"A STUDY OF MALARIA ON THE KANO PLAINS, KISUMU DISTRICT, KENYA: A COMMUNITY STUDY OF CURRENT KNOWLEDGE, ATTITUDES AND CONTROL PRACTICES; PARASITE AND SPLEEN RATES; MOSQUITO BIONOMICS AND THE FEASABILITY OF VECTOR-CONTROL AT THE COMMUNITY LEVEL".

BY

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A DISSERTATION SUBMITTED IN PART FULFILMENT FOR THE AWARD OF THE DEGREE OF MASTER OF PUBLIC HEALTH

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1985

D E C L A R A T I O N

I CERTIFY THAT THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY

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Some of them will saye, seynge that I graunte that I have gathered this booke of so manye writers, that I offer unto you an heape of other mennis labours... To whom I aunswere, that if the honeye that the bees gather out of so manye floure of herbes, shrubbes, and trees, that are growing in other mennis medowes, feldes and closes maye justelye be called the bees' honeye... so maybe I call it that I have learned and gathered of manye good autoures...my booke.

William Turner

A New Herbal (1551).

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SUMMARY

A Study of Malaria on the Kano Plains, Kisumu District, Kenya was carried out between April and August, 1985. The study included the following:-

1. A Knowledge, Attitudes and Practices (KAP) Survey was conducted, it covered 187 households, representing 20% of the total households in the study area. The responses were analysed using the Statistical Packages for the Social Sciences (SPSS) system on the ICL 2950 computer. In general knowledge about malaria was found to be good, however knowledge about the life cycle and habits of the mosquito was found to be poor. Various plants with possible insecticidal and/or repellent action were mentioned and are discussed.

2. During a clinical and parasitological survey 1216 people of all ages were examined for malaria parasites and 414 children aged 2-9 years were examined for splenomegaly as well. Malaria was found to be highly endemic in the area with an 84.1% parasite rate in children aged 2-9 years. The spleen rate in the same age group was found to be 50.2%. The results and further analysis are given and fully discussed.

3. The Entomological Survey was based upon six selected collection stations. A total of 599 adult mosquitoes and 424 mosquito larvae were collected. All the important local vectors of malaria were found in the area. In addition many nuisance mosquitoes and potential arbovirus vectors were found breeding. The species distribution is analysed and discussed.

4. The validity of clinicaldiagnosis in malaria was studied by comparing the clinical and blood film findings in 1216 subjects. 43 people were found with symptoms suggestive of clinical malaria. The practical usefulness of clinical diagnosis is discussed on the basis of these findings.

5. An Intervention Strategy is described based upon the survey findings. The feasibility of vector control at community level is explored with emphasis on environmental measures and the use of local resources.

INTRODUCTION

Malaria is the term used to describe the acute or chronic infection caused in man by four species of protozoan parasites belonging to the genus Plasmodium. The parasites are transmitted from man to man in nature by the bites of certain anopheline mosquitoes in which they pass an essential part of their life cycle. Four species of Plasmodium are known to infect man in nature. These are Plasmodium falciparum Plasmodium vivax, Plasmodium ovale , Plasmodium malariae. The disease in man is characterized by fever, anaemia, splenomegaly and often by other symptoms resulting from lesions of particular organs.

In general the distribution of malaria transmission is limited by the distribution of the mosquito vectors. Thus malaria is absent from areas where anopheline mosquitoes exist but where the mean monthly temprature does not exceed 15.6^{0}C; the minimum for P.vivax development in the mosquito, and 20^{0}C the minimum required by P. falciparum.(1) The presence of mosquito vectors without malaria is called anophelism without malaria.

Indigenous malaria has been recorded as far north as 64^{0}N latitude (Archangel in the USSR) and as far south as 32^{0}S latitude (Cordoba in Argentina). It has occured in the Dead Sea area 400 metres (1,300 ft) below sea level, and at Londiani (Kenya) at 2,600 metres (8,450 ft) above sea level or at 2,800 metres (9,100 ft) above sea level at Cochabamba in Bolivia. (2)

World figures during 1980-83 at 210-220 million cases of malaria. Out of these, 160-170 million infections were estimated to be from Africa. The majority of infections from Africa, over 85%, were thought to be due to Plasmodium falciparum, the most dangerous and life threatening species of the malaria parasite. This species is thought to account for upto 1 million deaths in infants and young children annually (3).

Here in Kenya, exact figures are not available due to poor diagnosis and reporting. There is evidence however that the situation has remained almost the same if not deteriorated as the following figures show:-

Year	Clinical Cares	Deaths
1975	435,803	241
1976	481,005	196
1977	483,750	308
1978	844,033	328
1979	1,724,341	484
1980*	237,804	52

*1st Quarter January - March 1980

Table 1: Clinical cases of malaria reported 1975-1980

Source: Kenya National Anti-malarial Strategy 1981.

Malaria is a major health problem in nearly all parts of Kenya. It ranks first in morbidity although exact figures are not available. It is estimated that in endemic areas e.g. Kisumu District, about five children out of a class of forty are absent from school on any given day due to malaria. This gives an absenteism rate of 12.5%. In the absence of reliable data on morbidity, it is difficult to speculate the extent to which the economic potential of Kenyans is affected by malaria.

OBJECTIVES

1. To study Knowledge , Attitudes, and Practices of the people in relation to malaria and the mosquito vector.
2. To determine current endemicity of malaria in the area using parasite rates and spleen rates.
3. To study the relationship between clinical and parasitological diagnosis.
4. To gather entomological data including:-
    1. Identification of important breeding sites.
    2. Larval collection at selected sites.
    3. Collection of adult mosquitoes resting inside dwellings.
5. To propose an intervention programme or strategy appropriate to the study area and similar areas.

JUSTIFICATION

The objectives are highly relevant to the stated goals of the Declaration of Alma-Ata (WHO 1978) which states in part that " by the year 2000 health care should be available to all including the methods of preventing and controlling locally endemic diseases."(5)

The objectives are also in agreement with the defined objectives of the Scientific Working Group(SWG) in Applied Field Research in Malaria (FIELDMAL) of WHO which states in part that " various strategies for malaria control should be developed which are applicable under the different epidemiological and social circumstances which prevail in different endemic areas." (3)

The objectives also fit well into the defined objectives of the Kenya National Anti-Malarial Strategy (1981) which states in part that "...prevalance should be reduced using all available control methods." (4)

The project will also try to add to the existing knowledge on malaria vector control at community level.

In addition the project will also try to gain better knowledge of human behaviour and attitudes related to malaria and the mosquito vector.

BACKGROUND

Between the two World Wars, anti-larval operations were the traditional and almost the only anti-malarial control measures applied on a large scale in Africa.

Thereafter residual insecticides provided the tools for the malaria eradication effort culminating in the Global Malaria Eradication Programme starting in 1955. Tropical Africa was not included in this programme due to epidemiological, financial, and logistical reasons.

Other factors have since emerged. The increasing resistance of Anopheline mosquitoes to the traditional and cheaper residual insecticides like D.D.T. has been almost phenomenal.(6)

The increasing resistance of Plasmodium especially to chloroquine and other first line drugs of treatment is another factor.(7)

Other factors include the high intensity of transmission, the bionomics and behaviour of Anopheles gambiae, the charcteristics of residual insecticides, the mobility of the population, and limited size of the trial areas allowing reintroduction of mosquito vectors.(8)

These and other factors necessitate a fresh look at the problem of malaria control in Tropical Africa.

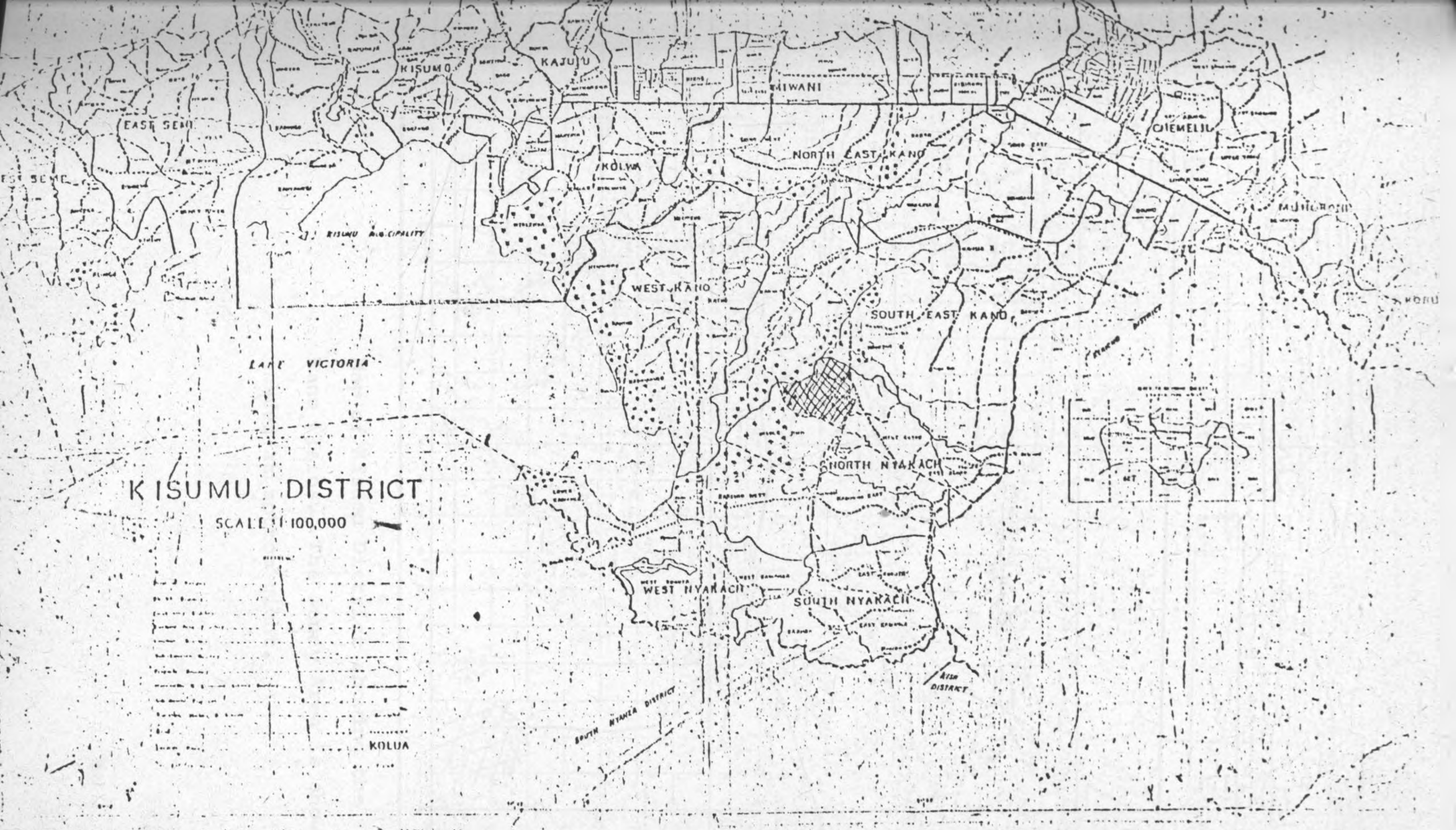
THE STUDY AREA

The study area is situated in the Kano Plains in Gem-Rae Sub-location, North-East Kano Location, Kisumu District, Nyanza Province Kenya. The area is some thirty kilometres South-East of Kisumu Municipalty on the eastern edge of the Kano Plains.See Maps 1,2 and 3.

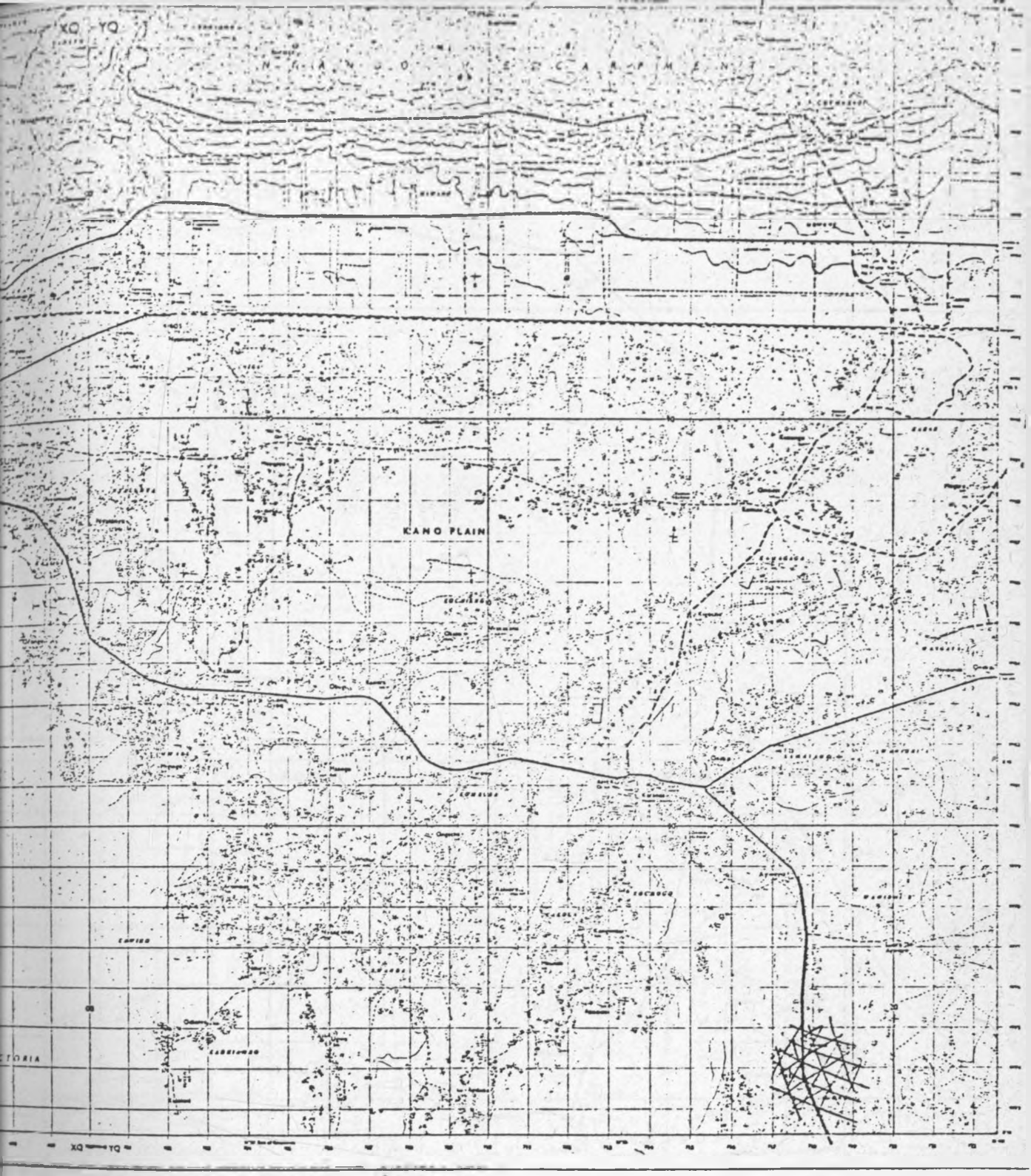
The Plains have been described in detail by various authors including Fontaine (1973) (9). The plains are bordered to the north, east and south by the Nandi Hills rising to 2000-3000 metres (6,500-9,750ft) above sea level and the Nyabondo Plateau. To the west the plains slope gradually into Lake Victoria. The plains are drained mainly by the Nyando River. A number of small rivers and streams rising in the surrounding highlands traverse the plains before draining into Lake Victoria.

The plains are composed of quaternary deposits, mainly alluvial in origin, and a range of black cotton soils. There are peaty swamps along the margins. Much of the area is relatively bare scrub without any extensive tree growth. The predominant tree species is a variety of thorn tree. See Plate 6 . The main crops cultivated are maize and millet. Cotton is grown as a major cash crop. Rice is also grown and is becoming an important cash crop in the area.

