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REPORT ON A VISIT TO NEPAL TO EVALUATE TRAINING AND FACILITY NEEDS AT THE RESEARCH AND TRAINING CENTRE AT HETAUDA

by

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INTRODUCTION

Antimalarial activities in Nepal began in 1952, with residual house-spraying starting in 1953-54 in different parts of the country. By 1963, all areas below 1220 meters were routinely sprayed with DDT. Active case detection (ACD) began in 1970, and in 1981 passive case detection (PCD) was introduced. Initially the program was very successful, and during 1970-71 the Annual Parasite Index (API) was only about 0.5/1,000 population. Unfortunately malaria transmission increased thereafter, for a variety of reasons including agricultural expansion at the expense of reducing forest areas, increased human population movement, and DDT resistance in Anopheles annularis. During the 1980s there has been an even greater increase in malaria with many of the cases coming from India. In 1986, for example, 29,426 vivax and 3,278 falciparum cases were reported from the NMEO area, with about 21% of the cases estimated as being imported. On average about 30,000 malaria cases are recorded annually.

Malaria is consequently still a problem in certain areas of Nepal, particularly in the inner terai (see Figure 1) and the situation is aggravated by the presence of chloroquine-resistant P. falciparum. Presently, USAID is providing support for the malaria program, mainly by purchasing insecticides (malathion), but for various reasons insecticidal usage is being reduced in Nepal and USAID will phase out its donation of insecticide after 1988. As a result, attention is now being focused on alternative methods of control, such as biological methods, environmental manipulation and permethrin-impregnated bed-nets.

It has been recognized by both USAID and NMEO that there is an urgent need for both better and increased training of upper-level (Malaria Assistants and Entomologists) and lower level (Malaria Inspectors) personnel in malarial entomology. As a consequence of this, we were invited to Nepal to review the structure of training that is currently undertaken at the Research and Training Centre at Hetauda, and also to identify new courses that would benefit upper-level (graduate) scientists involved in entomology.

It was also appreciated that in addition to malaria, there are a few other arthropod-borne diseases in Nepal, such as visceral leishmaniasis (kala-azar) which is an increasing problem in eastern areas adjacent to the Indian border. Moreover, the proposed reduction in house-spraying in the malaria program might well be accompanied by a rise in leishmaniasis if the vectors are endophilic. Bancroftian filariasis is also commonly encountered in Nepal. Of more immediate concern, however, is the sudden increase in what appears to be Japanese Encephalitis. Last year there were 907 recorded cases with 277 deaths (31% mortality), although fortunately infections are mainly restricted to two areas of the terai, one in the Far West and the other in the East District. Most cases occur in April-May. Although the epidemio-

logy of J. E. has not been established in Nepal, the principal vectors are likely to be Culex tritaeniorhynchus and Cx. vishnui. Pigs may be the amplifying hosts, and aquatic birds the reservoir hosts. One of the new courses we propose for the training center at Hetauda is in arbovirology, with emphasis on J. E.

ITINERARY

April 15, 1987 — Arrived at Kathmandu, and had discussions that afternoon with Mr. J. L. Anderson and Mr. Shreedhar Pradhan at the USAID mission. We then planned an itinerary that would allow us to meet as many people as possible who would have advice and opinions to offer on the present RTC training at Hetauda and our proposed additional courses.

April 16 — Had appointments with Dr. F. M. A. Dixit (Director of NMEO), Dr. M. K. Banarjee (epidemiologist) and Dr. R. R. Arora (temporary WHO epidemiologist and malariologist). We also met with Mr. S. P. Shrestha (Deputy Director of ICHSDP). Although we had an appointment with Dr. D. N. Regmi, Chief of ICHSDP, he was unavailable.

April 17 — Left by road to travel to the Western Region to meet Mr. R. G. Vaidya, acting Regional Malaria Officer at Bhairahawa, and renewed our discussions with him on April 18. We left later that day for the RTC at Hetauda (Central Region).

April 19 — We were shown the RTC facilities by Mr. I. D. Bhatta (Health Educator) and we reviewed the curricula and attendance records of the various training courses.

April 20 — En route to the Eastern Region, we briefly met with Dr. M. N. Bajracharya, Director of the Research and Training Centre of ICHSDP at Pathalaiya. From there we proceeded to Janakpurdham. There we spoke with Mr. Shambha L. Shrestha (vice director, NMEO), who had kindly crossed the border from India (where he was on assignment) to meet with us. We finally went to Biratnagar to meet Mr. M. Chambling (RMO, Eastern Region), but he was away and so we discussed training needs with his deputy, Mr. I. K. Bhattarai (M. O.).

April 22 — Had further discussions with Mr. I. K. Bhattarai and then flew back to Kathmandu, arriving in the late afternoon.

April 23 Had meetings at NMEO headquarters with Dr. M. K. Banarjee (epidemiologist), Mr. J. D. Shrestha (RMO, Central Region), Mr. J. P. D. Shrestha (Deputy Chief, NMEO), and Mr. R. P. Sharma (Section Chief, operations). In the afternoon, we started preparing the curricula of the various courses, reviewed future teaching and research facility needs, and then had a final meeting with Dr. J. Anderson at the USAID mission.

April 24 Dr. L. Lacey had to leave Kathmandu a day earlier than planned in order to go to Papua New Guinea. Dr. Service remained at Kathmandu writing up his mission report. He was also specifically requested by Mr. J. D. P. Shrestha, Mr. J. D. Shrestha and Mr. R. P. Sharma to spend the afternoon of April 24 discussing sampling procedures and protocols. After this he had a session with M. Shreedhar Pradhan on his preliminary research proposals for a study of Japanese Encephalitis in Nepal. As there was insufficient time to go through his protocols, it was agreed that Dr. Service would take a copy to England, and would send any suggestions and comments at a later date.

SUMMARIES OF DISCUSSIONS WITH NMEO AND ICHSDP PERSONNEL

ICHSDP

This is a vertical project that has responsibility for malaria control (and a variety of other diseases under the primary health care approach), and consists mainly of drug administration, limited house-spraying, and taking of blood slides. Surveillance is carried out in 16 districts, spraying is undertaken in 10 districts, and malaria treatment only undertaken in six districts in the Central Region. Village Health Workers are trained in all aspects of health for three months at ICHSDP training centers. They dispense prophylactic and presumptive treatment, and if blood slides are positive for malaria parasites, a follow-up radical treatment is given.

The ICHSDP is planning a health campaign for the year 2000. Average infant mortality rate is currently 111/1,000 and life expectancy is 53 years. It is hoped these figures will be 60/1,000 and 65 years by the year 2000.

There are four ICHSDP training centers where staff receives training integrated aspects of health care, but only the basics of "malariology" are taught. It was said that training in malaria was generally poor and that staff would benefit from

increased training. At present 20 of the 26 malarious districts have no one from ICHSDP knowledgeable in malaria surveys.

