CEER – E-59

REPORT

OF

CONSULTING EPIDEMIOLOGIST

FOR

BLUE NILE HEALTH PROJECT

SUDAN

SUBMITTED BY

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REPORT OF CONSULTING EPIDEMIOLOGIST FOR BLUE NILE HEALTH PROJECT

By

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Barakat and Khartoum, Sudan

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I. Introduction

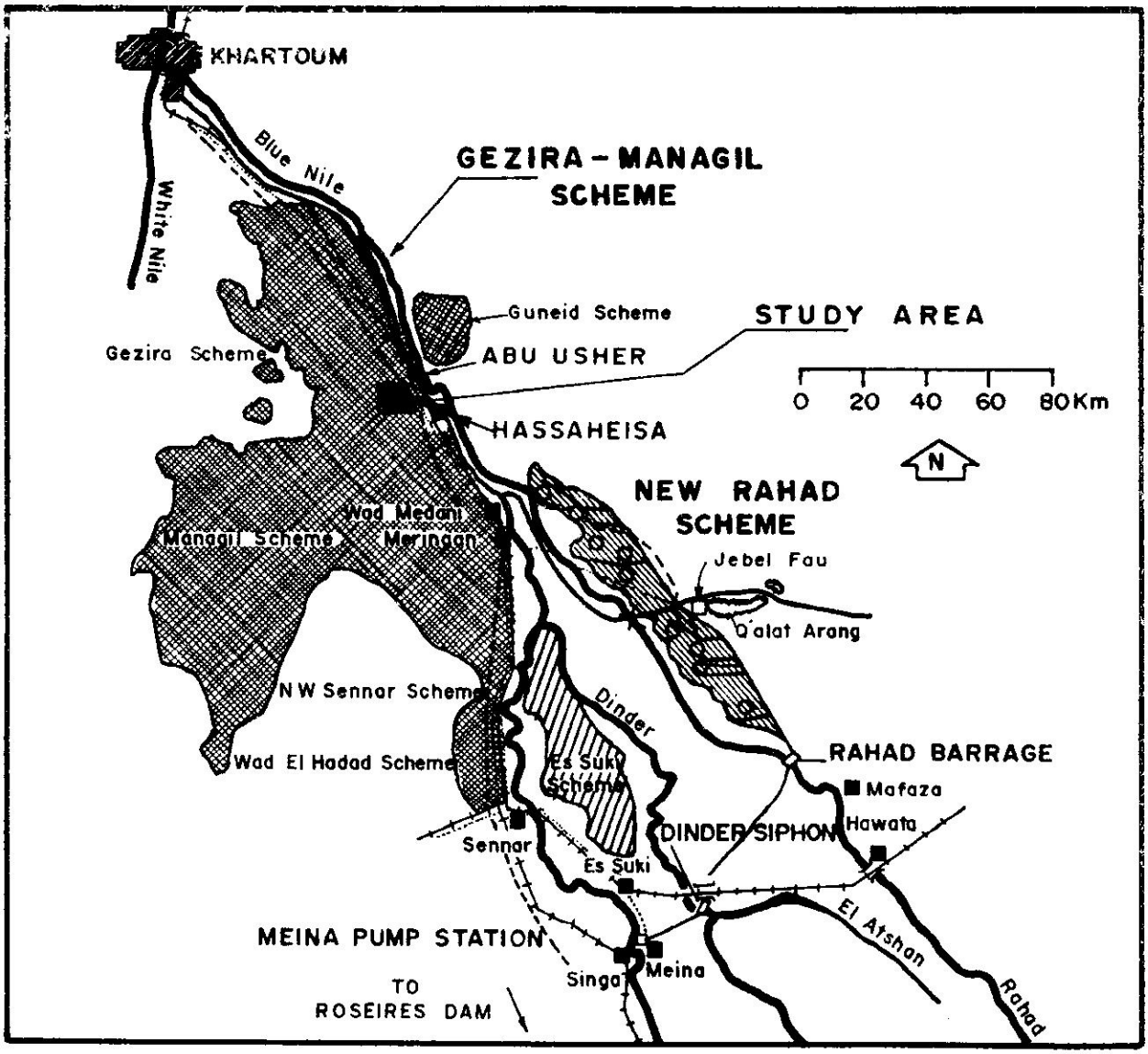
The Blue Nile Health Project is divided into 3 zones. In the Rahad Scheme presently available control measures will be used to prevent malaria and bilharzia transmission from becoming a serious problem (Map 1). In the 2 million acres of the Gezira-Managil Scheme, improved methods and strategies will be gradually applied on an operational basis, as they become available from present knowledge and from the Study Zone (Table 1). The Study Zone near Abu Usher in the northern Gezira will be given an intensive epidemiological baseline survey in 1980, before introduction of an integrated comprehensive control strategy to decrease the water-associated diseases. The Study Zone includes 55 villages in blocks 26 and 27 of the Mehereiba Council on Wadhabuba Group IV* where control will be started in 1981, and 28 villages in other parts of the Gezira, Managil Scheme, which will be monitor area (G-M) (Untreated Surveillance Areas until 1985).

This consultant participated in the planning sessions and this report cover the period during and after the meeting of the First Scientific Advisory Group (SAG-I) for the Blue Nile Health Project. It includes specific recommendations on items not completely covered in SAG-I, the size of epidemiological samples to be taken in each Zone, the manner of selection of the samples, the timing of the sampling and the age-groups to be involved. These recommendations are aimed at achieving the most cost-effective manner of evaluating human disease transmission in the Project.

For evaluation of bilharzia transmission, the most useful and sensitive measure of changes in transmission will be achieved by a yearly prevalence survey of a specific age-group with the measurement of the rate of passage of schistosoma eggs/gram in the excreta. From this, it will be possible to calculate the total schistosome egg-output of the human population in the endemic zones. This parameter is more useful and reliable than estimates of incidence

*See Appendix 6.

LOCATION OF BLUE NILE IRRIGATION SYSTEMS AND PROPOSED PROJECT



MAP 1

Table 1

Area	Locality	Population	Villages	Area in Acres	Remarks
Rahad	New Rahad Scheme	50,000**	30**	target 300,000	Rapidly expanding since 1976.
Gezira-Managil Monitor	Entire Gezira-Managil Scheme	1,600,000	1,936	2.1 million	Existing malaria and bilharzia control organization to be upgraded gradually.
Study Zone	Blocks 26-27 of Mehereiba Council or Wadhaubouba Group IV* (Gezira Board Sub-divisions).	50,000	55	46,000	Proposed area for development of comprehensive strategy.

*See Appendix 6.
**1978.

and more sensitive to changes in transmission than is incidence or prevalence, which could be due to therapy or other control measures.

