables 71-75).

On the other hand laboratory observations on mosquito larvae collected from treated sites showed definite growth inhibition at the 4th instar larvae and pupae stage. In comparison such inhibition was not observed in the larvae or pupae collected from the untreated sites. (Table 76).

TABLE 71

DENSITY OF MOSQUITO LARVAE NEAR ALAM EL HUDA AFTER TREATMENT WITH IGR-DIMILIN

Locality Alam El Huda	Treatment	Average number of Anopheline larvae per 10 dips				% reduction due to treatment
Days after treatment		Instars 1-111	Instar IV	Pupae	Total	
0	treated	6.3	14.8	7.8	28.9	0
	control	3.6	10.1	4.2	17.9	
1	treated	2.0	4.9	5.4	12.3	57.4
	control	2.1	10.4	6.0	18.5	
3	treated	0.30	6.5	0.1	6.9	76.1
	control	2.4	9.8	1.5	13.7	
5	treated		dried out			

TABLE 72

DENSITY OF MOSQUITO LARVAE NEAR ABU SENEINA AFTER TREATMENT WITH IGR-DIMILIN

Date 7.2.82	Treatment	Average Number of Anopheline larvae per 10 dips				% reduction due to treatment
Days after treatment		Instars 1-111	Instar IV	Pupae	Total	
0	treated	12.0	6.5	0.7	19.2	0
	control	7.5	1.3	0	8.8	
1	treated	7.2	1.3	0	8.5	55.7
	control	7.4	1.3	0.8	9.5	
3	treated	6.8	0.5	0	7.3	61.9
	control	18.3	0.1	0	18.4	
5	treated	15.3	0.1	0	15.4	0?
	control	13.0	0.2	0	13.2	

TABLE 73

DENSITY OF MOSQUITO LARVAE NEAR SEED FARM LOCALITY NUMBER I AFTER TREATMENT WITH IGR-DIMILIN

Date 23.2.82	Treatment	Average Number of Anopheline larvae per 10 dips				%reduction due to treatment
Days after spraying		Instars 1-111	Instar IV	Pupae	Total	
0	treated	11.8	5.5	1.8	19.1	0
	control	2.1	3.9	2.4	8.4	
2	treated	0.6	0.8	0	1.4	92.7
	control	1.5	0.30	0.6	2.4	
5	treated	0.1	0	0	0.1	99.5
	control	0.3	0.5	0.4	1.2	
7	treated	4.1	0	0	4.1	0?
	control	0.1	0.5	0	0.6	

TABLE 74

DENSITY OF MOSQUITO LARVAE NEAR SEED FARM LOCALITY NUMBER TWO, AFTER TREATMENT WITH IGR-DIMILIN

Locality Seedfarm II Date 22.3.82	Treatment	Average Number of Anopheline larvae per 10 dips				% reduction due to treatment
Days after spraying		Instars 1-111	Instar IV	Pupae	Total	
0	treated	71.0	22.0	6.0	99.0	0
	control	98.3	15.0	1.7	115.0	
3	treated	0.8	6.3	0	7.1	92.8
	control	13.8	3.8	0.8	18.4	
5	treated	0.2	0.4	0.1	0.7	99.2
	control	3.4	4.4	2.0	9.8	
7	treated	0.5	0.2	0	0.7	99.2
	control	0.1	0.6	6.6	7.3	

TABLE 75

DENSITY OF MOSQUITO LARVAE NEAR SEEDFARM LOCALITY NUMBER 3 AFTER TREATMENT WITH IGR-DIMILIN

Locality Seedfarm III Date 23.3.82	Treatment	Average Number of Anopheline larvae per 10 dips				% reduction due to treatment
Days after treatment		Instars 1-III	Instar IV	Pupae	Total	
0	treated	117.4	24.5	12.5	154.4	0
	control	182.8	79.2	20.0	282.0	
2	treated	0	18	0	18	88.2
	control	36	56	12.1	104.1	
5	treated	2.5	0.7	0	1.5	79.9
	control	38.0	14.0	3.4	16.5	
7	treated	1	0.5	0	1.5	99
	control	8.8	4.3	3.4	16.5	

TABLE 76

MORTALITY AND INHIBITION OF EMERGENCE OF ANOPHELINE LARVAE IN LABORATORY TESTS

Locality	Condition	Larvae emergence in 48 hrs				Pupae emergence in 48 hrs		
		Larvae	Pupae	Adult	Emergence Inhibition	Pupae	Adults	Emergence Inhibition
Alam El Huda	treated	20	0	0	100%	20	2	90%
	control	20	18	15	25%	20	18	10%
Abu Seneina	treated	20	1	0	100%	20	0	100%
	control	20	20	20	0%	20	16	20%
Seedfarm I	treated	20	3	2	90%	20	5	75%
	control	20	20	19	5%	20	14	30%
Seedfarm II	treated	20	8	3	60%	20	0	100%
	control	20	17	12	40%	20	11	45%
Seedfarm III	treated	20	0	0	100%	20	5	75%
	control	20	20	18	10%	20	18	10%

The above studies although carried out on a small scale, clearly demonstrated the inhibitory action of Dimilin against Anopheles mosquito larvae. In the near future more trials will be conducted to study its effect on An. arabiensis in this area.

3. The impact of pesticides on aquatic fauna

The widespread use of pesticides aerially applied to cotton and wheat fields has caused unintentional mortality to the aquatic fauna in major, minor and Abu eshreen canals. A study has been made to examine the effects of some currently used pesticide mixtures on fish, arthropods and molluscs.

Methods:

a. Laboratory

Two chemicals, Endosulphan, a chlorinated hydrocarbon, and Dimethoate, an organophosphorous compound, were available in pure technical form for laboratory evaluation. Mosquito fish (Gambusia affinis) and the ampullarid snail Lanistes carinatus were selected as targets and exposed to different concentrations of both chemicals for up to 7 days.

b. Field Observations

The aquatic fauna in El Soreiba minor canal during May 1982 and then El Soreiba and Abdel Daiem minor canals in Barakat and Darwish blocks respectively were observed during all cotton apraying in September, October and November 1982.

Population densities of fish, arthropods and molluscs were estimated before each spray and then 24 hours after spraying. Any immediate mortality during the spray was noted.

Results

a. Laboratory Screening

Gambusia was extremely susceptible to Endosulphan with a 100% mortality to 0.1 ppm in under three hours (Table 77). The mortality

TABLE 77

SUSCEPTIBILITY OF MOSQUITO FISH G. AFFINIS TO ENDOSULPHAN UNDER LABORATORY CONDITIONS

Concentration ppm	Mortality of Gambusia		Time of Exposure
	Treated group	Control group	
1	100%	0%	45-50 mins.
0.1	100%	0%	160-165 mins.
0.01	50%	0%	24 hrs.
0.001	2%	0%	24 hrs.

to Dimethoate was zero at all concentration from 1-50 ppm using 7 day exposure. However, two females during exposure to 30 ppm and 40 ppm Dimethoate gave birth to 5 and 41 offspring respectively and they were all dead within 2 hours. Thus the young may be susceptible to the chemical.

Lanistes snails were susceptible to Endosulphan at 5 ppm for 24 hours but were not susceptible to up to 40 ppm Dimethoate and 7 days exposure.

b. Field Observations

El Soreiba Minor canal

The aquatic fauna recovered from El Soreiba canal during May 1982 showed substantial repopulation after any mortality from the 1981/82 spraying season (Table 78).

The canal was then sampled in late 1982 to show the effects of sprays with a Décis/Dimethoate mixture on October 3rd 1982 and a Dursban/Endosulphan mixture on November 18th. The first spray affected only the minor canal population of Ephimetellidae, but the second spray containing Endosulphan affected everything except the snails (Tables 79 and 80).

Abdel Daiem Minor Canal

The October 19th spray killed the Hemiptera in the minor canal and the Abu eshreen while on November 3rd all except the molluscs were killed. After a third spray on November 18th only Cleopatra snails and Hydrophilidae were still alive (Tables 81, 82 and 83).

Due to sampling difficulties caused by the dense vegetation and high turbidity of the canal water Oreochromis niloticus could not be sampled. However visual observations showed an immediate fish mortality whenever Endosulphan was sprayed.

Conclusions

1. Endosulphan is acutely toxic at sprayed concentrations to fish and arthropods but not to snails. Dimethoate toxicity to non-target

TABLE 78

AVERAGE DENSITY OF AQUATIC ORGANISMS SAMPLED THREE MONTHS AFTER THE SPRAYING SEASON 1981/82 AT EL SOREIBA MINOR CANAL

Taxa	Average density per 10 dips
Coenagridae	43
Aeshnidae	3
Ephemerellidae	0
Belostomatidae (Giant Water Bug)	13
Nepidae	1
Lanistes sp.	4
Cleopatra sp.	12
Melanoides sp.	2
Gambusia affinis	4

TABLE 79

TOTAL AQUATIC ORGANISMS BEFORE AND AFTER TREATMENT OF EL SOREIBA MINOR CANAL WITH DÉCIS/DIMETHOATE ON 3RD OCTOBER 1982

	*Average Density before the spraying		Average Density after the spraying	
	Minor canal	Abu eshreen	Minor canal	Abu eshreen
Coenagridae	2	0	0	5
Ephemerellidae	69	24	4	28
Hemiptera	25	8	24	47
Lanistes sp.	1	1	1	1
Cleopatra sp.	9	6	10	4
Melanoides sp.	0	1	0	0
Gambusia affinis	0	0	1	0

* Average density is given per 10 dips

TABLE 80

TOTAL AQUATIC ORGANISMS BEFORE AND AFTER TREATMENT OF EL SOREIBA MINOR CANAL WITH DURSBAN/ENDOSULPHAN ON NOVEMBER 15TH 1982

Taxa	Average density before spraying *		Average density after spraying	
	Minor canal	Abu eshreen	Minor canal	Abu eshreen
Coenagridae	3	4	0	0
Ephemerellidae	6	9	0	0
Hemiptera	0	0	0	0
Ranistes sp.	1	0	0	0
Cleopatra sp.	5	2	2	1
Melanoides sp.	2	3	1	1
M. affinis	0	0	0	0

* Average density is given per 10 dips

TABLE 81

TOTAL AQUATIC ORGANISMS BEFORE AND AFTER TREATMENT OF ABDEL DAIEM MINOR CANAL BY ENDOSULPHAN/DIMETHOATE ON 19TH OCTOBER 1982

taxa	Average density before spraying		Average density after spraying	
	Minor canal	Abu eshreen	Minor canal	Abu eshreen
Coenagridae	7	3	1	8
Ephemerellidae	3	6	1	3
Hemiptera	12	3	0	0
Lanistes sp.	1	0	1	1
Cleopatra sp.	9	21	10	20
Melanoides sp.	2	1	3	1
G. affinis	1	0	0	0

TABLE 82

TOTAL AQUATIC ORGANISMS BEFORE AND AFTER TREATMENT OF ABDEL DAIEM MINOR CANAL BY DURSBAN/ENDOSULPHAN ON NOVEMBER 3RD 1982

Taxa	Average density before spraying		Average density after spraying	
	Minor canal	Abu eshreen	Minor canal	Abu eshreen
Coenagridae	6	4	0	0
Ephemerellidae	2	1	0	0
Hemiptera	4	0	0	0
Lanistes sp.	2	0	0	0
Cleopatra sp.	18	12	6	29
Melanoides sp.	1	1	0	3
G. affinis	17	0	0	0

TABLE 83

TOTAL AQUATIC ORGANISMS BEFORE AND AFTER TREATMENT OF ABDEL DAIEM MINOR CANAL BY DURSBAN/ENDOSULPHAN ON NOVEMBER 18TH 1982

Taxa	Average density before spraying		Average density after spraying	
	Minor canal	Abu eshreen	Minor canal	Abu eshreen
Coenagridae	0	0	0	0
Ephemerellidae	0	0	0	0
Hemiptera	0	0	0	0
Belostomatidae (Giant Water Bug)	1	0	0	0
Lanistes sp.	1	0	0	0
Cleopatra sp.	9	6	6	10
Melanoides sp.	0	0	0	0
G. affinis	0	0	0	0
Hydrophilidae	3	1	1	1

organisms is apparently low.