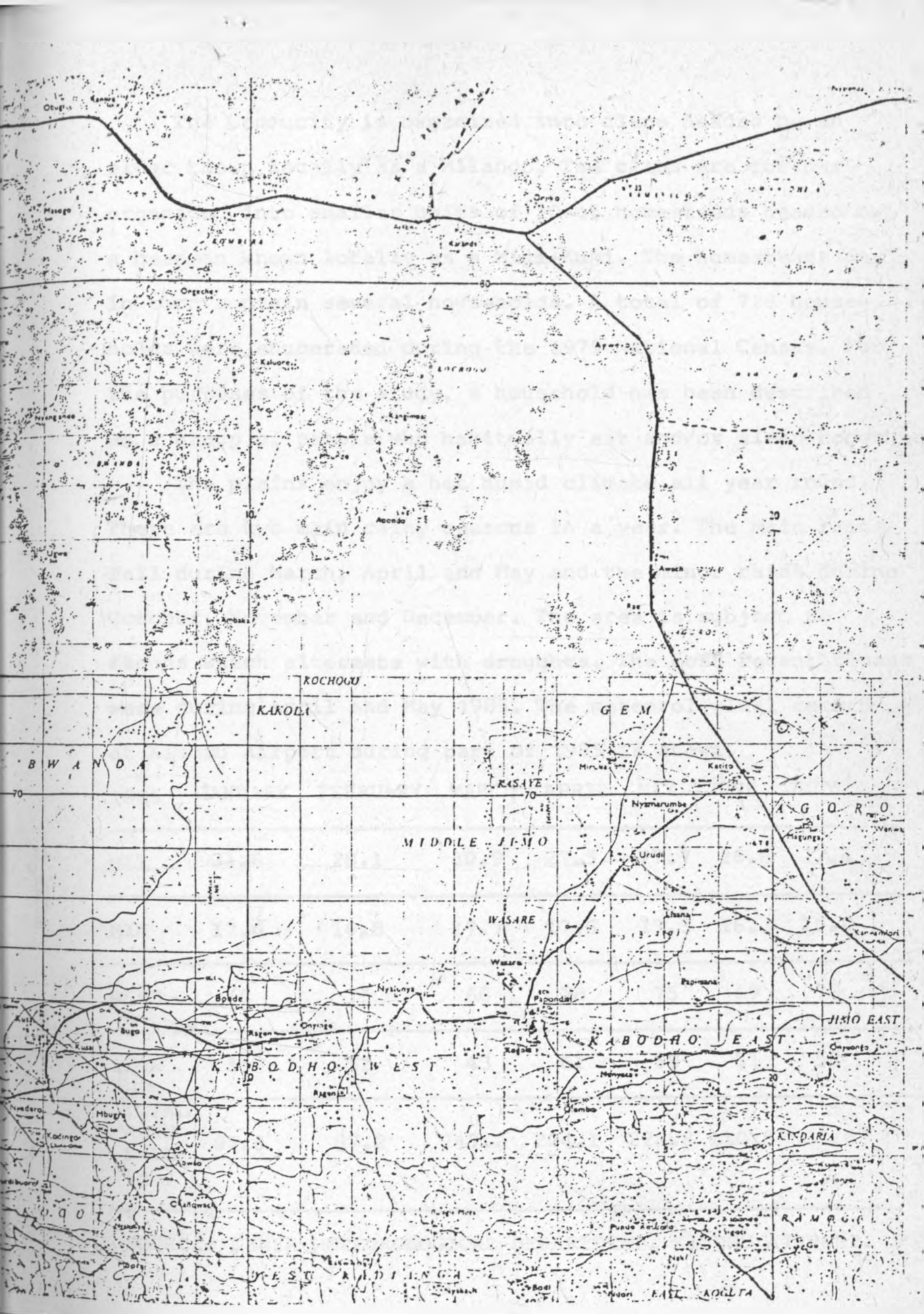
The majority of the inhabitants belong to the Luo ethnic group and live in homesteads surrounded by a hedge. A typical homestead consists of several huts for sleeping, several grain storage structures or granaries, and a central enlosure for livestock.



Map of Kisumu District. The study area is shown shaded.



Map of Kisumu District showing the Kano Plains. The Study Area is shown shaded at bottom right.



Map showing Gem-Rae Sublocation and the sorrounding areas.

The Community is organized into clans headed by an elder known locally as a Milango. The clans are further organized into smaller units of 10-15 homesteads headed by a headman known locally as a Miji-Kumi. The homesteads may in turn contain several households. A total of 728 households were enumerated during the 1979 National Census. For the purposes of the study, a household has been described as a group of people who habitually eat and/or sleep together.

The plains enjoy a hot humid climate all year round. There are two main rainy seasons in a year. The main rains fall during March, April and May and the minor rains during October, November and December. The area is subject to floods which alternate with droughts. The most recent floods were during April and May 1985. The meteorological record at Kisumu Airport during part of 1985 is shown.

1985	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY
TEMP°C MAX	31.6	28.1	30.9	27.5	27.7	28.6	27.4
MIN	17.0	16.8	17.7	17.6	17.3	16.3	15.0
R/H% 0600 Hrs	58	75	66	78	75	69	70
1200 Hrs	36	52	43	61	58	51	52
TOTAL RAIN FALL (mm)	97.3	87.2	247.2	224.1	226.8	110.8	86.6

SOURCE: KENYA METEOROLOGICAL DEPARTMENT, KISUMU AIRPORT.

The population of the Sublocation compared to the rest of the country as at 1979 census is shown below.

	TOTAL	MALES	FEMALES	DENSITY PER KM
KENYA	15,327,061	7,607,113	7,719,648	
NYANZA PROVINCE	2,643,956	1,271,672	1,372,284	211
KISUMU DISTRICT	474,516	238,042	244,285	230
SOUTH EAST KANO LOCATION	36,853	17,645	19,208	124
GEM-RAE SUBLOCATION	3,637	1,729	1,908	166

FROM: Kenya National Population Census 1979

Most inhabitants are engaged in subsistence farming. Papyrus reeds are also exploited for the manufucture of reed mats for sale. The main market is Katito which also serves as the social and administrative centre for the area.

Several Women's groups are active in the area mainly dealing in rice and flour milling.

The area is served by six primary schools, one secondary school and a village polytechnic.

Several Christian denominations enjoy a huge following in the area.

There are no Government Health Institutions in the area. The nearest health facilities are at Ehero and Pap-Onditi, both more than ten kilometres away from the centre of the sublocation.

METHODS AND MATERIALS

Selection of Study Human Population

The population of study was that resident in Gem-Rae Sublocation of South East Kano Location, Kisumu District in Western Kenya. The individual households were used as the sampling units for the Knowledge, Attitude, and Practice Survey. The homesteads were the sampling units for the clinical and parasitological survey.

The sublocation was divided into two blocks of 440and 430 households respectively. From each block a 20% sample was drawn and the households selected from a table of random numbers. The questionaire was administered to the head of the household or a senior representive.

K.A.P. Study

After careful formulation the questionaire was translated into the vernacular by the Principal Investigator and Senior field staff from Vector Biology and Control Research Centre Kisumu. The questionaire was pretested in the field before final preparation. It was administered with the help of '0' Level school leavers from the sublocation. The assistants were trained, orientated and tested on the questionaire in the field before finally being allowed to administer the questionaire. The questionaire was administered in the vernacular and responses recorded both in English and the vernacular. A copy of the questinaire appears in the appendix. See Appendix 1.

Clinical and Parasitological Study

The homestead was the sampling unit for the clinical

and parasitological survey. A list of homesteads was drawn from village head-men, known in the community as Miji-Kumi. From the list a 25% sample of homesteads was randomly selected. Each member of the selected homestead was examined for malaria parasites. Both a thick and a thin blood slide was taken for each member of the homestead. Those aged 2-9 years of age were examined for splenomegaly and the results recorded according to Hackett's classification.

The thin blood slides were fixed within 24 hours of collection and subsequently stained using Field's rapid stain and then examined for malaria parasite density and species identification. A copy of the Clinical and Parasitological Survey form used appears in the appendix. See Appendix 4.

Entomological Study

The entomological survey was designed to give as complete and representative data on the mosquito population of the area as possible. It included:-

(1) Outside survey of breeding grounds

(2) House survey for domestic and peri-domestic mosquitoes.

(3) Estimation of rate of natural infection in the mosquito population mainly by the determination of sporozoite rates in the mosquitoes.

The Pyrethrum Spray-Sheet Catch (P.S.C.) Collection, and Larval Collection forms appear in the appendix.

See Appendix and 5, 6.

The entomological survey was preceeded by a preliminary survey to identify and select suitable larval and adult collection points. A sketch map of the area was procured and the selected points marked to serve as the permanent

larval and adult collection points. The collection stations were sampled at fortnightly intervals for larval and adult forms. Dipping was the principal method of larval collection. Adult mosquitoes resting inside dwellings were collected using Pyrethrum Spray-Sheet Catch (P.S.C.) collection method. From each collection point a minimum of two huts/houses were selected for adult collection. All adults collected were kept in labelled petri dishes with moist filter or blotting paper and taken to the laboratory where they were sorted out into culicines and anophelines and identied to species using keys. Their numbers, sexes, and abdominal conditions were recorded.

Adults collected were also used for sporozoite-rate determination. Female Anopheles gambiae and Anopheles funestus were dissected in saline and their salivary glands examined for sporozoites.

RESULTS:

K.A.P. Study:

The results reported here were obtained by the use of the SPSS system on the University of Nairobi Institute of Computer Science ICL 2950 Computer. A list of all the variables and the Code-book used is given in the Appendix. See Appendix 2&3 . A total of 187 households were interviewed on Knowledge, Attitudes and Practices about Malaria and the Mosquito Vector. This represented 21.5% of the total number of households registered as at the last census carried out by the Aga Khan Primary Health Care Unit. (Personal Communication).

The interviews were carried out over two weeks with a range of 10-33 questionnaires being done per day. Average interview time was 30 minutes per questionnaire.

The respondents ranged in age from 12 years to 88 years with 16 people not stating their ages. The mean age of the respondents was 43 years with a mode of 35 years.

Another respondent characteristic is given in Table 2.

Head	14.4%
Wife	78.1%
Child of Head	5.3%
Parent of Head	0.5%
Others	1.6%

Table 2. Respondent Characteristic.

86.6% of the respondents were farmers. The rest included, teachers , businessman, village elder, birth attendant and students.

The Christian faith had the majority of adherents. The religion characteristics of respondents is given in Table 3.

Catholic	31%
Pentecostals	35.3%
AIC-Anglican	15.5%
S.D.A.	9.1%
Other	7.5%

Table 3. Religion of Respondents.

The Pentecostals included various christian off-shoots from the main Christian denominations. These included groups like Episcopals, Power of the Lord, Roho, Voice of Salvation, Hera, A. Israel. N and many others.

Education status of the respondents was a bit surprising with 52% of respondents claiming they had no education at all and 33% replying they had at least primary level education.

When asked about the major problem in the area, diseases was the most frequent response with over 70% of the respondents giving the response. This was followed by natural calamities like frequent floods and droughts, given by 11.2% of respondents. Food shortages was third being given by 9.6% of the respondents. The distribution of the responses are given in Table 4.

Diseases	71.7%
Natural Calamities	11.2%
Food Shortages	9.6%
Financial Problems	1.1%
Lack of Health Services	2.1%
Other	0.5%

Table 4. Responses to the question "Major problem in

When asked about the health problems in the area, malaria and related problems like headaches, malaise, backache, body and joint pains were the most frequent response being given by 61.5% of the respondents. This was followed by Gastro Intestinal Tract-related problems like abdominal pains, epigastric pains, diarrhoeas, vomiting and dysentery. This was given by 13.9% of the respondents. Respiratory tract and related problems like coughs, chest pains, colds and flu accounting for 9.6% of responses. Measles accounted for 8.0% of the responses. The distribution of the responses can be seen in Table 5:

Malaria and Related Problems	61.5%
G.I.T. & Related Problems	13.9%
Respiratory Tract & Related Problems	9.6%
Ear Problems	1.1%
Eye Problems	0.5%
Skin Diseases & Burns	1.1%
Measles	8.0%
Other	3.7%

Table 5: Responses to the question "Health problems in the area".

Knowledge of malaria appeared universal with 187 out of 187 respondents replying in the affirmative.

Fever and chills was the symptoms most commonly associated with malaria, being given by 30.5% of the respondents. Nausea and vomiting was given by 29.9% of the respondents. Headache was given by 18.7% of the respondents, 4.8% of the respondents gave yellow eyeballs as a symptom of malaria. The distribution of the symptoms is shown in Table 6:

Malaise	4.8%
Fever/Chills	30.5%
Nausea & Vomiting	29.9%
Headache	18.7%
Joint & Body Pains	1.1%
Yellow Eyeballs	4.8%
Other	5.3%

Table 6: Responses to the question "Symptoms of Malaria".

When asked "who suffers from malaria" 46.5% of respondents thought both children and adults suffer from malaria, while 43.9% thought infants and young

children suffered most from malaria. Only 5.3% of respondents thought infants suffered most malaria. When asked in whom malaria was more serious, 70.6% of respondents thought it is more serious in infants and young children. 18.7% thought it was more serious in infants.

On "How people get infected with malaria", 36.4% of respondents related malaria to the bite of the mosquito. 34.2% related it to water. This included such practices as walking in cold water, walking near rivers and walking in flood waters. 3.7% of respondents associated malaria with insanitory living conditions. This included eating bad food, drinking dirty water, using dirty utensils, association with flies and from dirty home surroundings. See Table 7.

Bite of Mosquito	36.4%
From Water	34.2%
Walking on Mud	0.5%
Insanitary Living Conditions	3.7%
From Infected People	1.1%
Other	7.0%

Table 7: Responses to the question "How people get infected with malaria".

When asked about possible disability caused by malaria, 43.5% of respondents thought it caused mental illness, commonly referred to as madness. 5.9% thought it caused chronic rheumatism including chronic joint pains, body stiffness, neck distortion and severe backache. 35% of respondents thought malaria does not cause any disability.

On malaria treatment, 96.8% of respondents thought malaria could be treated while 2.7% thought it could not.

When asked "How malaria could be treated", 30.5% said it could be treated by taking tablets. 27.8% thought it could be treated by going to a hospital, dispensary or seeing a doctor. 10.7% thought it could be treated by getting an injection. While 26.2% thought it could be treated by taking tablets and getting an injection. Only 1.1% of respondents thought it could be treated by traditional drugs and treatment. See Table 8 on the next page.

When asked "How they treated malaria in themselves or their children" 74.9% said they use tablets, 18.7% said they visited hospital, dispensary or went to see a doctor while 2.7% said they get injection.

Take Tablets	30.5%
Visit Health Unit	27.8%
Get Injection	10.7%
Pray & Use Medicine	0.5%
Traditional Drugs & Treatment	1.1%
Other	0.5%
Injection & Tablets	26.2%
Don't Know	2.7%

Table 8: Responses to question - "How malaria can be treated".

Table 9 on the next page gives the distribution of responses to the question "How malaria treated in self or family".

On prevention 72.2% of respondents thought malaria could be prevented and 26.7% thought it could not be prevented.

Take Tablets	74.9%
Get Injection	2.7%
Visit Health Unit	18.7%
Take Traditional Herbs	0.5%
Pray	0.5%
Other	1.1%
Don't Know	1.6%

Table 9: Responses to the question "How malaria treated in self or family".

Taking tablets was the most common method of prevention mentioned. This was mentioned by 33.7% of respondents. Visiting hospital, dispensary or clinic was mentioned by 12.3%. Good living habits including boiling water, eating clean food, keeping cooking utensils clean, wearing gum boots when it is wet and wearing sweaters when it is coldwere mentioned as methods of prevention by 10.2% of respondents. Environmental sanitation including covering ponds and pools, draining stagnant water and clearing tall grass was mentioned by 8.6% of the respondents. 26.7% of respondents thought malaria could not be prevented. 2.7% said use of mosquito net. See Table 10 on the next page.

Take Tablets	33.7%
Environmental Sanitation	8.6%
Do Away with Mosquitoes	2.1%
Visit Health Unit	12.3%
Good Living Habits	10.2%
Use Mosquito Net	2.7%
Don't Know	2.1%
Not Applicable	28.3%

Table 10: "Method of Prevention of Malaria".

