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Vector Biology & Control Project
1611 North Kent Street, Suite 503
Arlington, Virginia 22209
(703) 527-6500

Telex 248812 (MSCI UR)
Cable MSCI Washington, D.C.

An External Assessment of the Malaria Control Program in Nepal

June 1-21, 1990

By a Joint HMG/WHO/USAID/ODA Assessment Team

VBC Report No. 132

Managed by Medical Service Corporation International
under contract to the U.S. Agency for International Development

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Annex 1

Table A. Fiscal Summaries of NMEO

Authors

Dr. J. Akiyama, Regional Entomologist, WHO, SEARO;
Dr. R. Andre, VBC Consultant and Medical Entomologist, Uniformed Services University of the Health Sciences;
Mr. L. Cowper, VBC Consultant, former USAID Malaria Program Advisor
Dr. C. Draper, ODA UK;
Dr. A.V. Kondrashin, Senior Regional Adviser, WHO, SEARO;
Dr. Lossev, Malaria Adviser, WHO, NMEO, Nepal;
Dr. D.N. Regmi, Additional Secretary, MOH

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Term A1. Technical and operational efficiency and the effectiveness of different methods of case detection.

Term A2. Impact of decentralization of the district laboratories to Ilaka/ Health Post in relation to the diagnosis and treatment of malaria cases.

Term A3. *P. falciparum* malaria, its temporal and spatial features with particular reference to drug resistance.

Term A4. Exacerbation of malaria focal outbreaks.

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To analyze the current objectives and approaches to malaria control and provide guidelines for further sub-stratification of the malarious areas with the view to planning and developing appropriate control strategies.

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To evaluate the present entomological activities and suggest further strengthening of the entomological activities with reference to the recommended strategies of malaria control.

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Acronyms and Abbreviations

ABER	Annual Blood Examination Rate
ACD	Active Case Detection
A.I.D.	Agency for International Development
An.	*Anopheles*
APCD	Active Passive Case Detection
API	Annual Parasite Incidence
ARD	Agricultural and Rural Development (Division, USAID/Nepal)
BHS	Basic Health Services
CD	Communicable Diseases
DPHO	District Public Health Office
EA	Environmental Assessment
EAT	External Assessment Team
EC	Emulsifiable Concentrate
EEWS	Epidemiological Early Warning System
EPA	Environmental Protection Agency
GHS	General Health Services
GON	Government of Nepal
HFP	Health, Family Planning Division (A.I.D./Nepal)
IEE	Initial Environmental Examination
MCP	Malaria Control Program
MDA	Mass Drug Treatment
MT	Metric Ton
NMEO	Nepal Malaria Eradication Organization
NRTC	National Malaria Research and Training Center
ODA	Overseas Development Administration, UK
OP	Organophosphate
P	*Plasmodium*
PCD	Passive Case Detection
PCD/V	Passive Case Detection/Volunteer
RHC	Rural Health Center
SFR	Slide Falciparum Rate
S/P	Sulfadoxine-pyrimethamine (Fansidar[R])
SPR	Slide Positivity Rate
ULV	Ultra Low Volume
USAID	United States Agency for International Development/Nepal
VBC	Vector Biology and Control Project
WHO	World Health Organization
WDP	Water Disposal Powder
WP	Wettable Powder

Executive Summary

His Majesty's Government of Nepal, with the assistance of the World Health Organization (WHO), the British Overseas Development Administration (ODA) and the Agency for International Development (A.I.D.), carried out an external assessment of the malaria control program in Nepal June 1-21, 1990. The principal goals of the assessment were to evaluate the overall malaria situation in the country and the impact of different methods of case detection; progress in the decentralization of laboratories; the status of drug-resistant falciparum malaria; and identification of focal malaria outbreaks. Other goals were to analyze present and proposed stratification of control efforts, entomological inputs to malaria control, changes in manpower needs in District Public Health Offices (DPHOs), future insecticide spraying requirements, and estimated training demands. To facilitate data gathering for assessment purposes, the Team divided into two sub-teams for field observations, one sub-team covering the Eastern and Central Regions and the other the Mid-Western and Western Regions.

From an examination of the data provided by the NMEO, the Team found that the malaria situation in the country had generally improved since 1987. Of over one million slides taken in 1989, only about 22,000 were detected as positive and the API was 2.12, down from 2.71 in 1987. However, the Team found that a number of district data were incomplete or inaccurate, leading to concern that the reported case reduction may be due to reduced surveillance activities and quality control. Although the NMEO generally has held malaria under control during the last four years, the longer-term view is not so encouraging, because it appears that a "stairstep" increase in incidence is occurring. Fortunately, containment of *Plasmodium falciparum* has apparently been accomplished by the program.

Although there has been a slight increase in the collection of blood slides through Passive Case Detection (PCD) activities during the last two years, the Team found that a great number of slides still were being obtained through Active Case Detection (ACD). The establishment of Ilaka Health Posts and decentralization of laboratories is still in progress for various reasons. Unfortunately, this delay has had a negative impact on timeliness and quality of slide diagnosis and therefore, of prompt radical treatment. The Team was, however, impressed with the contributions of the Malaria PCD volunteers PCD(V)s to the malaria control program.