2. All organisms other than fish quickly repopulate the canals after high mortality from spraying.

E. Studies on Larvivorous Fish

Following the plan of activity for the year 1982, 5 earthen ponds measuring 5 X 3 X 3/4m^3 were constructed within the Ministry of Irrigation grounds of Abu Usher. The ponds were filled with water after arranging for a continuous water supply system. In May 1982 the ponds were seeded with Gambusia fish and they multiplied rapidly. Fish distribution into the Study Zone canals is planned after careful studies on the biology and habitat of these larvivorous fish such as the observations on feeding habits of Oreochromis niloticus (formerly Tilapia nilotica) and Gambusia affinis in progress in Medina Arab Council.

In order to find out the time of peak feeding activity, fish were sampled at three-hourly intervals over 24 hour periods once a month for one season. The results of stomach analysis for the two species revealed that both fish followed a similar pattern, with peak feeding activity during the afternoon just before dusk and a second but lesser one at dawn.

Fish were caught regularly from canals, dissected, and food organisms from the stomach were identified. There was a clear relationship between the size of Oreochromis niloticus and food consumed. In 2 to 5 inch fish a high proportion of the stomach contents was phyto - and zooplankton, although aquatic insects occurred in the same size group during April, May and June. These insects belong to the orders Ephemeroptera, Diptera 'mosquitoes', Odonata and occasionally Hemipteran 'bugs' or coleopteran beetles. A change to phytophagous mode of feeding occurred as the fish size increased to 6-10 inches, and large quantities of higher aquatic plants were found in the stomach contents of this size group. Mud and debris were also observed, especially during the flood season when the water is more turbid and snails were also found on occasion.

Young Gambusia fish were mostly dependent on algae for their diet, while adults consumed aquatic insects, with mosquito larvae most commonly found in the stomach contents examined. Annelid worms were also observed in Gambusia guts, and fish remains appeared during May.

Laboratory experiments on the number of mosquito larvae consumed by fish showed that young Creochromus consumed more mosquitoes than did adults. A fish measuring 8 inches ceased to prey on larvae unless starved for several days. However, Gambusia fish preyed on mosquito larvae a few days after being born (1 cm. in length) but the number of larvae consumed increased with the increase in size of the fish. Gestating females ate more larvae than non-gestating ones, and female fish consumed more larvae than males.

In order to determine the efficiency of fish in controlling mosquitoes, small-scale trials were carried out in four Abu eshreens, which often contained mosquito larvae and which never dry out. One of them was stocked with 1,000 Gambusia fish at 1 fish/1m^2 water surface, and a second with Or. niloticus, and in the third both fish were seeded. The fourth one was kept free of fish. The seeding caused a marked decrease in mosquito larvae and mosquito density in the one containing only Gambusia was maintained very low throughout the follow up period. Moreover, survival of Gambusia in the ditches was much higher than that of Or. niloticus which disappeared after a few months. Mosquito density in the control Abu eshreen showed seasonal variations but generally levels were much higher than in those seeded witn fish.

A third fish species, Tilapia zillii, which has been reported as a successful species in mosquito control by many workers, was brought from the White Nile at Jebel Awlia lake. About 500 fish were kept in large ponds since November 1982, and to date they have survived well. The newly introduced fish have not yet reached sexual maturity.

F. Small-Scale Filtration Units for Unregistered Villages

As an experimental control measure to reduce the transmission of S. mansoni and S. haematobium, hand operated water pumps were provided

in four unregistered villages within the Gezira Scheme (Figure 31). As there was no piped water supply this population of about 536 people had previously been dependent for water on infected canals. A fifth village served for comparison.

The four villages - Warali, 10 Nafie, Wad El Amin and Wad Bella - have a combined population of about 536 people (about 92 houses) and are situated outside the Study Zone, in the northern part of the Gezira Scheme. The control village, Wad El Ageb (about 50 people and 10 houses) is situated in the same area.

A survey was carried out on 20th February 1982. All houses in the project area were visited, and the name, age and sex of every occupant noted.

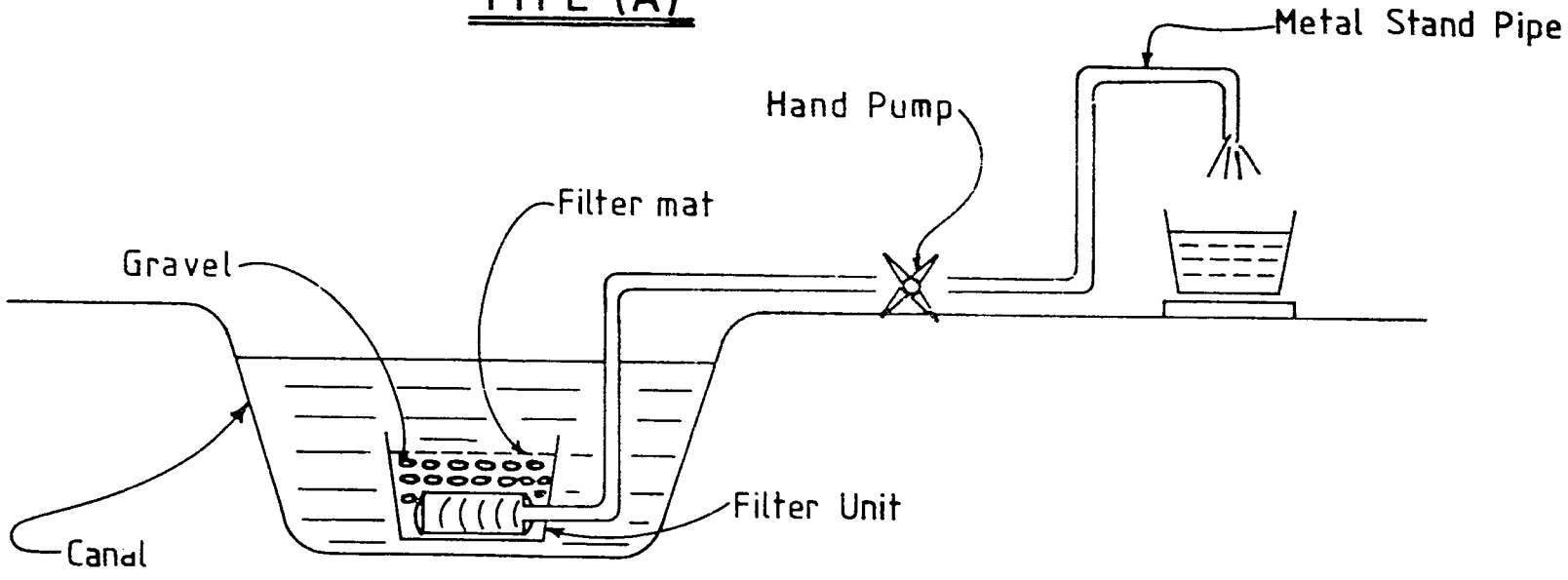
Stool and urine containers individually labelled were left at each house with instructions that all occupants should provide specimens. Containers were collected the following day and used to determine the prevalence of schistosomiasis. All positive cases were then treated with Praziquantel. The survey will be repeated at the end of February 1983 (i.e. after one year) to measure the incidence of new infections in both the pumps and control villages.

Initial observations were made to determine the contact sites and optimum situation for the pumps. The observations on human water contact and other activities by the villagers were made discreetly with binoculars to minimise observer interference, for a total of 12 hours per month. The approximate age and sex of each person was recorded as well as the time, duration and bodily extent of any water contact. All types of human activity were noted, with priority given to water contacts and quantity of water collected.

Once a month, the canals around the villages were examined for snails. Concentrating on the water contact sites, samples were collected using a dip scoop on the basis of 20 scoops per site. All the snails were taken to Meilig laboratory for screening.

Figure 31 Use Of Filter Units For Small Villages

TYPE (A)



The SWS mini-filter which has been tried in these four villages is made of stainless steel, thermoplastic and brass. A continuous spiral band of stainless steel is electro-welded at each of nearly 200 intersections with parallel rods to form a string cylindrical screen. Fine sand passes freely but the unique construction ensures that all grains larger than 1.5 mm are excluded and, just as important, cannot block the slots. The gravel held back by the screen retains progressively finer grains of sand, which in turn form the surface where the physical filtration takes place. After a period of development and regular pumping, the bed becomes biologically active.

Two types of pumps have been tried out - the Lee Howl semi-rotary pumps and Patay double-acting diaphragm pumps. The Lee Howl semi-rotary pump is ideal for low lifts but was difficult to repair. For greater heads the Patay double-acting diaphragm pump was the best.

Two pumps of the Lee Howl type were put on trial, one at 10 Nafie (240 people) and the other at Warali (116 people). Their life-times were 1½ months and 4 months respectively. These were then replaced by the Patay double-acting diaphragm ones. The duration of service without need of maintenance for these pumps was influenced by many factors; the size of the pump, the length of the hose, the population of the village and the quantity of water collected (Figure 32).

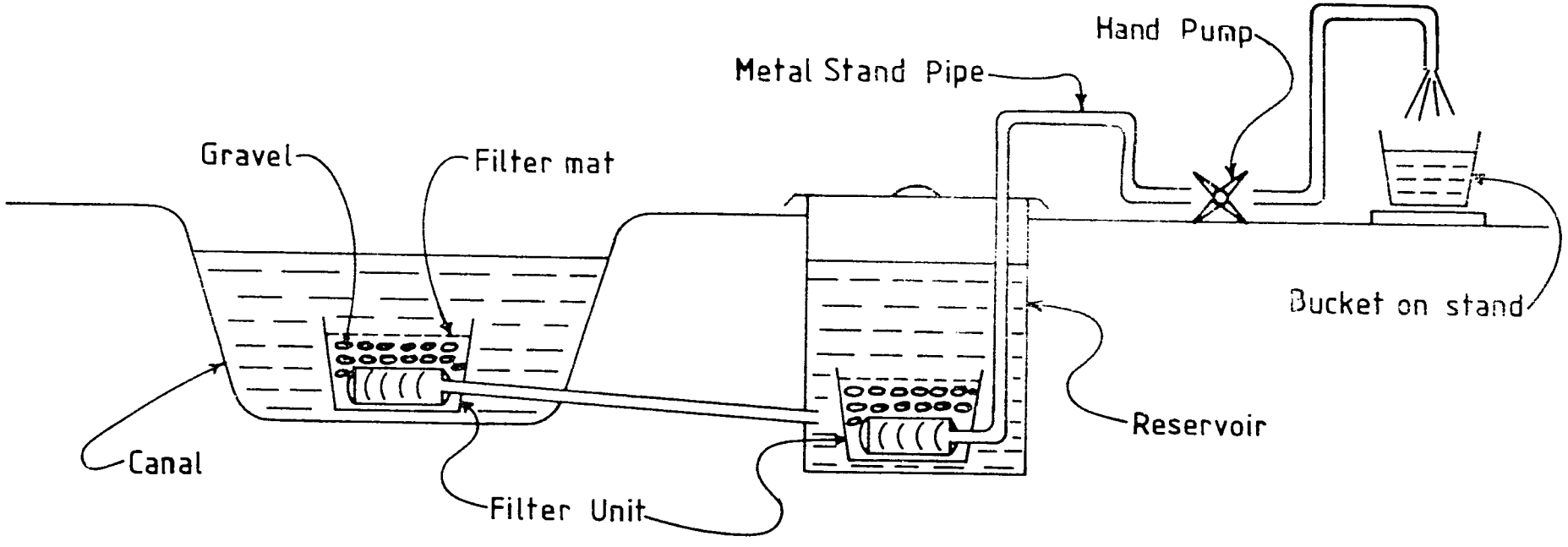
We now depend solely on the Patay double-acting diaphragm pumps which come in two sizes; the DD 70 which takes 1 inch hose and the larger DD 120 with a 1½ inch hose fitting. By the end of 1982 the following were in use:-

10 Nafie	2 X DD 70 1 X DD 120
Warali	1 X DD 120 (recently replaced a single DD 70)
Wad El Amin	1 X DD 70
Wad Bella	2 X DD 70 in different contact sites
Toba 16	1 X DD 120
Shajara camp	1 X DD 120

The problem which develops with constant use of these pumps is

Figure 32 Use Of Filter Units For Small Villages

TYPE (B)



Reservoir size varies according to village. Population up to 75 people requires a 44 gallon reservoir. Greater than 75 people requires an 88 gallon reservoir.

worn diaphragms. However these can easily be replaced. Therefore a certain amount of regular inspection will always be required to ensure the proper functioning of these pumps until local villagers are fully trained.