When asked what method of prevention they used, 42.8% of respondents said they took tablets, 8.6% said they used mosquito net, 4.8% said they used pyrethrum based repellents/insecticides, while 31% did not use any methods of preventing.

Mosquito knowledge was universal with 187 out of 187 respondents replying in the affirmative. Mosquitoes were present in the area. They were mainly thought to breed in stagnant water. This was given by 80.7% of respondents." 10.2% of respondents thought they breed in vegetation including tall grass, green maize, in the garden and in millet. 3.2% thought they breed in running water.

Stagnant Water	80.7%
In Vegetation	10.2%
Running Water	3.2%
Dark Places	0.5%
Other	3.2%
Not Applicable	1.1%
Don't Know	1.1%

Table 11: Responses to the question "Breeding sites of Mosquitoes.

Mosquitoes were thought to rest in dark places inside houses during the day by 40.1% of respondents. 41.7% of respondents thought they rest in vegetation during the same period. 8% thought they rest at the edges of streams and 8% thought they rest on walls and roofs inside houses. See Table 12 on the next page.

On resting at night, 28.6% of respondents thought they were flying all over the house, while 62.6% thought they were flying around biting.

Dark Places Inside Houses	80.7%
On Walls & Roofs	8.0%
In Vegetation	41.7%
At Edges of Streams	8.0%
Other	1.1%
Don't Know	1.1%

Table 12: Responses to the question "Resting sites of Mosquitoes".

When asked when mosquitoes are more numerous, most respondents, 95.2%, thought they were so during the rainy season.

On problems caused by mosquitoes, 48.7% of respondents thought they were a biting nuisance, 12.3% thought mosquitoes transmit diseases and 33.2% thought mosquitoes are both a biting nuisance and transmit diseases. When asked what diseases mosquitoes transmit, 81.3% of respondents mentioned malaria and such related problems like headaches, body weakness, and fevers. 11.2% thought mosquitoes cause skin diseases including body rash, pruritus and boils. 3.2% thought mosquitoes cause measles. See Table 13 for the distribution of responses.

Malaria & Related Problems	81.3%
Skin Diseases	11.2%
G.I.T. & Related Problems	1.1%
Measles	3.2%
Respiratory Tract & Related Problems	0.5%
Finish our Blood	0.5%
Others	1.1%

Table 13: Responses to the question "Problems Mosquitoes Cause".

On knowledge of methods to prevent mosquitoes bites, use of net was given by 51.9% of respondents, use of pyrethrum products includingpyrethrum powder, mosquito coils and spray products was given by 13.4% of respondents, burning Lantana rhodhesiensis, leaves was given by 3.7% of respondents while burning cowdung was given by 6.4% of respondents. See Table 14 on the next page.

On knowledge of traditional methods of preventing mosquitoes bites, 78.6% of respondents replied in the affirmative, while 20.9% replied in the negative.

Use Bed Net	51.9%
Use of Pyrethrum Products	13.4%
Burn Euphorbia leaves	0.5%
Burn Eucalyptus leaves	18.7%
Burn Lantana rhodesiensis	3.7%
Environmental Sanitation	1.6%
Burning Cowdung	6.4%
Others	3.7%

Table 14 Knowledge of Method of Prevention.

When asked to name the traditional methods of preventing bites, the following answers were given. Burning Lantana rhodhesiensis leaves was given by 38.5% of respondents, burning cowdung was given by 10.2% of respondents, burning Eucalyptus leaves was given by 4.3% of respondents and burning Euphorbia leaves was given by 3.2% of respondents. 20.9% of respondents said they used a variety of methods inluding burning sisal leaves, burning rice husks, burning cotton pods, burning rubber, burning dirty clothes and burning any leaves. See Table 15 on the next page.

Burn Eucalyptus leaves	4.3%
Burn Euphorbia leaves	3.2%
Burn Lantana rhodesiensis leaves	38.5%
Burn Cowdung	10.2%
Burn Goat/Donkey droppings	2.1%
Other	20.9%
Not applicable	20.9%

Table 15: Knowledge of "Traditional method of preventing mosquito bites".

On use of any methods of prevention, 65.2% of respondents said they used a method while 33.2% said they did not use any method of prevention.

On the method of prevention used 23.2% said they used pyrethrum products like repellents and insecticides, 16.0% said they burned Lantana rhodesiensis leaves, 10.2% said they used mosquito net, 1.1% said they burn Eucalyptus leaves while 33.2% did not use any method of prevention. See Table 16 on the next page.

Mosquito net	10.2%
Use of Pyrethrum products	23.2%
Burn Eucalyptus leaves	1.1%
Burn Lantana rhodesiensis leaves	16.0%
Clean home environment	0.5%
Other	16.0%
Not applicable	33.2%

Table 16 "Method of prevention used".

The Clinical & Parasitological Survey

The parasite and spleen survey was carried out during the months of May, June, and part of August 1985.

The target was a 20% sample of the population of study which was estimated at 4600 up from 3673 at 1979 census.

The study was preceeded by a preliminary survey in April, 1985 to determine the minimum sample size.

A pilot survey was carried out in the study area during the month of April, 1985. A total of 100 persons were sampled using the method of simple random sampling. Out of this population, 34 were children aged from 2-9 years. Out of these children 30 or 88.2% (30/34) were found to harbour parasites in their blood. This gave a parasite rate of 88.2% in children aged 2-9 years. This proportion has a standard error (SE) of 5.53 given by:

$$SE(P) = \sqrt{\frac{P(100 - P)}{n}} = \sqrt{\frac{(88.2)\ (11.8)}{34}}$$

$$SE(P) = 5.53$$

Setting a confidence limit of 95%, we wished to sample a minimum number of children aged 2-9 years for this parasite rate within -2SE of the 88.2% i.e.

88.2 - 2 x 5.53 = 77.14%.

Given the two proportions, P_1 and P_2, the sample size was obtained as follows:-

(Snedecor and Codran 1971, Statistical Methods) (10).

$$n = (\mathcal{Z}a + \mathcal{Z}B)^2 \quad \frac{P_1Q_1 + P_2Q^2}{(P_2 - P1)^2}$$

Where:-

n = minimum sample size

$\mathcal{Z}$ a = the normal deviate corresponding to the significance level to be used with the test.

$\mathcal{Z}$B = the normal deviate corresponding to the two tailed probability B.

P1 = Percentage obtained during the pilot survey.

P2 = Percentage equal to (P1 - 2SE).

Setting a power of 90% of obtaining the sample size n at 5% significance level. Parasite rate from pilot survey

P1 = 88.2%

P2 = 77.14%

$$n = (\mathcal{Z}\,a + \mathcal{Z}\,B)^2 \quad \frac{P1Q1 + P2Q2}{(P2 - P1)^2}$$

$$= 8.6 \quad \frac{(88.2 \times 11.8) + (77.14 \times 22.96)}{(77.14 - 88.2)^2}$$

n = 198.

The minimum sample size of children aged 2 - 9 years was thus found to be 198 children.

A total of 1216 persons of all ages were examined for malaria parasites. Both a thick and a thin blood slide were taken for everybody examined. These were used for parasite species identification and estimation of parasite density. Desnity was estimated against 300 white blood cells.

A total of 414 children aged 2 - 9 years were examined for splenomegaly. The spleen sizes were recorded according to the method of Hackett.

Of the people examined for malaria parasites, overall, 663 or 54.5% were found positive for malaria parasites. 62.8% were positive among those aged under 1 year. 83.7% of those aged 2 - 9 years had malaria parasites in their blood. The parasite distribution is given in Table 17 on the next page.

OVERALL PARASITAEMIA LEVELS			
AGES	NUMBERS	POSITIVE	% POSITIVE
0-11 months	43	27	62.8
12-23 months	108	63	58.3
2-9 years	435	364	83.7
10-14 years	134	89	66.4
15 + years	496	120	24.2
TOTAL	1216	663	54.5

Table 17: Malaria slide positivity distribution by age group.

A 25% sample of boarding Secondary School girls aged 14-19 were examined for malaria parasites. A total of 67 girls were examined of which 24 were found positive for malaria parasites giving a rate of 34.8%.

A total of 43 symptomatic cases were encountered during the survey of these 26 or 60.5% were found positive for malaria parasites. The significance of this finding is discussed later.

Overall, the species distribution of the malaria parasites was as follows:-

Plasmodium falciparum	88.54%
Plasmodium malariae	0.45%
Plasmodium ovale	0.30%
P. falciparum/malariae	7.69%
P. falciparum/ovale	2.11%

See also Table 18.

SPECIES	NUMBER OF SLIDES	%
Plasmodium falciparum	587	88.54
P. malariae	3	0.45
P. ovale	2	0.30
P. falciparum/P. malariae	51	7.69
P. falciparum/P. ovale	14	2.11
Not identified	6	0.90
TOTAL	663	100

Table 18: Species distribution among positive slides.

Out of a total of 652 blood slides positive for Plasmodium falciparum, 59 or 9.05 % were found positive for gametocytes.

					TOTAL
(1) Spleen class	1	2	3	4	
(2) No. of Children	109	83	15	1	208
(1) x (2)	109	166	45	4	324

Table 19: Distribution of spleen classes. This gives an Average Enlarged spleen (A.E.S.) of 1.56.

The A.E.S. tells us how many subjects have, or recently had, malaria. Because every infection is liable to increase the size of the spleen, the A.E.S. is more sensitive to variations of transmission.

Parasite density was calculated by counting malaria parasites against 300 white blood cells (wbc's). Overall, the range was 1 to 2670 parasites per 300 wbc's, with a mean of 155 and mode of 50. See also Table 20 on the next page.

DENSITY 300 W.B.Cs.	MID-VALUE (X)	FREQUENCY (F)
1 - 99	50	503
100 - 199	150	60
200 - 299	250	29
300 - 399	350	20
400 - 499	450	8
500 - 599	550	10
600 - 699	650	5
700 - 799	750	8
800 - 899	850	2
900 - 999	950	5
1000 +	1,500	9
TOTAL		659

Table 20: Distribution of parasite density per 300 WBC's.

Those who were found to be clinically sick and had a positive blood slide were further assessed for parasite density. The range of parasites was found to be 1-909 per 300 wbc's with a mean of 160 and

standard deviation of 284 parasites per 300 wbc's. The parasites were too numerous to count in two of the cases. See also Table 21 on the next page. When analysed statistically, there did not appear to be any relationship between parasite density and symptoms.

First we compared the parasite density in those who had a positive blood slide. The following results were obtained:-

		ILL	WELL	
Parasite Density /300 WBC's	Less than 100	17	486	503
	Greater than 100	9	147	156
		26	633	659

$$X^2 = \sum \frac{(O-E)^2}{E}$$

$$= 1.79.$$

This has a probability "P" as follows;

$$0.50 < P < 0.10$$

which is statistically not significant.

CLINICALLY SICK & SLIDE POSITIVE SERIAL NO.		AGE (YEARS)	PARASITE DENSITY PER 300 WBC	SPECIES
1.	027	12	6	P. falciparum
2.	184	7	5	P. falciparum
3.	237	2½	190	"
4.	335	3	78	P.falcip/P.malariae
5.	336	6	Uncountable	P. falciparum
6.	358	4	24	"
7.	409	19	720	"
8.	489	4	48	"
9.	529	30	21	"
10.	555	5	4	"
11.	575	2	22	P.falcip/P.malariae
12.	578	2½	18	P. falciparum
13.	591	5	6	"
14.	649	10	3	"
15.	666	37	1	"
16.	886	8	10	"
17.	888	2	174	P.falcip/P.malariae
18.	951	15	1	P. falciparum
19.	1031	3	126	"
20.	1086	3	600	"
21.	1131	11	1	"
22.	1145	$1^{9}/_{12}$	819	"
23.	1148	3	909	"
24.	1167	18	45	"
25.	1239	$1^{2}/_{12}$	Uncountable	"
26.	1255	" 16	6	P.falcip/P.ovale

Table 21: Parasitological finding in those diagnosed as clinical malaria.

Next we compared the parasite density in all the subjects. The following results were obtained:-

		ILL	WELL	
Parasite Density /300 WBC's	Less than 100	34	1026	1060
	Greater than 100	9	147	156
		43	1173	1216

$$x^2 = \sum \frac{(O - E)^2}{E}$$

$$x^2 = 2.62$$

This has a probability "P" as follows:-

$$0.50 < P < 0.10.$$

This again is not statistically significant.

A total of 414 children aged 2 - 9 years were examined for splenomegaly by the method of Hackett. 208 or 50.2% were found to have palpable splenic enlargement. Out of those who had enlarged spleens, 176 or 84.6% were found to harbour malaria parasites as well. While in those without enlarged spleens, 188 out of 206 or 91.3% (S.E. 1.97) had malaria parasites in their blood. The two groups were compared statistically and the following results were obtained:-

SPLENOMEGALY

		+	-	
PARASITES	+	176	188	364
	-	32	18	50
		208	206	414

$$x^2 = \sum \frac{(O - E)^2}{E}$$

$$= 4.306$$

This is statistically significant at $P < 0.05$. It appears therefore that there is an inverse relationship between splenomegaly and parasitaemia.

Entomological Survey

The entomological survey was carried out during July and August 1985. The work consisted of two separate but related surveys carried out at the same time.

One was the adult pyrethrum Spray-Sheet Catch (PSC) Collection and the other was the larval collection.

A total of six stations were selected. These were chosen to correspond to the different ecological situations in the sublocation. Both the adult and larval collection points were situated close to one another; at most within 500 metres of one another.

The collecting stations were chosen to correspond to the following ecological situations:-

1. Slow moving sun-exposed stream with both emergent and floating vegetation as well as overhanging shade. This corresponded to station 1.

2. Open marshy area being drained by many rivulets and rain ditches with a lot of emergent vegetation. This corresponded to station 2.

3. The edge of a swamp draining the main river of the sublocation. This corresponded to station 3.

4. Next to rice - fields. This corresponded to station 4.

5. Sun-exposed polluted rain ditches at the edge of the road. This corresponded to station 5.

6. Man-made open sun-exposed stagnant ponds with both floating and emergent vegetation. These were used for domestic consumption. This corresponded to station 6.

Two rounds of adult P.S.C. collections were done at two weeks intervals. One round of larval collection was done.

A total of 563 adult mosquitoes were collected by P.S.C. method of which 373 were dissected for sporozoites. The species distribution of the adult mosquitoes included 293 Anopheles funestus and 267 Anopheles gambiae. The rest were culicines. A total of 32 culicines were collected. These included 12 Culex quinquefasciatus, 1 Aedes circumluteolus mosquito, and 1 Mansonia uniformis.

A total of 373 Anopheles were dissected. These included 185 Anopheles funestus and 188 Anopheles gambiae. Of the Anopheles funestus dissected, one was found positive for sporozoites giving a sporozoite rate of 0.54% in Anopheles funestus. None of the Anopheles gambiae was found positive for sporozoites.

The distribution of the adult mosquitoes among the catching stations is shown in Table 22 and 23 in the following pages.

A total of 424 mosquito larvae were collected and identified, species composition varied as follows:-

Anopheles gambiae	109
Anopheles funestus	6
Anopheles coustani	43
Anopheles pharoensis	21
Culex poicilipes	160
Culex quinquefasciatus	52
Culex ethiopicus	22
Culex simpsoni	1
Ficalbia splendens	2
Ficalbia uniformis	1
Ficalbia minomyformis	-
Uranotaenia balfouri	7
Culex tigripes	6

Details of the larvae found in the 6 different stations is given in Table 24 on the next pages.

Date	Station	House	An. Funestus	An. Gambiae	Others
30/7/85	1	1	10	5	2
		2	2	0	1
30/7/85	2	1	2	2	2
		2	18	11	0
31/7/85	3	1	15	25	5
		2	9	30	0
31/7/85	4	1	22	96	0
		2	72	6	3
31/7/85	5	1	3	2	2
		2	0	1	0
31/7/85	6	1	3	4	2
		2	4	1	0
12/8/85	1	1	12	6	1
		2	5	2	1
12/8/85	2	1	17	12	1
		2	6	6	2
13/8/85	3	1	24	14	5
		2	4	10	1
13/8/85	4	1	37	13	4
		2	17	13	0
14/8/85	5	1	1	-	0
		2	-	2	0
14/8/85	6	1	1	6	0
		2	4	2	0
TOTAL	12	24	298	269	32

Table 22: Mosquitoes captured by Pyrethrum spray catch (PSC) method at the six catching stations (each sampled on two occasions).

