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KOBO-CHERCHER MALARIA PILOT PROJECT

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The Kobo-Chercher malaria pilot project was established with the primary aim of testing the effectiveness of residual house spraying for malaria control in a representative malarious area of Ethiopia. It additionally served the purpose of a demonstration and experimental area from which technical and operational data could be accumulated as a basis for planning of future programmes, and also provided an opportunity for Ethiopia personnel to acquire practical field training in malaria control work.

Description of the Area

The Kobo-Chercher area is a fertile agricultural valley lying at an elevation of about 1500 meters approximately 600 km. north of Addis Ababa on the main highway to Asmara. It is geographically bounded by the high escarpment of the main plateau on the west and a lower range of hills on the south and east. To the north, the valley opens through a narrow pass, which widens to a plain that declines to the deserts of the northern Danakil. The valley lies at an elevation ranging between 1500 to 1600 meters. Streams and small, swiftly flowing rivers rising in the highlands on the west, debouch on the valley, providing water for the various needs of the inhabitants. However the rivers are intermittent and during the peak of the dry season the water supply is limited to a few small springs and seepage areas.

Climate

There are two seasons - wet and dry. During the wet season, the heaviest rainfall is recorded in July and August. Precipitation falls mainly as light to heavy showers usually accompanied by lightning and thunder. The distribution of rainfall by month and the maximum and minimum temperatures for Alamata which is located at the North end of the Project Area are shown in Tables I and II respectively.

Table I

Rainfall
Alamata, Wollo Province
4 Year Average - 1954 - 1957
In Millimeters

J	F	M	A	M	J	J	A	S	O	N	D	Total
26.5	1.0	109.4	113.5	46.8	21.9	213.9	142.8	40.8	13.5	8	13.1	771.2

Table II

Mean Monthly Maximum & Minimum Temperatures
Alamata, Wollo Province

	Max.	Min.		Max.	Min.
January	24.2	12.7	July	28.9	17.9
February	22.3	13.6	August	29.0	16.2
March	28.8	13.6	September	31.1	15.7
April	26.2	16.3	October	30.6	12.5
May	30.3	16.5	November	29.8	10.6
June	31.4	17.6	December	29.5	12.7

Lowest Temperature - December 7° C.
Highest Temperature - May 34° C.

The coolest months are December and January, with temperatures sometimes falling to 7° C. The warmest months precede the rainy season, when maximum temperatures may reach 34° C.

Relative humidity is variable with the seasons. During the dry season, the relative humidity may range daily between 15% and 60%. The wet season daily range varies between 50% and 90%.

Population

The inhabitants are mainly farmers of the Arraya Galla tribe. They live in small villages and settlements scattered over the valley, which are inter-connected by a network of foot and cattle trails. The population was estimated at 34,000 in 1955, but has since grown to over 46,000 in 1959.

The growth is partly attributed to the elimination of malaria as an important health problem in the protected area of the pilot project. This has encouraged the immigration of settlers, particularly from the surrounding sub-marginal farmlands in the mountain and tableland surrounding Kobo-Chorcher.

Housing

Typical dwellings are circular, mud-plastered walled structures surmounted by a cone-shaped thatched roof. Often the plastering is limited to the lower half of the wall or is omitted entirely, leaving only a wall of upright sticks interlaced with slender switches and thatch. The floor diameter of the hut ranges from 3 to 5 meters and the height from the floor to the apex of the roof varies from 3 to 4 meters. The interior space is often partitioned into two or three rooms, some of which are used as stables for calves and goats. The inhabitants invariably sleep indoors on beds of straw covered by animal skins and hides. Indoor fires are utilized for cooking and heating, which produce a heavy coating of smoke deposit on the ceilings.

Preliminary Malaria Investigations

Malaria is markedly seasonal with the peak incidence occurring in the October-November period. Transmission is most intense immediately following the end of the wet season in September. During the relatively dry months from October through June, transmission is confined mainly to the vicinity of a few scattered breeding places associated with springs, seepage, marshes and residual pools in drying stream beds. Villages adjoining such places appear to be the major endemic foci from which malaria spreads during the heavy transmission of the wet season.

Table III gives the results of malaria surveys made before the initiation of the spray campaigns in July 1956:

Table III

Spleen Examinations - October 1955

Index Village Location	Spleen Rate	Parasite Rates
Kobo	26	18
Alamata	67	32
Wajia	64	44
Bobokurma	81	61

The examinations were made at the height of the malaria season. The relatively low rate at Kobo is attributed to the fact that this village is situated at a considerable distance from any permanent breeding place. The three other villages are located on the banks of streams.

Blood Parasite Surveys

A blood parasite survey made from the general population in October 1955 revealed a 34% rate in 464 examinations. During the low transmission season in April 1956 the rate dropped to 21.9% in 574 examinations.

The malaria incidence by age group is shown in Table IV.