The water from the SWS mini-filter is excellent on visual assessment, and is free from insects, grass, dirt and other debris. But chemical and bacteriological analysis, turbidity measurements and cercarial filtration tests are needed for a more objective assessment.

II. T R A I N I N G

A. Health Services Research and Tropical Diseases

A comprehensive course on Health Services Research and Tropical Diseases for the senior staff on the project was held in Wad Medani and Khartoum from 6th-23rd March 1982 (Table 84). Drs W.A. Hassouna Mary T. Taylor and Shadia Hakim all from Egypt visited as temporary advisers to the course, and Dr. Abdel Rahman El Tom, Dr. Beshir Hamad, Dr. Omer El Bagir and Dr. Mohamed Ali Awad El Karim joined as temporary advisers from within Sudan. The course participants represented several local institutions within Sudan concerned with health. They produced three proposals for research into socio-economic aspects of diseases:-

a) Barriers to Health Services Utilisation among sedentary and migrant ethnic groups
b) Health education and community participation for control of tropical diseases
c) Measurement of economic impact of tropical diseases.

These proposals were subsequently submitted to the TDR Scientific Working Group on Socio-Economic Research. One was funded and the others will be revised and re-submitted.

B. Internal Blue Nile Health Project Training

Within the project, training courses were held for paramedical staff in preparation for intervention.

TABLE 84 SUMMARY OF TRAINING ACTIVITIES IN 1982

PERSONS TRAINED	NUMBER OF PERSONS	SUBJECT OF TRAINING	DAYS OF TRAINING
		A. Health Services Research	
Senior Scientists from BNHP and U. of Gezira	21	Preparation of Research proposals	10
		B. General Epidemiology and Control	
Medical Assistants, Nurses and Community Workers	52	Epidemiology of Schistosomiasis and Praziquantel Chemotherapy	7
Village Microscopists	32	Microscopy of Malaria and Schistosomiasis	30
Medical Assistants, Nurses, Volunteer Workers, Midwives and Village Observers	102	Epidemiology and Control of Diarrhoeal Diseases	5
Spraymen	10	Integrated Vector Control	10
Village Health Committee Members	50	Control of Water-Associated Diseases	3
Senior Scientists from BNHP and U. Khartoum	5	Mathematical Modelling of Diseases	5
Graduate Students	8	Thesis Research	Full time
Ahmed M. Babikir		Schistosomiasis	
Salah Hassan El Safi		Fish	
Afaf Abdel Rahim		Aquatic Biology	
Mohamed Ahmed Mohamed		Sociology	
Elias El Ghayeb		Schistosomiasis	
Abdel Moneim Hassan		Botany	
Lutfi Abdel Gadir		Botany	
Faisal El Mehaisi		Economics	
		C. International	
Biologist from Saudia Arabia	1	Schistosomiasis	30
Biologists from Somalia	2	Vector Control	30

1. Praziquantel Chemotherapy

Medical assistants, nurses and community health workers attended courses in the Study Zone which covered the treatment, prevention and control of schistosomiasis. A manual describing treatment with praziquantel, i.e. dosage, possible side effects, contra indications, and on schistosomiasis control was distributed. During the courses a demonstration of mass chemotherapy took place including clerking, weighing patients, calculation of dosage and distribution of drug.

2. Microscopists for the Diagnostic Centres

Six locally employed men were trained as microscopists in the diagnosis of schistosomiasis and malaria at courses held respectively in Abu Usher and the Sennar Malaria Training Centre. They then established laboratories in six Study Zone villages with arrangements for transport of people and specimens from surrounding villages.

3. Epidemiology and Control of Diarrhoeal Diseases

All medical assistants, nurses, community participation workers, midwives (trained and traditional), village observers and volunteer adult education social workers received a course of simplified epidemiology of diarrhoeal diseases with emphasis on nutrition and Oral Rehydration Therapy. The courses were run by Dr. Omer Tameem assisted by a nutritionist from Khartoum University, and a refresher course was held just prior to intervention. The recipients of the course then trained mothers in all the Study Zone villages to recognise signs of dehydration and to use ORS.

4. Snail Control and Mosquito Control

Labourers originally employed as "mosquito men" or "snail men" were trained to do each others' jobs to integrate the schistosomiasis and malaria control efforts. All health workers now carry out focal molluscicidng, larval spraying and house insecticide spraying as and when required.

5. Others

Other project personnel received training in a variety of subjects, including 8 graduate students.

C. International Training

Other training activities included study tours for health personnel from Saudia Arabia and Somalia (Table 84).

CHAPTER VII

GENERAL PROJECT OVERVIEW

During 1982 the Blue Nile Health Project became fully operational with all senior staff positions filled, the Headquarters and field stations virtually complete, and transport, equipment and supplies delivered on site. Given this advanced state of the Project, it was thus undertaken in this chapter to review progress and to compare the current status of the project with the expected status as outlined in the original planning documents. Finally it was proposed to establish a revised list of aims and priorities in the light of three years experience.

A. The project activities, schedule and goals as originally defined:

The project document signed in 1979 by the government of the Sudan and W.H.O. described two major phases. The first phase, from 1979 through 1983, was to cover the following:

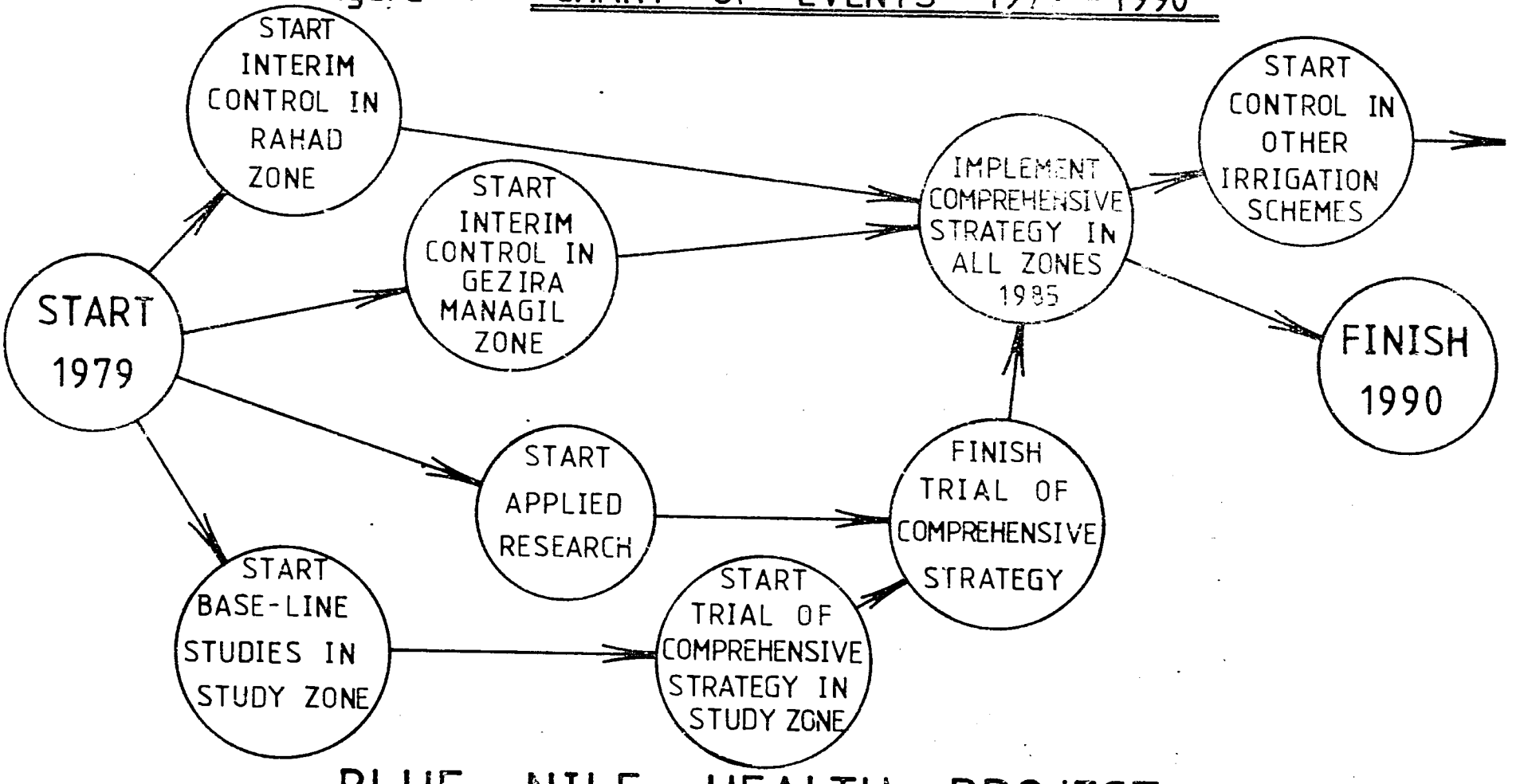
1. Activities planned for phase 1.

   a. Improvement of malaria and schistosomiasis control operations.
   b. Review of health services and improvement of malaria diagnosis and treatment.
   c. Review of water supply and sanitation systems, strengthening of their maintenance programmes, and development of new designs.
   d. Strengthening of health education and community participation.
   e. Developing more permanent and economical control methods.
   f. Continuously evaluating progress.
   g. Training of personnel from Sudan and elsewhere.

2. Original Schedule of Events

The originally planned Schedule of the Project was expressed in a typical Chart of Events, using standard symbols. The Chart of Events indicated parallel activities in three Zones and in applied research, converging in the implementation of a comprehensive strategy for all Zones by 1985. Eventually the special control effort would be completed in the Project area, and expansion would occur to other irrigation schemes (Figure 33). This is the overall framework and calendar within which the Project operates.

Figure 33 CHART OF EVENTS 19[illegible] – 1990



BLUE NILE HEALTH PROJECT (Feb.1980)

1979 | (90)

3. Specific Goals for Control of the Three Diseases

The precise numerical goals of the Project, in terms of disease prevalence, have been developed during the meetings of the first two Scientific Advisory Groups (Table 85). They are tentatively:

a. to reduce the prevalence of schistosomiasis to 10% in the Gezira-Managil Zone and to 5% in the Rahad Zone.
b. to reduce the malaria parasite rate in children to 1%.
c. to reduce the mortality rate from diarrhoea in children to 25 per 1000 per year.

B. Achievements in Phase I by the end of 1982.

1. Finance and Staff

Before considering the specific activities of Phase I, the current status of the Project in terms of finance and staff were reviewed.

a. Finance

In 1978 the existing government budget for the activities to be managed by the Blue Nile Health Project was under $6 million. The estimated cost for the planned ten-year programme of the Project was $155 million at that time. During the first three years the government contributions to the project increased considerably, and all commitments to build offices, stores and housing were met. Government expenditures in 1982 were almost $11 million, at official exchange rates (Figure 34).

International Donors have contributed sufficient funds to allow the project to be adequately staffed, to carry out malaria control and schistosomiasis research, to implement training programmes and to be self sufficient in transport and fuel (Figure 34). However, within the budget prepared in 1978, funds have not been received for schistosomiasis control or for extensive engineering works. If the proposed Gezira Rehabilitation and Modernisation Loan from the World Bank is finalised in 1983 as expected, then the Project funding would be virtually complete (Figure 35). That loan provides for drainage works ($25 million), village water supplies ($15 million) and drugs and molluscicides for schistosomiasis control ($6 million).