CULICINES CAPTURED BY PSC METHOD

Date	Station	House	Culicines	Numbers
30-7-85	1	1	Culex quinque fasciatus	2
		2	C. quinque fasciatus	1
30-7-85	2	1	unidentified	2
		2	None	Nil
31-7-85	3	1	Unidentified	5
		2	None	Nil
31-7-85	4	1	None	Nil
		2	Unidentified	3
31-7-85	5	1	C.quinquefasciatus	2
		2	None	Nil
31-7-85	6	1	C.quinquefasciatus	2
		2	None	Nil
12-8-85	1	1	Unidentified	1
		2	Aedes circumluteolus	1
12-8-85	2	1	Unidentified	1
		2	Unidentified	2
13-8-85	3	1	C.quinquefasciatus	5
		2	Mansoni uniformis	1
13-8-85	4	1	Unidentifed	4
		2	None	Nil
14-8-85	5	1	None	Nil
		2	None	Nil
14-8-85	6	1	None	Nil
		2	None	Nil
TOTAL	12	24		32

Table 23: Culicines captured by PSC method.

LARVAE COLLECTED

BREEDING SITES / SPECIES	Anopheles gambiae	Anopheles Funestus	Anopheles coustani	Anopheles pharoensis	Anopheles ziemanni	Culex quinquefasciatus	Culex poicilipes	Culex simpsoni	Culex ethiopicus	Ficalbia splendens	Ficalbia uniformis	Ficalbia mimomyformis	Uranotaenia balfouri	Culex tigripes	
STATION 1	14	3	12	5	-	25	55	1	-	2	-	-	-		117
STATION 2	23		5	2		9			7						46
STATION 3		1	14				23				1				39
STATION 4	7	1	12	3		8	46		14			1	1	6	99
STATION 5	54			7		2	28					6			97
STATION 6	11	1		6			8								26
TOTAL	109	6	43	23		44	160	1	21	2	1	7	1	6	424

Table 24: Larvae collected at the six selected breeding sites.

DISCUSSION:

The K.A.P. Survey

The knowledge, atttitudes and practices (K.A.P.) survey was analysed using the S.P.S.S. (Statistical Packages for the Social Sciences) system on the ICL 2950 computer at the Institute of Computer Sciences, University of Nairobi.

The computer was used to draw frequency distributions of the different variables as well as to make crosstabulations between the variables. Crosstabulations between selected pairs of variables. The chi-square values and the corresponding degrees of freedom are given in Tables 25A,B,C,D,& E, on the following pages. All statements in this discussion that describe significant relationships are statistically signigicant at the level P = 0.05 or less.

Calculating such a large number of chi-squares without any a priori hypothesis may lead to significant results which in effect do not reflect "real" associations. At a significance level of 5% this probability will be at least one chi-square comparison in 20. To test the hypothesis that the Chi-square values obtained were arrived at by chance alone, we perform a t - test on the means of the Chi-squares and the attached degrees of freedom (DF).

NO.	COMPARISONS	CHI-SQUARE	D.F.	SIGNIFICANCE
1.	Interviewer by Health Problems	19.35	20	0.499
2.	Interviewer by Definition, Malaria	94.56	24	0.000
3.	Interviewer by Malaria, Symptoms	64.46	28	0.001
4.	Religion by Malaria, How Infection	13.65	16	0.624
5.	Religion by Malaria, How Treated	25.81	16	0.057
6.	Religion by Treatment in Self	13.86	16	0.609
7.	Religion by Prevention Method Used	58.004	28	0.0007
8.	Occupation by Major Problems	29.425	14	0.0091
9.	Occupation by Health Problems	2.871	10	0.9843
10.	Occupation by How Infected	13.381	8	0.094
11.	Occupation by How Treated	16.924	8	0.0309
12.	Occupation by Treatment in Self	3.1013	8	0.928
13.	Occupation by Prevention Method Used	7.772	14	0.9009
14.	Education by Health Problems	20.844	15	0.1419
15.	Education by Malaria, Definition	17.076	18	0.5179

Table 25 A: Crosstabulations between the variables.

NO.	COMPARISONS	CHI-SQUARE	D.F.	SIGNIFICANCE
16.	Education by Symptoms of Malaria	37.045	21	0.0166
17.	Education by How Infected	27.699	12	0.0061
18.	Education by Malaria, Sufferer	21.939	18	0.234
19.	Education by Malaria, Whom Serious	59.266	24	0.0001
20.	Education by Kind of Disability	9.165	12	0.688
21.	Education by How Treated	19.051	12	0.087
22.	Education by Treatment in Self	4.818	12	0.964
23.	Education by Malaria Prevention	26.703	15	0.0313
24.	Education by Prevention Method Used	44.732	21	0.0019
25.	Malaria Definition by Symptoms of Malaria	56.383	42	0.152
26.	Malaria Sufferer by Malaria Whom Serious	271.824	48	0.000

Table 25"B: Crosstabulations between the variables.

NO.	COMPARISONS	CHI-SQUARE	D.F.	SIGNIFICANCE
27.	Malaria How Treated by Treatment in Self	28.645	16	0.026
28.	Malaria, How Prevented by Method of, Used	42.969	35	0.166
29.	Education by Mosquito Breeding	21.147	18	0.272
30.	Education by Mosquito Resting Day	18.976	12	0.089
31.	Education by Mosquito Resting Night	7.622	9	0.573
32,	Education by Mosquitoes when Numerous	2.186	9	0.988
33.	Education by Problems Mosquito Causes	3.538	6	0.739
34.	Education by Diseases Mosquito Transmit	21.403	9	0.011
35.	Education by Prevention of Bites, Method	18.631	18	0.4148
36.	Education by Method of Prevention Used	12.960	15	0.605
37.	Religion by Mosquitoes Breeding	28.806	24	0.227

Table 25C: Crosstabulations between the variables.

NO.	COMPARISONS	CHI-SQUARE	D.F.	SIGNIFICANCE
38.	Religion by Problems Mosquito Cause	18.092	8	0.0205
39.	Religion by Diseases Mosquito Transmit	14.102	12	0.294
40.	Religion by Method of Prevention Used	42.263	24	0.0121
41.	Religion by Prevention Method Traditional	22.311	20	0.324
42.	Religion by Method of Prevention Used	22.776	20	0.299
43.	Age by Education	44.705	18	0.0005
44.	Age by Health Problems	37.743	30	0.156
45.	Age by Malaria, Defination	46.499	36	0.113
46.	Age by Malaria, How Infected	26.084	24	0.349
47.	Age by Treatment in Self	43.621	24	0.0084
48.	Age by Malaria, Prevention Used	43.542	42	0.406
49.	Age by Mosquito Breeding	33.170	36	0.604

Table 25 D: Crosstabulations between the variables.

NO.	COMPARISONS	CHI-SQUARE	D.F.	SIGNIFICANCE
50.	Age by Mosquitoes, Problems Caused	11.942	12	0.450
51.	Age by Diseases Mosquito Transmit	20.091	18	0.328
52.	Age by Mosquito Prevention Method	31.348	36	0.689
53.	Age by Method of Prevention Used	42.476	30	0.065
54.	Where Mosquitoes Breed by Mosquito Numerous	12.073	18	0.8434
55.	Mosquito Problems by Mosquito Diseases	9.211	6	0.162
56.	Method of Prevention by Method Traditional	33.328	30	0.3085
57.	Method of Prevention by Method Used	30.721	25	0.1984
58.	Malaria Prevention by Mosquito Prevention	34.446	30	0.263
59.	Malaria Prevention Method by Used by Mosquito Method of Prevention Used	34.494	35	0.492

Table 25 E: Crosstabulations between the variables.

We proceed as follows:

X^2 values -

$$\text{Mean} = \overline{X^2} = 31.124$$

$$SD_1 = 36.378$$

$$SE_1 = \frac{SD_1}{\sqrt{n}} \quad \text{wherein} \quad n = 59$$

$$SE_1 = \frac{36 \cdot 378}{\sqrt{59}}$$

$$SE_1 = 4.736$$

Degrees of Freedom DF

$$n = 59$$

$$\overline{DF} = 20.084$$

$$SD_2 = 9.947$$

$$SE_2 = \frac{SD_2}{\sqrt{n}}$$

$$SE_2 = \frac{SD_2}{\sqrt{n}} = \frac{9.947}{\sqrt{59}}$$

$$SE_2 = 1.295$$

The difference between the two means is given by D.

$$D = \overline{X^2} - \overline{DF}$$

$$D = 31.124 - 20.084$$

$$D = 11.13$$

$$t = \frac{\overline{X^2} - \overline{DF}}{\sqrt{SE_1^2 + SE_2^2}}$$

$$t = \frac{11.13}{\sqrt{(4.736^2 + 1.295^2}}$$

$$t = \frac{11.13}{4.91}$$

$$t = 2.27$$

$$DF = (59 - 1) + (59 - 1) = 116$$

This has a probability $0.05 > P > 0.02$. The null hypothesis is rejected. The X^2 values obtained were not arrived at by chance. They show real relationship between the variables.

Various respondent characteristics including age, religion, occupation and education were compared with the various disease variables as well as various mosquito vector variables. The following were some of the highlights of this analysis; and their possible inferences.

First the various interviewers were compared on their performance on the questionnaires. In two out

of three of such comparisons there was a significant relationship between the different interviewers and the responses to the same questions. It was thus inferred that there was consistency among the interviewers.

Religion had a significant relationship with the method of preventing mosquito bites used by the people. The Catholics claimed they use pyrethrum based repellents and insecticides, environmental sanitation and methods including killing mosquito eggs, burning old blankets, burning rice pods and closing door at night. The Pentecostals claimed they use bed-nets, pyrethrum based repellents and insecticides. They also burn L. rhodesiensis leaves. The AIC - Anglican use pyrethrum based products and also burn cow dung. S.D.A. burn Euphorbia leaves and cow dung.

From the above, it appears that use of repellents of some sort is quite popular. This is a good practice that should be encouraged. It is however quite expensive and clearly cannot be used on a continous basis by most of the inhabitants. Where local indigenous plant-products exist and are being used, as was the case in this sub-location, these should be investigated for efficacy and effectiveness. Their use could then be encouraged.

Religion again had a significant relationship with knowledge of method of prevention of malaria. The Catholics preferred environmental sanitation. This includes; filling up ponds, draining stagnant water and clearing bushes. AIC - Anglican appear to use pyrethrum-based repellents and insecticides, mosquito net and good living habits including: general cleanliness in the home, taking fruits regularly and clean toilet habits. S.D.A. adherents use environmental sanitation and good living habits.

In addition to prevention, religion also had a strong relationship with the perceived problems caused by the mosquito. Catholic adherents thought they were both a biting nuisance and transmitters of disease. The Pentecostals and S.D.A. adherents thought the same. While the AIC-Anglican adherents thought they were a biting nuisance alone. These are very important findings as removal of nuisance caused by a biting insect has been known to be one of the main factors that encourages communities to take part in vector control programmes. It is also the factor that often maintains their interest in such programmes.

There was no relationship between religion and the method of treatment of malaria. Again there was also no relationship between religion and any of the following:

(1) the knowledge of the breeding sites of mosquitoes

(2) the knowledge of the resting sites of mosquitoes

(3) the knowledge of the diseases transmitted by mosquitoes

(4) the knowledge of traditional methods of preventing mosquito bites

(5) the use of any methods of preventing mosquito bites

From the above findings, it appears that knowledge of the life cycle and habits of the mosquito is poor. The public health importance of mosquitoes is also not fully appreciated. It is essential that people know at least the life cycle and habits of the mosquito if they are to participate effectively in vector control programmes. Perhaps the various religious groups could be used in health education. This should not be too difficult as many religious denominations have a medical component in their establishments.

Occupation was significantly associated with peoples opinion as to their major health problems. Most of the respondents who were farmers, said that disease was the major problem. Again when occupation was compared with knowledge of treatment of malaria, there was a significant and positive association. Most respondents thought taking tablets and injections, and visiting health unit were the methods of choice.

Occupation is one variable that is often difficult to involve in disease control programmes. People usually do not see the benefits of such programmes. Perhaps one line of entry would be to make people aware of the relationship between health and productivity. But this is often difficult to achieve. One method that has been used is to link disease prevention (and promotion) activities with socio-economic activities.

Education was significantly associated with knowledge of symptoms of malaria. Those with no education thought body rash, yellow urine, chest pains, abdominal pains and diarrhoea and redness of the eyes were the main symptoms. Those with primary education thought headaches was the main symptom while those with secondary education thought, malaise, fever and chills were the main symptoms.

Education was also significantly associated with the people's attitude of how they thought they were infected with malaria. Those with no education related it to water and miscellaneous causes like walking on mud. They also related it to changing weather, the air and unexplainable circumstances. Those with primary education related it to bite of mosquito and water. Those with secondary education related it to bite of mosquito.

Education was also significantly associated with awareness, of the seriousness of malaria in different population subgroups. Those with no education thought that all age groups and also pregnant women were more susceptible. Those with secondary school education thought children and infants were more susceptible while those with primary education thought infants were more susceptible.

On the other hand, education was barely significantly associated with knowledge of method of prevention of malaria. Those with no education thought taking tablets, visiting health unit and practising good living habits were the methods of choice. Those with at least primary education thought environmental sanitation, visiting health unit and good living habits were appropriate. Those with secondary education thought environmental sanitation, visiting health unit and use of mosquito net were the methods of choice.

Again education had a significant association with method of prevention of malaria used. Those with no education preferred going to hospital. Those with primary education preferred taking tablets, and using pyrethrum based insecticides and repellents. Those with secondary education preferred bed nets.

Education was again significantly associated with knowledge of diseases mosquitoes transmit. Those with

no education thought mosquitoes transmit skin diseases, measles and other diseases like abdominal pains and diarrhoeas. Those with primary education thought they transmit malaria and skin diseases while those with secondary education thought they transmit skin diseases.

On the other hand there was no significant association between education and any of the following:-

(1) the perceived health problems

(2) definition of malaria

(3) who suffers from malaria

(4) disability caused by malaria

Education was again not significantly associated with:-

(1) knowledge of breeding sites of mosquitoes

(2) resting sites of mosquitoes

(3) when mosquitoes are more numerous

(4) problems mosquitoes cause

(5) knowledge of method of preventing mosquito bite and

(6) use of any such methods.

Again it can be seen that there is lack of knowledg of both the disease and the vector; especially the latte Health education should concentrate more on the vector than the disease with more emphasis being placed on the life-cycle and habits of the vector. Both formal and informal educational institutions could be used for this purpose as it appears that education has had little impact on the peoples outlook towards the disease and the vector especially the latter.

As expected age showed significant inverse relationship with the level of education. Those who were below thirty years of age had primary and some secondary education. Those 31-40 had secondary and other education including Teacher training. Those aged 40+ years had very little education.

These findings are to be expected, the younger age-groups usually have better education than the older people.

Age also appeared to be significantly related to the method of treatment of malaria used. Those aged 12-30 volunteered use of tablets predominantly. Those 31-40 rely more on visiting health unit. Those 41-50 visit health unit and take tablets. Those 61-70 use other treatment methods including taking salt water, hot water and sleeping. Those aged 71 and above take tablets.

Most inhabitants take some form of medication. They often, however, take suboptimal doses. This practice may lead to development of resistance to drugs. People should be educated on the best methods of treatment. Village health workers could be used for this purpose.

On the other hand there was no significant association between age and;

(1) perceived health problems

(2) definition of malaria

(3) mode of infection of malaria and

(4) method of prevention of malaria used

Age was also not significantly associated with knowledge of

(1) mosquito breeding sites

(2) problems mosquitoes cause

(3) diseases mosquitoes transmit

(4) method of preventing mosquito bites

Again the same picture appears to be emerging. There does not seem to be any significant association between age and the people's knowledge and practices of the disease and the vector, more particularly the

vector. More emphasis should therefore be placed improving the peoples knowledge of the vector.

There was significant relationship between a person's knowledge of malaria treatment and the treatment method actually used. It appears that people "practice what they preach". There was however no significant association between people's knowledge of preventive method and the method of prevention actually used.