It was very difficult to get an overall picture of the operations of ICHSDP, current objectives, and plans of action for malaria control. For this assignment, the difficulty in fully comprehending the system and its present and future manpower needs, is not too serious because our emphasis is on entomological training, especially of mid- and upper-level entomological staff; this does not apply to ICHSDP.

NMEO

NMEO is still a "development project" because of the early belief that malaria would be eradicated from Nepal and the organization disbanded. This clearly did not happen. Vigorous efforts are being made for NMEO to become a functional unit of the Ministry of Health, with responsibilities not just for malaria but for other vector-borne diseases and their control. It must be pointed out, however, that the organization has for the past 3-4 years been trying, without success, to achieve this objective.

Dr. K. A. Dixit (Director, NMEO) and other senior staff members emphasized that community participation would become increasingly important in any strategy of malaria control. Dr. Dixit also explained that there is sometimes a lack of supervision in control operations. Another problem he identified, and one that was also mentioned by other NMEO staff, is that senior staff members have poor prospects for promotion, mainly because NMEO is not fully integrated into the Ministry of Health. There are several entomologist and malaria assistant (entomology) posts vacant, due, we understand, to unattractive pay and service conditions. Another problem encountered by both NMEO and ICHSDP is that staff members trained in entomology are frequently shifted to non-malarious areas and sometimes are replaced by staff that have had no entomological training.

Mr. R. G. Vaidya and Mr. S. Pradhan said that the numbers of entomological malaria assistants should be doubled in each of the five regions and the number of malaria inspectors (entomological field assistants) should be increased to four in each region. Mr. Shambhu Shrestha, however, disagreed and suggested that in epidemic emergencies staff from headquarters in Kathmandu or from one of the regions could be mobilized to epidemic areas. In fact he believed staff in some areas were often underutilized. Mr. J. P. B. Shrestha thought that the first priority was for the existing entomological staff better training, only then should consideration be given to recruitment of more entomologists. Nevertheless, because of the policy of decreasing spraying and

placing greater emphasis on biological and environmental control of malaria vectors, we believe there is indeed a case for increasing the entomological team, if not at present, in the very near future.

Dr. K. A. Dixit, and also many other senior staff members, emphasized the need for strengthening training of NMEO staff. He seemed very receptive to our proposals for USAID-sponsored special courses in entomology. It was unanimously agreed amongst Mr. J. L. Anderson, Mr. S. Pradhan, and ourselves that at least one of these courses should be implemented as soon as possible, and that the courses should not be delayed until new laboratories, lecture rooms and accommodations are built at Hetauda. We all believe that continued interest in these special training courses should be encouraged. Mr. Shambhu Shrestha, Mr. R. G. Vaidya, Mr. J. S. Shrestha and Mr. J. P. B. Shrestha concurred, although the last named expressed some concern over present facilities at Hetauda and the lack of space to store equipment needed to teach some of the proposed courses.

In summary, NMEO operates in 26 malarial districts distributed throughout the five regions (see Figure 1), in each of which there is a Regional Office. The scientific regional staffing arrangement is shown in Table 1, while Table 2 lists district manpower.

TABLE 1. REGIONAL STAFFING IN FIVE DISTRICTS

Staff	Eastern	Central	Western	Mid-West	Far-West	Total
Regional Malaria Officer (RMO)	1	1	1	1	1	5
Malaria Officer	1	1	1	1	-	4
Entomologist[1/]	1[3/]	1[4/]	1[5/]	-[6/]	1[7/]	4
Ent. Unit						
Malaria Assistant[1/]	1	1	1	-	1	4
Malaria Inspectors[2/]	5	2	2	1	1	11
Insect Collector	2	5	5	4	4	20
Lab Aide	1	1	1	1	1	5
Parasit. Unit						
Malaria Assistant	2	2	2	2	2	10
Lab Aide						
Technician	8	8	7	3	2	28
Recorder	1	1	1	1	1	5
Lab Aide	1	1	1	1	1	5

1/ Mid- and upper-level staff engaged in entomology (graduates)
2/ Lower-level staff engaged in entomology (non-graduates)
3/ Returns in May 1987 from two-year study in Philippines
4/ Goes in May 1987 for two-year study in Philippines
5/ Vacant post
6/ No post, but might be created in July 1987
7/ Gone for two-year study in Philippines

TABLE 2. DISTRICT MANPOWER

Staff	Eastern	Central	Western	Mid-West	Far-Wes
Malaria Officers	8	6	5	4	2
Malaria Assistants	45	39	35	22	10
Malaria Inspectors	64	33	46	34	17
Lab. Technicians	37	63	27	14	8
Malaria Field Workers	342	274	243	163	81

Relevant staff at the National Headquarters at Kathmandu are listed be

1 Senior Entomologist 1 Entomologist 1 Malaria Assistant 5 Malaria Inspectors 1 Laboratory Aide	Entomological Section
1 Senior Parasitologist 1 Parasitologist 2 Malaria Assistants 1 Recorder	Parasitological Section
1 Epidemiologist 1 Entomologist 2 Malaria Inspectors 1 Laboratory Aide	Planning, Research and Training Section

Relevant staff at RTC Hetauda are listed as follows. Actual num present at the time of our visit is shown in parenthesis.

1 Senior Malaria Officer	(0)
1 Entomologist	(0)
1 Parasitologist	(1)
1 Health Educator	(1)
1 Malaria Officer	(0)
2 Assistant Entomologists	(1)
4 Malaria Assistants	(1)
4 Malaria Inspectors	(4)
9 Insect Collectors	(9)

COURSES AND TRAINING PROGRAMS HELD AT RTC HETAUDA

Training courses were established at Hetauda in 1979, and currently occur during 32-36 weeks of the year. With various seminars and meetings that are occasionally held, training can occupy as much as 43 weeks a year. The greatest limitation of the Research and Training Centre at Hetauda is the lack of good facilities. We were informed that a maximum of 28-30 people could be accommodated in the lecture room. An inspection of this room, however, indicated that seating at benches and tables is restricted to 26 people. The laboratory can comfortably accommodate only about 16 people.

The course load taught at RTC during 1985 and 1986 is presented in Table 3. Although the basic courses provide sound background in the various subject areas for mid- and lower-level NMEO staff, these staff members, nevertheless, require periodic upgrading and refresher training. Currently, this type of training is provided to approximately 10% of the mid- and lower-level staff each year. We recommend that refresher training be increased to 25% - 30% of the staff (i.e., every 2-4 years vs. every 10 years). Increasing the frequency of refresher courses will increase the efficiency of case reporting and other surveillance activities. The inclusion of a course on advanced entomological techniques will also increase the efficiency of NMEO. The extra demand that these functions will place on the facility are obvious. An increase in both lecture and laboratory space is needed.

All NMEO personnel that could receive training at the RTC are listed in Table 4. The list is broken down by headquarters, staff, RTC staff, and regional and district staff. It includes upper-level personnel (entomologists, regional malaria officers, etc.) that do not currently receive training at the RTC.