II. Calculation of sample sizes

The following calculations indicate the estimated numbers of persons and villages to be sampled the estimated work load and number of microscopist needed.

A. Rahad Area

From the Rahad area 8 villages from 30 have been selected, from which a sample of 10% of the people and all the school children should be tested for malaria, S. mansoni, S. haematobium and other parasites, as recommended at SAG-I. I recommend that the concept of village area should be applied. A census of all the people in the village areas should be made and maps with households and members of families should be prepared.

The census sheet shown in page 2 will be the document where all participants, their personal information and results will be collected on each survey (Yearly). This document will be used by the statistical unit for follow-up tabulation and analysis (should be in cardboard).

The persons who perform the census can use the same data sheet in plain mimeograph paper and the sample collectors can also use this sheet, which should go to the laboratory with the sample.

Each sample should be appropiately identified with the number that consists of: Area number=one digit, Rahad=1, Monitor=2 and Study Zone=3; Block Number=Three digits; Village area number=Two digits; Household number=Three digits and Household member number=Two digits (from 1 to 10 or more). This will give an eleven digit identification number for each participant.

CENSUS SHEET

Names of Persons doing Census and collecting samples

Date Census Taken

Village Area Name

Identification Number

Area ___ Block ___ Village ___ Household ___

1 Name	2 Relationship	3 Age	4 Sex	5 Activity or Occupation	6 Attends School (grade)	7 Known illness (treatment)	8 Date sample collected	9 Malaria Negative or Positive for F. M. V. O.	10 S. mansoni Negative or Positive #eggs/gram	11 S. haematobium Negative or Positive #eggs/gram	12 Other Parasite (name)	13 Reasons for not Collecting
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												

1.Name-given name, family name and other. 2.Relationship-father (head of household), mother, son, daughter, niece nephew, aunt, uncle, grandson, grandaughter, visitor, paying guest, servant, etc. 3.Age in years by certificate (c) by estimate, by parents (E.P.), by census employee (E.C.E.), 4.Sex, M or F. 5.Activity:Housewife, servant, cook, student, etc., Occupation:farmer, labourer, merchant, mechanic, office worker etc. 6.Attends school: no, if yes, give grade he is in. 7.Known illness, give name of same and has he received treatment. 8.Date sample collected 9, 10 11 and 12 Results, M=malariae, V=vivax, O=ovale, with initials of technician. 13.Give reasons for not collecting samples or data.

The census sheet should have the name of the person doing the census and collecting the samples. Date of census, collection of samples and laboratory testing should be noted, as well as the village area name.

Eight village areas in the Rahad will have a population of 8 to 10,000 people. From 10,000 people the age group of 2 to 9 years would have a population of approximately 10 x 258*=2,580 children. The number of slides to be derived from this population will be 2,580 x 5=12,900 slides. This work will be performed by two microscopists in one year.

The 2 to 9 years age group is preferred for evaluation as it is a total population segment where all people are to be sampled and should give a better answer than a 10% percent sample which could be very variable and erratic since these diseases (malaria, schistosomiasis and other parasites) are not homogenously spread throughout the population.

If the rest of the population is to be diagnosed for treatment purposes, as a preventive measure and the moneys to buy drugs are available, then the whole population needs to be examined.

If the purpose is to determine when autochthonous infection to Rahad starts, I recommend that you keep expanding the sample by age groups as your capacity to hire and train microscopists increases and at the same time treat all positives as they are found.

A vertical sample of the population should indicate who is passing the greatest number of eggs, but you must corroborate this fact with water pollution and water contact practices of these individuals with high egg counts. Are they, the main contributors to the continuity of the parasite cycle?

*See Appendix 1.

Migrant workers coming to Rahad during the months of January and February amount 50,000 or an increase of half of the population which exists there now (90,000). The malaria programme treats all migrant labourers that come in through the official hiring system.

For schistosomiasis several questions must be answered: Where do they come from? Is their place of origin endemic or not? To what disease? Have they been to the Gezira or any other endemic area before? On the basis of these questions, a decision must be taken whether to make a diagnosis on him or not. As a means of checking the truth of their answers, to the above questions, I would test a percent of the supposedly negative population to verify the assumption.

The first year in the Rahad, since there are no snails present in the irrigation system, I would investigate the cost and time of doing diagnosis and treat selectively vs. the cost and time of mass drug treatment of migrants.

In the malaria programme during October 1978 in seven villages surveyed within the Rahad, out of an approximate population of 75,000 people, a sample of 824 children were found to have a positive rate of 0.9% for parasitemia. I was informed that during 1979 a positive rate of 20% was found, but there are no details on the type of sample taken and where or who were the most severelly affected. Dr. Haridi will investigate.

Dr. Mutamid Amin is training 10 or 11 microscopists for the Rahad Area starting November 10 or 12, 1979. With this number of microscopists in Rahad they will be able to produce 10 x 50=500, 500 x 20=10,000 slides/ month or more which would be about 2,500 individuals tested for S. mansoni and haematobium where 4 slides would be processed per individual. In 2 months of work 5,000 individuals can be diagnosed, that, probably would be the amount of migrant labour present in the 8 selected villages.

It may be mentioned that one of the villages sampled by the malaria programme has 2 to 3,000 inhabitants, it is an old established village and its name is Khiari. This is the maximum size village which the programme should be involved with, unless there is no other choice and transmission is present.

B. Monitor area (Gezira-Managil)

The consensus of the opinion in the Scientific Advisory Group was for the surveillance sample to be taken in 28 village areas from the 14 Groups of the Gezira-Managil Irrigation System (Total villages 1,936).

After examining the prevalence survey performed by the malaria programme, where 9 councils and 29 villages within them are sampled, deriving from each of them 20 to 100 slides from children of 2 to 9 years of age, it appears that this sample is insufficient for malaria as well as for Schistosomiasis (See Appendix 4).

The following is recommended for the Gezira-Managil Irrigation System as a minimal monitoring sample (if finances permit, a larger number of villages should be monitored): from 14 Groups* a listing of existing permanent registered villages with approximate population from Malaria Programme should be made and located on a map of the Gezira Board. Two villages from each Group should be selected in the following manner:

NOTE: All villages or towns with more than 3,000 population should be excluded from this selection. Reasoning: towns with more than 3,000 people are too complex in their mobility, have a better socio-economic status and are less than ten percent of the total villages in the Gezira-Managil Area.

*Group=Irrigation Block Area-Not to be confused with Councils.

(See Appendix #6).