TABLE 85

QUANTITATIVE GOALS OF THE BLUE NILE HEALTH PROJECT

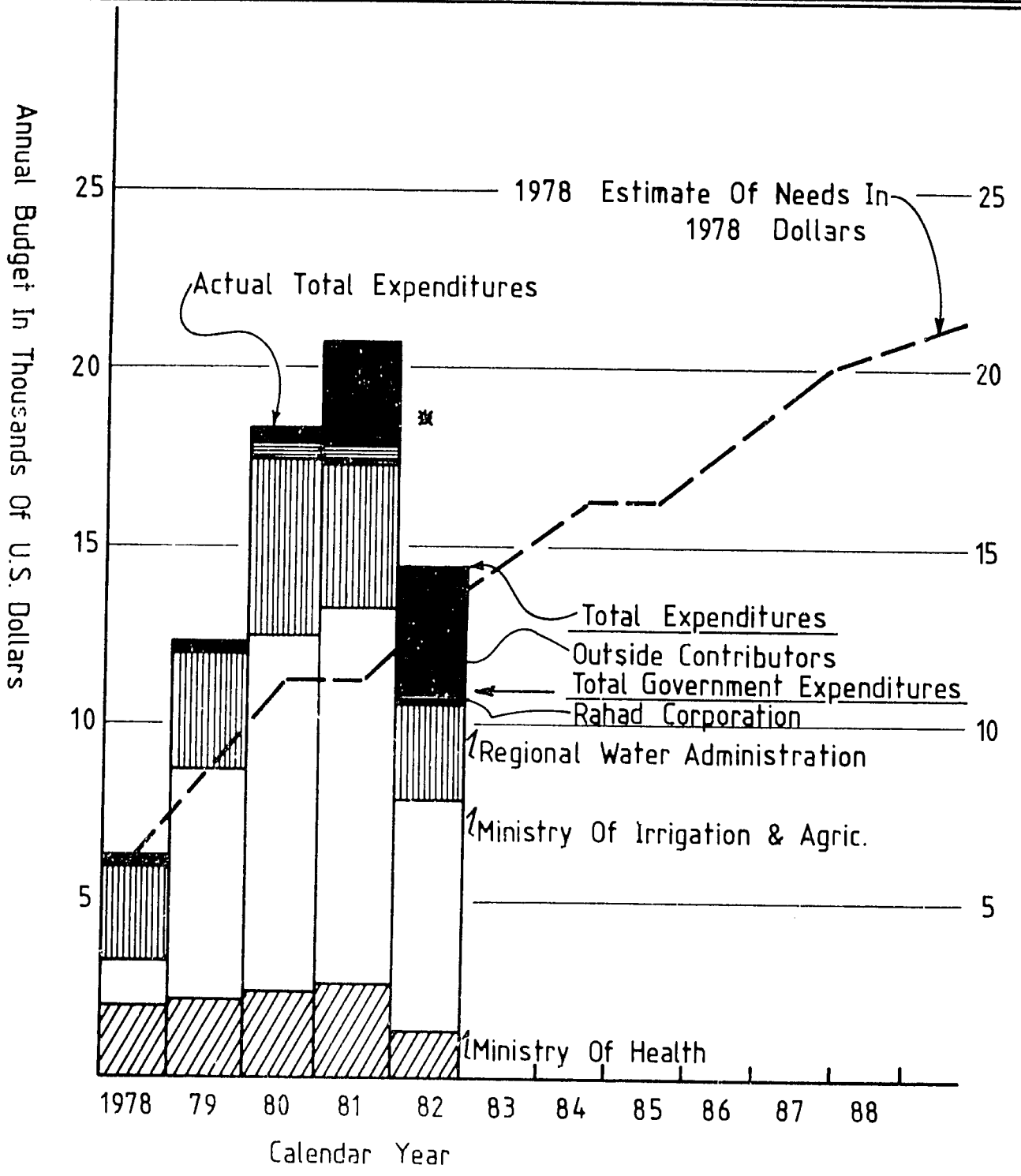
NUMBERS IN PARENTHESES ARE TENTATIVE

Zone	Malaria Prevalence	Schistosomiasis Prevalence	Child-hood deaths per year from diarrhoeal diseases
Rahad	1%	(5%)	(25/1000)*
Gezira-Managil	1%	10%	(25/1000)
Study	1%	10%	(25/1000)**

* was 63/1000 in 1981

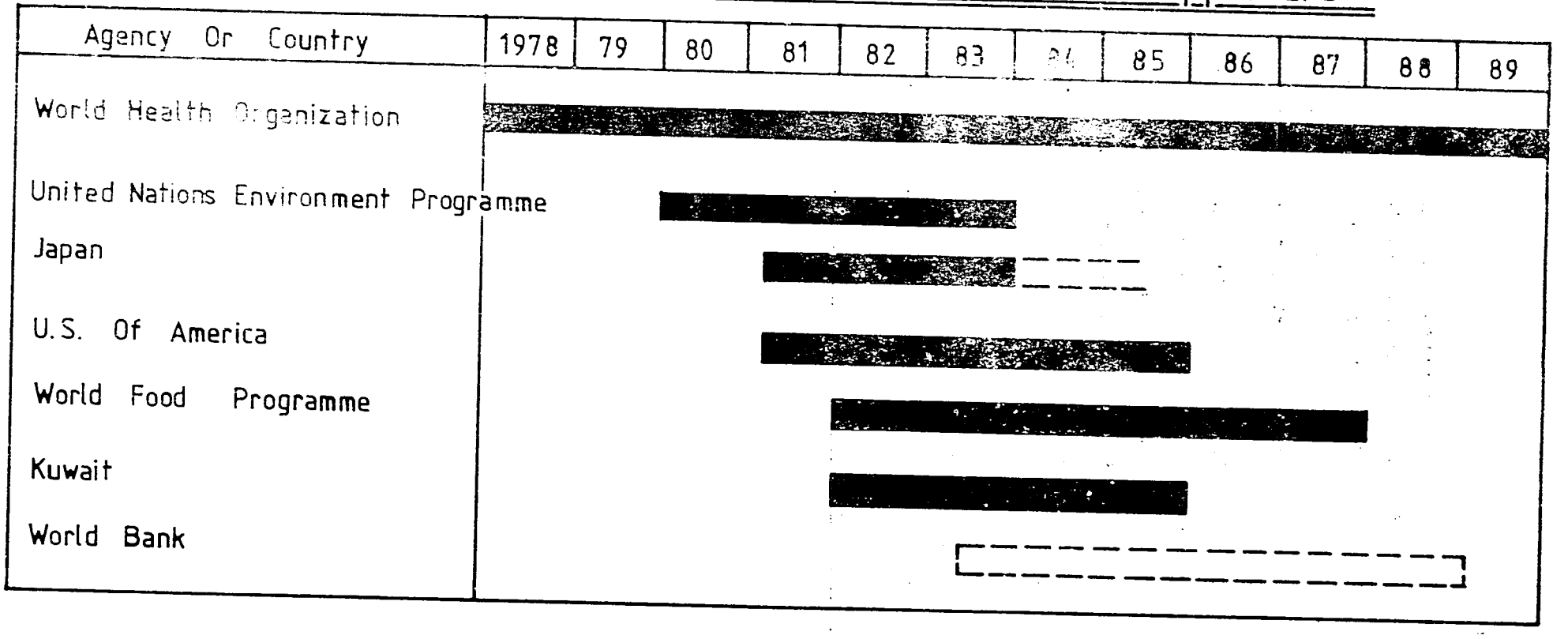
** was 49/1000 in 1981

Figure 34 Estimated Budget Needs & Actual Expenditures For Blue Nile Health Project, In US Dollars 1978-88



* Drop In Calculated Government Expenditures Due To Devaluation Of Sudanese Pound By 1982

Figure 35 Funding Schedule Of Major External Supporters



b. Staff

The Project became operational in 1980 without a full complement of senior staff, but the remaining positions were finally filled by mid 1982. Even so, the appointed Directors of both the Engineering Unit and the Statistics Unit are at present sharing their time with other government appointments.

During 1983 it is anticipated that the Engineering Unit will be strengthened by the appointment of more staff, that the Epidemiology Unit will fill its vacancy for an epidemiologist in schistosomiasis, and that Junior staff will be recruited to strengthen both the Statistics Unit and the Community Participation Unit.

2. Specific Activities

The specific activities under Phase I are evaluated as follows:

a. Malaria and Schistosomiasis control operations

With assistance from Japan, malaria control has continued effectively in Gezira. It was also initiated in Rahad. Routine schistosomiasis control by molluscicidng in the Gezira has been ineffective in the past and therefore has been stopped. Schistosomiasis control on a massive scale is planned for 1983-88 utilising the World Bank Loan to implement an Interim Strategy of mass chemotherapy, focal molluscicidng, village water supplies, and sanitation.

b. Review of Health Services and Improvement of Malaria Diagnosis and Treatment

Activities in the Study Zone have led to the establishment of six laboratories with trained microscopists capable of examining blood films and stool and urine specimens for both malaria and schistosomiasis.

c. Water Supply and Sanitation

The engineering unit concentrated initially on redesigning water supply filters for Rahad and then moved to upgrading Study Zone water systems. The Gezira Rehabilitation loan will mean a massive increase in progress towards improving water supplies

and the Project will be recruiting extra staff to handle the increase in work and to advise the Rural Water Administration.

Environmental sanitation in Rahad is very poor and the failure of the communal latrines has led to massive pollution of canals and drains. In Gezira the Study Zone is the target for a pit latrine installation programme with cement slabs being produced by the Project in Hasaheisa.

d. Strengthen Health Education and Community Participation

After a slow start the Community Participation Unit in conjunction with health educators from Khartoum is moving forward well, working with the 31 Village Health Committees formed in the Study Zone. The Unit was particularly successful in gaining the confidence of the villagers to cooperate with the mass chemotherapy campaign against schistosomiasis, and to help with spraying of houses for mosquito control.

e. Develop more permanent and economical control methods

This activity is more difficult than others, and progress towards achieving the cheaper control methods has been slow. Progress using machines to control aquatic vegetation, development of new drugs against schistosomiasis, improving application techniques for molluscicides, and finding new insecticides has been satisfactory, but testing of biological control agents for mosquitos and snails is still at the stage of laboratory or field trial, environmental control methods have not been tested, and no research has been started on community participation in disease control, on health education, or on improved health services.

f. Continually evaluate progress

Evaluation of all activities has continued satisfactorily with National Coordination Committee meetings held in 1980 and 1981, with the next one planned for early 1983. Scientific Advisory Group Meetings were held in 1979 and 1981 and the third meeting will be in late 1983. Monthly staff meetings are held

in Wad Medani to review progress, to make policy decisions and to improve communication among the diverse groups within the Project staff.

g. Train personnel from Sudan and elsewhere

Senior Project Staff have been trained abroad and at home, and all levels of staff have received some training. Training of visitors from other countries in the region has been carried out whenever candidates were available. The first International Workshop for training health planners will be held in early 1984.

C. Proposed Revision of Aims and Priorities

The Blue Nile Health Project has developed satisfactorily according to the initial plans, although the various Units have progressed at different rates. In the next 2 to 3 years it is proposed that the Project should:

1. Solve the problem of environmental sanitation in Rahad and develop an Interim Strategy for that zone.

2. Emphasize research on more economical forms of disease control.

3. Improve the balance between the Units by adding personnel to the Engineering Unit to handle activities under the Gezira Rehabilitation Loan.

4. Initiate research on diarrhoeal diseases, the least studied of the 3 target diseases.

5. Continue all other project activities, which are progressing well and on schedule.

Ultimately this list of revised aims should serve as a basis for reaching a new consensus during 1983. During the Third Scientific Advisory Group late in the year these aims will be discussed and refined, giving precise guidance to the Project management for the future years of the Blue Nile Health Project.

FUTURE PLANS:

During 1983 it is hoped to extend the project still further with the following planned programmes and events:-

1. Provision of pure water supply and pit latrines with reinforced concrete slabs, to all Study Zone villages.

2. Expansion of the malaria and schistosomiasis diagnostic facilities in the Gezira and Rahad Zones.

3. Construction of re-inforced concrete slabs for pit latrines in Rahad to cover most of the villages.

4. Initiation of community projects on water supply, sanitation, drainage and health services in all zones utilizing the World Food Programme Grant and the remainder of the UNEP Grant.

5. Improvement of water supply in the villages of the Gezira-Managil Zone.

6. Treatment of many inhabitants of Gezira-Managil Zone for schistosomiasis depending on receipt of the World Bank Loan for this purpose.

7. Encouragement of the use of oralytes among all the inhabitants of the Gezira-Managil and Rahad for the treatment of diarrhoeal diseases.

8. In terms of international meetings, during 1983 we intend to convene:

(a) The 3rd National Coordinating Committee Meeting in February

and

(b) The 3rd Scientific Advisory Group Meeting with particular reference to present and future strategies for Rahad.

and in 1984:

(c) The Seminar on Prevention and Control of Health and Environmental Problems in Water Resource Developments, February 4 - 19.

