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DEMBIA PILOT PROJECT BEGHEMDER PROVINCE, ETHIOPIA

by

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INTRODUCTION

From September 1955 to September 1959, members of the United States ICA Malaria Team, in cooperation with the Public Health College and Training Centre at Gondar, conducted malaria surveys, residual spraying campaigns and assessment of results in the Dembia Plain.

The objective, aside from demonstration and training, was to gather pertinent data which, in coordination with findings from other pilot projects, was to be used as a basis for an expanded national antimalaria campaign.

Some of the factors which influenced the selection of this area were:

1. Outbreaks of malaria of varying severity occur in the autumn of each year (Covell, 1952).

2. Excluding few foci of seasonal breeding and transmission, malaria was presumed to be of nature, flaring up periodically to cover the plain and encompassing other settlements surrounding Lake Tana (Najjar, 1956).

3. The location of Dembia was ideally suited to serve as a field training and demonstration project for students of the Public Health College in Gondar less than 20 kilometers north.

DESCRIPTION OF AREA AND PEOPLE

The Dembia Plain is situated above the northern shore of Lake Tana. It is a fertile plateau 2,500 square kilometers in area, roughly triangular in shape and narrowing northward to an apex at the foothills just south of Gondar. Its elevation ranges from 1,820 metres at the lake shore to 2,075 metres at Azozo town on the northern edge.

Dembia is an intensely cultivated plain that has been the site in the past of severe malaria epidemics, one of which occurred in 1953 and, as best as could be assessed, resulted in the death of 7,000 people among a population of 60,000 (Chabaud et al, 1953).

The climate is temperate, cool in the mornings and evenings, but warm at midday and afternoons. Daily extreme temperature records run as low as 3-5°C. and reach a maximum of 30-33°C.; however, the mean annual temperature varies very little. The average annual rainfall is around 1,250 millimeters. The relative humidity is rarely over 75% during the wet season (June-September) or under 35% in the dry periods.

Generally, the villages are inaccessible by motor transport unless they happen to be situated near the two gravel roads that service the main centres. The plain is traversed by many rivers and creeks draining into Lake Tana: however, accessibility to such water sources seems to play a minor role in the location of villages, which are generally located on hilltops and elevated tracts. There is a popular belief that highlands give a sanctuary from malaria.

The human dwelling (the tukul) is typically a round structure built with sticks and straw, having an average floor diameter of five meters. Frequently the lower parts of the wall are plastered with mud. The roof, rising an average of 3.1/2 metres from the centre of the floor, is a thatched cone superimposed over the walls. Other structures, especially in the market place, are rectangular or square, but basically of the same general construction, except for some with tin roofs.

There are great agricultural resources in the enormous herds of cattle and in the fertile soil that produces maize, millet, wheat and oil seeds, plus a variety of cereals.

The problem of migration of people as it relates to antimalaria measures is insignificant. However, people of neighbouring villages might spend an overnight following or preceding a market day, when various products and produce are bartered.

The population census, canvassed by house-to-house inspection during the DDT spraying cycles, ranged from 45,000 in Dembia proper to 69,000 during the 1959 campaign. This latter figure included many villages on the periphery of the plain which were not previously included in the control measures. On the average, a village consists of approximately 65 huts with a population of 206 (Table IV).

Prevalent diseases in Dembia are various and numerous. Some that have been frequently encountered or reported are: venereal disease, relapsing fever, typhus, diarrhoea, tuberculosis, bilharziasis, helminthic infections, amoebiasis, skin ulcerations and tetanus.

EPIDEMIOLOGY OF MALARIA

Outbreaks of malaria of various severity occur in the autumn of each year in the Lake Dema region, one of which Dembia Pilot Project is a part. The extensiveness and unpredictability of the outbreaks are largely influenced by meteorological conditions. Heavy rainfall over a long period is favourable for vector breeding, thus resulting in severe and widespread epidemics originating from isolated endemic foci. Two such epidemics occurred in 1953 and 1959.

P. falciparum is the predominant species accounting for over two thirds of all infections, although a slight seasonal variation in its frequency has been observed. P. vivax ranges from 14-20% and P. malariae from 6-11% (Table I).

Collections of Anopheles species between November 1955, and September 1959, were identified as follows: A. pharoensis, A. squamosus, A. coustani, A. demicilloni, A. christyi, A. pretoriensis and A. gambiae. Previous workers reported that A. funestus was encountered (Serre and Nuri, 1954), in the course of their investigation during the 1953 epidemic.

Between November 1955, and June 1956, there was a conspicuous absence of A. gambiae as well as other vectors. In June a sudden appearance of A. gambiae and large numbers of A. pretoriensis (a known vector in other parts of Africa) were observed.

RESIDUAL INSECTICIDAL CAMPAIGNS

Three applications of DDT water wettable insecticide were made once each year: May 20 - June 23, 1957; May 1-30, 1958; and May 1 - June 7, 1959. The timing of the spraying campaigns was necessitated by the fact that the area was not accessible after the advent of the rains in July, nor at the end of them, just when the vector mosquito population reaches its highest density.