Because the NMEO is assuming vector control responsibilities for other vector-borne diseases (Japanese encephalitis and filariasis), it is recommended that a series of short courses be provided to mid- and upper-level staff to upgrade their operational, research and teaching capabilities.

Further details concerning the lack of facilities at Hetauda follow later in this report.

TABLE 3. COURSES TAUGHT AT THE RESEARCH AND TRAINING CENTER (HETAUDA) DURING 1985 AND 1986, TARGETED AUDIENCE AND NUMBER OF INDIVIDUALS TRAINED

1985

Course	Audience	Duration of course	No. trained
Basic Malariology	Malaria Assistants	7 wks.	30
Vector Control Orientation	Malaria Assist. and Dist. Malaria Officers	8 wks.	18
Malariology Orientation	Malaria Inspectors	6 wks.	22
Basic Parasitology	Lab techs (ICHSDP)	8 wks.	16
Malariology Refresher	Malaria Inspectors	2 wks.	24
Parasitology Refresher	Lab techs (2 sessions)	2 wks.	28
Malaria Orientation	Senior Auxiliary Health Worker (Health post in charge) ICHSDP	1.5 wks.	21
		36.5 wks.	159

1986

Basic Malariology	Malaria Assist. and Malaria Inspectors	7 wks.	35
Basic Parasitology	Malaria Inspectors	5 wks.	17
Basic Parasitology	Lab techs	7 wks.	21
Malariology Refresher	Malaria Inspectors	2 wks.	8
Parasitology Refresher	Lab techs	2 wks.	11
Statistical Orientation	Malaria Assist. and Malaria Inspectors	2 wks.	20
Malaria Orientation	Sr. Aux. Health Worker (Health post in charge) ICHSDP (4 sessions)	1.5 wks.	126
Malaria Orientation	Health Inspector and Training Officers (ICHSDP)	1.5 wks.	29
		32.5 wks.	267

TABLE 4. NMEO PERSONNEL ELIGIBLE FOR TRAINING AT THE RTC INCLUDING UPPER LEVEL STAFF THAT COULD PARTICIPATE IN ADVANCED ENTOMOLOGICAL TRAINING

NMEO Headquarters, Kathmandu*

Sr. Malaria Officer	1**
Malaria Officer	1**
Malaria Asst.	8**
Sr. Parasitologist	1**
Parasitologist	1**
Sr. Entomologist	1**
Entomologist	2**
Malaria Inspector	15
Sr. Health Educator	1**
Health Educator	1**
Lab Technician	1
Epidemiologist	1**
Sr. Statistician	1**
Statistician	1**
	36 (20**)

NMEO Research & Training Center Staff

Sr. Malaria Officer	1**
Entomologist	1**
Parasitologist	1**
Health Educator	1**
Malaria Officer	1**
Asst. Entomologist	2**
Malaria Assistant	4**
Malaria Inspector	4
	15 (11**)

*Includes personnel from: Field Programme Division, Epidemiology & Operation Section; Parasitology Section; Entomology Section; Health Education Section; Malaria Clinic; Planning Research & Training Division; Library Unit; Planning & Evaluation & Statistic Section; Cartography Unit; Pool; Pool posts attached to the Ministry of Health, Dept. of Health & ICHSDP

TABLE 4 cont.

Regional Personnel

Direction	E	C	W	MW	FW	Totals
Regional Malaria Officers	1	1	1	1	1	5
Epidemiology, Health Education						
Spraying & Surveillance Section, Malaria Officer	1	1	1	1	-	4
Operation						
Malaria Assistant	1	1	1	1	1	5
Malaria Inspector	3	3	3	2	2	13
Health Education Unit						
Malaria Assistant	1	1	1	1	-	4
Malaria Inspector	1	1	1	-	1	4
Entomology Unit						
Entomologist						
Malaria Assistant						
Malaria Inspector						

E = East
C = Central
W = West
MW = Mid West
FW = Far West

REVIEW OF COURSES CURRENTLY TAUGHT AT RTC

ORIENTATION COURSE IN VECTOR CONTROL (33 days)

This is the most advanced course offered by the center and is aimed at District Malaria Officers and Malaria Assistants. It is also available to District Health Inspectors of ICHSDP, although only one attended in 1985, and none attended in 1987. No course was taught in 1986.

The course consists of a series of lectures and some hands on training on the following topics:

1. Basics of mosquito biology, morphology of adults, internal anatomy, classification of mosquito genera. Identification of larvae and adults of Anopheles found in Nepal.

2. Sampling techniques, preservation methods, parity dissections, salivary gland dissections, and colonization procedures.

3. Malaria epidemiology, vectors in Nepal, and biology of Anopheles vectors.

4. Introduction to filariasis, arboviruses, dengue, yellow fever, plague, typhus, schistosomiasis and leishmaniasis.

5. Control: insecticidal, biological and integrated, and WHO insecticide susceptibility tests.

6. Geographical reconnaissance.

7. Mathematical entomology, and lectures in basic parametric statistics.

8. Field trips to collect specimens and sporozoite dissection, age-grading, WHO susceptibility tests, and mosquito identification.

9. Integrated approaches to vector control, community participation, and vectors prevalent in rice fields and their control. (In 1985 these topics were presented by invited lecturer Dr. Y. Bang, WHO entomologist in Delhi.)

Comments

General contents are good, but why include loiasis, schistosomiasis and yellow fever (diseases not found in Nepal) and yet exclude other more relevant nuisances and potential vectors? If this course is an orientation to vector control then there should be lectures on human lice, scabies, mites, bedbugs, cockroaches, houseflies and human myiasis, and possibly on life cycles and relationships to diseases of rodents and ticks, as well as their control. There should also be lectures on insecticide safety.

There is some lack of organization in the scheduling of the lecture program. For example, a lecture on the life cycle of mosquitoes comes after lectures on vector-borne diseases such as filariasis and dengue.

Finally, each trainee should be given (1) a series of "handouts" on parasitology, blood-slide preparation, identification of malaria parasites in thick blood films, preparation and use of stains, and (2) a series of entomology handouts depicting the life cycle and identification of vectors such as mosquitoes, sandflies, houseflies, and bedbugs. Representative handouts are appended to this report.

COURSE FOR MALARIA ASSISTANTS (48 days + six-day field trip)

This is a long course designed specifically for malaria assistants who are involved either in entomology or parasitology.

The course is 54 days in duration. It covers a very broad spectrum of topics including parasitology, entomology, control methods, geographical reconnaissance, and statistics. Some of the major subjects taught are: malaria parasite life cycles, malaria epidemiology, blood cytology, diagnostics of different malaria parasites, practical identification of malaria parasites, surveillance methods, ACD and PCD, drug usage, malaria immunity, non-human malaria, strategies of malaria control and eradication, mosquito morphology, internal anatomy of mosquitoes, mosquito life cycle, differentiation of mosquito genera, identification of mosquito adults, mosquito collecting methods, mosquito dissections (not specified, but presumably involving salivary glands and nulliparous/parous dissections), principles of residual spraying, larviciding, insecticide and drug resistance, spraying equipment, insecticide toxicity and safety precautions, planning control operations, community participation, and mathematical statistics. In addition, there are a few lectures on filariasis, leishmaniasis and encephalitis viruses. There is a six-day field component midway through the course, and preceding this there is

a mid-course test in theory and practical aspects of control. There is a final examination on the theoretical and practical components of the course.