Select from a random table the number that will correspond to the first village and locate it in the map for each Group* Once the first village is located in map, select the village that is farthest away from the first, as the second village to be monitored in that Group (Reasoning: if both villages are selected at random they might be next to each other and an even distribution of the monitoring villages would not be possible. With such a small number of villages to monitor, an even distribution should give the best estimate. Otherwise a representative sample (which would be too large and with the available information impossible to select) would have to be procured in time).

The 28 villages would yield a population of approximately 28,000 people: 28 x 258=7,224 children. Thus the sample size for the 28 village areas (of 2 to 9 year old children) would be 7,224. 7,224 children would generate 7,224 x 5=36,120 slides. One microscopist reviews 50 slides per day and in nine months he would review 50 x 140=7,000 slides, therefore $\frac{36,120}{7,000}$= 5.16 or six (6) microscopists are needed to perform the work derived from 28 village areas sampling 2 to 9 year old children, in one year. Two months of the year these microscopists could be moved to the Study Area to help do the survey of the migrant labour (January and February).

NOTE: The microscopists are calculated on the basis of carrying the work load generated by the surveys performed and cannot be used for other services in hospitals or health centers. If such a responsibility is given to them, some arrangement must be made to fulfill the commitment of the Study Area and the monitor area work load. I have not taken in consideration the existing malaria programme microscopists, since their present participation in the annual

*See Appendix 6.

prevalence survey is limited to 5 microscopists for 10 to 15 days. The rest of the time they are doing slides from hospitals and health centres from people who have fever and are suspected of having malaria (case detection).

C. Study Zone

According to the malaria main office, Wad Medani, the blocks have the following characteristics:

Block 26

Registered villages	23
Unregistered villages	6
Office of bridges (block)	9
Total population	19,748
No. of families	3,209

Block 27

Registered villages	17
Unregistered villages	8
Offices and bridges (block)	9
Total population	10,470
No. of families	1,939

If twenty villages areas are to be selected from the existing fifty registered villages and the surrounding unregisted villages, temporary labour camps and scattered thatched households. That would be 40% of the village areas in which a sector of the population would be monitored (2 to 9 year olds in the existing households). The age group of 2-9 year olds was selected to test for malaria from the malaria data (Dr. Haridi see Appendix 2 and 5). The village areas are mapped and the households are located and numbered. The malaria spraying data is used to

identify families living in households and a census to obtain pertinent information is conducted. From this census the households and families to be examined in each village area are marked and the population determined (2 to 9 year olds).

An estimate of the population to be examined in the Study Area is as follows:

Block 26 has from 20,000 to 24,000 (in 23 villages) permanent population (from malaria spraying data), 6,000 migrant transient labourers (fellata etc.) are estimated.

Block 27 has from 10,000 to 16,000 (in 17 villages) permanent population (from malaria spraying data), 4,000 migrant transient labourers are estimated.

Thus for the permanent population a minimum of 40,000 people and a maximum of 50,000 people in 40 villages in blocks 26 and 27 are estimated.

The number of children to be examined of 2 to 9 years of age would be:

40% of 40 x 258*=4,128 or 40% of 50 x 258*=20 x 258*=5,160

One blood smear for malaria is taken. One faecal sample for ova and parasites is obtained and one urine sample S. haematobium is collected.

*See Appendix 1 for Life Table Estimate. 258 children per 1000 population.

The amount of slides derived from the samples is as follows:

	No. slides
Malaria	1
S. mansoni	3
S. haematobium	1
Total Number of slides per person	5

In the Study Area for the permanent population, the total number of slides to be collected are:

Max. 5,160 x 5=25,800

Min. 4,128 x 5=20,640

One microscopist can review 50 slides per day, so the number of slides reviewed in nine months will be 50 x 140=7,000 slides.

To review the slides of the Study Area, we would need a minimum of:

$\frac{25,800}{7,000}$ = 4 Microscopists

During the months of January and February when the migrant labour is picking cotton all activities should move towards this population. If we estimate that there will be a population of labourers in the Study Area of 10,000 people, the available four microscopists should be able to process 8,000 slides during the two months. This would amount to 17% of the work load of slides that can be derived from this population. For malaria no slides need be taken and all should be treated when they come in the area.

For Schistosomiasis mansoni and haematobium, the persons will be questioned during the census as to their place of origin and if they have been to the Gezira or other endemic areas before. According to information given in Sudan this would eliminate approximately 30-40% of the population. Although a sample of these so-called negative should be done to ascertain the judgement. This would leave 6 to 7,000 people to examine, if four (4) slides are derived per person, that would mean that the 4 microscopists could do one quarter of these samples, and the microscopists would have to be increased to 16 during two months.

Probably during the first year of work and investigation should be performed to determine if it would be more economical (depending on the cost of drug) to treat them all at the very beginning, since it is known that S. haematobium is more prevalent in this population. This may help to bring down cost of control with Metrifonate.

It also may be possible that during the two months (January and February) of cotton picking when the migrant workers are present in the Study Zone the microscopists of the monitoring area and quality control can help to do the whole work load in the Study Zone.

D. Quality Control

The malaria program reviews all positive malaria slides and 10% of the negatives. This system should be continued for the three diseases involved (malaria, Schistosomiasis haematobium and mansoni) therefore a special group should be established to perform this responsibility (Directed by Dr. Hasim Hussein or Dr. Osman Zubeir).

1. The amount of malaria slides derived from Rahad, Monitor (G-M) and Study Area will be the following:

Area	Number of 2 to 9 years old
Rahad	2,580
Monitor (G-M)	7,224
Study Zone	5,160
Total Malaria Slides per year	14,964

Positive malaria slides to be reviewed:

14,964 x .186*=2,783 slides

Negative slides to be reviewed:

(14,964 - 2,783) x .10=1,008 slides.

Total malaria slides to be reviewed=3,791 slides.

*Average percent of positive for malaria in 2 to 9 years old from life curve and malaria prevalence (Appendix 1 and 3).

2. The amount of positive S. mansoni slides derived from Rahad, Monitor (G-M) and Study Areas will be the following:

Area	Number of positive 2 to 9 years old
Rahad	2,580 x . 20* x 3= 516 x 3= 1,548
Monitor (G-M)	7,224 x .352** x 3=2,543 x 3= 7,629
Study Zone	5,160 x .352** x 3=1,816 x 3= 5,449
Total S. mansoni positive slides to be reviewed.	=14,626 slides.

Negative slides for S. mansoni to be reviewed:

(14,964 x 3)-14,626 x .10=3,027 slides.

Total S. mansoni slides to be reviewed =17,653 slides.

* Estimated 20% prevalence for Rahad.

**Average percent of positive for S. mansoni in 2 to 9 years old from life curve and S. mansoni prevalence (Appendix 1 and 2).