When knowledge of the general methods of preventing mosquito bites was compared with knowledge of traditional methods of mosquito control, there did not appear to be any significant relationship. Again when knowledge of method of prevention was compared with actual methods used, there did not appear to be any significant association. It appears that knowledge and attitudes towards mosquito control are divorced from the actual practices. This perhaps is to be expected. Vector contro activities in most rural communities are simply non-existent.

In summary, knowledge of malaria, as a disease, appears to be quite high. There appears to be some confusion as to the best methods of treatment. There is some knowledge on prevention of malaria but actual practices of prevention appear to be minimal. On one hand, knowledge of the mosquito, as an adult insect, appears to be universal but the knowledge of the life-

cycle appears to be very poor. There appears to be some knowledge on preventive methods but their actual use is minimal.

The mosquito vector as the biological link in transmission is the most poorly understood aspect of malaria control. Perhaps health education could be fashioned around the mosquito vector especially its life-cycle and habits. The relationship between the mosquito and human activity could be highlighted for better control. This applies particularly to man made breeding sites like "borrow" pits. The importance of environmental management could also be emphasised.

Entomological Survey:

Mosquitoes or Culicidae belong to the order of Diptera, Sub-order Nematocera and Family Culicidae.

The Culicidae are divided into three subfamilies:-

1. Anophelinae
2. Toxorhynchitinae
3. Culicinae

All three Sub-families are represented in the African Continent. The culicinae make up most of them and are further divided into two tribes:-

1. Sabethini
2. Culicini

Each Sub-family and tribe is represented by one or more genera and these are divided into species; local forms of the species are known as subspecies.

Anopheles gambiae is the principal vector of malaria in Kenya and the Afro-tropical region. Anopheles gambiae is a medium sized species; general coloration yellowish brown to brown; except recently fed females which are darker. Female palpi normally have 3 pale bands the apical very broad, the other two narrow. Femora and tibiae are usually speckled or

spotted, the marking being usually obvious, but sometimes very inconspicous. Front tarsi usually have well marked pale bands. The hind tarsi usually have distinct pale apical rings on the 4th segments; last segments being normally dark (11).

Anopheles gambiae usually rests inside, but sometimes rests outside houses.

Anopheles gambiae is an important transmitter of malaria in the Afro-tropical region. It is also an important transmitter of filariasis. O'nyong nyong virus has also been recovered from it.

Early researchers were baffled by the extremely varied morphological and behavioural characteristics exhibited by Anopheles gambiae. It has now been shown that the abberations observed are actually due to cryptic speciation, which can only be detected using polytene chromosomes from the larval salivary glands and adult ovarian nurse cells (Greene 1972). (12). It is now universally recognized that Anopheles gambiae is a complex of at least five sibling species, comprising two salt - water breeding species and three fresh-water breeding species. The salt water species have been designated Anopheles merus and Anopheles melas and have been found breeding on the East and West Africa Coasts respectively. The fresh water species were at first referred to as Species A, B and C. All of

them have now been designated with full specific names by Mattingly (1972) (13). Species A has been designated Anopheles gambiae sensu stricto, species B as Anopheles arabiensis and Species C Anopheles quadriannulatus.

Anopheles funestus is the other major transmitter of human malaria in Kenya and the Afro tropical region, Anopheles funestus is a small dark anopheline with almost entirely dark legs and three narrow white rings on the palps.

In most parts of its range, Anopheles funestus breeds characteristically in bodies of clear water that are either large and more or less permanent e.g. swamps, weedy sides of streams, rivers, furrows or ditches, protected portions of lake - shore, ponds etc. especially when weedy. Shade from trees is commonly present at breeding sites, but not very dense shade (14).

Anopheles funestus is robust, long lived and will readily feed on man, mainly inside houses at night. It rests mainly inside houses.

Anopheles funestus is a very important transmitter of human malaria. It also transmits filarial worm. Several viruses including the virus of O'nyong nyong, Bwamba forest fever, Tanga, and Nyando have been recovered from it (11).

Anopheles funestus was found breeding in all the stations except, station 2, which was next to open sun-exposed marshy area; and station 5 which was next to sun-exposed polluted rain ditch at the edge of the road.

The breeding places are extremely varied for Anopheles gambiae. In most of its range, Anopheles gambiae is characteristically a small pool breeder; its breeding places are almost always, at least partially exposed to direct sunlight. Breeding places include puddles, shallow ponds, borrow (or murram) pits; animal footprints, isolated collections of water in roadside and other drains, ditches, irrigation furrows, seepage areas and in drying up beds of streams or near the edges of lakes and swamps. Many prolific breeding places are created by human activities.

In our case Anopheles gambiae was found breeding at the edge of a slow moving sun-exposed stream with both emergent and floating vegetation. It was also found breeding in open sun-exposed marshy areas draining small rivulets and rain ditches. No breeding was recorded from sun- exposed ponds with much floating vegetation. Breeding was also recorded from rice fields. The heaviest breeding was however recorded from sun-exposed rain ditches at the edge of the road. Moderate breeding was recorded from the edge of a swamp draining the main river of the area.

Anopheles gambiae feeds readily on human blood, and will enter dwellings in large numbers in most regions where it is found. Symes (1932) states definitely that the species is essentially anthrophilic (15). Feeding is usually at night and mostly indoors.

Of the three known freshwater species of Anopheles gambiae complex two species A and B are known to occur in the Kisumu area. Service (1969) (16) made some observations on the Anopheles gambiae complex near Kisumu. He conducted his study at Chiga on the Kano Plains some six miles (9½ km.) East of Kisumu. He found that species A was the commonest of the two species in breeding places near the village. 71.9% of adults collected from huts were species A. 80.6% of adults caught from outside sites were species B. These observations showed that species B is clearly more exophilic than species A. This might have some important implications for control using residual insecticides.

G.B. White (1970) found both species A and B present in the area of this study. Species B was by far the dominant member of the complex throghout the main Nyando Valley and Kano Plains. This species was found accounting for 99% of the P.S.C. collections (17). As the survey was carried out during the dry season, this may be a manifestation of the greater powers of species B to survive under drier conditions.

Such powers have been accredited to species B in several investigations. (COLUZZI, 1964, OMER & CLOUDSLEY THOMPSON 1970) (18).

Surtees (1969) compared species composition and relative abundance of mosquitoes biting man and of larval populations on the Ahero Irrigation Scheme and at Withur Village 12 km. away to the South-East. In the Irrigation Scheme Anopheles gambiae made up to 65% of the catch, Mansonia uniformis 28%, and Culex pipiens fatigans 5%. In the undisturbed village, Mansonia uniformis constituted 86% of the catch, Anopheles gambiae less than 1%. Larvae of Anopheles gambiae were more abundant in rice nursery paddies while among older plants Culex antennatus was the more dominant species. In the unmodified area Anopheles gambiae was the more dominant (19).

In the present survey Anopheles funestus was the predominant species forming 49.5% of the adult P.S.C. collection. It was followed by Anopheles gambiae forming 45.0% and lastly by culicines forming 5.4%.

Larvae of Culex poicilipes were the most abundant, forming 37.8% of all the larvae collected. It was followed by Anopheles gambiae forming 25.8% of the total. Culex quinquefasciatus formed 12.3% of the total larvae collected. While Anopheles funestus formed only 1.4%

of the total larvae collected. This may be partly explained by the fastidious nature of the breeding sites selected by Anopheles funestus.

Both mosquitoes Anopheles gambiae and Anopheles funestus are usually found in any one area but with one species predominating at any one time. Anopheles funestus is usually present in low densities throughout the year. Anopheles gambiae however shows marked increases during the rainy season. As the survey was carried out during the dry part of the year, this may partly explain the distribution of the adult mosquitoes.

Of the 593 mosquitoes collected, a total of 373 Anophelines were dissected. These included 185 Anopheles funestus and 188 Anopheles gambiae. Of the Anopheles funestus dissected, one was found positive for sporozoites giving a sporozoite rate of 0.54%. None of the Anopheles gambiae was found positive for sporozoites.

Mosquito dissection for sporozoites is a laborious and time consuming exercise and thousands of mosquitoes usually have to be dissected before a small number of sporozoites can be detected. The small number of mosquitoes dissected may partly explain the results obtained. Usually sporozoite rates are higher in Anopheles gambiae than in Anopheles funestus.

A mean sporozoite rate of 4.0% for Anopheles gambiae

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A mean sporozoite rate of 4.0% for Anopheles gambiae

was reported by Symes during 1928 - 1933. (15) Garnham (1945) found a rate of 4.0% in Anopheles gambiae (20) Joshi et al (1975) recorded a high rate of 9.4% in Anopheles gambiae species A and B combined (21). Bakri (1977) (22) reported a sporozoite rate of 7.0% in Anopheles gambiae species A prior to residual treatment of houses with Fenitrothion (OMS-43). In a more recent investigation carried out at Awendo, Obudho and Kamunvi (1981) recorded a rate of 1.8% in Anopheles gambiae species A (23).

Records show that sporozoite rates are usually lower in Anopheles funestus than in Anopheles gambiae. Garnham (1945) recorded a rate of 3.0% in Anopheles funestus. The Division of Vector-Borne Diseases (DVBD) Ministry of Health, Kenya (1962/63) recorded a sporozoite rate of 3.2% in Anopheles funestus (24). In 1977 the Division's recorded rates were variable ranging from 3.6% in January and 1.4% in May.

The other adult mosquitoes caught were mainly culicine. The species distribution included Culex quinquefasciatus, Aedes circumluteotus and Mansonia uniformis.

Culex quinquefasciatus is a medium sized culicine with brown thorax and striped abdomen. It has been described as the commonest' nuisance mosquito' in most urban and peri-urban parts of Africa. Culex

quinquefasciatus is a member of the Culex pipiens complex. Culex pipiens sensu stricto (ss st) and Culex quinquefasciatus (also known as Culex pipiens fatigans) differ in a number of morphological characters, the most constant and reliable of which concern the male phallosome. In C.p. pipiens the dorsal arms of the phallosome are widely divergent. In C. quinquefasciatus they are closely approximated. (25).

The C. pipiens complex breed in drains, gulley traps, pit-latrines, motor tyres, domestic water containers, old coco-nut shells and so on. The species will breed in the foulest water.

The species complex is the main transmitter of the filarial worm Wuchereria bancrofti. The following viruses have been recovered from the species complex; West Nile Virus and Chikungunya Viruses.

The other culicine caught was Mansonia uniformis. This is a medium-sized very scaly culicine with six pale rings on hind tarsi. The species is widely distributed in Africa South of the Sahara. It is a very common feeder on man, both inside and outside houses, mainly by night. It rests commonly inside houses.

M. uniformis is a common transmitter of filarial worms, but not in Africa. The following viruses have

also been recovered from M. uniformis: Bwamba fever virus, Chikungunya, Ndumu, Rift Valley fever, Spondweni and Wesselsbron virus. The species breeds mainly in swamps of all kinds associated with vegetation; the larvae and pupae remain below water, attaching themselves to roots, stems and leaves of plants.

The other culicine caught was Aedes circumluteolus. This is a medium sized brown culicine with yellow borders to thorax and bounded abdomen. The species is widely distributed in Africa. It feeds readily on man by day and by night but mostly just before sun-down. It feeds mostly outside houses both in the open country and in the forest. The species rests mainly among grass and other low-growing plants, also in houses.

More viruses have been isolated from this species than from any other African species. These include Bunyamwera, Kamese, Middleburg, Ndumu, Pongola, Rift Valley fever, Simbi, Spondweni and Wesselbron viruses.

Breeding places of A. circumluteolus are mainly associated with grass and other vegetation in ground pools and at the edge of swamps, following periods of heavy rain. Sometimes also found in animal foot prints.

Of the mosquito larvae collected and identified, Culex poicilipes was the most abundant. This is a medium to large culicine very common throughout Africa. It has been described as breeding in ditches, pools in

swamps and pools in river beds. Larvae are usually associated with clear water and vegetation. In our survey they were collected from all stations except station 2, the open sun-exposed marshy area with much vegetation, mainly emergent.

C. poicilipes feeds occasionally on man mainly outside houses by day. Disease transmission is not important in this species.

The other larval species collected was Anopheles coustani. This has been described as breeding in comparatively permanent rain-puddles at the sides of the road and on grass lands; slowly flowing or stagnant rivers and streams, marshes or swamps. Disease transmission is not important. But possibly an occasional transmitter of malaria in local areas. Anopheles coustani feeds mainly on cattle and other animals, also on man, mostly by night but by day in some shady places. In our survey it was found breeding in all stations except stations 5 and 6 i.e. roadside ditches and man-made ponds.

Anopheles pharoensis was another larval species collected. It was collected from all stations except station 3 i.e. the edge of the swamp. Anopheles pharoensis is a medium sized cream - coloured anopheline with shaggy palps and tufts along each side of the abdomen. It feeds on animals and man inside

houses and outside mainly at night. It rests mainly outside among vegetation. Anopheles pharoensis is an important local or occasional transmitter of malaria. Sindbis virus has been recovered from this species. Anopheles phoroensis has been described as breeding in swamps, in grass and other plants both inside and outside the papyrus zone fringing lakes and rivers. It has also been found breeding in rice fields. (14).

The other mosquito larvae found in abundance was Culex ethiopicus . This was found breeding in open marsh land, and rice fields. It has been described as a breeder in clear water containing masses of filamentous algae among which larvae lurk; its habitats include ditches holes, pools, slow running streams and grassy swamps. This species does not appear important in disease transmission.

Other larvae were found but in very low densities. Culex simpsoni was found in station 1 corresponding to slow moving sun-exposed stream. It has been described as a breeder in pools at edges of river beds and a backwater and a small stream breeder. It does not appear to important in disease transmission.

The other mosquito larvae found belonged to the genus Ficalbia. Larvae have been described as breeding in clear stagnant water with vegetation growing in it. Association with the water lettuce

seems invariable. The species found were Ficalbia splendens and Facalbia uniformis. These were found breeding in man-made ponds, rice fields and most unusually by the roadside in slightly polluted water. The mosquitoes belonging to this genus are reported to feed very occasionally on man in forests both day and night. They do not appear to be important in disease transmission.

The other larvae found belonged to the species Uranotaenia balfouri. The larvae can be identified by the head setae B and C which have stout and serrated spines. Adults are small or very small mosquitoes. They can be distinguished from all other mosquitoes by the apparent absence of microtrichia on the wing membrane (26). Little is known of the habits of this genus. None of the African species has been observed to feed on human blood (27). The members of this species have been reported to breed in association with dense aquatic vegetation (26). In our survey it was found breeding in rice fields.

Culex tigripes was found breeding in rice-fields. This is a large culicine with dark proboscis and pale-spotted legs. The species is widely distributed throughout the continent. It will attack man occasionally mainly outside houses at night. It does not appear important in disease transmission. Breeding has been

reported in many different types of water including swamps, tree holes, leaf-axis of plants and artificial containers of all sorts (26). The larvae adopt a horizontal position at the surface of the water, and because of this characteristic is more often mistaken for Anopheles. The larvae of this species are predaceous on those of other species and will eat each other in the absence of other species.

Because of the predaceous nature of its larvae and its ability to breed in many types of breeding sites, the possibility of its use in the control of larvae of other mosquitoes has been raised. One big drawback is that the adult feed on man as well, unlike Toxorynchites which do not feed on man at all. The latter however breed in highly restricted habitats like tree axils.

Clinical and Parasitological Survey

Malaria is endemic in many parts of Kenya. The degree of transmission ranges from holoendemic in parts of Nyanza and at the Coast to no transmission on the Aberdares, Mount Kenya and Mount Elgon areas. L.C. Vogel and others (1974) (28) described the following epidemiological states for some parts of Kenya:-

I ENDEMIC

1. Holoendemic	-	Coast Province, Coastal area, Tana River, Kano Plains.
2. Hyperendemic	-	Siaya, Bungoma, Busia, Shimba Hills.
3. Mesoendemic	-	Machakos, Kitui, Thika, Parts of Siaya, Murang'a, Parts of Embu.
4. Hypoendemic	-	Meru, Pokot, Samburu, Isiolo, Baringo.
II EPIDEMIC	-	Highlands over 1,600m (5,200 ft.). Dry areas with exceptional rainfall. Including Masailand, Nandi, Kisii, Kericho, Elgeyo,

Eastern Kitui, Londiani.