Comments

This is a very full and comprehensive course, but as in previous courses there appears to be some lack of organization in the sequence of the lectures. For example, lectures on life cycles of mosquitoes and vectors in Nepal come before lectures on basic morphology of mosquitoes. There appears to be no practicals on identification of Anopheles larvae; if so, this should be corrected. Nor is it not clear whether practical dissections include both salivary gland dissection and dissections for parity.

We believe that there should be lectures on mosquito colonization, including hand-mating techniques, and on different methods of marking mosquitoes to determine flight range, longevity and other important epidemiological parameters.

COURSE FOR MALARIA INSPECTORS (9 days)

This course consists mainly of lectures and practical training in recognition of malaria symptoms, parasite life cycle, taking of blood slides, epidemiology, and drugs and their modes of action. It also covers entomology bionomics of vectors, their medical importance, and spray equipment and maintenance.

Comments

We strongly recommend that this course be extended by about six days to include more practical training such as: use of taxonomic keys for identification of adults and larvae of Nepalese Anopheles. "Local" keys should be prepared and all couplets fully illustrated; a copy should be given to each malaria inspector. There should also be training in collection techniques for larvae and adults, methods of obtaining eggs from gravid females, techniques for preservation, larvae and mounting of adults, dissection of adults for parity determination based on ovarian tracheation, preservation methods of adults and larvae for further cytotaxonomic identification, preparation and storage of insect bloodmeals for host determination, and salivary gland dissections.

Handouts should be given to each trainee on the preparation of blood slides, staining of blood films, the malarial life cycle in man and the mosquito, and on the method of dissecting salivary glands from Anopheles adults.

Again there appears to be some lack of organization in the present course. For example, lectures on insecticide formulations and their modes of action occur and before lectures on surveillance methods, bionomics of malaria vectors.

The courses described above are offered for senior (district malaria officers, malaria assistants) and middle management (malaria inspectors) staff. NMEO at Hetauda also presents the following six courses:

1. Course in Reorientation (23 hours theory, 7 hours practicals)

2. Refresher Course in Malariology (40 hours theory, 11 hours practicals) for malaria inspectors

3. Basic training of laboratory technicians (16 days), also attended by some malaria inspectors. This is the same as the Basic Course in Parasitology.

4. Refresher Course for laboratory technicians (13 days) also attended by some malaria inspectors. This is the same as the Refresher Course in Parasitology.

5. Statistical Refresher Course (2 weeks) for malaria assistants and malaria inspectors. This is the same as Statistical Reorientation Course.

6. Orientation Course for Auxiliary Health Workers of ICHSDP (10-14 days)

We note that the duration of some of these courses as shown in the curricula and on the sheets summarizing training at RTC Hetauda sometimes are contradictory. For example, the Orientation Course was given as two weeks in the curriculum but as only 10 days on the summary sheets. In 1985, the Basic Malariology Course for malaria assistants was seven weeks and six weeks for malaria inspectors, whereas, in 1986, the course was seven weeks for both malaria assistants and malaria inspectors.

It should be mentioned that the Statistical Course (5) is not devoted to statistics sensu strictu, but includes about a week of lectures on surveillance methods, spraying operations, health education activities, parasitological activities, entomological activities, and also administration and finance. There are, however, some real statistical lectures and practicals, including ones on computer usage and language. This is a rather badly constructed course dealing with such basic subjects as surveillance and spraying, which are already adequately covered

in other courses, and the statistical input is far too small to be of much practical use.

The Orientation Course for Auxiliary Health Workers (6) includes no entomological component, apart from a few basic lectures on insecticides and residual spraying techniques. These individuals, all belong to ICHSPD and should be taught some rudimentary entomology, such as methods of collecting and preserving adult and larval Anopheles.

PROPOSED TRAINING COURSES FOR MID- AND UPPER-LEVEL STAFF

One purpose of our visit was to determine whether courses in advanced and modern entomological techniques would benefit to mid- and upper-level graduate scientists such as entomologists and malaria assistants assigned to entomology. Discussions with Mr. Shambhu R. Shrestha, Dr. M. K. Banarjee, Mr. R. G. Vaidya, Mr. Indra Kumar Bhattarai, Mr. Shreedhar Pradhan and Mr. J. L. Anderson clearly showed that such proposals would be both appropriate and welcome.

Although such courses would be designed mainly for entomologists, it is obvious that some of the courses, or components of them, would be of interest to non-entomologists. For example, a course on arboviruses would be of value and interest to parasitologists and epidemiologists as well as entomologists, and at least parts of a course on surveillance, statistical analysis and data management would be of interest to NMEO statisticians as well as to field scientists. Three proposed courses are outlined below.

COURSE IN ADVANCED ENTOMOLOGICAL TECHNIQUES (12 days)

Over the past few years there have been considerable advances in certain entomological techniques, many of which are germane to studies currently being undertaken by NMEO staff. Moreover, it is also envisaged that other techniques will be applicable in the near future in research programs of NMEO. The following course of lectures and practicals is suggested to give a good sound training in advanced entomological methods.

1. ELISA test for detection and identification of falciparum sporozoites — 1 day
2. ELISA test for detection and identification of vivax sporozoites — 1 day

3.	Concentration and filtration method of Ramsey et al. (1986) for detection of sporozoites	1/2 day
4.	Concentration method for detecting filarial parasites in mosquitoes	1/2 day
5.	ELISA test for identification of human-blood meals	1 day
6.	Age-grading methods, e.g., serial dilatations	1/2 day
7.	Analysis of insect age-structure and survival rates	1 hour
8.	Methods of marking adults and larval mosquitoes for mark-recapture studies	1 day
9.	Use of mark-recapture experiments to determine flight range and dispersal, survival rates, duration of gonotrophic cycle and feeding intervals in the field, population estimates, etc.	1/2 day
10.	Genetic isolation, population genetics and cytotaxonomy	1 hour
11.	Mosquito cytogenetics and chromosome preparations from both larvae and adults	1 day
12.	Principles of isoenzyme electrophoresis in taxonomy	1 hour
13.	Use of other taxonomic techniques, such as morphometrics, DNA probes, and cuticular hydrocarbons	2 hours
14.	Ecological concepts of biological control	1 hour
15.	Immunological methods of detecting natural predators	1 hour
16.	Advanced techniques in biological control. Isolation and identification of pathogens and parasites from mosquitoes and mosquito habitats	1/2 day
17.	Bioassay techniques for insect pathogens	1/2 day
18.	Introduction to recent advances in biological control	1 hour

19.	Biological control and alternative methods in the IPM strategy	1 hour
20.	Fish as biological control agents	1 hour
21.	Construction and use of both time-specific and age-specific lifetables to determine pre-adult mortalities	2 hours
22.	Life history strategies of mosquitoes (e.g., r + K strategies)	1 hour
23.	Hand-mating techniques	1/2 day
24.	Detection of Organophosphate resistance by enzyme-based tests	4 hours
25.	Membrane feeding, and cryopreservation of micro-filariae	3 hours
26.	Sieving and flotation techniques for aedine eggs, larvae of ceratopogonids and phlebotomine sandflies	1/2 day
27.	Methods of calculating vectorial capacity	2 hours
28.	Vector-parasite relationships	1 hour
29.	Vector competence, inoculation procedures to overcome gut barriers	1/2 day
30.	Possibly a lecture on satellite remote sensing in mosquito surveys	1 hour

Audience. The above course is designed for malaria assistants specializing in entomology, entomologists, and malaria officers and regional malaria officers who are interested in anopheline biology, identification and diagnostic techniques.