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APPENDIX A — OBJECTIVES OF BLUE NILE HEALTH PROJECT

The following objectives of the Blue Nile Health Project are condensed from the original agreement establishing the Project in 1979. They are, specifically:

a) To prevent schistosomiasis transmission from developing in the Raha irrigation system, emphasizing permanent and long-term vector control measures.

b) To assess and reorganize immediately the on-going water-associated disease control programme in the Gezira/Managil scheme and develop and implement an interim comprehensive strategy based on improving currently used methods and materials and strengthening the existing infrastructures.

c) To develop and assess a long-term comprehensive strategy in a Study Zone, which will reduce considerably water-associated disease transmission and which will maintain the results achieved at low cost and minimal environmental hazards, and to apply this strategy in the project area.

d) To seek innovative control measures which are considerably more cost-effective than present techniques, and which have low hard currency requirements, emphasizing environmental management, biological control, community participation and health education.

e) To maximize the socio-economic benefit of disease control by improving basic health services, water supply and sanitation and integration of project activities into the health services.

f) To establish the costs and benefits of water-associated disease in tropical agricultural systems, including measurement of community productivity, for planning of new water resource developments.

g) To train decision-makers, planners, designers and operators of water resources projects and health staff in the Sudan and elsewhere on the approaches and methods for the prevention and control of water-associated diseases.

h) To coordinate relevant agencies.

The general staff included 32 members, 13 with doctoral degrees and 5 with masters degrees. There are 29 Sudanese Staff and 3 non-Sudanese.

I. MANAGEMENT

1. Project Manager, Dr. Ahmed Ayoub El Gaddal
2. Advisor on Research & Training, H.E. Dr. Mutamad Ahmed Amin
3. Deputy Co-Manager, Dr. William R. Jobin, also Acting Director of Engineering Unit

II. ADMINISTRATION AND FINANCE UNIT

4. Director, Mr. Osman Bakri El Gammaz

III. BIOLOGY UNIT

5. Director, Dr. Abdel Aziz Mohamed Haridi
6. Mr. Salah Hassan El Safi
7. Mr. Bol Kolock Manjing
8. Miss Afaf Abdel Rahim Abdel Rahman

IV. COMMUNITY UNIT

9. Director, Mr. Abu El Gasim Ali Murda

V. ENGINEERING UNIT

10. Mr. Kamal Mohamed Abdu
11. Mr. Seif El Din Babikir

VI. EPIDEMIOLOGY UNIT

12. Director, Dr. Omer Tameim

VII. RESEARCH AND TRAINING UNIT

13. Director, Dr. Asim Abdel Rahman Daffalla
14. Dr. Alan Fenwick
15. Mr. Ahmed Babikir
16. Mr. Mohamed Ahmed Mohamed
17. Dr. Mohamed Kardaman
18. Dr. Mohamed El Tayeb
19. Dr. Abu Bakr El Igail
20. Mr. Elias El Ghayeb
21. Mr. Omer Saeid
22. Mr. Abdel Moneim Hassan Hilal

VIII. STATISTICS

23. Director, Dr. Kheiri Abdel Rahman
24. Dr. M.S. Rao

STAFF OF OPERATIONAL UNITS

IX. STUDY ZONE

25. Mr. Kamal Abdel Azim

X. GEZIRA MANAGIL ZONE:

26. Dr. Hashim Hussein
27. Mr. Hussein Abdel Gadir Waziri
28. Mr. Faisal El Tayeb

XI. RAHAD

29. Mr. M.A. Haboub
30. Mr. Z.B. Zakaria
31. Mr. Samani M. Nour
32. Mr. Ibrahim Abu Ali

TABLE A1 GOVERNMENT BUDGET FOR THE BLUE NILE HEALTH PROJECT IN 1982 IN SUDANESE POUNDS

	UNIT	CHAPTER I	CHAPTER II	CHAPTER III	TOTAL
1	Project Headquarters from National Budget	96575	98815	119700	315090
2	Malaria Control for Gezira from Regional Budget (1)	332580	91159		423739
3	Schisto Control for Gezira from Regional Budget (1)	145000	160000		305000
4	National Research Council Schistosomiasis Research in Gezira Zone	12960			12960
5	Malaria and Schisto Control in Rahad Zone (1)		121779		121779
6	Water Supply Operations in Rahad	80691	234000		314691
7	Water Supply Maintenance and Construction in Gezira Province (2)	403736	331275	1,676,817	2,411,828
8	Weed and Canal Clearance in Gezira and Rahad Zones (3)		5,900,000		5,900,000
	TOTAL	1,071,542	6,937,028	1,796,517	9,805,087

1 Not including curative health services

2 Not including cost of operating village water supplies

3 Not including Sudan/Holland Project on weeding Machines or expenditures under Gezira Rehabilitation Loan, of the total, £1.04 million was for manual weeding of canals.

TABLE A.2

BUDGET SUMMARY FOR 1978 - 1982

ACTUAL EXPENDITURES IN THOUSANDS OF US DOLLARS

Year	1978	1979	1980	1981	1982
Official equivalent of one US Dollar	£ 0.50	£ 0.50	£ 0.50	£ 0.50	£ 0.90
DOMESTIC GOVERNMENT					
Ministry of Health (1)	2,000			2,714	1,295
Regional Water Admin.(2)	2,821			4,078	2,680
Ministry of Irrig. (3)	1,230			10,500	6,555
Rahad Corporation	0			630	350
National Research Council				14	14
Subtotal $	6,051	n.a	n.a.	17,936	10,894
OUTSIDE SOURCES					
Japan (J.I.C.A.)				1,800	1,650
World Health Organization - EMRO (5)	50	138	148	698	100
America (U.S.A.I.D)				18	747
World Food Programme(4)					345
Kuwait				149	761
Great Britain (O.D.A.)(5)			100	100	100
Clark Foundation (5)					30
WHO EDR Special Programme (5)				15	15
U.N. Environment Progr.				16	
Subtotal $	50	138	248	2,796	3,255
Totals $	6,101			20,732	14,149

(1) Does not include cost of health services

(2) Does not include cost of operating water supply systems

(3) Does not include Sudan/Holland Project on Mechanical Weed control, or expenditures under Gezira Rehabilitation Loan

(4) Based on 8,673 Food rations distributed at estimated Market value of £35 per ration, plus £7,000 spent from staff contributions

(5) Approximate

TABLE A.3 CENTRAL REGION GOVERNMENT EXPENDITURES IN SUDANESE POUNDS

CATEGORY	1981/82		1982/1983	
	BUDGET	ACTUAL	BUDGET	ACTUAL
MINISTRY OF HEALTH				
Recurrent	n.a.	n.a.	10,954,346	n.a.
I	7,141,966	n.a.	7,276,286	n.a.
II	3,096,799	n.a.	3,369,365	n.a.
III	n.a.	n.a	308,695	n.a.
Development	150,000	130,000	927,000	n.a.
T O T A L	n.a.	n.a.	11,881,346	n.a.
ALL MINISTRIES				
Recurrent	83,452,000	n.a.	94,638,300	n.a.
I	61,807,260	n.a.	67,000,000	n.a.
II	19,868,820	n.a.	22,837,270	n.a.
III	1,776,000	n.a.	4,801,030	n.a.
Development	n.a.	n.a.	9,335,585	n.a.
T O T A L	n.a.	n.a.	103,973,885	n.a.

Note: Fiscal year 1 July - 30 June

Source: Central Region Ministry of Health

n.a. = Not Available

TABLE A.4 POPULATION OF CENTRAL REGION, 1982

PROVINCE	1982
Gezira	2,761,000
Blue Nile	1,200,000
White Nile	1,049,921
T O T A L	5,011,084

Sources : Central Region Ministry of Health.

TABLE A.5

POPULATION PROJECTIONS IN THOUSANDS OF PEOPLE IN GEZIRA-MANAGIL ZONE
BLUE NILE HEALTH PROJECT AREA

POPULATION	1981	1982	1983	1984	1985	1986	1987	1988
Core Villages	1919	1973	2029	2085	2144	2204	2266	2330
Registered	1769	1819	1870	1922	1976	2032	2088	2147
Unregistered	150	154	159	163	168	173	178	183
Road Villages & Towns	250	261	273	285	298	312	326	341
Registered	119	122	126	129	133	137	141	144
Wad Medani	131	139	147	156	165	175	185	197
Seasonal	191	165	150	150	150	150	150	150
T O T A L	2360	2399	2452	2520	[illegible]	2666	2742	[illegible]

N o t e : Projections assume annual population growth rates of 6% in Wad Medani and 1.8% elsewhere.

Source : Blue Nile Health Project staff, January 1983

APPENDIX D. MATERIAL RECEIVED IN 1982

FROM JAPAN (J.I.C.A)

1. Fenitrothion - insecticide	200 metric tons

FROM THE WORLD HEALTH ORGANIZATION

Vehicles

2. Four wheel drive cars - Suzuki	30 each
3. Spare parts for Suzuki vehicles	1 lot
4. Four-Wheel Drive Station Wagons - Toyota Land Cruiser	5 each
5. Spare parts for Toyota ½ ton Pick-ups	1 lot
6. Spare parts for Lukh Diesel Engines for water yards	1 lot

Chemicals

7. Praziquantel drug for Schistosomiasis - 600 mg tablets	335,000 tablets
8. Pale pyrethrum extract - insecticide	1 drum
9. Oral Rehydration salts	330 cartons
10. Chloroquine - Malaria tablets	42 cases
11. Primaquine phosphate - Malaria tablets	30 cases
12. Laboratory reagents, stains and misc. chemicals	3 lots

Equipment

13. Cannon Copier	1
14. Gestetner Duplicator	3
15. Microscopes, Slides and Accessories	25
16. Typewriters	3
17. Humidifier and Humidistat	1
18. Insecticide Sprayers and Spare Parts	100
19. Insulated ice boxes	15
20. Aquaria	6
21. Laboratory and field supplies for malaria studies	1 lot

FROM THE UNITED NATIONS ENVIRONMENT PROGRAMME

Equipment

22.	Sound Film Projectors - 16mm	2
23.	Slide/Film Strip Projectors - 35mm	1
24.	Overhead Transparency Projector	1
25.	Stands for Projectors	3
26.	Screens for Projectors	3
27.	Generating Set	1
28.	Starter Kit for overhead Projector	1
29.	Cannonet Camera - 35mm	1

FROM AMERICA (U.S.A.I.D.)

Equipment

30. Two electricity generators
31. Air conditioners
32. A project communication system
33. Typewriters
34. Zoom microscopes
35. A range of basic laboratory reagents and equipment for chemical analysis, biological research and diagnosis of parasitic infections.

APPENDIX E

THE WORLD FOOD PROGRAMME

The Blue Nile Health Project is being implemented under difficult working conditions. The availability and attraction of qualified workers, already in short supply, has continued to be a difficult problem. In this respect the World Food Programme has played an extremely valuable Role. The role of the WFP is two-fold: providing food as an incentive to the workers, either salaried or community workers and, through nominal contribution by beneficiaries, deriving savings for the Project to be utilized for the improvement of drinking water supply and sanitation.

The following figures of beneficiaries which are extracted from the most recent Quarterly Report (Oct. - Dec. 1982) show the total number of people who received aid as well as their distribution among the Project's main activities:

MONTH	Salaried Workers	Volunteers	Total
October	948	-	948
November	1149	20	1169
December	1202	44	1246
Grand Total	3299	64	3363
SUB TOTALS BY ACTIVITY			
Malaria Prevention and Control			
October	721	-	721
November	917	-	917
December	983	-	983
Sub Total	2621	-	2621
Bilharzia Prevention & Control			
October	108	-	108
November	110	-	110
December	105	-	105
Sub Total	323	-	323

Table continued on P A 13

Table continued from P A 12

MONTH	Salaried workers	Volunteers	Total
Diarrhoea Prevention & Control			
October	-	-	-
November	-	20	20
December	-	44	44
Sub Total	-	64	64
Administration and Supervision			
October	119	-	119
November	122	-	122
December	114	-	114
Sub Total	355	-	355
GRAND TOTALS	3299	64	3363

During the previous Quarterly Report, the first quarter during which food rations were distributed, a total of 5,310 rations had been given out. Thus the total number of rations distributed in 1982 was 8,672. The market value of one food ration in Wad Medani during 1982 was about £ 35. Also about £ 7,000 were spent from contribution by beneficiaries, to begin construction of latrine slabs in Hasaheisa. Thus the total expenditures were £310,555 in 1982, or about $ 345,000 at the official exchange rate of one dollar to 0.9 Sudanese pounds.