3. The amount of positive S. haematobium slides derived from Rahad, Monitor (G-M) and Study Areas will be the following:

Area	Number of positive 2 to 9 years old
Rahad	
Monitor (G-M)	14,964 x .10***=1,496
Study Zone	
Total S. haematobium positive slides to be reviewed.	1,496 slides.

Negative slides for S. haematobium to be reviewed:

(14,964 - 1,496) x .10=1,347 slides.

Total S. haematobium slides to be reviewed = 2,843 slides.

***See Appendix 5.

4. The amount of slides to be derived in two months from migrant labour in the Study Zone will be the following:

   Average S. mansoni slides =7,500 x 3=22,500 slides.

   Average S. haematobium slides=7,500 x 1= 7,500 slides.

   Positive slides for S. mansoni =22,000 x .15* =3,300 slides.

   Positive slides for S. haematobium= 7,500 x .30**=2,250 slides.

   Total number of positive slides to be reviewed =5,550 slides.

   Number of negative slides to be reviewed=(29,500 - 5,550) x .10=2,395 slides.

   Total number of slides from migrant labour to be reviewed in the Study Zone = 7,945 slides.

   Total number of slide for all diseases and migrant labour to be reviewed will be: 3,791 + 17,653 + 2,843 + 7,945=32,232 slides.

   To review these slides we would need: $\frac{32,232}{7,000}$ = 5 microscopists.

NOTE: Only the Study Zone migrant labour slides will have quality control done, unless there is more personnel to perform the test and this trial shows that under the limitations of time the task of testing and quality control can be performed. Also the therapy trial for migrant labor vs. diagnosis and therapy from the point of view of cost and time should be considered.

The total number of microscopists per year of work load is as follows:

Rahad Area	2
Monitor Area (G-M)	6
Study Zone	4
Quality Control	5
Total	17 microscopists

*From C. H. Teesdale and M. A. Amin (Appendix 5).

**Percentages informed by Dr. M. A. Amin.

III. Timing of Sampling and Laboratory Facilities.

Timing of the sampling will have to depend on the available personell to procure, and process the samples. The economical problem which will limit sample size will limit timing.

Prevalence and egg counts per gram of feces each year should answer all epidemiological questions, insofar as evaluation is concerned, as long as all or near all people selected in the sample are tested. If more than one surveys are done per year, seasonal transmission can be assessed, if present. This could be so, for malaria and for S. haematobium, specially during or after the rainy season, but not for S. mansoni. In the Study Area where intense surveillance will be important and if the economy permits, a prevalence, incidence and egg count per gram of feces would permit a more thorough analysis at double the cost. Furthermore it would give some good training to the personnell and organization of the task would be improved for future years. The excess personnell would be use to increase the age group studied and also follow up cohorts. This is all hinged on economies (money).

The laboratory facilities should be at Rahad for that area, Abu Usher for blocks 26 and 27 and at Wad Medani for the Quality Control. If possible, for the Monitor Area (G-M) the microscopists should be located strategically, so that travel time would be minimized. It might be feaseable to locate them in Rural Hospitals, with the provision that services to the Hospitals should be done, if it does not interfere with the main responsibility of the Program. A centralized laboratory is very ideal as long as transportation and gasoline is available since the cost would be increased. The quality of work and management of personnell would be improved in a central laboratory but decentralized laboratories can be maintained doing good quality of work, when quality

control is well done and in time. Continued training and unknown test samples, unknown to the microscopists, but known to the central laboratoy, should be periodically given to the microscopists from the central laboratory as part of their routine, to see how well they perform.

IV. Studies that should be done in this Project as soon as possible.

A. A comparative study in Dr. Amin's laboratory of (a) the formol-ether faecal examination modified by Ms. W. Knight. (b) the Teesdale-Amin modified Kato method and (c) the sedimentation method by Hoffman, in egg passers of high, medium and low quantity (1,000 +, 500 and 50 egg or less). Approximately 1,000 or more stools should be run (50 stools/day, one month for each test, and 3 months of work for the total comparative trial).

This study would determine the specificity and sensitivity of all the test and would serve as reference for future work, if control is successfull in the Gezira-Managil and Rahad Schemes.

B. The problem of defining a village area is not as simple in the Gezira as it is in Rahad. This is very important when you try to evaluate your efforts of control by means of prevalence, incidence and egg load changes in the population studied. We know that a newborn gives an indication of the home environment since this is where he spends most of his time. When he starts to walk within the house and around outside of the house, his environment increases in size. As soon as he reaches schoool age he walks to school and by whatever environment he encounters in his or near his school, the size is increased again. Thus as time goes by he, increases the size of his environment in relation to various circumstances of his development. If we are to do our evaluation with 2 to 9 years old it would be very important to know the size of the environment which they represent. If the age groups are increased (which would be the most

logical procedure to increase the sample size) every time this is done in each community the environment in which the sampled individuals move should be the unit evaluated.

A study of this complex behaviourial pattern of man should be done to be able to understand the results found by the diagnostic tests.

It may be possible to have tenants with land in various areas and they work several days on one area and several days in another. The same could happen to a labourer or an ambulatory merchant in a village or any adult in the village. Also students of intermediate and higher educational levels go away from their villages to school. These people's environment are quite large and do not represent their village endemic status.

C. The data derived from hospitals and health centres should be analyzed and morbidity studies for malaria, schistosomiasis and other diseases diagnosed, should be performed to take advantage of this information for the proper planning of health services, budgeting and distribution of human and material resources. The malaria programme does a lot of diagnosis of malaria throughout the Gezira and I have the feeling that this informatio would help tremendously in the planning of malaria control efforts. The same can be said for other diseases.

Finally I wish to thank all the people, nationals as well as international and WHO personnel who helped me through these two weeks of work in the Sudan.