COURSE IN SURVEILLANCE AND DATA MANAGEMENT (9 days)

The need to take adequate numbers of samples and the mathematical treatment of data to obtain reliable and meaningful results cannot be stressed too much. This proposed course will discuss the different sampling techniques and strategies available, the statistical treatment of the data, the use of computers to store relevant data, and their use in constructing predictive models.

In teaching this important course for the first time, it might be better to divide it into two parts. The component on surveillance and sampling (1-5), with field collections, would last six days. The computer and data management components could be taught later when necessary software and hardware has been purchased and installed.

1.	Introduction to different sampling methods, e.g., attractant and non-attractant methods	1/2 day
2.	Use of specific sampling methods, e.g., CDC light traps in houses, artificial shelters for exophilic mosquitoes, use of sentinel animals, improved techniques for detecting dispersal, ovitraps, Reiter's trap for *Culex quinquefasciatus*	2 hours
3.	Statistical problems in sampling aggregated mosquito populations, use of transformations and non-parametric tests	2 hours
4.	Numbers of samples to be taken, stratified sampling, subsampling, deterministic and stochastic models. The type of information required from sampling	1 hour
5.	Field collections and data analysis	4 days
6.	Computer training, storage and retrieval of data	4 days
7.	Introduction to building predictive models, e.g., adult survivorship	2 days
8.	Computer models for generating dispersion patterns, sampling with different numbers of samples, comparing means	1 day

Audience. This course is designed for entomologists and malaria assistants specializing in entomology, but it is believed that biostatisticians and epidemiologists might benefit from some of the lectures.

COURSE IN ARBOVIROLOGY (6 days)

A short course in arbovirology with emphasis on Japanese encephalitis epidemiology, covers entomological surveillance methods, detection of virus in mosquitoes, and antibodies in

vertebrate hosts. The course has been prepared by one of the authors (L.A.L.) and Dr. D. J. Gubler (CDC Lab, San Juan).

PROPOSED SCHEDULING

1.	Introduction to arbovirology, Togaviridae, Flaviviridae	1/2 day
	Field demonstration of ovitraps and CDC light traps for adult mosquito surveillance	1/2 day
2.	Lectures on Bunyaviridae, Japanese Encephalitis (JE) (Introduction), and Dengue/dengue hemorrhagic fever	1/2 day
	Field demonstration of larval survey methods	1/2 day
3.	Epidemiology of JE; distribution and epidemiology of JE in Nepal; control of JE (with emphasis on Nepal); use of vaccines and chemotherapy	1 day
4.	Lectures on serodiagnosis, virologic diagnosis, and demonstration of age grading techniques	1/2 day
	Demonstration of age grading techniques (cont.); Demonstration of ELISA	1/2 day
5.	Lectures on surveillance for arboviruses; field methods in arbovirology, and ELISA (cont.)	1/2 day
	ELISA (cont.); demonstration of mosquito inoculation; demonstration of immunofluorescence	1/2 day
6.	Review, process field-collected specimens for viruses	1/2 day
	Review, process field-collected specimens for viruses (cont.)	1/2 day

Audience. This course should be of value to entomologists, malaria assistants (entomology), epidemiologists, parasitologists and malaria officers. Details of required laboratory equipment for outfitting a basic diagnostic and teaching lab are presented in Annex 2.

INSECT COLLECTION

A well-maintained, fully labeled and curated collection of medically important insects should be maintained at Hetauda for class demonstrations and teaching purposes, and also for research. Voucher specimens for research should be kept separate from the teaching material to prevent damage by trainees.

ILLUSTRATIVE MATERIALS

It would be useful to build up a collection of photographic slides demonstrating collection methods, surveillance techniques, and breeding places, and also to collect suitable photographs, diagrams, and other illustrations that could be used in lectures and classroom demonstrations. Such materials should be kept at Hetauda, but care should be taken to prevent damage by fungus of color transparencies.

Reference and instruction materials on topics such as identification, sampling, and control could be compiled into a training/operations manual. The manual would emphasize the vector fauna and the vector-borne diseases of Nepal and would be a lasting resource for NMEO. Although it was not in the scope of work to develop such a manual during our stay in Nepal, we recommend that consideration be given to creation of such a manual. Also, as mentioned earlier in this report, a key to the anopheline and culicide larvae and adults is badly needed for both operational and instructional purposes. Such a key could be a precursor to the above proposed manual.

RESOURCES OF THE RTC

As pointed out in previous reports (e.g., W. K. Reisen March 1987[1]), training facilities of Hetauda are very basic and even rather primitive.

There is one un-airconditioned lecture room (26 x 22 feet) which can seat a maximum of 26-28 people. It has a poor blackboard and poor lighting. The laboratory situated directly above the lecture room is the same size and also has poor lighting.

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[1]Reisen, W. K. March 1987. Malaria in Nepal. Development of a Detailed Working Plan for Entomological Research in Sindhuli (Central Region) and Kanchanpur (Far Western Region) Districts with Comments on Japanese Encephalitis. VBC Activity AR-026: 36 pp.

The laboratory can accommodate only about 16 people. The insectary measures 16 x 16 ft, and has no temperature, humidity or light controls. Humidity is currently raised by hosing the insectary floor with water; lights are on during the day and are turned off at night.

Accommodations for the students are extremely poor. The sleeping quarters consist of one long room measuring 28 x 20 feet which houses beds consisting of wooden planks raised on small legs. Students must bring their own bedding. Washing facilities consist of one outdoor nearby standpipe. There are no cooking facilities; students must either go into town to buy their meals or persuade one of the junior RTC staff members to cook for them.

Some modifications could be made to the present establishment to improve working and living conditions, but the long-term future of the center rests on building of extra laboratories, lecture rooms and accommodation units.

SHORT-TERM IMPROVEMENTS

Lecture room. Fix an air conditioner. Provide better fluorescent strip lighting. Provide a white board. Repaint the existing blackboard with two coats of blackboard paint. Provide a carousel-type slide projector, and a roll-up pull-down projection screen.