VISITORS IN 1982

No.	N A M E	ORGANIZATION	COUNTRY	SUBJECT OF VISIT
1	Mr. Nohoru Harasawa	Olympus Optical Co.	Japan	Training our microscopists
2	Prof. Suzuki	JICA Mission	Japan	JICA Grant
3	Mr. John Hadely	Journalist BBC	Britain	Interview
4	Dr. Lipman	Consultant to Sudan Govt.	Sudan	Briefing
5	Mr. Paulus Cerdes	Eduardo Mondlane University	Mozambique	Mathematical Models
6	Dr. Abdel Ghayoum A. Babikir	University of Khartoum	Sudan	Mathematical Models
7	Dr. Ingemar Hasell	Royal Inst. Technology	Sweden	" "
8	Dr. Isam Abdel Rahman	University of Gezira	Sudan	" "
9	Dr. Fergus McCullough	W.H.O.	Switzerland	Biological Control
10	Mr. Paul Converse	John Hopkins University	U.S. of America	Briefing
11	Dr. Jean Marc Olivé	W.H.O.	Sudan	"
12	Ambassador of Canada	Canadian Government	Canada	"
13	Mr. Tayeb Essayem	World Food Programme	Sudan	W.F.P. Grant
14	Mr. Yousif Lutfi	FACO	Sudan	" "
15	Mr. D. Tollemache	W.H.O.	Egypt	Briefing
16	Ms. Cynthia Hyntti	Ford Foundation	Egypt	"
17	Dr. Henry Mosley	" "	Indonesia	"
18	Mr. Van Alan Clark	Clark Foundation	U.S. of America	"
19	Dr. Joseph Cook	" "	U.S. of America	"
20	Miss Sharon King	" "	U.S. of America	"
21	Mr. Jacques Dupuy	W.H.O.	Switzerland	Data Processing
22	Prof. Yowa	Abu Usher Hospital	China	Malaria Diagnosis
23	Dr. Lew	" "	China	" "

No.	N A M E	ORGANIZATION	COUNTRY	SUBJECT OF VISIT
24	Dr. Sewin	Abu Usher Hospital	China	Malaria Diagnosis
25	Mr. J. Shivakumar	World Bank	U.S. of America	Gezira Loan
26	Ms. Marjory Bromhead	" "	" " "	Gezira Loan
27	Mr. Aftab Raza	" "	" " "	Gezira Loan
28	Dr. Suzuki	University of Chome	Japan	Malaria serology
29	Dr. Igarashi	" "	"	" "
30	Mr. Abdulla M. El Hazzaa	Ministry of Health	Saudia Arabia	Training
31	Mr. Salim Osman A/Khalid	" " "	Somalia	"
32	Mr. A/Khadir Ibrahim Kasim	" " "	Somalia	"
33	Mr. Zahro Yousif Nur	" " "	Somalia	"
34	Mr. Hushang Rafatjah	Consultant to WHO	Switzerland	Engineering
35	Mr. Jack Sell	World Bank	U.S. of America	Gezira Loan (Water Supplies)
36	Dr. L. Molineaux	W.H.O.	Switzerland	Malaria Mathematical Model
37	Prof. K. Deitz	University Tubingen	Germany	Mathematical Models
38	Prof. Zuhair El Subaai	Sabha University	Saudi Arabia	Briefing
39	Prof. James E. Banta	Tulane University	U.S. of America	"
40	Prof. A/El Al A. Osman	Juba University	Sudan	"
41	Dr. Adil Mohamed	Gezira University	Sudan	"
42	Prof. Thomas Scott	University Leeds	Britain	"
43	Mr. Hassan Khalifa Osman	Sudanow Magazine	Sudan	Interview
44	Dr. John Briscoe	University North Carolina	U.S. of America	Sanitation
45	Dr. L.F. Delfini	W.H.O.	Egypt	Malaria
46	Prof. Abdel Rahman El Tom	University Khartoum	Sudan	Seminar
47	Students (35)	" "	Sudan	"
48	Mr. Peter Bradford	Shell Film Unit	Britain	Film Making (Malaria)

APPENDIX G INTERNATIONAL MEETINGS

The project staff attended the following Seminars or meetings:

A. Dr. A.A. El Gaddal

a. Attended Workshop 82, "Planning Management Systems for Programme Coordination and Control" University of North Carolina at Chapel Hill in July.

b. Visited Centers for Disease Control in Atlanta, Georgia for 10 days.

c. Visited C.D.C. Unit for malaria control with special emphasis on voluntary collaborators doing malaria control work from Guatemala.

d. Attended the Fifth International Congress on Parasitology (August - Toronto, Canada)

e. Attended the second meeting of the Joint WHO/FAO/UNEP Panel of Experts on environmental management for vector control - Nairobi, Kenya in September.

f. Participated as Director of the "Course on Health Services Research and Tropical Diseases", Sudan in March, organized by T.D.R. (W.H.O)

B. Dr. A.L. Haridi

a. Workshop on Malaria Control by Primary Health Care in Africa, Washington D.C. June 28 - July 2.

b. Workshop and Symposium on Microbial Control of Pests and Vectors of Diseases in Cairo, November 24 - December 2.

c. WHO Expert Committee on Vector Control, Geneva 6 - 14 December.

d. Study period for a Course on Epidemiology and Public Health Administration at CDC, Atlanta, Georgia, USA, June 14 - July 2.

e. Field visit to the Schistosomiasis Project, Puerto Rico, 8 - 11 June.

f. Participated in the "Course on Health Services Research and Tropical Diseases", Sudan in March - organized by T.D.R. (W.H.O)

C. Dr. W.R. Jobin

a. United Kingdom. Lecturer on BMHP for course at National College of Agricultural Engineering, Silsoe, England, 22 - 25 June.

b. Cyprus. Annual Meeting of Committee on Medical Research for Eastern Mediterranean Region of WHO, August 30 - September 2 in Nicosia. Presented Research Programme of BNHP.

c. USA. Annual Meeting of American Society of Tropical Medicine and Hygiene in Cleveland, Ohio, November 11 - 15. Presented paper on BNHP.

D. Dr.Asim Daffalla

a. Attended Workshop, "Planning Management Systems for Programme Coordination and Control" University of North Carolina at Chapel Hill, July.

b. Visited Centers for Disease Control in Atlanta for 10 days.

c. Attended the Fifth International Congress on Parasitology (August, in Toronto, Canada)

d. Participated in the "Course on Health Services Research and Tropical Diseases"- Sudan in March. Organized by T.D.R. (W.H.O)

e. Study period for a Course on Epidemiology an Public Health Administration at CDC, Atlanta, Georgia, USA. June 14 - July 2.

f. Field visit to the Schistosomiasis Project, Puerto Rico. 8 - 11 June.

g. Visit to School of Medicine, Tulane University, New Orleans, USA, 19 - 22 August.

E. The following attended the International Congress on Parasitology (August, Toronto, Canada)

Dr. A. Fenwick
Mr. Ahmed Sabikir
Dr. Suad Suliman
Dr. Mohamed Bardaman

F. Dr. A. Fenwick presented the introductory paper to the Royal Society of Tropical Medicine and Hygiene joint meeting with Institute of Civil Engineers April 1982;Subject, Irrigation and Health.

APPENDIX H. LIST OF REPORTS AND PUBLICATIONS

1. Daffalla A.A., Fenwick A. & Babikir A. (1982). Focal snail control in irrigation canal water contact sites. ICOPA V Toronto (Abstract) August.

2. Feldmeir H.,Doehring E., and Daffalla A.A. (1982). Simultaneous use of a sensitive filtration technique and reagent strips in urinary schistosomiasis. The Transaction of the Royal Society of Tropical Medicine and Hygiene (in press).

3. Fenwick A., Cheesmond A.K., Kardaman M., Amin M.A. & Manjing B.K. (1982). Schistosomiasis among labouring communities in the Gezira Irrigated Area, Sudan. J. Tropical Medicine and Hygiene 85, 3-11

4. Fenwick A., & Amin M.A. (1982). Marking snails with nail vanish as a field experimental technique. Annals Tropical Medicine and Parasitology (in press).

5. Fenwick A. (1982). Planning Irrigation Projects for developing countries: Health considerations. Paper read at Institute of Civil Engineers. Royal Society of Tropical Medicine and Hygiene 24 April.

6. Feldmeier H., Doehring E, Daffalla A.A., Omer A.H.S. and Dietrich M. (1982). Efficacy of metrifonate in urinary schistosomiasis in light and heavy infections. Tropenmed. Parasit. 33 102-106

7. Feldmeier H, Doehring E., Daffalla A.A., Omer A.H.S., and Dietrich M. (1982). Efficacy of metrifonate in urinary schistosomiasis : Comparison of reduction of Schistosoma haematobium and S. mansoni eggs Am. J. Trop. Med. and Hyg. 31 (16) 1188 - 94.

8. Babikir A., Fenwick A., & Amin M.A. (1982). The invasion of Biomphalaria pfeifferi by Schistosoma mansoni miracidia and the development of daughter sporocysts. Hydrobiologia (in press).

9. Babikir A., Fenwick A., & Amin M.A. (1982). Location of Biomphalaria pfeifferi by S. mansoni miracidia in stagnant and running water under field conditions. Hydrobiologia (in press).

10. Babikir A., Daffalla A.A., & Fenwick A. (1982). Seasonal variations in schistosomiasis transmission in the Gezira Irrigated Area, Sudan. ICOPA V Toronto (Abstract) August.

11. Daffalla A.A. & Fenwick A. (1982). Resurgence of S. haematobium and S. mansoni after the end of a 4 year control programme against S. mansoni. Transactions of the Royal Society of Tropical Medicine and Hygiene 76 (5) 701.

12. Amin M.A., Fenwick A., Teesdale C.H., McClaren M., Marshall T.F.de C. & Vaughan P.J. (1982). The assessment of a large scale snail control programme over a 7 year period in the Gezira Irrigated Area, Sudan. Annals of Tropical Medicine and Parasitology. 76 (4) 415 - 424

13. Fenwick A., Kardaman M. & Dixon H.G. (1982). Reinfection with S. mansoni and S. haematobium in the 24 months following successful chemotherapy with praziquantel. ICOPA V Toronto (Abstract) August.

14. Kardaman M., Fenwick A., Amin M.A. & Cheesmond A.K. (1982). A field trial using praziquantel to treat S. mansoni and/or S. haematobium in Gezira, Sudan. Annals of Tropical Medicine and Parasitology (in press).

15. Kardaman M., Fenwick A., Igail A.B., Taib M. El, & Daffalla A.A. (1982). Phase III field clinical trial of Oltipraz against S. mansoni in the Gezira, Sudan. ICOPA V Toronto (Abstract) August.

APPENDIX I

INSTRUCTIONS GIVEN TO PUBLIC TO ASSIST IN CONTROLLING WATER ASSOCIATED DISEASES

A. General Instructions:

1. Participate in village clean-up by cleaning your house and placing garbage in proper place.

2. Assist in environmental sanitation by carrying dead animals outside village and burning them.

3. Don't take earth from inside village for building purposes because the pit makes a good place for mosquito breeding.

4. Be sure about diagnosis of 3 diseases; you must go to health unit where they can examine blood, urine or faeces with microscope.

5. The villages in the Study Zone with microscopists are:
   - Tayeba Qurashi
   - Mustafa Qurashi
   - Safia/Katfia
   - Sharafat
   - Angado
   - Sheikh El Basir

6. If you see a new settler in your village or nearest camp, you must tell the health committee in your village, who will tell the authorities in Abu Usher.

B. Instructions for Malaria

1. There are a lot of fevers that appear to be malaria but are not malaria, and you must check this through diagnosis by the blood slides.

2. We recommended mosquito nets at night and especially for children, to protect you and your family from mosquito bites and malaria infection.

3. Let the malaria spray crews enter your house to do a thorough spray job.

4. It is important to go to the nearest health unit for diagnosis as soon as you feel fever.

5. For malaria treatment the tablets of chloroquine are better than injections, and you must complete the full dosage.

C. Instructions for Bilharzia

1. The most dangerous areas for becoming infected are the tails of the minor canals or other places with a lot of weeds and slow water.

2. Do not defecate or urinate near or in irrigation canals.

3. Prevent your children from playing or swimming in canals.

4. If it is necessary to use canal water, you must boil it first, or keep it for 24 hours before using.

D. Instructions for Diarrhoeal Diseases

1. You must wash hands with soap before eating and after defecating.

2. Keep food stored in closed containers or cupboards and in rooms with good screens. Screen doors should always be closed tightly.