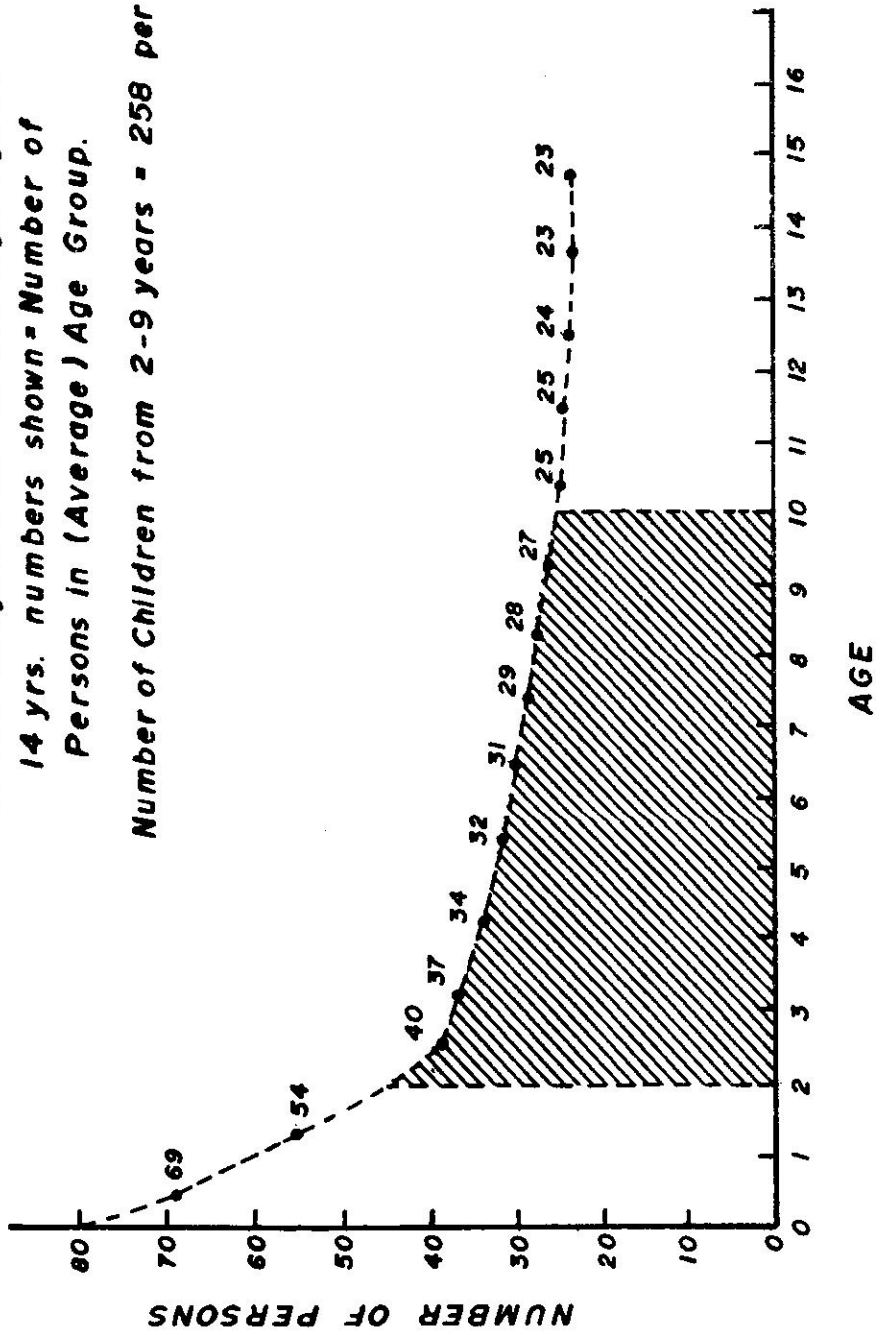
Appendix 1

Estimated

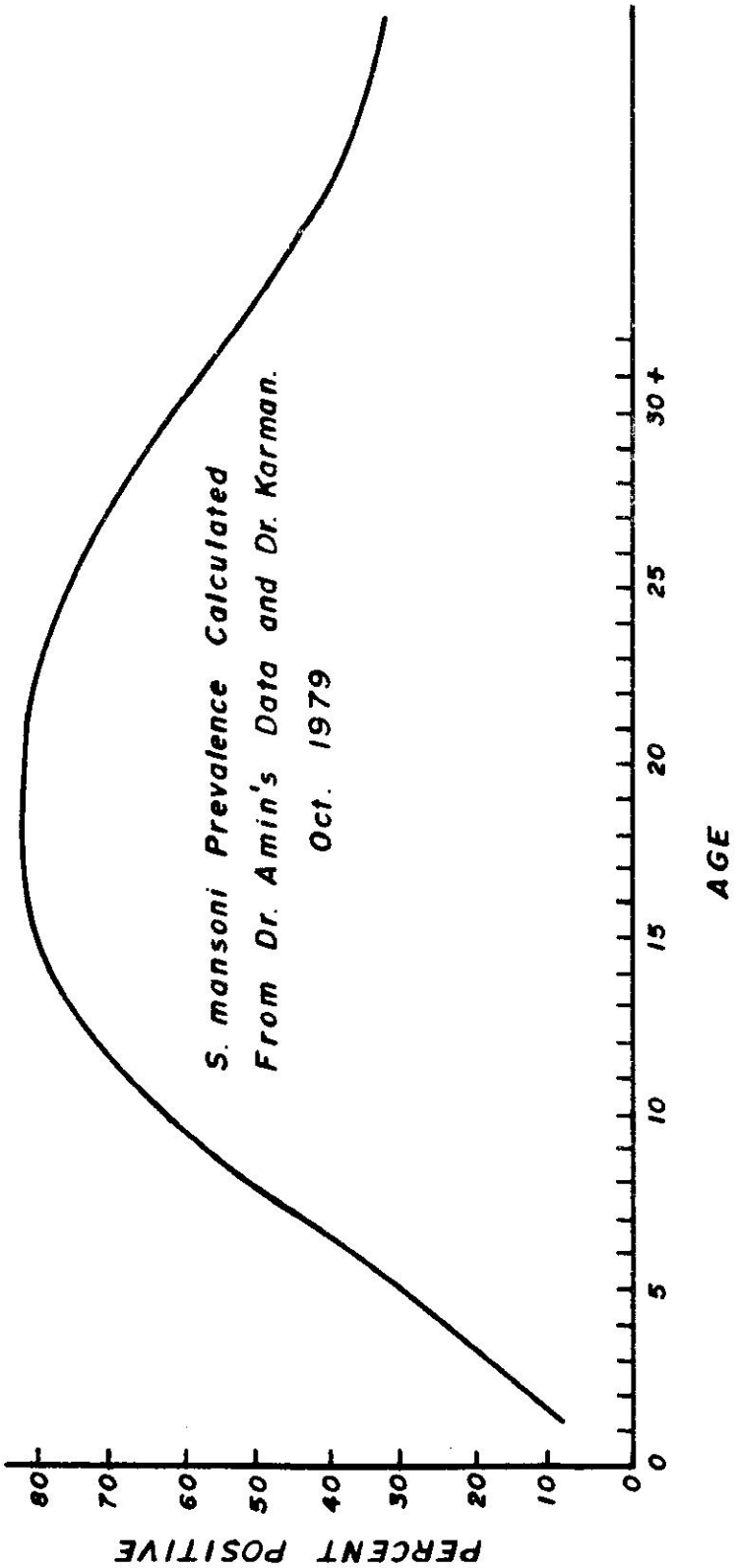
Live Curve Per 1000 Population

Age curve for population of 1000 people in the Gezyra. with an average age of 14 yrs. numbers shown = Number of Persons in (Average) Age Group.