III NO TRANSMISSION - At altitudes over 2000m. (6,500 ft.).
Aberdares, Mt. Kenya, Mt. Elgon.

The situation from some of the available data on parasite rates in children aged 2 - 9 years from different parts of the country is shown below:-

I. NYANZA PROVINCE

Kisumu District	
Ahero	71.9%
Nyakach	77.6%
Muhoroni	47.9%
Saradidi	79.5%

II. COAST PROVINCE

Tudor	12.4%
Kisauni	26.8%
Miritini	47.9%
Magongo	32.4%
Likoni	28.7%

III. WESTERN PROVINCE

Busia	78.2%
Bunyala	75%
Kimilili	49.1%
Mumias	71.9%

IV. RIFT VALLEY

Nandi	64.8%
Kacheliba	65.0%
Kilgoris	54.2%

Source: Kenya National Antimalarial Strategy 1981.

Table 17 shows that the overall parasite rate in the sample was 54.5% (SE =1.43%). The rate in children aged 2-9 years was found to be 83.7% (SE = 1.77%). The Kenya National Antimalarial strategy 1981 found a parasite rate of 77.6% in children aged 2-9 years in Nyakach Location adjacent to the study area.

All four species of human malaria have been reported in Kenya. The commonest according to virtually all the reports is P. falciparum with a percentage frequency of upto 85% according to some source (28). A study done for the World Health Organization (WHO) showed that upto 85% of all malaria infections in Africa as a whole are

due to P. falciparum (3). In the present survey, P. falciparum was found to be responsible for 88.5% (SE = 1.24) of all the infections. Table 18 page 35 gives the percentage distribution of the other species as well as mixed infections. Out of a total of 652 people of all ages who had P. falciparum in their blood, 59 or 9.05% had gametocyctes as well. This gives a gametocycte rate of 9.05%.

A total of 414 children aged 2-9 years were examined for splenomegaly. 208 or 50.2% were found to have enlarged spleens. The frequency distribution of spleen sizes, using Hackett classification is given in Table 19. Vogel et al (1974) described malaria as holoendemic at the Coast, along the Tana River and on the Kano Plains. This is equivalent to a splenomegally of 75% or greater in children aged 2-9 years. The clinician who wants to palpate the spleen of his patients usually examines them in a recumbent position, the abdominal wall being bare, the muscles fully relaxed and perhaps the knees flexed. In the field this technique cannot always be applied. See plate 1. It is generally expedient to examine the subjects in a standing position so that complete relaxation of the abdominal muscles cannot always be obtained. This results in some slightly enlarged spleens being missed by the examiner. No doubt this contributed to the

relatively low spleen rate obtained.

The spleen is also known to respond rapidly when an antimalarial administered. The practice of giving an antimalarial for any febrile illness is widely spread in most rural communities in Kenya. This also no doubt contributed to the low spleen rate obtained.

Nevertheless, the results obtained may warrant further assessment of the value of splenomegaly in malaria surveys.

Clinical Diagnosis Survey

A limited clinical-parasitological survey was carried out. Out of 43 people who were symptomatic, 26 or 60.5% were found to harbour malaria parasites in their blood. This gives history a positive predictive value of 60.5%.

		FILM		
		+	-	
HISTORY	+	26	17	43
	-	637	536	1173
		663	553	1216

On further analysis history was found to have a sensitivity of only 3.9%. This is the proportion of those who were truly symptomatic and were also found to harbour parasites in their blood. In other words the true cases of malaria identified by history. In our case this is given by:-

$$\frac{26}{663} \times 100 = 3.92\% \pm 1.48. \text{ (95\% C.L.)}$$

History was also found to have a specificity of 96.92%. This is the proportion of cases who were rejected by history as not having malaria. This is given by:-

$$\frac{536}{553} \times \frac{100}{} = 96.62\% \pm 1.44 \text{ (95\% C.L.)}$$

Thus history is valuable in ruling out those who do not have malaria. On the other hand it is not a very useful test to pick out those who may have malaria.

There was no significant association (Chi square = 0.87 DF 1) between history and the blood film finding.

Rees et al (1969) (29) found that malaria is overdiagnosed at Kenyatta National Hospital Filter Clinics. He found out that malaria is a 'catch all' diagnosis leading to blanket therapy with chloroquine. Clinical malaria is an inaccurate diagnosis. Bhatt et al (1980) (30) showed that there is an overdiagnosis of malaria in febrile patients in Nairobi. He stressed the need for doing blood films in febrile patients. Owaga, Wekesa and Kamunvi (1979 - 1980) (31) working in Bungoma found that more than half the cases diagnosed as clinical malaria were treated for a disease they did not have.

Between September, 1979 and October 1980, 15.039 cases were diagnosed as clinical malaria by Clinical Officers at a Health Centre. The same cases had parasitological examination done by a team from the then Malaria and other Protozoal Diseases Research Centre. Out of these, 6751 or 44.73% were found positive for malaria parasites. The results indicate

that more than half the cases diagnosed as clinical malaria were treated for a disease they did not have.

An ideal screening device should have a sensitivity and specificity of 100%. History as a screening test has been found to be grossly inadequate.

At present the diagnosis of malaria is based on finding malaria parasites in a blood slide preparation of the patients blood. In an endemic area the situation may be more complicated than this.

Out of a total of 663 people who were found positive for malaria parasites in their blood, only 26 out of 663 or 3.92% exhibited any symptoms of malaria (See table on page 85). Blood slide then appears to have an even poorer predictive value and a lower sensitivity than history. The reasons for this may be manifold. The state of premunition in endemic areas requires that parasites are present at all times to induce immunity. This and other factors may explain the presence of malaria parasites without symptoms.

The situation is complicated even further. An attempt was made to compare the level of parasitaemia in those who had symptoms and those who did not. The idea was to find out if there is a threshold level of parasitaemia at which symptoms appear. Though they had a higher average (Mean = 160, SD = 284) parasite

than those without symptoms
density (Mean = 132, SD = 828), there did not seem to be such a level. When compared statistically, no relationship was found between parasitaemia in those who were ill and those who were well. See also page 38 and 40 . The question of which test is better than the other, especially in endemic areas, then becomes quite an academic one.

History, as has been seen, has low sensitivity. It also has a very high specificity in the order of 96.62%. This is of limited practical value. One is usually called upon to rule out malaria in those with symptoms and not vice-versa. On the other hand history has a very good positive predictive value, of the order of 60.4%, which makes it fairly good as a screening device.

In conclusion I think that history as a method of diagnosing malaria has its merits and demerits. Where a blood slide can be done let it be done by all means. This will assist in assessing the response to treatment and the appearance of resistance. When it cannot be done, the signs and symptoms that constitute the picture "clinical malaria" should be standardized for better diagnosis. Despite all the critisism the diagnosis "clinical malaria" has received, it will remain the mainstay of our diagnosis of malaria for quite some time to come.

RECOMMENDATION: A PROPOSED INTERVENTION PROGRAMME FOR THE STUDY AREA AND SIMILAR AREAS

The International Conference on Primary Health Care (P.H.C.) jointly sponsored by WHO and UNICEF in 1978 defined Primary Health Care as follows:-

"Primary Health Care is essential health care based on practical, scientifically sound and socially acceptable methods and technology, made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self reliance and self-determination. It forms an integral part both of the country's health system, of which it is the first level of contact of individuals, the family and the community with the national health system, bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process". (5).

The promotion of health implies that by the year 2000 health care should be available to all including "Education concerning prevailing health problems and the methods of preventing and controlling them; including the methods of prevention and control of locally endemic diseases". (32).

This broad programme would be difficult to realize

without the decentralization of health projects and community participation.

The Declaration of Alma-Ata also defined community participation as "the process by which individuals and families assume responsibility for their own health and welfare and for those of the community and develop the capacity to contribute to their community development".

Vector control is an intergral part of the prevention and control of some locally endemic diseases and should be planned and evaluated in terms of its epidemiological impact. The elemination of the nuisance effect caused by a biting insect makes an appropriate additional incentive for action at the community level (33). Of the harmful effects of mosquitoes it is the one most immediately and most directly felt by the population. It is a factor which encouraged the community to lend its support to control operations and helps to maintain their motivation.

The control measures recommended must be simple, effective, inexpensive and adapted to the local ecological and social conditions. The control measures villagers are asked to carry out should be compatible with the other tasks on which their survival depends. Farmers and other economically productive persons are easily persuaded to adopt measures which will result in economic or other tangible benefits (34). Their

participation in vector control measures involves giving them a clear explanation of the life cycle of the vector. Health education is often a necessary step at the beginning of operations.

Legal sanctions imposing some sort of punishment for non-cooperation have also been sought, but these are not appropriate for all societies and/or political systems.

C.P. Pant (35) has suggested the following measures in the control of malaria vectors. Most of them rely on reducing man-mosquito contact.

1. Sleeping inside mosquito nets

2. Use of repellents

3. Launching of mass campaigns against some specific health hazard e.g. filling up "borrow pits".

4. Rearing of fish and their dissemination in vector breeding habitats, and removing floating vegetation to help predation by fish and other natural enemies.

5. House spraying by residual insecticides by community participation.

6. Distribution of drugs to symptomatic cases and to those at special risk e.g. children and

pregnant women.

Each of the techniques should be evaluated for both their entomological and epidemiological impact.

Among the promising techniques that have been under consideration include the collection of all available information on natural products, especially plants (Jacobsen & Crossby 1971) (36), known for insecticidal, molluscicidal or repellent action. However, before their use can be fully recommended trials should be carried on their activity and on their toxixity for man, mammals and non-target organisms. It must also be verified that they are plentiful enough to ensure that the source of supply is not rapidly exhausted (34).

Rajagopalan et al (37) working in Pondicherry India showed that environmental control of vectors of malaria is possible and no elaborate technology is necessary for control of certain species of mosquito vectors in rural areas. He showed that for success, vector control programmes should be intergrated into the overall socio-economic development and health care delivery system. His study was aimed at environmental modifications that prevented, eliminated or reduced larval habitats. A massive door-to-door health education campaign was carried out to create awareness of vectors and vector-borne diseases.

For long-term operational success some kind of incentive appears to be necessary. Barodji et al (1982) (38) working in Java S.E. Asia found that insecticide treatments of cattle shelters were safely and adequately applied by village spraymen. However, it soon became apparent that for long term operational success some kind of incentive for the hamlet Chiefs was necessary to maintain their interest.

Here in Kenya, Were (1978) was able to show that people were interested in their own health problems. She went on to show that in communities where people had not voiced a perceived need to participate in their own health care, dialogue could be started and interest stimulated so that they could begin to look into the issue. She also showed that people at the community level could establish an organizational framework through which they could participate in their own health. And most interesting of all, she was able to show that it was feasable for organized community effort to operate within the context of health services administered by the Ministry of Health (39).

During this study, the community was found to be well organized. The hierarchy of village/community administration consisted of Miji-kumi, Milango and Sub-chief. The Miji-kumi is an elder selected directly by the villagers. He is responsible for 10 homesteads and it was his duty to inform the homesteads on any new

developments. Senior to the Miji-Kumi was the Milango. The Milango is also elected directly by the villagers. He is responsible for a clan; the Miji-Kumis are supposed to be responsible to him. The sub-chief administers a Sub-location; which is the first formal administrative unit. He is appointed by the Government. The Milangos are answerable to the Sub-chief.

In addition there are many recognized and respected Traditional Birth Attendants (TBAs) and Traditional healers. Also there are numerous Women's Groups and Church groupings. In this context it would be a fairly straight forward exercise to establish Village Health Committees and for these to select Village Health Workers for training.

Due to easy availability and indiscriminate use of chloroquine, many malaria cases escape detection and radical treatment. In addition there is lack of proper knowledge regarding the correct dose of the antimalarials leading to Sub-optimal treatment which almost certainly lead to development of resistance to the drugs. The first step in vector-control activities should be to disseminate information on the symptoms and the treatment of the disease to be controlled. This could be done through the schools, Churches, Barazas, Markets, Women's group etc. Simple self explanatory posters that require minimal verbal explanation could be used. Village health workers could be used for this purpose.

The lake shore and some permanent swamps are thickly vegetated with papyrus. Even though many species of predatory fish are probably present in these swamps, effective predation is not possible due to the papyrus.

The papyrus are already being harvested for commercial use to a certain extent for the following purpose:-

1. The making of reed mats.

2. Provisions of building thatch.

The first is a fairly well organized industry but being carried out on an individual basis. The papyrus-reed-mat industry could be expanded and better organized for greater economic benefit. Use could be made of the cooperative movement which has been so successful in Kenya. A small paper or card-board industry could be started using the papyrus as a raw material. In this way the swamps could be rid of papyrus and effective predation could take place.

Another important source of mosquitoes is ponds or "borrow pits" used for domestic water consumption. These are extensively covered with vegetation both floating and emergent including the water-lettuce Pistia spp. The presence of the vegetation makes predation extremely difficult. Filling these ponds

would be impracticable. The best method to control vectors in such habitats would be predation by fish. Health education would be a necessary first step. The villagers would then be persuaded to remove the vegetation from the ponds. Species of larvivorous fish would then be introduced in such habitats. Such fish could be exploited commercially and would be a source of food and income. This could further enhance people's participation in the programme.

Another source of mosquitoes is the rice fields and other irrigated areas for agriculture. Various methods have been tried in such situations. Periodic flooding and flushing have been attempted with some success. Again health education could be used as a starting point.

Toxorhynchites spp could also be used to control mosquitoes in a variety of larval habitats.

The river and the marsh are also major sources of mosquitoes. Ideally the river edges should be cleared of vegetation and the marsh drained. This may however be difficult and slow to achieve. Under such conditions one should concentrate on the protection of the community from mosquito bites. As has already been shown the peoples knowledge of control measures is quite good. The use of bed nets should be encouraged. The bed nets could be made available at subsidised rates.

The other source of mosquitoes was roadside stagnant pools. Local authorities should be in the forefront here. They should be able to provide culverts and drains for such sites. The community in the long run could be persuaded to carry out such activities once they begin to realize the benefits of disease-free life.

Not all areas are amenable to some sort of control. One will recall that Anopheles gambiae is essentially a small pool breeder. These habitats are often numerous and impossible to eliminate in rural communities. Emphasis should be on protection of man to reduce man-mosquito contact. Use of mosquito nets has already been mentioned. These could be made available at subsidised rates. They could be purchased collectively from the proceeds of the papyrus and fish industry.

As has already been shown knowledge of repellents and fumigants of plant and animal origin is widespread in the community. Some of these beliefs are age old and have probably been held for a very long time. These should be tested for efficacy, efficiency, and toxicity to man and domestic animals. Their use could justify the setting up of small cottage industries for their commercial exploitation.

Of the plants mentioned, the following should be investigated further:-

Lantana spp

Eucalyptus spp

Euphorbia spp

Lantana spp was the most common species mentioned in the traditional methods of mosquito control.

Lantana belongs to the family Verbenaceae. It is a thicket forming shrub reaching a height of 3-4 metres. The stems are four angled and prickly. The opposite, ovate, aromatic leaves have serrate margins and a rough upper surface. It is widely spread and is an undesirable weed on waste land and elsewhere. The species most commonly encountered was Lantana rhodesiensis (Nyabend Winy). Kokwaro (1976) states that the leaves of this plant are chewed and swallowed for the treatment of gland disorders, sore throats and tongue troubles. Roots are boiled in water and decortion drunk twice a day for rheumatism. (40).

The knowledge of the use of this plant as a repellent for mosquitoes was widespread. The method of use most commonly mentioned was burning green leaves. It is recommended that this plant be investigated for its efficacy and effectiveness in mosquito control.

The other plant mentioned was Eucalyptus spp. Eucalyptus or Blue Gum belongs to the family Myrtaceae. It is a very fast growing tree which often attains a

height of about 100 metres. The bark breaks of continously in strips from the trunk and the branches. The mature lanceolate, slightly curved leaves smell strongly of camphor, Kokwaro (1976) states that an infusion of the leaves of this plant is used for the treatment of gland disorders (40). The most common species encountered was Eucalyptus globulus. This was fairly widespread in the area.