Table IV

Per Cent Malaria Incidence by Age Group

Date	Age Group 0-1	2-4	5-9	10-14	15-19	20 +
Oct. 1955	25	42	30	30	-	-
April 1956	13	27	25	20	20	18

The distribution of Plasmodia is given in Table V.

Table V

Per-Cent Distribution of Plasmodia

	P. falciparum	P. vivax	P. malariae	mixed	Un-identified
Oct. 1955	62	12	10	5	11
April 1956	25	14	48	7	6

The wide difference in the P. falciparum rate between October and April reflects seasonal fluctuations in malaria incidence. The month of October coming just after the main transmission season would be expected to show a high proportion of P. falciparum infection which gradually disappears as the dry season progresses, leaving the relapsing malarias as the predominant infection during the months of lowest incidence from March through July.

Entomology

Observations of mosquito occurrence made during the period October 1955 to July 1956 disclosed the following nine species of Anopheles: A. gambiae, cinereus, pretoriensis, coustani, demeilloni, macmahoni, pharoensis, christyi, funestus. In these preliminary findings only A. gambiae was found frequently in human habitations. The larvae of A. gambiae were taken in stream

pools and swamps throughout the year. During the wet season, temporary breeding places for A. gambiae are multiplied enormously throughout most of the valley. With the advent of the dry season, water collections rapidly disappear, leaving only a few permanent breeding places to carry over the species during the rather prolonged dry season.

A sporozoite infection rate of 3% was revealed in Anopheles gambiae on the basis of salivary gland examinations made in September, 1955.

Control Campaigns

First Spray Cycle

On August 15, 1956, the first cycle of residual house spraying was initiated and completed within four weeks. Three insecticides were applied—dieldrin, benzine hexachloride and DDT—each in separate districts. The population protected numbered 34,000 inhabitants and over 9,000 dwellings were treated.

Evaluation of the First Spray Cycle

The results of the first spray cycle were encouraging as measured by spleen and parasite rates taken in November, 1956, approximately three months following the end of the spray campaign.

Spleen rates showed a reduction of over one half that of the previous year among comparable age groups in the same index villages.

Parasite rates in the index villages also dropped significantly, as indicated in Table VI.

TABLE VI

Spleen and Parasite Rates in Four Index Villages
Before and After the House Spraying in August, 1956.

Index Village	Spleen Rate %		Parasite Rate %	
	Before Spray	After Spray	Before Spray	After Spray
Kobo	26	21	18	6
Alamata	67	20	32	11
Wajia	64	34	44	27
Bobokurma	81	45	61	33

The above parasite rates were based on 464 examinations (34.3% positive) before spraying and on 514 examination after spraying (14% positive). The incidence of malaria by age group in the November, 1956, examinations is shown in Table VII.

Table VII

Malaria Incidence by Age Group
Following First Spray Cycle

Age Group	0-1	2-4	5-9	10-14	15-19	20+
No. examined	27	104	189	130	23	51
No. positive	3	16	27	20	0	6
Per cent positive	11	15	14	15	0	12

Second Spray Cycle

A second spray cycle utilizing DDT and dieldrin was started and completed during a four-week period in May-June, 1957. This second cycle resulted in a further drop in the parasite rate. This is indicated in Table VIII.

Table VIII

Malaria Incidence by Age Group
Following Second Spray Cycle

Age Group	0-1	2-4	5-9	10-14	15-19	20+
No. examined	58	191	204	73	7	5
Per cent positive	0	4.2	2.5	1.4	14.8	20

Since no cases were found in the 0-1 age group, it suggested the possibility that interruption of transmission had been achieved.

Third Spray Cycle

A third spray cycle was completed in June, 1958, using DDT exclusively. An additional area to the north was included in the campaign, increasing the project territory by about 50% and adding about 16,000 persons to the malaria-protected zone. This additional population, together with the immigration of new settlers in the malaria-protected area, brought up the estimated total number of local inhabitants to approximately 61,500 persons.

Evaluation of the Third Spray Cycle

In view of the substantial decrease in malaria achieved by the house sprays of 1956 and 1957, it was felt that the previous evaluative method of a general survey of index villages was not sufficiently sensitive for purposes of disclosing occasional cases of indigenous malaria in a large protected population. A more selective approach was needed in order to ascertain whether interruption of transmission had been achieved. It was, therefore, decided to adopt the active fever case search method instead, utilizing experienced technicians on a village-to-village investigation. Such an investigation was conducted during the October-November period in 1958, the results of which are shown in Table IX.

TABLE IX

Active Fever Case Search
Kobo-Chercher Malaria Pilot Project
October-November, 1958.

No. Communities	Estimated Population	No. Fever Cases	No. Malaria Positive *	No. Suspected Indigenous Cases
23	8612	150	67 (44%)	52

* Out of sixty-seven positives, fifty-nine (88%) were P. falciparum, four (6%) P. vivax, two (3%) P.malariae and two (3%) multiple infections. Four of these positives were in the 0-1 age group.