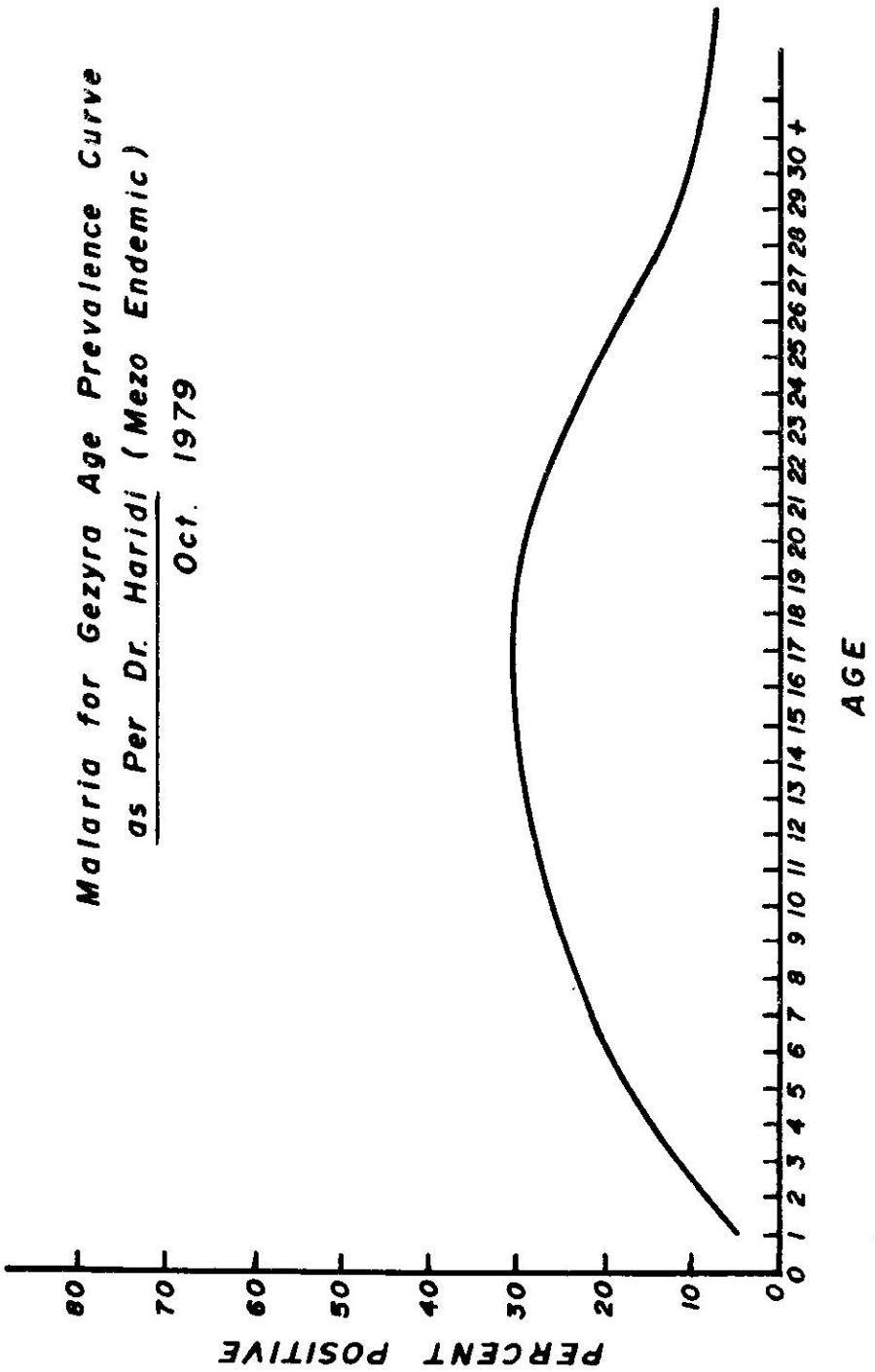
Number of Children from 2-9 years = 258 per 1000 population



APPENDIX 2


S. mansoni Prevalence Calculated
From Dr. Amin's Data and Dr. Karman.
Oct. 1979
PERCENT POSITIVE
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30+
AGE

Appendix 3


Malaria for Gezyra Age Prevalence Curve
as Per Dr. Haridi (Mezo Endemic)
Oct. 1979
PERCENT POSITIVE
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 +
AGE

APPENDIX 4

Malaria Parasite Rate for 27 Indicator Villages in Gezyra-January 1976.

Council	Village	2 to 4 years old			5 to 9 years old			2 to 9 years old			Total Population of Village
		Exam.	Pos.	%+	Exam.	Pos.	%+	Exam.	Pos.	%+	
El Hosh	Nefeida	10	1	10.0	36	3	8.3	46	4	8.6	89
	El Shokaba Taba	--	-	0.0	100	11	11.0	100	11	11.0	1,144
	Dar El Haj Bargo	11	0	0.0	24	0	0.0	35	0	0.0	314
Medina Arab	Wad Rabia	--	-	----	100	3	3.0	100	3	3.0	1,271
	Amara Youssif	8	0	0.0	74	3	4.0	82	3	3.6	385
	Sharafat Fallata	4	1	25.0	54	6	11.1	58	7	12.0	577
	Fallata Musaad	7	0	0.0	13	1	7.7	20	1	5.0	218
Hasa-heisa	Wad Sulaiman	--	-	---	89	6	6.7	89	6	6.7	478
	El Guzuli	11	1	9.1	22	1	4.5	33	2	6.0	296
	Qoz El Reheid	--	-	----	---	--	----	---	--	----	-----
	Bagari	--	-	----	---	--	----	---	--	----	-----
	El Laota	28	3	10.7	62	1	1.6	90	4	4.4	239
Meheiriba	Katfiya	24	3	12.5	76	3	3.9	100	6	6.0	930
	El Ajan	16	0	0.0	84	4	4.8	100	4	4.0	499
	Meheiriba	19	0	0.0	81	2	2.5	100	2	2.0	2,979
	Bekari	9	3	33.3	30	0	0.0	39	3	7.7	272
El Meiliq	Taiba Hasaballa	23	0	0.0	77	2	2.6	100	2	2.0	350
	El Sireiha	5	0	0.0	95	0	0.0	100	0	0.0	2,231
	El Masoudia	4	0	0.0	96	2	2.1	100	2	2.0	4,319
	El Gadid El Atasha	--	-	----	79	8	10.1	79	8	10.1	1,036

APPENDIX 4 (Continued)

Malaria Parasite Rate for 27 Indicator Villages in Gezyra-January 1976.