All species of Eucalyptus yield a volatile oil, known as oil of eucalyptus which for medicinal purposes contains not less than 70% w/w of cineol $C_{10}H_{18}O$ an anhydride of menthane - 1:8 - diol (G160). Cineol is also known as eucalyptol and cajuputol. Oil of eucalyptus is colourless or pale yellow, has an aromatic camphoraceous odour and a pungent camphoraceous cool taste. It has long been a household remedy for colds and an ingredient in nasal drops. In India the oil is used as a mosquito and vermin repellent and as an important component of many insecticidal and repellent preparations. Tests have shown that the mosquito repellency is effective for about one hour (41).

Eucalyptus spp are fast growing trees whose root systems are very extensive and reach great depths. The uptake of ground water by Eucalyptus roots is very great. Planted next to swamps they have proved very effective in reducing the level of the water table and hence the amount of surface water. They should be

planted in marshy areas to drain such areas. The most common method was burning of leaves. The other plant mentioned was Euphorbia spp. This belongs to the family Euphorbiaceae. The species encountered was Euphorbia tirucalli (Ojuok). Euphorbia or the milk bush is a much branched shrub or small tree. It reaches a height of about 6 metres. Small young branches are green, fleshly and leafless. The plant is commonly planted as a hedge. Its milky sap causes strong pain when in contact with the eyes. Kokwaro (1976) states that young branches can be roasted and chewed, the juice acts as an emetic in cases of snake bite and also for sterility in women. He cautions that any medicine made from the plant must be used with extreme care due to its high toxicity. Euphorbia tirucalli, the common "rubber hedge" of Zimbabwe, the latex is highly irritant to the skin and produces so intense a reaction on the eye as to produce temporary blindness, lasting several days. The tree is regarded by the African in Tanganyika as a mosquito repellent and as an insecticide in India. (41).

These were the main plants encountered during the study. Perhaps they could be investigated further to justify the setting up of cottage industries that could enhance vector-control activities.

PLATE 1:

The author 3rd from left examining children for enlarged spleen.

His assistant 2nd from left is meanwhile preparing to take a blood slide.

PLATE 2:

These are the assistants who assisted in the administration of the KAP Survey. From left to right are: Obira, Atieno, Obuya, Okombo and Otieno.

PLATE 3:

Typical living huts in the study area. Adult P.S.C. catches were done in such huts. The child on the left had ulcerated advanced jaw tumour and massive hepatosplenomegaly.

Typical appearance of the countryside during the rainy season. The small pools and puddles shown are the typical breeding sites for An. gambiae. In the background can be seen trees belonging to Eucalyptus spp.

PLATE 6:

Typical tree found in the area. It is reputed to have molluscicidal properties. The tree is called "Othoo" in the vernacular.

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APPENDIX

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Appendix Form 1

UNIVERSITY OF NAIROBI

DEPARTMENT OF COMMUNITY HEALTH

AND

KENYA MEDICAL RESEARCH INSTITUTE

DIVISION OF

VECTOR BIOLOGY AND CONTROL RESEARCH CENTRE

PROJECT: VECTOR CONTROL IN MALARIA AT COMMUNITY LEVEL

REF:

DATE:

PART. I. A K.A.P SURVEY ON MALARIA IN GEM-RAE SUBLOCATION
KISUMU DISTRICT

SERIAL NO.

DATE _____ INVESTIGATOR _____ INTERVIEWER _____

DIVISION _____ LOCATION _____

CHIEF _____ ASSISTANT CHIEF _____

VILLAGE LEADER(MILANGO) _____

VILLAGE ELDER(MIJI-KUMI) _____

HOMESTEAD NO: _____

HEAD OF HOMESTEAD : -

NAME _____ AGE _____ SEX _____

NO OF BUILDINGS IN HOMESTEAD _____ NO. OF HOUSEHOLDS IN HOMESTEADS _____

NO. OF PEOPLE IN HOUSEHOLD :-

DE FACTO _____

DE JURE _____

HEAD OF HOUSEHOLD:-

NAME _____ AGE _____ SEX _____

RESPONDENT :-

NAMES _____

AGE _____ SEX _____ RELIGION _____

OCCUPATION _____

MARITAL STATUS : MARRIED SINGLE SEPARATED DIVORCED WIDOW

HIGHEST CLASS REACHED IN SCHOOL _____

OTHER TRAINING RECEIVED (SPECIFY) _____

RELATION TO HEAD OF HOUSEHOLD _____

YEARS RESIDENT IN AREA _____

...../2

1. What are the major problems in this area?
GIN YORE MAGE MAG NGIMA MA THAGO JI E GWEN'G KA?

2. What are the major health problems in this area?
GIN TUOCHE MAGE MA THAGO JI E GWEN'G KA?

3. Have you heard of malaria?
BENDE NSEWINJO CHA ILUONGO NI MALARIA?

Yes ☐ No ☐ Don't Know ☐

4. What is Malaria?
TO MALARIA EN ANG'O?

5. What is the local name for malaria?
MALARIA ILUONGO NI ANG'O GI PIOLOG?

6. What are the symptoms of malaria?
RANYISI MAG MALARIA CIN MAGE?

7. How do people get malaria?
TO JI YUDO MALARIA NADE?

8. Who suffers from malaria?
TIENG MANE MA MALARIA OMERO THAGO?

9. In [illegible] is malaria more serious?
GI TIENG MANE MA MALARIA RACH AHINYA KUOHBI?

10. Does malaria cause any disability?
BENDE MALARIA NYALO NGOLO NGATO?

Yes ☐ No ☐ Don't Know ☐

111 If yes, what kind of disability does it cause?
KA KAMAKO TO ONYALO NGOLO NGATO E YO MANADE?

12. Is malaria fatal?
TO BENDE MALARIA NYALO NEGO NGATO?

Yes ☐ No ☐ Don't Know ☐

13. If yes, in whom is it fatal?
KA KAMANO TO EN THENG MANE MA OTHORO NEGO?

14. Can malaria be treated?
BENDE MALARIA NYALO THIEDHO?

Yes ☐ No ☐ Don't Know ☐

15. If yes how can it be treated?
KA KAMANO, TO NYALO THIEDHE NADE?

16. How do you treat malaria in self?
NYISIE KAKA ITHIEDHO MALARIA KA OMAKI?

17. Can malaria be cured?
BENDE MALARIA NYALO THIEDHO MA NGATO KWO?

Yes ☐ No ☐ Don't Know ☐

18. Can malaria be prevented?
BENDE NYALO GENGO MALARIA MONDO KIK MAK DHANO?

Yes ☐ No ☐ Don't Know ☐

..../4

19. If yes, how can it be prevented?
KA KAMANO, TO INYALO GENGE NADE?

20. Do you use any methods of prevention?
BENDE IKONYORI GI YO MORO AMORA MAR GENGO MALARIA?

Yes ☐ No ☐ Don't Know ☐

21. If yes what methods do you use?
KA KAMANO TO EN YO KATA YORE MAGE MA IKONYORI GO?

22. Have you heard of a mosquito?
BENDE ISEWINJO GIMA ILUONGO NI SUNA?

Yes ☐ No ☐ Don't Know ☐

23. Are they present in this are?
BENDE GIYUDORE E GWENG KA?

Yes ☐ No ☐ Don't Know ☐

24. Where do they breed?
TO GINYUOLORE KANDE?

25. Where do adult mosquitoes hide or rest
a) During the day b) During the night
TO SUNA THORO YWEYO KATA PONDO KANYE
a) DIEGIENG _____ OTIENO _____

26. When do you experience a lot of mosquitoes here?
EN NDALO MANE MA SUNA NGENYIE AMENYA A GWENGU KA?

27. Do mosquitoes cause you any problems?
TO BENDE SUNA THAGOU E YO MORO AMORA?

Yes ☐ No ☐ Don't Know ☐

...../5

28. If yes, what problems do they cause you?
KA KAMANO TO GITHAGOU E YO MANADI?

29. Do mosquitoes transmit any disease?
TO BENDE SUNA KELO TUO MORO AMORA?

Yes ☐ No ☐ Don't Know ☐

30. If yes what disease(s) do they transmit?
KA KAMANO TO GIKELO TUO KATA TUOCHE MAGE?

31. Do you know of any methods of preventing mosquitoes from biting you?
BENDE INGEYE YO KATA YORE MAG GENGO SUNA MONDO KIK KAYI?

Yes ☐ No ☐ Don't Know ☐

32. If yes, describe the method(s) you know of
KA KAMANO TO NYISIE YO KATA YORE MA INGEYO GO?

33. Do you know of any traditional methods of preventing mosquitoes from biting you?
TO BENDE INGEYE YO KATA YORE MAG NAYLUO MAG GENGO SUNA MONDO KIK KAYI?

Yes ☐ No ☐ Don't Know ☐

34. If yes, describe the mathod you know of?
KA KAMNO TO NYISIE YO KATA YORE MA INGEYO GO?

35. Do you use any method(s) to protect yourself from mosquito bites?
TO BENDE IKONYORI GI YO MORO AMORA MAR GENGO SUNA MONDO KIK KAYI ...
GENGO SUNA

Yes ☐ No ☐ Don't know ☐

...../6

35. If yes describe the method used?
KA KAMANO TO NYISIE YO KATA YORE MA EKONYORIGO?

37. Do you know of any anti-malaria measures that have taken place or are taking place in this area?
TO BENDE ISENENOE JO-MALARIA KA TIYO E GWENG'U KA CHON KATA SANI?

Yes ☐ No ☐ Don't Know ☐

38. If yes describe the measure mentioned.
KA KAMANO TO NYSIE TICH MA IWACHONO KAKA CHALO

39. What part did you play in themeasure mentioned?
TO EN KONY MANADI MA NE IGI WO E TIJNO?

40. When was the measure carried out?
TO TICH NO NENE OTIYORE KARANG'O?

DISEASE SURVEY

1. Has anybody from this household been ill over the last one month?
E DWE MOKALO NIBENDE NG'ATO OSETUORE E ODU KA?

Yes ☐ No ☐

2. If yes, what was the problem?
KA KAMANO TO EN ANG'O MA NEDCHA TUO'E?

...../7

3. What symptoms did he/she have?
GIN MANYISI MAGE MA NYOCHA EN/GIN GO?

4. Did he/she seek treatment?
TO BENDE NENE OCHIEGHE?

Yes No

5. If yes from where did he/she seek treatment?
KA KAMANO TO NENE ODHI DHARO TIETH KANYE?

6. What was the out come?
EN ANG'O MA NENE OTIMORE BAN'G YUDO TIETH?

FOR ALL WHO HAVE BEEN ILL
FILL OUT THE FOLLOWING

Name	Age	Sex	Symptoms	Remarks
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Appendix Form 2

A STUDY OF MALARIA ON THE KANO PLAINS KISUMU DISTRICT, KENYA

A STUDY OF KNOWLEDGE, AND PRACTICES

By: DR. ONGORE

FOR: MPH PROJECT PAPER
DEPARTMENT OF COMMUNITY HEALTH
UNIVERSITY OF NAIROBI.

SUPERVISED By:

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VARIABLE	VARIABLE NAME	NO. OF COLUMNS	COLUMN NO.
1. Serial No.	SERIAL	3	1 - 3
2. Date of Interview	DATE	6	4 - 9
3. Interviewer	INTERVIEWER	1	10
4. Household size (De facto)	SIZE	2	11-12
5. Household Size (De jure)	SIZE	2	13-14
6. Respondent (R)	RESPONDENT (R)	1	15
7. R' Age	R'AGE	2	16-17
8. R' Sex	R'SEX	1	18
9. R' Religion	R'RELIGION	2	19-20
10.R' Occupation	R'OCCUPATION	2	21-22
11.R' Marital Status	R'MARITAL	1	23
12.R' Education	R'EDUCATION	1	24
13.R' Years Resident	R'RESIDENCY	2	25-26
14.Major Problems	PPOBLEMS	1	27
15.Health Problems	HEALTH	1	28
16.Knowledge of MALARIA	MALARIA KNOWLEDGE	1	29
17.Defination,Malaria	MALARIA DEFINATION	1	30
18.Local Name, Malaria	MALARIA, LOCAL NAME	1	31
19.Symptoms of Malaria	MALARIA, SYMPTOMS	1	32
20.Getting, Malaria	MALARIA, HOW INFECTED	1	33
21.Malaria Sufferer	MALARIA, SUFFERER	1	34
22.Malaria Severity	MALARIA, SEVERITY	1	35
23.Malaria Disability	MALARIA, DESABILITY	1	36
24.Malaria Disability	MALARIA, DISABILITY	1	37
25.Malaria Farality	MALARIA, FATALITY	1	38
26.Malaria Fatality	MALARIA FATALITY	1	39
27.Malaria Treatment	MALARIA TREATMENT	1	40
28.Malaria Treatment	MALARIA TREATMENT	1	41
29.Malaria Treatment	MALARIA TREATMENT	1	42

	VARIABLE	VARIABLE NAME	NO. OF COLUMNS	COLUMN NO.
30.	Malaria Curability	MALARIA CURABILITY	1	43
31.	Malaria Preventability	MALARIA PREVENTABILITY	1	44
32.	Malaria Preventability	MALARIA PREVENTABILITY	1	45
33.	Method of Prevention	PREVENTION METHOD	1	46
34.	Method Used	METHOD USED	1	47
35.	Mosquito	MOSQUITO KNOWLEDGE	1	48
36.	Mosquito	MOSQUITO PRESENCE	1	49
37.	Mosquito	MOSQUITO BREEDING	1	50
38.	Mosquito	MOSQUITO RESTING(DAY)	1	51
39.	Mosquito	MOSQUITO RESTING (NIGHT)	1	52
40.	Mosquito	MOSQUITO, WHEN NUMEROUS	1	53
41.	Mosquito	MOSQUITO, PROBLEMS	1	54
42.	Mosquito	MOSQUITO PROBLEMS CAUSED	2	55-56
43.	Mosquito	MOSQUITO AND DISEASE	1	57
44.	Mosquito	MOSQUITO AND DISEASE	1	58
45.	Mosquito	MOSQUITO PREVENTION	1	59
46.	Mosquito	MOSQUITO, METHOD OF PREVENTION	1	60
47.	Mosquito	MOSQUITO, PREVENTION TRADITIONAL	1	61
48.	Mosquito	MOSQUITO, METHOD OF PREVENTION TRADITIONAL	1	62
49.	Mosquito	METHOD OF PROTECTION USED	1	63
50.	Mosquito	METHOD OF PREVENTION USED	1	64
51.	Anti Malaria Measure	ANTI-MALARIAL MEASURE, KNOWLEDGE	1	65
52.	Measure Description	MEASURE DESCRIPTION	1	66
53.	Part Played in Measure	MEASURE PART PLAYED	1	67
54.	Measure, when	MEASURE, WHEN CARRIED OUT	4	68-71

Appendix Form 2

A STUDY OF MALARIA ON THE KANO PLAINS KISUMU DISTRICT, KENYA

A STUDY OF KNOWLEDGE, ATTITUDE AND PRACTICES

BY

DR. ONGORE

FOR: MPH - Project Paper
Department of Community Health
University of Nairobi.