Laboratory. Rewire to provide each bench with a series of power sockets to operate simple microscope lamps, consisting of 40 W domestic light bulbs in holders. The central bench also needs power sockets.

Insectary. Purchase one or two appropriate Mains operated humidifiers that will automatically cut on and off to maintain about 80% RH. If purchase and installation takes a long time, humidity levels could be maintained by having plastic or galvanized metal troughs filled with water and placed on the floor. Hessian sacking (burlap) can be hung vertically with its lower ends in the water-filled troughs. An electric fan can be trained on the damp sacking to increase humidity greatly.

A simple clock could be installed to automatically turn the lighting in the insectary off and on to maintain a regime, of say, 11 hours light and 13 hours darkness. It would be better, however, if a dimming mechanism could be installed to permit a gradual decrease and increase in light to mimic dawn and sunset. This might encourage natural mating in cages.

Accommodations. Provision of metal beds with mattresses, or at least mattresses for the existing wooden beds, is urgently required. Lockable lockers are needed for students in the bedroom. The existing standpipe could be retained but another should be installed and a very simple shower, screened by matting, could be made at very little cost. A better proposition is a pump to raise water to a header tank, which would then provide gravity-fed water to one or more standpipes.

LONG-TERM IMPROVEMENTS

The proposed facility detailed in the 1980 WHO report of Green et al. (WHO SEA, Mal/124) is well planned and provides ample space for teaching and living purposes. Its construction, however, would entail considerable expense. In the absence of adequate funding, some less expensive improvements are proposed below.

Lecture Rooms. There should be at least two lecture rooms, consisting of either a refurbished existing room and a newly constructed one to accommodate 30 people, or two newly built rooms.

At least two carousel-type slide projectors are required, with two spare carousels, and six spare bulbs each. It would be useful to have a third projector as a backup in case of temporary failures of one of the other two. Two projection screens, two overhead projectors and the necessary transparencies are needed. As it is anticipated that the students will be given handouts, a good and reliable photocopying machine is essential.

Laboratory. There must be two laboratories, either two newly constructed ones, or a new one and the renovated existing laboratory. Both laboratories need bench space for 26-30 students, and power sockets for microscope lamps. Each laboratory also requires a large domestic refrigerator for keeping certain media, and also for insects, and one medium-sized deep freezer for certain reagents. Two simple desiccators are needed. There should be a white board in each laboratory. Running water and sinks are required for each laboratory. One water still is required for production of distilled water. A heater and circulator for membrane feeding mosquitoes with blood, as well as glass vials, motor and stirrer for blood mixing will be required.

One good phase-contrast microscope (with green filter) is required for cytotaxonomy and for Fluorescent Antibody in virological studies. In addition, an extra 20 compound microscopes and 20 dissecting microscopes will be required. At

least six CDC-type and two Monks Wood light traps are needed for field work, a variety of micropipettes are needed for ELISA tests, and two small aquarium-type suction pumps are needed for artificial mating techniques. Clearly, numerous other expendable and consumable items will be wanted, such as fluorescent powders and paints for marking insects, silicon for siliconizing cover-slips, and various stains. Microtitre plates, conjugates and substrates will be needed for ELISA testing of sporozoites and bloodmeals.

Two or three additional vehicles, depending on size, will be required to take trainees and lecturers on field collection trips.

In addition to the above proposed improvements in the RTC for teaching and research, further additions/improvements will be in order if arbovirus work is to be conducted at the facility. In addition to a minimum of 600 sq. ft. of laboratory space, the equipment listed in Annex 2 will also be required.

Insectary. The present insectary should be equipped for humidity and light control as already discussed. There is a need for an additional small, newly constructed laboratory (with humidity, temperature and lighting controls). This would serve as extra space for colonization of other *Anopheles* species and the production of adequate numbers of mosquitoes for class use. Such a room would also serve as a place for conducting WHO insecticide susceptibility tests under controlled temperature and humidity.

Library. A reference library as such is virtually non-existent at the RTC. It has 11 copies of the 1981 edition of *The Anopheles of India* by Ramachandra Rao, but unfortunately this edition is full of errors. The library should have the 1984 revised edition, which also contains errors, but has a long list of corrections appended at the back.

A list of other books on malariology and medical entomology that the Centre needs to serve its function as a teaching and research station is included in the appendix.

The second function of the Hetauda Centre is operational research. Currently, with exception of the insectary, no other facilities at RTC are capable of supporting research that would result in improved operational capability. In addition to the extra laboratory space and arbovirology unit, the Centre could benefit from a variety of equipment (listed below). External facilities could include several small ponds and two to three moderately sized ones (for larvicide evaluations and

pisciculture), and experimental housing, with several types of surfaces for residual insecticide evaluation.

SUMMARY OF EQUIPMENT NEEDED AT HETAUDA

The following is a summary of equipment needed at Hetauda to fully equip the laboratory, and for use in the above three courses. (Virology equipment is not included.)

1 air conditioner (existing lecture room)
Extra fluorescent lighting (existing lecture room)
2 white boards and pens for 2 lecture rooms
2 white boards and pens for 2 laboratories
3 carousel-type 35 mm slide projectors
2 extra carousels
12 spare projector bulbs
2 pull-down roll-up projection screens
2 overhead projectors, transparencies and pens
2 humidifiers (insectary)
1 time clock (controlled light on/off) (insectary)
Rewiring and 20-26 electrical sockets in laboratory for microscope lamps
1 phase contrast microscope plus green filter
20 binocular dissecting microscopes
20 compound microscopes
20 simple 40 W bulb lamps and holders for microscopes
2 refrigerators 17 cu ft
1 deep freezer 17 cu ft
1 water still for distilled water
2 dessicators
1 centrifuge
1 water heater (37°C) and water circulator for membrane feeding
4 glass double-walled membrane feeders (specially made and obtained from Liverpool School)
1 small motor and stirrer for above
6 CDC light traps
12 spare bulbs for above
4 spare motors for above
2 Monks Wood light traps with daylight fluorescent strips
2 UV fluorescent strips for above
2 extra white fluorescent strips
2 spare motors for above
2 small battery chargers for NiCa dry cell batteries (CDC trap)
1 12-V mains battery charger for car battery (Monks wood trap)
2 insulated cool boxes
Colored powders (about 4 different colors)
Humbrol paints (about 8 colors)
Humbrol paint thinner
2 aquarium-type small electric pumps (for artificial mating)

50 g Rhodamine B stain (for marking larvae)
Carnoys fixative (chromosomes)
50 g Lacto-aceto orcein (chromosomes)
500 ml liquid silicon (chromosomes)
3 patella hammer (chromosomes)
6 aquatic nets
ELISA material for sporozoites
ELISA material for bloodmeals
Micropipettes 1000 µl
100 µl
10 µl
5 µl
ideally each trainee should have one each for ELISA tests
Numerous tips for above micropipettes
13- and 25-mm Swinnex millipore filters
Whatmans no 2 filter paper
Sodium oxide
10-cc Luerlock syringe
Glutaraldehyde
Sodium nitrite
Hanks BSS solution
Needed for Ramsey et al. sporozoite concentration method
4 bednets (animal bait traps)
2-3 vehicles capable of taking about 24 people to field collecting sites