Council	Village	2 59 4 years old			5 to 9 years old			2 to 9 years old			Total Population of village
		Exam.	Pos.	%+	Exam.	Pos.	%+	Exam.	Pos.	%+	
El Huda	El Shateta	--	-	----	100	3	3.0	100	3	3.0	900
	El Amera Karamulla	--	-	----	99	5	5.0	99	5	5.0	973
	Kouz El Raheed	6	0	0.0	85	3	3.5	91	3	3.3	1,261
	Hegres Bilal	--	-	----	94	2	2.1	94	2	2.0	711
El Korashi	Housheri	--	-	----	100	13	13.0	100	13	13.0	1,256
	Kampo El Debba	23	2	8.7	22	2	9.1	45	4	8.8	145
Kabauja	Zohal	3	1	33.3	97	9	9.3	100	10	10.0	2,048
El Geneid	El Kedina	11	0	0.0	86	4	4.6	97	4	4.1	1,205
	Wad Sayed	5	1	20.0	95	2	2.1	100	3	3.0	3,821

After reviewing this information-I believe that for prevalence of malaria in the Gezira is the most inadequate.

1. Not all councils are represented.
2. The sample is not representative of the age groups studied 25.8% of the village population belong to this age group. Why does the sample stop below 100, no matter what the village size? Why do the 2 to 4 year olds are not taken in some villages? There are none?
3. Is there a document written of how this sample should be taken?

APPENDIX 5

Proc. Int. Conf. Schisto., 81 -- 84 (1978).

INCIDENCE AND PREVALENCE OF *SCHISTOSOMA MANSONI* IN THE GEZIRA SCHEME, SUDAN

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Dr. Amin will introduce the Gezira irrigated area of the Sudan in his paper to be read in the plenary session dealing with molluscicide control of vector snails. I want briefly to describe the work being undertaken to assess the control measures from the epidemiological viewpoint and to relate the results to date.

I must stress the preliminary nature of these results, since the assessment has been conducted for 21 months only, and a true indication of what is occurring cannot really be expected for about four years.

The assessment has been based on stool examination since no immunological test was considered reliable enough. A thick smear technique was chosen after comparison of three methods : the Bell filtration method, the digestion method, and a modification of the Kato thick smear technique. This technique differs from the Kato technique in that thick glass coverslips are used instead of polyethylene or cellophane. The glass allows pressure to be applied to the sieved stool sample on a microscope slide in such a way that there results a thin layer of stool in which the eggs are amongst the largest particles. With the light adjusted correctly the eggs appear as transparent objects under the microscope and are easily visible under low power (× 40). If eggs are not clear, they may be rolled over to expose the spine by moving the coverslip ; or they may be viewed under higher power (× 100). Scanning is done at × 40 magnification.

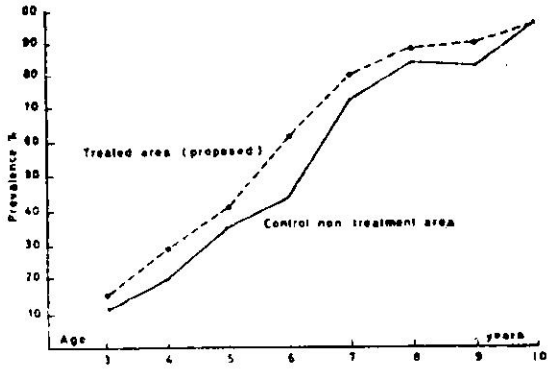

Fig. 1. Incidence of *Schistosoma mansoni* infection in Gezira school children at beginning of assessment period.

Initial prevalence studies indicated that villagers, though keen at first to be examined, soon became unenthusiastic when asked for further re-examination, and there would be too large a proportion who would not cooperate in subsequent re-examinations. Evaluation was therefore based on incidence and prevalence rates in younger school children, aged 7-10 years.

However, as can be seen from Table 1 and Fig. 1, prevalence of the disease was so high in these children that there were too few children found negative to constitute sufficient numbers to make up negative

cohorts for future examinations in incidence studies, unless a very large number of schools were included in the study. The personnel required for this work was not available and, instead, it was decided to investigate the 3-6 year old pre-school children in certain villages to help make up the negative cohorts. It is important to note that prevalence was higher in the area where chemical control (by Frescon) was to be applied.

Schistosoma haematobium infection tended to be focal and generally very much less prevalent that *S. mansoni* infection and was not included in the assessment (Table 2).

TABLE 1. **Prevalence of *Schistosoma mansoni* infection in Gezira children aged 3-10 years at the beginning of the assessment period.**

Area	Age yrs	No. examined	No. positive	Prevalence %
Proposed treatment area	3	102	12	11.76
	4	107	32	29.90
	5	114	48	42.11
	6	145	89	61.38
	7	346	277	80.06
	8	334	293	87.12
	9	309	277	89.64
	10	87	83	95.40
Totals		1544	1111	71.96
Control non-treated area	3	112	12	10.71
	4	108	21	19.44
	5	92	32	34.78
	6	121	57	47.11
	7	132	95	71.97
	8	122	101	82.79
	9	140	114	81.43
	10	87	83	95.40
Totals		914	515	56.36

TABLE 2. **Prevalence of *Schistosoma haematobium* infection in Gezira children age up to 10 years in the latter part of 1973.**

Village	Prevalence %
Bint El-Hag	14.6
Azrag	0.8
El-Sereiha	12.2
El-Aidaid	14.2
El-Gemeibi	0.4

and reversions (+ to —) are considered (Table 4), a trend towards a reduction in prevalence in the treated area is evident. This must be held in light of the fact that there was a higher prevalence rate in treatment area originally. The trend the non-treated area is for a rise in prevalence.

TABLE 4. Prevalence of *Schistosoma mansoni* in Gezira school children before and 21 months after the beginning of assessment.

Area	No. examined in 1973 and re-examined in 1975	Positive 1973		Conversion − → +	Reversion + → −	Positive 1975	
		No.	%			No.	%
Treated	588	420	71.43	46	68	398	67.68
Non-treated	296	187	63.18	34	25	196	66.22

Table 5 presents the findings on re-examination of those children that were positive at the outset of assessment. Once again the trend is for a reduction in the intensity of infection in the treated area compared with the area where no molluscicide has been applied, except for one village (Aidaid) which shows an increase in intensity of infection as measured by egg load.

TABLE 5. Intensity of infection with *Schistosoma mansoni* in Gezira school children initially, and 21 months after the beginning of the assessment.