The Team reviewed the 1988-89 insecticide spray operations in the four regions visited and found a considerable difference between the target spray program and the actual spray operation due to lack of insecticides. Even if NMEO carries out an autumn spray cycle in

1990, which would protect only 350,000 people instead of the planned 550,000 living in the most highly malarious areas (Stratum I), the Team doubts that even 200,000 people can be protected in 1991 unless additional stocks of insecticide are purchased or granted by assisting agencies.

Because it has relied upon donor-assisted insecticides, the NMEO has been obliged to use a number of chemically unrelated insecticides. The Team noted with concern that proper entomological studies had not always been carried out prior to operational use of available insecticides to prove the suitability of some of these insecticides against the suspected or actual malaria vectors. Also of concern to the Team is the requirement for safe handling and storage of these various toxic chemicals, particularly in light of the poor storage practices observed in several districts.

The Team noted many staff vacancies, particularly in the Entomological Unit and the Hetauda Research and Training Center. It was apparent that this lack of trained, professional manpower reduced the effectiveness of both entomology surveys and malaria training. The Team estimates that even with full staffing at the Hetauda Center, it would take a minimum of two years just to initially train individuals involved in the malaria program, primarily those from the Basic Health Services (BHS).

The Team's major recommendations are:

1. Reduction in available insecticides for malaria control necessitates better case detection to prevent serious malaria outbreaks; therefore, the number of PCD(Vs) and couriers should be increased significantly to expedite diagnosis and treatment of the disease.

2. NMEO should reassess its 1990-1995 insecticide requirements in light of reduced availability and should base these requirements on the focused control of receptive vectors in highly endemic communities. It is suggested that optional alternative projections be developed.

3. Lack of training leads to reduced efficiency in malaria control; therefore, full support in terms of manpower, facilities and materials should be given to the Hetauda Research and Training Center (RTC).

4. Successful control of malaria in Nepal during the last two years, despite reduced resources and unstable staffing patterns, was primarily due to the technical and operational efficiency of NMEO as a specialized unit. Consequently, it should remain as such with both advisory and supervisory responsibilities.

The Team expresses its sincere appreciation to the Government of Nepal and to the Officers of the Nepal Malaria Eradication Organization, as well as the regional and district public health offices, for their outstanding assistance to team members during the external assessment.

1.0 Introduction

1.1 Background

Nepal has been plagued by malaria for centuries. Indeed, malaria has contributed to Nepal's isolation from much of Asia and the world in the past. The malarious tracts of the terai and inner valleys provided a barrier to incoming populations from India as well as a detrimental force to orderly settlement of the fertile lands of the inner terai and forest fringes. The number of malaria cases occurring each year in Nepal before the 1950s has been estimated at two million, with approximately 10 to 15 percent of the cases resulting in death.

Today, approximately 11,300,000 people out of Nepal's total population of 18,353,867 (1989), or 60 percent, live at risk of malaria. The first formal program to combat the disease was initiated in 1954 by the Government of Nepal with the assistance of the U.S. government. In 1955, an additional pilot malaria project was jointly developed with the World Health Organization (WHO). In December 1958, the two projects were joined together, and the Nepal Malaria Eradication Organization (NMEO) was formed to carry out a nationwide malaria effort.

The Government's efforts were remarkably successful and the program was systematically phased in to cover all malarious areas by 1965. As a result of these efforts, malaria cases were dramatically reduced, deaths from malaria were effectively halted, and massive settlement and development of formerly underdeveloped and underutilized areas of Nepal became possible. By 1970, the control program had reduced reported malaria cases to approximately 2,500 cases annually -- a 99 percent reduction from former years.

Due to the apparent success of the malaria activities, support resources were reduced or reassigned to other activities. However, the existing basic health structure was unable to maintain the hard-won gains in malaria control, and malaria began to reappear. The Government's prompt action, together with the assistance of the United States, United Nations agencies, and other donors in 1974, halted the rise of malaria in Nepal and enabled the country to escape the massive epidemics experienced in India, Pakistan and Sri Lanka during 1975-1978. The program was able to maintain a level of control of approximately 10,000 to 16,000 cases annually, which did not interfere with economic or social development.

The 1984-1989 period was characterized by reduced support for the vertical malaria control program and an increase in integration activities by the Government and assisting external agencies. The results were the occurrence of disturbing focal outbreaks of malaria and a continuous level of indigenous cases, although the disease remained around the level of 23,000 to 26,000 cases.

1.2 External assistance efforts in malaria

The two major assisting agencies over the life of malaria control activities in Nepal have been the World Health Organization (WHO) and the U.S. Agency for International Development (A.I.D.). The UNDP, British Government (ODA) and other agencies have contributed substantially to malaria control activities in Nepal. The Government of Nepal has made exceptionally successful use of these technical and support resources. Reports of external evaluation teams over the years have consistently confirmed the proper use of externally supplied resources in the program. Literally hundreds of Nepalese scientists have been trained both within the country and abroad and now occupy responsible positions in the NMEO as well as the Ministry of Health. (See Annex 1, Table A, fiscal summary).