SUPERVISED BY

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	VARIABLE	VARIABLE NAME	NO. OF COLUMNS	COLUMN NO.
1.	Serial No.	SERIAL 001-183	3	1 - 3
2.	Date	DATE Eg. 230585	6	4 - 9
3.	Interviewer	INTERVIEWER	1	10
		Atieno = 1		
		Obuya = 2		
		Otieno = 3		
		Okombo = 4		
		Ongore = 5		
4.	Household Size	SIZE (de jacto)	2	11 - 12
5.	Household Size	SIZE (de jure)	2	13 - 14
6.	Respondent (R)	RESPONDENT (R)	1	15
		Head = 1		
		Wife = 2		
		Child of (1) = 3		
		Parent of (1) = 4		
		Other = 5		
7.	R'Age	R'AGE	2	16 - 17
		Actual Numbers/Years		
		99 = Unknown		
8.	R'SEX	R'SEX	1	18
		Male = 1		
		Female = 2		
9.	R' Religion	R'RELIGION	2	19 - 20
		Pentecost 01		
		Power 02		
		Catholic 03		
		A.I.C. 04		
		Episcopal 05		
		Anglican /CMS 06		
		S.D.A. 07		
		Roho 08		
		Voice of Salvation 09		
	R' Religion	Legio Maria 10		19 - 20
		Hera 11		
		A. Israel N 12		
		Others 13		

VARIABLE	VARIABLE NAME		NO. OF COLUMNS	COLUMN NO.
	- Ayem			
	- Injili			
	- S.T.			
	- Voice of the Lord			
	- U.I.L.M.C.			
	- E.C.A.			
	- C.C.A.			
10. R'Occupation	Farmer	01	2	21 - 22
	Mid-wife	02		
	Student	03		
	Pastor	04		
	Guard	05		
	Businessman	06		
	Teacher	07		
	Tailor	08		
	Fisherman	09		
	Casual Laborrer	10		
	- Agricultural Worker			
	- Cotton Mill Worker			
	- Builder			
	Policeman	11		
	Village Elder	12		
	No response	13		
11. R'Marital Status	Married - 1	1		23
	Single - 2			
	Separated - 3			
	Widowed - 4			
	Divorced - 5			
12. R'Education			1	24
	Nil - 0			
	Primary - 1			
	Secondary - 2			
	High School - 3			
	University - 4			
	Other - 5			
13. Years Resident in Area			2	25 - 26
	Actual Years	99-Unknown		

VARIABLE	COLUMNS	COLUMN NO.
14. Major problems in Area	1	27

0. Nil
1. Diseases
2. Natural Calamities (Floods/Droughts).
3. Food Shortages
4. Financial Problems
5. Water Scarcity
6. Lack of health services
7. Other; communications, housing
8. Don't know/Not clear

15. Health Problems in Area	1	28

0. Nil
1. Malaria related complaints; headaches, malaise, bachache, body and joint pains.
2. G.I.T. - related problems; nauseal, diarrhoeal, vomiting, dysentry, epigastric pains
3. Respiratory tract related problems; chest pains, coughs, colds and flu.
4. Ear problems
5. Eye problems
6. Skin diseases + burns
7. Measles
8. Helminthiasis
9. Other: Toothaches, diabetes, epilepsy abortion, "the wind"

16. Knowledge of Malaria	1	29

Yes = 1, NO = 2, DDK = 3, Blank = 4

17. Defination of Malaria	1	30

1. Disease
2. Disease associated with:-

   Coldness of the body, headaches, hotness of the body, joint pains, whole body pains.
3. Disease associated with:-

   Abdominal pains, nauseal, diarrhoeal, vomiting.
4. Disease caused by bite of mosquito.

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.
	5. Disease associated with:- colds and flu		
	6. Disease caused by walking barefoot in water		
	7. Other:- Disease that follows the back		
	Disease from the stomach		
	8. D/K		
	9. Blank/No response		
18.	Local name for malaria	1	31
	1. Midhusi		
	2. Kulbat		
	3. Tho amuor		
	4. Wich bar motegno		
	5. Other; wich bar, Tuo aginge Del ma hore, Dulme, ich kach koyo mar del, aremo, ahonda		
	6. Don't know		
	7. Blank/Not Applicable		
19.	Symptoms of Malaria	1	32
	Malaise 1		
	Loss of appetite 2		
	Fever/Chills 3		
	Nauseau and vomiting 4		
	Headaches 5		
	Joint & body pains 6		
	~~Other;~~ Yellow Eyeballs+ 7		
	Other; body rash, yellow Urine, chest, pains, abdominal pains, diarrhoea, redness of the eyes 8		
	Don't Know 9		
20.	Malaria, How infected	1	33
	1. Bite of Mosquito		
	2. From Water		
	- Walking in cold water		
	- Walking near rivers		
	- Walking in flood waters		
	3. Walking on mud		

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.

4. Unsanitary living conditions
   - Eating bad food
   - Drinking dirty water
   - Using dirty utensils
   - From flies
   - From dirty home sorroundings

5. From infected people

6. Other: From the air,
   Yamo (=the wind),
   auto matic, when the
   whether changes

7. D/K or Blank

21. Who suffers from Malaria? 1 34

1 = Children under 1 year
2 = Children and young children 2-9
3 = Older children 10-14
4 = Adults 15+
5 = Children and adults
6 = Old people 7 = D/K

22. In whom is Malaria More serious? 1 35

1 = Children under 1 years
2 = Children and young children 2-9
3 = Older children
4 = Adults 15+
5 = Children and adults
7 = Young and old peole
8 = Pregnant women
9 = D/K

23. Can malaria cause any Disability? 1 36

Yes 1
NO 2
OK 3
Blank 4

24. If Yes what kind of Disability? 1 37

1. Madness
2. Chronic joint pains
3. Body stiffness
4. Neck distorted
5. Severe backache
6. Finishes blood/Body weakness
7. Other; Polio, Sickness,
   Stomach ulcers, Headache,
   Inability to walk, lameness
8. Not Applicable

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.

9. Don't know

25. Is Malaria Fatal? 1 38

1. Yes
2. NO
3. Don't Know
4. Blank

26. If Yes; in whom is it fatal? 1 39

1 = Children under 1 year
2 = Children and young children 2-9 years
3 = Older children 10-14
4 = Adults 15+
5 = Children and adults
7 = Post partum women
8 = Old people
9 = Children and old people
0 = D/K

27. Can Malaria be Treated? 1 40

1. Yes
2. NO
3. Don't Know
4. Blank

28. How can Malaria be Treated. 1 41

1. Taking tablets
2. Going to Hospital/Dispensary/ Clinic
3. Seeing a Doctor
4. Getting an Injection
5. Praying and using medicine
6. Traditional drugs and treatment
7. Other: Hot-Water, attending Clinic for young children
8. Injection and Tablets
9. Don't Know/Not applicable

29. How do you treat malaria in self? 1 42

1. Take tablets: Aspro; Aspirin, Malariaquine, Chloroquine etc.
2. Get Injection
3. See a Doctor
4. Go to Hospital/Dispensary
5. Take traditional heals
6. Pray
7. Other: Salt water, Hot water

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO
	Sleeping		
	8. Don't Know		
30.	Can Malaria be cured?	1	43
	Yes - 1		
	NO - 2		
	DK - 3		
	Blank - 4		
31.	Can Malaria be prevented?	1	44
	Yes - 1		
	NO - 2		
	DK - 3		
	Blank - 4		
32.	How can Malaria be prevented?	1	45
	1. Taking Tablets		
	2. Environmental Sanitation		
	- Covering ponds		
	- Draining stagnant water		
	. Clearing tall grass & bushes		
	3. Doing away with mosquitoes		
	4. Going to Hospital/Dispensary/Clinic		
	5. Seeing a Doctor		
	6. Good living habits		
	- Boiling water		
	- Eating clean food		
	- Keeping cooking utensils clean		
	- Wearing gum boots		
	- Wearing sweater		
	7. Using mosquito net at night		
	8. Not applicable		
33.	Do you use any methods or prevention	1	46
	Yes - 1		
	NO - 2		
	D/K - 3		
	Blank - 4		

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO
34.	What method of prevention do you use	1	47
	1. Take tablets/Injection		
	2. Environmental Sanitation		
	- Filling up ponds, draining Stagnant water, clearing bushes		
	3. Using insecticides/repellents		
	- Spraying DDT, Pyrethrum		
	- Burning; Mosquito coil, Pyrethrum powder		
	4. Going to Hospital		
	5. Keeping warm when it is cold		
	6. Good living habits		
	- General cleanliness		
	- Taking fruits regularly		
	- Clean toilet habits		
	7. Mosquito net at night		
	8. Avoid children playing in water		
	9. Don't Know/Not applicable		
35.	Have you heard of Mosquito?	1	48
	Yes - 1		
	NO - 2		
	Don't Know - 3		
	Blank - 4		
36.	Are they present in this Area	1	49
	Yes - 1		
	NO - 2		
	Don't Know - 3		
	Blank - 4		
37.	Where do Mosquitos breed	1	50
	1. Stagnant Water; ponds, pods, pots and tins swamps, river banks.		
	2. Vegetation; tall grass, green maize, in the garden, millet		
	3. Running water		
	4. In dark places		
	5. In dry places		
	6. Other: Everywhere inside &		

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.

Outside houses.

7. Not applicable

8. Don't Know

38. Where do Adult Mosquitos rest

a) During the day 1 51

1. Dark places in the house
2. On the walls/roofs inside house
3. In vegetation; tall grass, bushy areas, garden etc.
4. At edges of streams, rivers, ponds, swamps, lake etc.
5. Other
6. D/K

b) During the night 1 52

1. All over the house
2. Flying around biting
3. Other
4. D/K

39. When are Mosquitos more numerous 1 53

1. During rainy season
2. The whole year
3. Don't Know
4. Other - during harvest

40. Do mosquitos cause you any problems 1 54

1.- Yes
2 - NO
3 - D/K
4 - Blank

41. What problems do mosquitos cause?

1 Biting nusance; body rash, body swelling, itching of the body 1 55

2 Transmit Diseases; Malaria, yellow fever, Measles 1 56

3 Other: Cause abdominal

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.

Finish our blood

4. Not applicable

4.4. Both 1 & 2

42. Do mosquitos transmit any diseases? 1 57

Yes - 1
No - 2
D/K - 3
Blank - 4

43. What diseases do mosquitos transmit? 1 58

1. Malaria related symptoms; Headache, body weakness, tiredness, malaise, fever.
2. Skin diseases; itching of the body, body rash, boils.
3. G.I.T. related problems; diarrhea, vomiting.
4. Measles
5. Worms
6. Respiratory tract related problems; chest pains, coughs, colds & flu.
7. Yellow fever
8. Finish our blood
9. Others: madness, sleeping sickness, plagues etc.

44. Do you know any methods of Preventing mosquitos from biting you? 1 59

Yes - 1
NO - 2
D/K - 3
Blank - 4

45. Method of preventing mosquitos bites 1 60

0 - Not applicable
1 - Using bed net
2 - Spraying pyrethrum products

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO

Doom, IT etc.

3 - Burning pyrethrum products

- Powder, coild

4 - Burning earphobia leaves

5 - Burning encalyptus leaves

6 - Burning Lantana camara leaves

7 - Environ-mental sanitation

- Filling up ponds, keeping compound clean, clearing bushy areas.

8 - Burnign cowdung, goat droppings

9 - Others: Killing mosquitos' eggs, burning old blankets, burning rice pods, closing door at night.

46. Do you know of any traditional methods of prevention of mosquito bites? 1 61

Yes - 1
NO - 2
D/K - 3
Blank- 4

47. Description of the method? 1 62

1 - Burning encalyptus leaves

2 - Burning euphobia leaves

3 - Burning Lantana camara leaves

4 - Burning cowdung

5 - Burning goat/donkey droppings

6 - Other: - burning sisal leaves
- burning rice husks
- burning cotton pods
- burning rubber

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO.

- burning dirty clothes
- burning any leaves

7 - Not applicable.

48. Do you use any method of preventing mosquito bites? 1 63

Yes - 1
NO - 2
D/K - 3
Blank - 4

49. Describe the method? 1 64

1 - Mosquito net
2 - Spraying pyrethrum products
3 - Burning pyrethrum products
- Mosquito coil
- Pyrethrum powder
4 - Burning encalyptus leaves
5 - Burning enphorbia leaves
6 - Burning Lantana camara leaves
7 - Cleanliness in home/compound
8 - Other: covering with blanket
- burning sisal leaves
- making smoke with anything
- taking tablets

9 - Blank/NA.

50. Do you know of any anti-malarial measures that have taken place here? 1 65

Yes - 1
NO - 2
D/K - 3
Blank - 4

VARIABLE	VARIABLE NAME	COLUMNS	COLUMNS NO
51.	Describe the measure	1	66

1 - Spraying

2 - Mosquito survey

- Catching mosquitos

3 - Disease survey

- Took blood (slides)
- Took stools

4 - Gave treatment

- Tablets
- Injections
- Treatment for small children.

5 - Aga Khan Primary Health Care Unit Work

- Census teaching
- Health Education.
- Vaccination
- Instructions on proper home management
- Asking problems

6 - Not applicable.

52.	What part did you play in the measure?	1	67

1 - Passive part

- No part
- Thanked them
- Welcomed them

2 - Helped in survey of mosquitos

- Cleared the compound

3 - Took children for treatment

- Provided children for measure.

VARIABLE	VARIABLE NAME	COLUMN	COLUMNS NO.

4 - Responded to questions

5 - Provided specimens

- stool - specimens
- blood

6 - Paid a fee

- paid Shs.5/=

7 - Not applicablee

53. When was the measure carried out? 4 68-71

1970's - 0084

April 1979 - 0484

May 1981 - 0581

April 1983 - 0483

1984 - 00'84

June 1984 -

September 1984

October 1984

December 1984

January 1985

February 1985

May 1985

Not - Specified = 9999.

Not Applicable = 8888.

Appendix Form 4

UNIVERSITY OF NAIROBI

DEPARTMENT OF COMMUNITY HEALTH AND KEMRI/WHO/UNDP VECTOR BIOLOGY AND CONTROL RESEARCH UNIT

PROJECT: VECTOR CONTROL IN MALARIA AT COMMUNITY LEVEL

PART II: A PILOT SURVEY OF MALARIA PARASAEMIA AND SPLEEN RATES GEM-RAE SUB-LOCATION OF KISUMU DISTRICT, KENYA.

HOMESTEAD NO. _____

DIVISION _____ LOCATION _____

SUB-LOCATION _____ VILLAGE _____

CHIEF _____ ASST. CHIEF _____

VILLAGE(MILANGO) LEADER _____ VILLAGE (MUJI-CHIEF RUMI) _____

HEAD OF HOMESTEAD _____

SERIAL NO.	NAME	SEX	AGE	SPLEEN CLASS	RESULT OF BLOOD EXAMINATION	REMARKS
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11						
12.						
13.						
14.						
15.						

Appendix Form 5

U N I V E R S I T Y O F N A I R O B I

DEPARTMENT OF
COMMUNITY HEALTH AND KENYA MEDICAL RESEARCH
INSTITUTE, VECTOR BIOLOGY AND CONTROL
RESEARCH CENTRE

PROJECT: VECTOR CONTROL AT COMMUNITY LEVEL

PART III: A PILOT SURVEY OF MALARIA VECTORS AND OTHER MOSQUITOES IN GEM-RAE SUBLOCATION, KISUMU DISTRICT KENYA

PYRETHRUM SPRAY-SHEET COLLECTION

LOCATION ..... SUB-LOCATION ..... VILLAGE ...

HOMESTEAD NO ..... TYPE OF BUILDING .....

DATE OF COLLECTION ..... TIME OF COLLECTION .....

		AN. GAMBIAE					AN.FUNESTUS					OTHER ANOPHELES		CULICINES		
No of Houses	No of sleepers	Male	Unfed	Fed	Gravid	Total	Male	Unfed	Fed	Gravid	Total	Male	Female	Male	Female	Catch No
1																
2																
3																
4																
5																
TOTAL																

Densities : An. gambiae per house .....
An. funestus per house .....

SALIVARY GLAND DISSECTION TO DTERMINE SPOROZOITE INFECTION

ANOPHELES SPECIES	NO DISSECTED	NO +VE	NO -VE	%+VE
An.gambiae				
An.funestus				

GUT-WALL DISSECTION TO DETERMINE OOCYST INFECTION

ANOPHELES SPECIES	NO DISSECTION	NO +VE	NO -VE	%+VE
An.gambiae				
An.funestus				

EEDING SITES	SPECIES																			

χ^2-DISTRIBUTION

n	$\alpha = 0.995$	$\alpha = 0.99$	$\alpha = 0.975$	$\alpha = 0.95$	$\alpha = 0.05$	$\alpha = 0.025$	$\alpha = 0.01$	$\alpha = 0.005$
1	0.0000393	0.000157	0.000982	0.00393	3.841	5.024	6.635	7.879
2	0.100	0.0201	0.0506	0.103	5.991	7.378	9.210	10.579
3	0.00717	0.115	0.216	0.352	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	11.070	12.832	15.086	16.750
6	0.676	0.872	1.237	1.635	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	18.307	20.483	23.209	25.188
11	2.603	3.053	3.186	4.575	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	43.773	46.979	50.892	53.672

Table of the Chi-square distributions.