In addition, other items that will be required, but may already be available include:

Pasteur pipettes
Larval ladels (dippers)
Flashlights
Entomological storage boxes
Larval slide boxes
Larval slide trays
Larval temporary and permanent mounting media
Adhesive labels
Polyporous strips
Assorted entomological pins
Minuten (headless pins)
Filter paper (100 cm)
Plastic preti dishes (100 cm)
Dissection instruments such as watchmakers No. 5 forceps, fine dissecting needles
Numerous (about 200 cardboard 1/2 pint size containers (cups)
About 20 one-gallon capacity cardboard cartons
Mosquito netting
Diethyl ether
Test tubes
3 x 1 in screw-cap Universal containers (glass/pitcher)
1000 small tubes (capacity about 5 ml only, for bloodmeal ELISA)
20 racks (to hold above tubes)

Chloroform
Ethyl alcohol
Cotton wool
Microscope slides
Large cover slips
Small (about 1/4" square) cover slips
Photographic-type white trays

DISCUSSIONS ON SAMPLING METHODS

Dr. Service was asked to discuss certain sampling problems with Mr. S. Pradhan, Mr. J. P. B. Shrestha, Mr. J. D. Shrestha and Mr. R. P. Sharma at NMEO headquarters on Friday afternoon of April 24.

He proposed a line transect of human bait collections to study the exophilic and endophilic biting behaviors of vectors such as Anopheles fluviatilis. Catches should be made in sprayed houses, on their verandas (these have sprayed walls and overhangs), in the open village compounds, and at the edges of villages in temporary "shelters" of grass having no walls -- in which they are reporting endophagy by An. fluviatilis -- and finally at a site beyond this in the forest area. He then suggested that these open-type shelters be closed in with matting and/or bamboo to convert them into more house-like structures. If biting continued in them, indicating endophagy, they should be sprayed. Biting inside then should be reassessed and compared with biting recorded at all other catching sites.

He also suggested that CDC-type light traps might be placed inside houses and evaluated as a surveillance tool.

Finally, he discussed the merits and limitations of the ELISA techniques for sporozoite detection and blood-meal identification; one problem in using these as routine methods could be their costs.

ANNEX 1. LIST OF BOOKS SUGGESTED FOR RTC LIBRARY

Bruce-Chwatt, L. J. (1985) Essential Malariology, 2nd edition, William Heinemann Medical Books, London, 452 pp. £25.

Cunnion, S. O. et al., (1984) Navy Medical Department Guide to Malaria Prevention and Control, Navy Environmental Health Center, Norfolk, Virginia 23511, USA, 90 pp.

Detinova, T. S. (1962) Age-Grouping Methods in Diptera of Medical Importance, Wld Hlth Org. Geneva, 216 pp.

Laird, M. & Miles, J. W. (1963) Integrated Mosquito Control Methodologies, Vol. 1; Academic Press, London, New York, 369 pp.

_____ (1985) Integrated Mosquito Control Methodologies, Vol. 2; Academic Press, London, New York, 444 pp.

Muirhead-Thomson, R.C. (1982) Behavior Patterns of Blood-Sucking Flies, Pergamon Press, Oxford, New York, 224. £25.

Phillips, R. S. (1983) Malaria, Studies in Biology No. 152, Edward Arnold, London, 58 pp. £2.50.

Ramachandra Rao, T. (1984) The Anophelines of India (Revised edition). Malaria Research Center, ICMR, 518 pp. US $45.

Service, M. W. (1976) Mosquito Ecology. Field Sampling Methods, Applied Science, Barking, Halsted Printers, USA, 583 pp. £30 in UK.

_____ (1986) Lecture Notes on Medical Entomology, Blackwell Scientific Publis' rs, Oxford, Boston, 265 pp. £12.50.

Sharma, V. P. (1984) Indo-UK Workshop on Malaria, Proceedings of the Workshop, New Delhi, November 1983, Malaria Research Center (ICMR), Delhi, 276 pp.

Strickland, G. T. (1986) Clinics in Tropical Medicine and Communicable Diseases. Malaria. W. B. Saunders Co., London, Philadelphia, 279 pp.

WHO (1973) Manual on Larval Control Operations in Malaria Control Programmes, Wld Hlth Org. m Offset Publ. 199 pp.

____ (1974) Equipment for Vector Control, Wld Hlth Org., Geneva, 179 pp.

ANNEX 1 cont.

____ (1980) Environmental Management for Vector Control, Wld Hlth Org. Tech. Rept. Ser., No. 649, 67 pp. £1.50.

____ (1982) Biological Control of Vectors of Disease, Wld Hlth Org. Tech. Rept. Ser., No. 679. 39 pp. £1.40.

____ (1982) Manual on Environmental Management for Mosquito Control, Wld Hlth Org., Offset Publ., No. 66. 283 pp.

____ (1983) Integrated Vector Control, Wld Hlth Org. Tech. Rept. Ser., No. 688. 72 pp. £2.40.

____ (1984) Advances in Malaria Chemotherapy, Wld Hlth Org. Tech. Rept. Ser., No. 711. 218 pp. £8.

____ (1984) Malaria Control as Part of Primary Health Care, Wld Hlth Org. Tech. Rept. Ser., No. 712. 73 pp. £3.20.

____ (1986) Resistance of Vectors and Reservoirs of Disease to Pesticides, Wld Hlth Org. Tech. Rept. Ser., No. 737. 87 pp. £5.

ANNEX 2. STARTING A SMALL ARBOVIRUS LABORATORY FOR DIAGNOSTIC AND TEACHING PURPOSES

In February, Dr. Lacey spent three days at the CDC dengue laboratory in San Juan to obtain background needed for consideration of the requests to set up a small arbovirus lab in Nepal. He also spoke with Dr. Gubler at length concerning the development of a short curriculum on arbovirology for the entomological personnel at the mid and upper levels of the Nepal Malaria Eradication Organization (NMEO). Dr. Gubler indicated that a week-long segment should be adequate initially and that more in-depth training should take place at a fully equipped laboratory under the close supervision of well-trained personnel. He also said that this training should precede establishment of a small arbovirus lab.

Dr. Gubler suggested that until a lab for training is established, the Arbovirus lab in Poona, India be considered as a possible location for two to four months further technical training for 1-2 individuals.

He suggested contacting:

Dr. Khorshed Pavri
National Institute of Virology
20-A Dr. Ambedkar Road
Poona, 411001, INDIA

Subsequent intermediate training could be in the form of a three-week workshop but a functional laboratory would be needed. He suggested that first one individual be identified, and trained for 2-4 months in Poona or a similar laboratory. This person then could help with the workshop.