3. Rooms for food handling should have good screens, and screen doors should be kept tightly closed.

4. Defecate in latrines if at all possible. If there are none do not defecate near water or near houses; you should cover it with earth.

5. Always wash hands with soap before preparing or handling food.

6. At the first sign of diarrhoea in children, give ORS.

7. Keep beers cleaned weekly, keep on a stand, and covered.

8. Do not use Bazaza (baby bottle) if possible. If it is necessary, clean it very well, sterilising it in boiling water.

WEEDING MACHINES

Equipment delivered to Pilot Project Area during 1979 under Sudan/Holland Project

The first lot of equipment consisted of the following:

- two tractors, Ford 5600 with Herder mowing bucket, side-mounted, reach 6.25m and bucket width 2.50m, machines number 10 and 11.
- one tractor, Ford 5600 with Herder mowing bucket, rear-mounted reach 5.50m and bucket width 2.50m, machine number 12.
- one tractor, Ford 7600 with Hemos rotary disc, diameter 0.80m, machine number 13.
- two tractors Ford 7600 with Hemos screw type excavator, length 2.60m, machines number 14 and 15.
- one hydraulic excavator, Benfra 3 Rb, with Herder mowing bucket, reach 4.80m and bucket width 3.00m, machine number 1001.
- one hydraulic excavator, Fiat Allis SL 9 with Herder mowing bucket, reach 11.75m and bucket width 3.00m, machine number 1002.
- one hydraulic excavator, Fiat Allis SL 11 with standard bucket, reach 7.50m, machine number 1003.
- one hydraulic excavator, Fiat Allis SL 9 with Herder mowing bucket, reach 7.50m and bucket width 3.00m, machine number 1004.
- one hydraulic excavator, Fiat Allis SL 11 with dredging bucket, reach 7.50m and bucket width 3.00m, machine number 1005.
- one DAF 1300 truck, equipped as mobile workshop for maintenance and repair of the equipment.
- a first consignment of spare parts, various tools, a Landrover, dredging bucket and a trapezoidal bucket.

Additional equipment delivered during 1980 and 1981

The second lot consisted of the following equipment:

- one tractor, Ford 5600 (machine number 16) with trailer and botman mowing boat.

- one bulldozer, Caterpillar D 6.
- one grader, Caterpillar 12 G.
- one DAF 1800 truck, equipped as fueltanker, capacity 1500 gallons.
- one DAF 1800 truck, equipped as service truck to supply fuel and lubricants to the equipment in the field.
- a field consignment of spare parts, tools and a number of diesel driven Landrovers.
- one amphibious mowing launch, Herder (machine number 1006), which was especially designed to deal with problems encountered in the Sudan, combining a number of functions.

TABLE J.1: EQUIPMENT INVESTMENT COSTS (in Dfl.) (1 D.fl = LS.0.6)

Type of equipment	Purchase value	Transport Europe - Port Sudan	Transport in Sudan	Costs of modifications	Total value	Year of purchase	Month operational
A. WEED CONTROL EQUIPMENT							
Ford 5600 tractor (2)	52,530						
plus		9,500	2,250	10,000	121,280	1978	79-3
mowing bucket (2)	47,000						
Ford 5600 tractor	26,265						
plus		4,750	1,125	-	64,590	1978	79-3
mowing bucket, rear-mounted	32,450						
Ford 7600 tractor	38,900						
plus		6,830	1,125	-	76,305	1978	79-3
rotary disc	29,450						
Ford 7600 tractor (2)	77,800						
plus		13,100	2,250	5,000	144,150	1978	79-3
Screw-type excavator (2)	46,000						
Benfra/mowing bucket	101,430	9,400	4,500	-	115,330	1978	79-3
Mowing boat/trailer	59,145						
plus		8,260	5,750	3,270	105,265	1980	80-3
Ford 5600 tractor	28,840						
Amphibuous mowing craft	180,000	19,000	5,000	20,000	224,000	1980	81-8
Fiat SL 9/mowing bucket	132,000	11,920	4,500	-	148,420	1978	79-3
(Fiat SL 11/backhoe	135,000	16,090	4,500		155,590	1978	79-3
SUBTOTAL	851,810	82,760	26,500	38,270	999,340		
B. SILT CLEARANCE EQUIPMENT							
Fiat SL 9/dredging bucket	133,655	13,615	4,500	5,230	157,000	1978	79-3
Fiat SL 11/dredging bucket	149,600	13,615	4,500	-	167,715	1979	79-3
SUBTOTAL	283,255	27,230	9,000	5,230	324,715		
C. AUXILIARY EQUIPMENT							
Bulldozer	171,200	16,260	5,750	-	193,210	1980	81-1
Grader	176,000	16,720	5,750	-	198,470	1980	81-2
Mobile workshop	153,365	13,580	1,000	21,760	189,705	1979	79-11
Service truck	121,440	11,330	1,000	-	133,770	1980	81-2
Fuel-tanker	112,400	10,680	1,000	-	124,080	1980	81-2
Landrover station Wagon(2)	62,640	9,600	1,000		73,240	1980	81-1
Landrover pick-up	28,090	4,800	500	-	33,390	1980	81-1
Communication equipment	23,765	4,000	500	-	28,265	1981	82-1
SUBTOTAL	848,900	86,970	16,500	21,760	974,130		
T O T A L	1,983,965	196,860	52,000	65,260	2,298,185		

TABLE J 2 : WEED CONTROL PLANNING FOR THE SEASON 1981/1982

SEASON MID SEPT. TO MID SEPT.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
RAINY SEASON													
IRRIGATING													
FIXED WEEDS													
FLOATING WEEDS													
FLOATING WEEDS IN MAJOR CANALS													

Normal calendar of events for weed control pilot area.

APPENDIX K

DETAILS ON PIT LATRINES

Safe sewage disposal involves two factors namely:-

a. The provision of efficient latrines and,

b. The full utilization of these latrines by the community. It is necessary for the success of any system adopted, that greater consideration be given to the human element. An approach to all these was made to find a disposal system which is effective, acceptable to the people, inoffensive, free from fly nuisance and economically feasible.

Arrangements were made to provide the necessary materials for a small workshop to manufacture sanitary fittings in Hasaheisa, near the Study Zone. The financial approval was given to purchase the following items in 1982:-

1. 50 cubic meters of gravel total cost	=	LS.1,000
2. 1 ton reinf steel No. 2 bars	=	900
3. 30 cubic meters river sand	=	150
4. 10 ton cement	=	2,175
5. 250, Asbestos, mechanical trap	=	1,250
		LS.5,475

An experienced mason from Managil Rural Council was placed in change of the workshop. One of our staff labourers was brought to gain training and practical experience.

A new trap device was suggested by Dr. Gaddal, which we believe is suitable for use in rural areas. The asbestos trap has a mechanical flap which allows the passage of stones, clothes, and other items used by the villagers.

PRODUCTION OF THE WORKSHOP

BILL OF QUANTITIES

a) Squat Plate (Dimensions 120 X 95 cm).

1. Cost of forms LS.48 1% proportional cost of mould	=	LS. 0.48
2. Cement ½ bag = 25 kilo	=	5.00
3. Sand 2 tins = 50 kilo	=	0.40
4. Coarse gravel 4 tins	=	1.60
5. Reinf Rod ¼", 3½ Rods	=	4.20
6. Misc.	=	0.25

Squat Plate cont.

7. Mason	=	LS 3.30
8. Laborers - 2	=	3.00
9. Asbestos trap	=	5.00
10. Mechanical flap	=	0.35
Total cost	=	23.58

b) Squat Plate (Modified, dimensions 120 X 95 plus beams)

1. Cost of Form LS.48 1% proportional cost of Form	=	LS 0.48
2. Cement 37 kilo	=	7.50
3. Sand 3 tins 75 kilo	=	60
4. Coarse gravel 6 tins	=	2.40
5. Reinf Rod ¼", 6 rods	=	7.00
6. Mason & labourer	=	3.00
7. Asbestos traps	=	5.00
8. Mechanical flap	=	50
Total cost	=	26.48

The following table shows the number of sanitary fittings which were ready for distribution in the Study Zone on February 1, 1983:

No.	Item	Remarks
45	Squat plates	120 X 95 cm.
45	Asbestos traps	4" diameters
45	Squat plates (modified)	170 X 95 cm.
45	Asbestos traps	4" diameters

TABLE L.1 PREVALENCE OF SCHISTOSOMA MANSONI INFECTION AMONG SCHOOL CHILDREN BY SEX AND AGE, SOUTHERN DIVISION VILLAGES, RAHAD ZONE, 1982

AGE	TOTAL EXAMINED		TOTAL	TOTAL POSITIVE		TOTAL	%
	M	F		M	F		
7	359	207	566	25	15	40	7.1%
8	586	278	864	34	22	56	6.5
9	412	300	712	49	22	71	10.0
10	273	168	441	32	8	40	9.1
11	265	110	375	22	7	29	7.7
12	357	132	489	64	15	79	16.2
13	327	72	399	47	7	54	13.5
14	83	31	114	7	1	8	7.0
15	158	73	231	16	1	17	7.4
TOTAL	2820	1371	4191	296	98	394	9.4

TABLE L.2 PREVALENCE OF SCHISTOSOMA MANSONI INFECTION AMONG SCHOOL CHILDREN BY SEX AND AGE, NORTHERN DIVISION VILLAGES, RAHAD ZONE, 1982

AGE	TOTAL EXAMINED		TOTAL	TOTAL POSITIVE		TOTAL	%
	M	F		M	F		
7	203	129	332	11	7	18	5.4%
[illegible]	278	151	429	32	20	52	12.1
[illegible]	224	171	395	34	12	46	11.6
[illegible]	190	129	319	19	7	26	8.2
[illegible]	289	111	400	43	6	49	12.3
[illegible]	252	113	365	56	7	63	17.3
[illegible]	222	64	286	26	8	34	11.9
[illegible]	108	30	138	6	2	8	5.8
[illegible]	88	92	180	2	2	4	2.2
[illegible]	1854	990	2844	229	71	300	10.5

TABLE L. 3

ANNUAL REPORT ON HOUSE RESIDUAL SPRAYING FOR RAHAD ROUND I

Country : Sudan

Average sprayable surface per room : 42 M^2

Date : June 1982

Zone	Localities		Houses		Rooms			Pop.Protect		Insecticide				Date of sp.	
	Planned to spray	Sprayed	Plan.	Spr.	Plan.	Spr.	% Covr.	Plan.	Prot.	Name & Form	Dose Gr/m^2	Used Kg	gr. per capit.	From	To
Rahad	61	61	13562	12619	28326	25567	90.3%	71154	64584	DDT 75%WDP	2/m^2	2,676	41	8 June	23 June
Cotton Pickers						5448		26225	26161	DDT 75%WDP	2g/m^2	589		Jan.	Feb.

TABLE M.1 : PREVALENCE OF SCHISTOSOMA MANSONI INFECTIONS IN WESTERN PORTION VILLAGES, GEZIRA MANAGIL ZONE, 1982

VILLAGE	EXAMINED		TOTAL	INFECTED		TOTAL	TOTAL PREV-ALENCE
	MALE	FEMALE		MALE	FEMALE		
1. Um Sinaita	168	184	352	132	126	258	73.3%
2. Um Dakat El Dar	44	49	93	33	27	60	64.5
3. Cambo Salama	1	0	1	1	0	1	100.0
4. Cambo Wad El Daly	9	6	15	8	4	12	80.0
5. El Amara A/alla	8	27	35	6	19	25	71.4
6. El Amara Kara-malla	77	65	142	59	37	96	67.6
7. Cambo David	21	24	45	19	15	34	75.6
8. Matoug H.Q	60	67	127	22	18	40	31.5
9. Cambo Wad Homeir	10	16	26	8	12	20	76.9
10. Tayba Jabir	61	58	119	38	38	76	63.9
11. El Radi *	79	79	158	67	60	127	80.4
12. Cambo Mamoun *	20	16	36	12	11	23	63.9
T O T A L	558	591	1149	405	367	772	67.2%

* Villages surveyed for the first time.