One is led to conclude from the above results that transmission had not been completely interrupted following the third spray cycle. On the basis of epidemiological evidence, it was found that ten of the twenty-three villages investigated harbored indigenous cases. One small village (200 population) revealed nearly 25% of all the infections.

It is significant to note, however, that during the period October-November, 1958, when this investigation was in progress, cyclic malaria epidemics of a fulminating type were concurrently under way in districts adjoining the project on the south and west. The effectiveness of the spray campaign was thus put to a severe test, and the results are regarded as highly satisfactory.

The 1958 surveillance disclosed two special problems which could interfere with the success of future campaigns unless corrective measures are included in the design of operational plans. One problem revealed was the high rate of wall replastering between spray cycles, thereby rendering the residual insecticide ineffective. The rate of construction of new dwellings was also high. For example, three months following the 1958 spray cycle, there were 163 dwellings with replastered walls and 160 newly constructed dwellings in 3187 structures inspected. This meant that 10% of human dwellings were unsprayed and therefore presented opportunities for transmission in the malaria-protected zone.

Another finding which may or may not prove to be a problem is outdoor biting by Anopheles gambiae which was observed to an appreciable extent in the vicinity of permanent breeding places at night.

Fourth Spray Cycle

In the 1959 campaign it was decided to limit house spraying to communities in the project which were indicated to be endemic foci and which had been sprayed once each year since 1956. All other villages were left unsprayed in 1959. To evaluate the results of this selective operation, a fever case search was made in late September, 1959, in both sprayed and unsprayed communities, the results of which are given in Table X.

TABLE X

Results of Fever Case Search
September, 1959.

	No. Villages	Estimated Census	No. Fever Cases	Per Cent Positive	Per Cent Plasmodia Distribution pf	pv	pm	Mixed
Sprayed 1959	12	12,000	211	12	78	22	0	0
Unsprayed 1959	17	9,000	305	20	65	29	6	0

The malaria cases by age group are in the sprayed and unsprayed communities as shown in Table XI.

TABLE XI

Malaria Cases by Age Group

	Sprayed Villages No. Examinations	No. Positive	Per Cent Positive	Unsprayed Villages No. Examinations	No. Positive	Per Cent Positive
0-1	47	2	4.2	55	2	3.6
2-4	43	2	4.7	78	5	6.4
5-9	33	6	18.1	41	14	34.1
10-14	10	2	20.0	17	5	29.4
15-19	11	2	18.2	10	4	40.0
20/over	67	13	19.4	104	32	30.7

Conclusions

It is apparent from the results of the 1958-59 surveillance activities that a low level of transmission persists in some villages in the sprayed area. The factors responsible for this are evident in part. Certainly, opportunities for transmission do exist between spray cycles in newly constructed and replastered dwellings. Also, extra-domiciliary transmission may occur in villages situated near permanent breeding places.

Since there is a considerable movement of population in and out of the protected area, this factor must be assessed, particularly as it relates to the origin of secondary cases.

The transmission disclosed is probably not due to insecticide resistant A. gambiae or other vectors, as recent resistance tests (1959) indicate a very low DDT-dieldrin tolerance level in wild-caught specimens. In future campaigns, it would appear advisable to provide for a semi-annual cycle of residual spraying in

communities situated near permanent places. It is also essential to check villages at frequent intervals for the presence of replastered and newly-constructed houses and to see that they are promptly sprayed.

The liberal and systematic use of antimalarial drugs as a supplementary measure to residual spraying may very well be required in order to achieve complete interruption of malaria transmission. Even the application of larvicides to permanent breeding places during the dry season should be considered in the malaria programme.

The statistics of the control operations are given in the appendix. On the basis of analysis of three campaigns, the unit cost per person protected was approximately U.S. $ 0.20.

Bibliography

COVELL, G. (1957), Malaria in Ethiopia, J. of Trop. Med. & Hygiene, reprint Jan. 1957, p. 7-16.

LANE, J.E. (1959), Completion of Assignment Report, U.S. International Cooperation Administration, August, 1959.

RICE, PAUL L. (1957), Completion of Assignment Report, U.S. International Cooperation Administration, August, 1957.

APPENDIX

Residual Insecticide Spraying Campaign
Kobo-Cherchef Pilot Project

	1956	1957	1958
Number of villages	62	86	115
Number of structures	8,643	9,791	17,582
Population directly protected	34,572	40,496	61,537
DDT used (100% equivalent) kg.	325	1,114	2,632
Dieldrin used (100% equivalent) kg.	403	116	-
BHC used (100% equivalent) kg.	268	-	133
Rate of application: DDT, gm./sq./m.	0.85	2.9	2.3
Rate of application: Dieldrin, gm./sq./m.	0.3	0.6	-
Rate of application: BHC, gm./sq./m.	0.2	-	0.5
Total cost per person protected	not calculated	Eth. $0.50	Eth. $0.3

The data for the two 1959 campaigns has not yet been compiled and reported on.