Village	No. re-examined	Mean egg count in g/head	
		initially	after 21 months
Treated area:			
Gemeibi	118	1308	508
Bint El Hag	83	664	580
Azrag	114	244	140
Sereiha Boys	72	260	196
Sereiha Girls	48	112	60
Aidaid Boys	100	524	672
Aidaid Girls	84	364	552
Totals	619	496	388
Untreated area:			
Wad Sulfab Boys	89	728	424
Wad Sulfab Girls	50	340	468
Kashamir	95	152	528
Totals	184	408	472

Summary

Preliminary assessment of the molluscicide control measures in the Gezira irrigated area in the Sudan by a thick smear stool examination technique indicates that after only 21 months in a longitudinal study there was reduction in prevalence where chemical has been applied to the canals. Intensity of infection, measured by egg loads has also dropped in the treated area, while in the non-treated area prevalence and intensity of infection are rising.

To obtain stools from school children was relatively simple since discipline is strict and the teachers are very willing to cooperate. If, however, a child was not able to produce a sample no pressure was put upon him to do so and it was collected on a subsequent visit.

For the 3-6 year old children it was necessary to number the houses in the village and approach each one in turn and ask for cooperation. Each child was given a card bearing his name, age, serial number and house number, and he was asked to deliver his sample to the dispensary in the container provided. Older brothers and sisters were asked to help whenever possible and on arrival with the stools the children were rewarded with sweets. Those unable to produce a sample were also rewarded so as to minimise the production of borrowed or animal stools in order to obtain the reward. Without the sweet system the response was very poor and the success of collection depended very much upon it.

Three slides with 25 mg of stool were examined for each stool specimen. If the sample was negative another three slides were examined from a subsequent day's stool and this procedure was repeated on a third day before a child was considered negative. For re-assessment after every 6 months only one stool was taken on account of the work involved. But in the final assessment three stools will again be examined to identify negatives.

The assessment of the 3-6 year old children began six months after that of the school children and it is considered too early as yet to place any significance on the results collected so far. The results of the remaining tables therefore involve the school children only 21 months after the beginning of the assessment period.

Table 3 shows a difference in the incidence rates of about 10% between the treated and non-treated areas. This does not appear significant. However, when the number of conversions (— to +)

TABLE 3. **Incidence of *Schistosoma mansoni* infection in Gezira shcool children 21 months after being identified as negative.**

School	No. negative originally	No. examimed after 21 months	No. positive	Incidence %
Treated area:				
Bint El Hag	16	14	3	21.43
Azrag	19	17	5	29.41
Sereiha Boys	33	28	7	25.00
Sereiha Girls	38	35	4	11.43
Aidaid Boys	15	12	3	25.00
Aidaid Girls	14	10	3	30.00
Gemeibi	40	34	6	17.65
Totals	175	150	31	20.66
Untreated area:				
Wad Sulfab Boys	28	25	7	28.000
Wad Sulfab Girls	31	20	4	20.00

APPENDIX 6-1

Gezira-Managil Irrigation System

(Gezira Board Irrigation Groups)

Group Number and Name	Block Number	Block Name	Number of Village Areas
I - South	1	Heg Abdalla	
	2	Fahal	
	3	El Guubshan	
	4	Wad Naaman	
	5	El Hosh	
	6	El Remetab	
	7	Wad El Atai	
	95	Wad El Haddad	
II - Center	8	Hamel Delnil	
	9	Seed Farm	
	10	Barakat	
	11	Darwish	
	12	El Kumor	
	13	El Radma	
	14	Abel Hakam	
	15	El Medina	
	106	El Horga	
	107	Nur-El-Din	
III- Messellemia	16	Tayiba	
	17	El Sileimi	
	18	El Tebub	
	19	Wad El-Bur	
	20	Abdel Galil	
	21	Wad Saadalla	
	22	Abdel Rahman	
	23	Wad Hussein	
	24	El Nidiana	

APPENDIX 6-2

Gezira-Managil Irrigation System

(Gezira Board Irrigation Groups)

Group Number and Name	Block Number	Block Name	Number of Village Areas
IV - Wadhabouba	25	Wad Sulfab	
	26	Dolga	23
	27	Istarihna	17
	28	El Rukn	
	104	Wad El Fadl	
	105	El Haddaf	
V - Wad-Ishail	29	El Nuiela	
	30	Feteis	
	31	Amara Kassir	
	32	El Keteir	
	33	Turis	
	34	El Fawar	
VI - North	35	Um De Garsi	
	36	De Beiba	
	37	Turabi	
	38	Meilig	
	39	Kadel Gidad	
	40	El Laota	
	92	Ruweina	
VII -North West	41	Abu Gin	
	42	El Gueiz	
	43	El Sudeira	
	44	El Faragin	
	45	Abu Ideina	
	46	Bagiga	
	94	Wadel El Kereil	
	98	Abu Quta	

APPENDIX 6-3

Gezira-Managil Irrigation System

(Gezira Board Irrigation Groups)

Group Number and Name	Block Number	Block Name	Number of Village Areas
VIII-Mikashfi	47	Hamad Nalla	
	48	Abu Digin	
	49	Murad	
	84	Wad Abib	
	85	El Tonsa	
	96	El Keratieb	
	97	El Nasseih	
IX-Huda	50	Wad El Zein	
	51	El Malan	
	52	Shandi	
	90	Fereigab	
	91	Surham	
	93	Gozel Rehid	
	103	Abdel Magid	
X-Wad El Mansi	53	El Geilei	
	54	Ras El Fil	
	55	El Neima	
	56	Mab Rour	
	58	El Gadid	
	59	El Kermit	
	83	El Tayef	
XI-Tahamid	57	Shakir	
	60	Beida	
	61	El Tarfa	
	86	El Sheweirif	
	87	Um Shadida	
	88	Meheila	
	89	El Nala	

APPENDIX 6-4

Gezira-Managil Irrigation System

(Gezira Board Irrigation Group)

Group Number and Name	Block Number	Block Name	Number of Village Areas
XII-Matug	62	Maturab	
	63	El Nur	
	64	Abu Hawa	
	65	Kartoub	
	66	El Hashaba	
	67	Um Higleiga	
	71	Affan	
	72	Elhgeirat	
XIII-Maturi	68	Agouba	
	69	El Tamad	
	70	El Zafir	
	73	El Nayir	
	74	El Yebel	
	75	Rahama	
	76	Um Sineita	
	77	Dishewat	
XIV-Gamusi	78	El Radi	
	79	Gabouga	
	80	Abu El Keilik	
	81	Ranjouk	
	82	Tuwemat	
	99	Kuwatit	
	100	Wa Geialla	
	101	Sagadi	
	102	El Waha	