TABLE M.2

PREVALENCE OF SCHISTOSOMA MANSONI INFECTIONS, IN SOUTHERN PORTION VILLAGES, GEZIRA-MANAGIL ZONE, 1982

VILLAGE	EXAMINED		TOTAL	INFECTED		TOTAL	TOTAL % PREVA-LENCE
	MALE	FEMALE		MALE	FEMALE		
1. Wad Soliman	97	111	208	75	71	146	70.2%
2. Hassan Mohamed Ali	22	32	54	15	22	37	68.5
3. El Batahein	53	55	108	33	35	68	63
4. Mayo Abbas	56	64	120	14	4	18	15
5. El Shalaikh	53	55	108	41	31	72	66.7
6. Wadi El Aros	14	14	28	10	14	24	85.7
7. Wad El Bur	43	25	68	30	15	45	66.2
8. Shendi Foug	32	20	52	27	13	40	76.9
T O T A L	370	376	746	245	205	450	60.3%

TABLE N. 3

PREVALENCE OF SCHISTOSOMA MANSONI INFECTIONS,
IN NORTHERN PORTION VILLAGES, GEZIRA-MANAGIL ZONE, 1982

VILLAGES	EXAMINED		TOTAL	INFECTED		TOTAL	TOTAL % PREVA-LENCE
	MALE	FEMALE		MALE	FEMALE		
1. Agan	37	44	81	20	22	42	51.9%
2. Saleem	263	326	589	175	208	383	65.0
3. Habeeba	224	191	415	123	82	205	49.4
4. Tayba El Naeim	40	46	86	8	6	14	16.3
5. Habiballa Burno	36	23	59	17	10	27	45.8
6. F o u r	30	45	75	23	26	49	65.3
7. El Laota	160	161	321	112	101	213	66.4
8. Nanawaza	-	-	-	-	-	-	-
T O T A L	790	836	1626	478	455	933	57.4%

TABLE M. 4

INCIDENCE OF S. MANSONI INFECTIONS, WESTERN PORTION BY AGE, GEZIRA-MANAGIL ZONE, 1982

A G E	EXAMINED	INFECTED	INCIDENCE
0 - 4	61	20	32.8%
5 - 9	76	37	48.7
10 - 14	27	16	59.3
15 - 19	21	10	47.6
20 - 24	19	9	47.4
25 - 29	20	10	50.0
30 - 34	28	7	25.0
35 - 39	17	9	52.9
40 - 44	23	11	47.8
45 - 49	12	3	25.0
50 - 54	13	7	53.8
55 - 59	2	1	50.0
60 - above	16	4	25.0
T O T A L	335	144	43.0%

TABLE E- 5

INCIDENCE OF S. MANSONI INFECTIONS, BY SEX AND AGE, IN SOUTHERN PORTION OF GEZIRA-MANAGIL ZONE, 1982

AGE	EXAMINED		TOTAL	INFECTED		TOTAL	TOTAL INCIDENCE
	MALE	FEMALE		MALE	FEMALE		
0 - 4	19	27	46	1	7	8	17.4%
5 - 9	39	37	76	13	14	27	35.5
10 - 14	14	17	31	5	5	10	32.3
15 - 19	8	13	21	6	2	8	38.1
20 - 24	3	12	15	2	5	7	46.7
25 - 29	7	10	17	3	5	8	47.1
30 - 34	6	11	17	3	4	7	41.2
35 - 39	4	13	17	2	7	9	52.9
40 - 44	6	10	16	3	2	5	31.3
45 - 49	5	6	11	4	2	6	54.5
50 - 54	4	3	7	2	2	4	57.1
55 - 59	1	4	5	1	-	1	20.0
60 +	6	6	12	3	2	5	41.7
TOTAL	122	169	291	48	57	105	36.1%

TABLE M. 6

INCIDENCE OF S. MANSONI INFECTION, NORTHERN PORTION, GEZIRA MANAGIL, 1982

AGE GROUP	TOTAL NEGATIVE (COHORT)	POSITIVE		TOTAL POSITIVE	INCIDENCE
		MALE	FEMALE		
0 - 4	205	10	8	18	8.9%
5 - 9	171	23	17	40	23.4
10 - 14	77	11	14	25	32.5
15 - 19	41	5	6	11	26.8
20 - 24	34	2	4	6	17.6
25 - 29	40	2	6	8	20.0
30 - 34	34	4	5	9	26.5
35 - 39	72	4	15	19	26.4
40 - 44	30	4	1	5	16.7
45 - 49	42	7	3	10	23.8
50 - 54	20	6	2	8	40.0
55 - 59	13	5	0	5	38.5
60 +	28	4	3	7	25.0
T O T A L	807	87	84	171	21.2%

WHO TEST FOR INSECTICIDE RESISTANCE IN ADULT INSECTS
REPORT FORM FOR DETERMINATION OF LT_{50}

1-3 Study number: 8 0 T

4-8 Record number*

* The boxes for the record number should be left blank, they will be filled in by VBC/WHO/HQ

9-32 Investigator: GASIM SEID AHMED

33-35 Country: SUDAN Code

36-47 Area GEZIRA 48-59 Locality ABU DAIM

Map coordinates 60-66 Longitude Box 60 E or W • 67-72 Latitude Box 67 N or S •

73-96 History of insecticide use Malathion house spraying since 1975, followed by textilion spraying since 1979

97-102 Date of test 1 Day Month Year 2 Starting time 211-214**

103-110 Insecticide tested: Textilion Code

Date of impregnation: Date of removal from packet: 23.2.82 No. of times paper used:

111-119 Species: An. arabiensis Code

120 Sex:

Male:		1
Female:	X	2
Unsexed:		3

121 Where Collected

Sprayed shelters	X	1
Unsprayed shelters		2
Field		3
Laboratory reared		4
F_1 progeny		5
Other:		6

122 Condition of insect:

Unfed		1
Blood fed	X	2
Sugar fed		3
Gravid		4
Unspecified		5

Temperature During:	Max.	Min.
123-125 & 215-217 Exposure	30	•
221-226 Holding period	32	13

Relative Humidity (%) During:	Max.	Min.
126-128 & 218-220 Exposure	•	•
227-232 Holding period	70	•

129-133 Concentration of insecticide used 5 •

	Exposure period days	hours	mins	no. dead	Total no. tested	% Mortality corrected
Control 134-144			60	0	10	0%
145-155			60	14	17	82%
156-166						
167-177						
178-188						
189-199						

200 Probable Insecticide Resistance Status

Criteria for diagnostic dosages

S: Susceptible	Mort. 98-100%
V: Verification required	Mort. 80-97%
R: Resistant	Below 80%

WHO 5281 VBC (11/81)/EMR

** Indicate time on 2400 hour basis

TABLE 1. 8

WHO TEST FOR INSECTICIDE RESISTANCE IN ADULT INSECTS
REPORT FORM FOR DETERMINATION OF LT_{50}

1-3 Study number: 8 0 T

4-8 Record number*

* The boxes for the record number should be left blank, they will be filled in by VBC/WHO/HQ

9-32 Investigator: GASIM SEID AHMED

33-35 Country: SUDAN Code

36-47 Area: GEZIRA 48-59 Locality: ALAM EL HUDA

Map coordinates: 60-66 Longitude Box 60 E or W • 67-72 Latitude Box 67 N or S •

73-96 History of insecticide use: Malathion house spraying since 1975 followed by Fenitrothion spraying since 1979

97-102 Date of test: Day 2 3 · Month 2 · Year 8 2 · Starting time 211-214**

103-110 Insecticide tested: Malathion Code

Date of impregnation:

Date of removal from packet: 23.2.82 No. of times paper used: 1

111-119 Species: An. arabiensis Code:

120 Sex:
- Male: 1
- Female: X 2
- Unsexed: 3

121 Where Collected
- Sprayed shelters: X 1
- Unsprayed shelters: 2
- Field: 3
- Laboratory reared: 4
- F_1 progeny: 5
- Other: 6

122 Condition of insect:
- Unfed: 1
- Blood fed: X 2
- Sugar fed: 3
- Gravid: 4
- Unspecified: 5

Temperature During: Max. Min.
123-125 & 215-217 Exposure: 25 -
221-226 Holding period: 28 - 21

Relative Humidity (%) During: Max. Min.
126-128 & 218-220 Exposure: -
227-232 Holding period: 54 -

129-133 Concentration of insecticide used: 50

	Exposure period days	hours	mins	no. dead	Total no. tested	% Mortality corrected
Control 134-144			60	2	25	
145-155			60	25	25	100%
156-166			60	22	25	88%
167-177						
178-188						
189-199						

200 Probable Insecticide Resistance Status

Criteria for diagnostic dosages
- S: Susceptible — Mort. 98-100%
- V: Verification required — Mort. 80-97%
- R: Resistant — Below 80%

WHO 5281 VBC (11/81)/EMR

** Indicate time on 2400 hour basis

WHO TEST FOR INSECTICIDE RESISTANCE IN ADULT INSECTS
REPORT FORM FOR DETERMINATION OF LT_{50}

1-3 Study number: 8 0 T

4-8 Record number*

* The boxes for the record number should be left blank, they will be filled in by VBC/WHO/HQ

9-32 Investigator: GASIM SEID AHMED

33-35 Country: SUDAN Code

36-47 Area: GEZIRA 48-59 Locality: ALAM EL HUDA

Map coordinates 60-66 Longitude Box 60 E or W • 67-72 Latitude Box 67 N or S •

73-96 History of insecticide use: House spraying with Fenitrothion since 1979

97-102 Date of test: Day 2 3 Month 2 Year 8 2 Starting time 211-214**

103-110 Insecticide tested: Fenitrothion Code

Date of impregnation:

Date of removal from packet: 23.2.82 No. of times paper used: 1

111-119 Species: An. arabiensis Code:

120 Sex:
- Male: 1
- Female: X 2
- Unsexed: 3

121 Where Collected
- Sprayed shelters: X 1
- Unsprayed shelters: 2
- Field: 3
- Laboratory reared: 4
- F_1 progeny: 5
- Other: 6

122 Condition of insect:
- Unfed: 1
- Blood fed: X 2
- Sugar fed: 3
- Gravid: 4
- Unspecified: 5

Temperature During: Max. Min.
123-125 & 215-217 Exposure: 2 5 -
221-226 Holding period: 2 8 - 2 1

Relative Humidity (%) During: Max. Min.
126-128 & 218-220 Exposure: -
227-232 Holding period: 5 4 -

129-133 Concentration of insecticide used: 1 0

	Exposure period days	hours	mins.	no. dead	Total no. tested	% Mortality corrected
Control 134-144			6 0	2	2 5	8%
145-155			6 0	2 5	2 5	100%
156-166			6 0	2 2	2 2	100%
167-177						
178-188						
189-199						

200 Probable Insecticide Resistance Status

Criteria for diagnostic dosages
- S: Susceptible — Mort. 98-100%
- V: Verification required — Mort. 80-97%
- R: Resistant — Below 80%

WHO 5281 VBC (11/81)/EMR

** Indicate time on 2400 hour basis

TABLE M. 10

QUARTERLY REPORT ON HOUSE RESIDUAL SPRAYING FOR 6.8.82 ROUND 9.12.82

Country : SUDAN - Gezira Province Average sprayable surface per room 47 sq/m Date : 6.1.1983

Gezira-Managil Zone (Councils	Localities		Houses		Rooms			Pop. Protec.		Insecticide				Date Spraying	
	Planned to spray	Sprayed	Plan.	Spr.	Plan.	Spr.	% Covr.	Plan.	Prot.	Name & Form	Dose gr/m^2	Used kg	gr. per capit	From 1982	to 1982
El Shukria	90	55	14209	8732	70798	40915	58%	73375	45846	Fenitrothion	1	5427	118	6/8	15/9
Hasaheisa	186	1	18052	1364	101506	6176	6	111400	7581	"	1	742	98	21/8	2/9
Meheiriba	147	118	17386	13215	132139	69254	52	105724	32470	"	1	8740	105	14/9	5/12
Abu Guta	192	185	13604	10407	54480	42671	78	68627	57293	"	1	5239	91	28/10	30/11
Meilig	144	133	17958	13841	100018	75738	75	100294	83919	"	1	9250	110	26/10	1/12
Wad Medani	72	50	22653	13516	115871	65108	56	131083	75862	"	1	790	104	16/9	22/11
El Hosh	324	116	27556	9971	105584	30100	28	159949	53477	"	1	3738	70	28/11	9/12
TOTAL	1155	658	131918	71046	680396	329962	48%	750952	406448	"	1	41045	101		