LABORATORY DESIGN AND EQUIPMENT

The size and sophistication of the laboratory will depend on its objectives. If serological detection is the only objective, the needs will be modest. The following serological tests are commonly utilized for diagnosis of arboviral infections:

1. Hemagglutination-inhibition test. Minimal equipment, easy, reliable, but lacks specificity (there is cross reaction between related viruses).

2. Complement fixation test. More specific than HI - more difficult to standardize.

ANNEX 2 cont.

3. Plaque-reduction neutralization test - specific. Reliable - requires use of tissue culture cell line with low sensitivity for wild type dengue viruses.

The equipment and procedures for virus isolation and identification are considerably more complex. One of the following two procedures is normally used:

1. Method of choice - mosquito cell line (C6/36 clone of *Aedes albopictus* or *Aedes pseudoscutellaris* or *Toxorynchites* for primary isolation. Positive cultures are then identified using type-specific monoclonal antibodies.

2. Second choice - mosquito inoculation, direct FA, and complement fixation. Requires mosquito colony.

Specific equipment items for setting up a small arbovirus lab for detection and isolation of virus are presented on the following page.

EQUIPMENT FOR BASIC ARBOVIRUS DETECTION AND ISOLATION

ITEM	APPROXIMATE 1984 PRICE
Low temperature freezer Revco, Ultra Low Model ULT 1285B	$ 5,200.00
Laminar Flow Cabinet Biohazard BBL, Class 11	8,000.00
Base for above cabinet	600.00
Water Purification System Barnstead RO pure Reagent grade water, 10 litres/hr	5,000.00
Freezer (20°C) 17 Cu ft.	1,000.00
Refrigerator 17 Cu ft.	1,000.00
Incubator, Dry Heat Gravity Convection-30°-60°C	550.00
Incubator-Same type as above	1,250.00
PH meter, Accumet	300.00
Water Bath, Precision Model 183	620.00
Vibrator, Vertical, Thomas Arthur H. Thomas & Co.	600.00
Vortex Mixer, Genie	150.00
Magnetic Stirrer Model 220T, Fisher	120.00
Magnetic Stirring Bar Kit	50.00
Refrigerated Centrifuge, IEC Model DPR 6000 with accessories	12,000.00
Refrigerated Incubator, Precision	2,600.00
FA Microscope	8,000.00

*Microtiter Supplies

Microtiter, Micropipet, reusable	
0.05 ml (2Bx) ($113.30)	224.40
0.25 ml (2Bx) ($116.00)	233.20
Microtiter, Microdiluter	
0.025 ml (4Bx) ($259.00)	1,036.00
0.05 ml (1 Bx) ($259.00)	259.00
Microtiter plates, Polystyrene (12 Bx) ($58.00) Rigid U Plates, disposable 100/box	696.00
Microtiter Go-No-Go Testers for 0.05 & 0.25 ml diluters 1 box each	30.00
Microtiter, mirror reader	80.00
Consumable supplies	4,000.00
Glassware	3,000.00
Chemicals	3,000.00
TOTAL	$60,100.00

*Items listed in order of priority
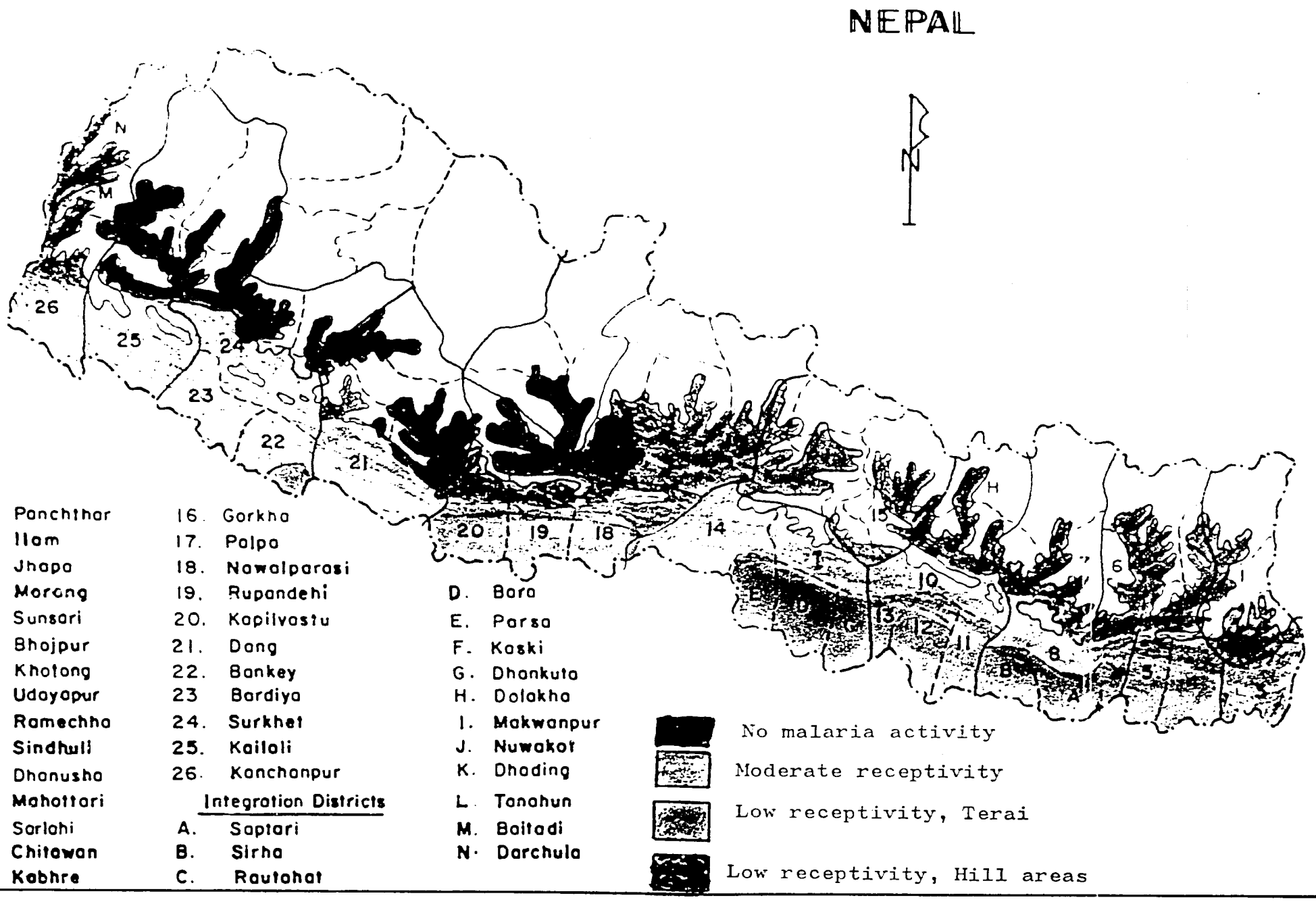
FIGURE 1 MALARIA SITUATION IN NEPAL