Tables IV through VI give an analysis of the three spraying cycles. During this three-year period, 121 public health college students received on-the-job training in survey and control measures through participation in the various aspects of field operations.

PARASITOMETRIC EVALUATIONS

A drop in the total parasite rate from 10.3% to 0.4% and in the rate of the 0-1 age group from 6% to 0% between October 1956, and September 30 1959, is very encouraging indeed (Tables I and II). In the interim epidemic period of 1958 (Table III), it was found that transmission in the indigenous population within the protected area did occur. It is of significance to note, however, that no cases in the 0-1 age group were found and not a single death was reported.

On the other hand, it was estimated that in 326 villages with a combined population of 131,000 adjoining the Dembia Pilot Project area, malaria cases numbered 75,100 and deaths attributed to malaria were 4,763 (year, 1958).

DISCUSSION OF RESULTS

Weekly reports from the Kolla Duba Health Centre, located in the Dembia Pilot Project, for the period December 1958, through September 1959, reveal an average of seven laboratory-confirmed malaria cases per week among outpatients reporting for treatment. Four of this total claimed their houses had been sprayed and that they did not travel overnight outside the protected zone during the last six months. This information, while in conflict with the latest survey of the area, leads us to believe that some transmission may yet be occurring due to undetermined factors. Repeated attempts to collect vector mosquitoes from sprayed tukuls after initiation of the spraying campaigns have always yielded negative results; however, such factors as replastering the inside walls of houses and the construction of new ones after application of the insecticide may require the institution of a mobile spraying team on a year-round basis.

Outdoor biting by A. gambiae, though apparently negligible, has been observed in other areas of the country. Since many farmers spend their nights in the fields guarding the crops prior to harvesting in the autumn, this may add another problem to the attainment of interruption of transmission. Another consideration is the influx of people from other malarious regions to the pilot project area, which is experiencing a noticeable improvement in the economy since control measures were implemented.

Future Plans

On October 17, 1959, a malaria zone headquarters located at Azozo airport, with office, laboratory, garage and storage space, was completed and staffed.

A surveillance team will henceforth search for and treat fever cases, spray newly constructed or replastered houses and conduct entomological and malariometric investigations on a routine and systematic basis.

Geographical reconnaissance and detailed plans for a fanning out of the spraying programme are expected to be completed by April 1960, when it is anticipated that all settlements around Lake Tana with an estimated population of 400,000 will be protected by residual spraying.

In estimating the average cost for protection of one person per year by residual insecticide applications, only those expenses in direct relationship to the duration of the campaigns were considered. The figure of US $0.20 (Tables IV and V) was calculated on the basis of complete accounting of every operating expense and depreciation of capital equipment; however, the cost of operating the National Malaria Service in connection with over-all activities during the balance of the year is not included in this estimate.

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TABLE I

HUMAN MALARIA INDICES BEFORE RESIDUAL SPRAYING AND AFTER DEMBIA PILOT PROJECT, BEGHEMDER PROVINCE, ETHIOPIA

Date of Survey	No. Blood Examinations	No. Positive	Per Cent Positive	Plasmodium Rates				
				P. falciparum	P. vivax	P. malariae	Multiple	Unidentified
October, 1956	749	93	12.3	68%	14%	6%	2%	10%
June, 1957	293	9	3.0	67%	11%	11%	-	11%
November, 1957	824	5	0.61	80%	20%	-	-	-
August 1958	69	0	0.	-	-	-	-	-
September, 1959	909	21	0.44	67%	-	-	33% (fv)	-

Three DDT spraying cycles were applied: May 20-June 23, 1957; May 1-30, 1958; and May 1-June 7, 1959.

TABLE II

HUMAN MALARIA INDICES BY AGE GROUP
DEMBIA PILOT PROJECT, BEGHEMDER PROVINCE, ETHIOPIA *

	Before Residual Spraying					
	October, 1956			June, 1957		
Age Group	No. Blood Examinations	No. Positive	Rate	No. Blood Examinations	No. Positive	Rate
0-1	119	7	6%	12	1	8%
2-4	156	22	14%	16	0	-
5-9	285	37	13%	51	2	4%
10-14	137	11	8%	124	5	4%
15-19	18	2	11%	42	0	-
20 and over **	34	14	41%	48	1	2%
Totals	749	93	12.3%	293	9	3%

	After Residual Spraying with DDT								
	November, 1957			August, 1958			September, 1959		
Age Group	No. Blood Examinations	No. Positive	Rate	No. Blood Examinations	No. Positive	Rate	No. Blood Examinations	No. Positive	Rate
0-1	102	0	0%	69	0	0%	134	0	0%
2-4	161	0	0%				76	1	1.3%
5-9	327	2	0.64%				113	0	0%
10-14	202	2	1%				110	0	0%
15-19	17	1	6%				44	0	0%
20 and over	15	0	0%				432	3	0.7%
Totals	824	5	0.61%	69	0	0%	909	4	0.44%

* Three spraying cycles were applied: May 20-June 23, 1957; May 1-30, 1958; and May 1-June 7, 1959.
** Many in the 20 and over age group who voluntered for blood examinations were suspected of being ill and seeking treatment.

TABLE III

RESULTS OF MALARIA INVESTIGATIONS MADE IN THE DEMBIA PILOT PROJECT AREA DURING MALARIA EPIDEMIC OF 1958

SPRAYED ZONE

Period of Investigation	No. Villages Visited	Estimated Population	No. Annual Sprayings	Suspected Fever Cases	Lab. Confirmed Cases	No. Infants Examined (0-1 yr.)	Infant Parasite Rate	Plasmodia Species F	V	M	Mixed	Place Where Malaria Was Transmitted
Aug. 29 - Sept. 6	8	10,000	2	92	4	67		4	0	0	0	Undetermined
Oct. 11 - Dec. 20	Out-patients*	40,000	2	197	76	0		Not reported				

Unsprayed Peripheral Villages Near Dembia Pilot Project Area

Oct. 25 - Nov. 15	5	1,600	0	518	215	0		158	43	4	10	Indigenous

* Outpatients from malaria-protected areas reporting to the Kolla Duba Health Center for treatment were given a blood examination to confirm the presence of malaria parasites. These slides were stained and read by technicians at the Gondar Hospital laboratory. Epidemiological investigations to determine the onset of the illness and where it was contracted were not furnished; however, it is assumed that some active transmission within the sprayed zone had occurred during this period.

TABLE IV

SUMMARY OF SPRAYING OPERATIONS
DEMBIA PILOT PROJECT
GONDAR ZONE, ETHIOPIA

		1957 May 20-June 23	1958 May 1-30	1959 May 1-June 7
1.	Number of villages sprayed	215	266	340
2.	Number of structures sprayed	14,505	16,599	22,320
3.	Population directly protected	45,006	54,799	68,783
4.	Estimated superficial area sprayed (square meters)	811,932	867,907	1,556,192
5.	DDT 75% consumed (kgs)	2,213.2	2,893.0	4,058.0
6.	Estimated application DDT 100% equivalent in gm/m^2	2.04	2.5	1.96
7.	Average m^2 sprayed per man hour (spraymen only)	181	167.4	389.42
8.	Average m^2 sprayed per man hour (all workers)	46	58	101.2
9.	Average daily hours spent at worksite	6	6	7.3
10.	Average daily hours spent in travel	3	2.33	3.29
11.	Average population per village	209	206	202
12.	Average number of structures per village	68	63	66
13.	Average number of inhabitants per structure	3.07	3.26	3.06
14.	Estimated superficial area sprayed/inhabitants in m^2	18	16	22.62
15	Average 75% DDT consumption per structure in gms.	152	174	181
16.	Number health officer students trained	31	19	18
17.	Number sanitarian students trained	12	20	21
18.	Total number paid workers	43	69	73
19.	Estimated total expenditure in Ethiopian dollars	20,013.57	17,761.72	30,550.19
20.	Cost per person protected in Ethiopian dollars	0.45	0.33	0.45

TABLE V

ESTIMATED EXPENSES OF RESIDUAL SPRAYING IN ETHIOPIAN DOLLARS DEMBIA PILOT PROJECT

	1957 May 20-June 23	1958 May 1-30	1959 May 1-June 7
1. Salaries, wages and per-diem	7,229.00 *	2,634,00	4,244.90 *
2. Supplies for field operation	941.82	458.15	400.00
3. Benzene, oil and grease	1,900.00	978.57	2,500.00
4. Operations equipment (protective clothing and camping needs)	800.00	531.00	1,400.00
5. Insecticide	3,651.75	4,160.00	6,895.29
6. Vehicle repair	400.00	400.00	860.00
7. Tires and vehicle spare parts	2,600.00	2,000.00	3,600.00
8. Vehicle depreciation	2,000.00	1,100.00	3,400.00
9. Depreciation of spray and field equipment	500.00	1,300.00	1,200.00
10. Other		4,200.00**	6,950.00 * *
Total	20,013.57	17,761.72	30,550.19
11. Average cost of protection of one person per year	Eth. $ 0.45	Eth. $ 0.33	Eth. $ 0.45

* Advisors' cost included
** An amount equivalent to the compensation due participating students, college staff and Malaria Eradication Service headquarters support.

TABLE VI

SUMMARY OF SPRAYING OPERATIONS IN THE LAKE TANA REGION

	1957		1958		1959	
	No. Villages Sprayed	No. People Protected	No. Villages Sprayed	No. People Protected	No. Villages Sprayed	No. People Protected
Dembia	215	45,006	266	54,799	340	68,783
Bahar Dar	1	1,670		-	10	7,020
Addis Zemen	-		-	-	1	2,080
Total	216	46,676	266	54,799	351	77,880