1.3 Economic impact of malaria control

Malaria control in Nepal has enabled the human settlement of formerly malarious areas, allowing these lands to be used for productive agriculture and resulting in major increases in rice, sesame, mustard, wheat and other crops. (Annex 2, Table B provides a comparison of specific food outputs during the pre-control and post-control period, by selected districts.) It has been estimated that between 2.0 to 2.5 million people from the over-used hill tracts moved into these newly opened lands and began to turn them from subsistence/importation areas to exportation areas.

The dramatic growth of market towns along the upper terai is testimony to malaria's impact. These urban towns now engage in industrial pursuits that would not have been possible before. For example, the highly malarious district of Kanchanpur had a population of some 18,000 in pre-control days. Settlement of the area began after malaria control and the district now has a population of some 250,000 engaged in agricultural pursuits. A 1987 report, "Economic Study of Malaria in Nepal" by Anne Mills, concluded that, compared to other programs, Nepal's malaria program was both efficient and economical.

1.4 Environmental aspects of malaria control

Since their inception in 1958, malaria control activities have been tailored to respect environmental concerns. Initial Environmental Examinations (IEE) and environmental studies have consistently yielded favorable environmental evaluations of the operational activities. There have been two major studies (IEE) of the malaria efforts in Nepal. Both concluded that the assessed operational procedures were not detrimental to the environment. Each year mandatory health and safety training is given to the hundreds of spray personnel in the program.

Cholinesterase testing is routinely carried out to ensure that personnel are not being subjected to harmful exposure to the insecticides. Protective clothing is provided to operational personnel. In the history of the program, there has not been a single reported case of serious insecticide intoxication in any of the spray personnel or in the village populations. In addition, operational practices, such as washing spray equipment, are routinely monitored to ensure environmental protection. The major insecticide used recently in the program is Malathion, 50%, WDP, which is biodegradable.

1.5 Evaluation dates and methods

The Government of Nepal, with the assistance of A.I.D., WHO and the British Government (ODA), carried out the external assessment of the Malaria Control Program in Nepal June 1-21, 1990. The leader of the External Assessment Team (EAT-90), Dr. D.N. Regmi, met with GON/WHO/AID team members in Kathmandu to review planned activities prior to departure of two sub-teams to the field. One sub-team covered the Central and Eastern Regions while the other sub-team reviewed activities in the Western and Mid-Western Regions of the Country. The Team visited representative hospitals, health centers, health posts, malaria offices and community health activities in the regions visited. Upon their return from the field, the Team members prepared this report and presented the findings to the Minister of Health, Dr. Mathura Prasad Shrestha, and other senior GON Officers June 19, 1990.

2.0 Terms of Reference

A. To study the overall malaria situation of the country and to evaluate the anti-malaria activities being conducted during the Year 1988-1989 in relation to the facts listed below and to recommend appropriate measures for further improvement of the malaria situation.

   A1. Technical and operational efficiency and the effectiveness of different methods of case detection.

   A2. Impact of decentralization of the district laboratories to Ilaka/Health Post in relation to the diagnosis and treatment of malaria cases.

   A3. *P. falciparum* malaria, its temporal and spatial features with particular reference to drug resistance.

   A4. Exacerbation of malaria focal outbreaks.

B. To analyze the current objectives and approaches to malaria control and provide guidelines for further sub-stratification of the malarious areas with the view to planning and developing appropriate control strategies.

C. To evaluate the present entomological activities and suggest further strengthening of the entomological activities with reference to the recommended strategies of malaria control.

D. To review the resource requirements for the adequate management of malaria control through the District Public Health Offices based on PHC concepts.

E. To review the insecticide requirements and logistic support including transport necessary for anti-malaria activities on a long term basis.

F. To review the present manpower development for adequate management of malaria control and training resources requirements.

3.0 Term A:

To study the overall malaria situation in the country and to evaluate the anti-malaria activities being conducted during the Year 1988-1989 and to recommend appropriate measures for further improvement of the malaria situation.

3.1 Malaria situation from 1986–1989

Table 3a. presents the benchmark epidemiological data for 1986-1989. As can be seen, the total slides collected dropped by almost 900,000 during this period. While the malaria positives and the amount of *P. falciparum* malaria have shown steady reductions, this reported reduction may be due in part to reduced surveillance activities instead of being a real reduction. The Team found in its field and central reviews that a number of district data were incomplete or of questionable accuracy due to a large number of clinically diagnosed cases that are not reported within the surveillance system. The occurrence of focal outbreaks are also warning signs of a malaria situation that remains unstable and in need of careful field study and review. The increase in cases of imported malaria from 1988 (3,494 cases) to 1989 (4,635 cases) indicates that intense vigilance is required to ensure that these cases do not lead to new outbreaks.

3.2 Malaria profile by region in the 1988–1989 period

Tables 3b. and 3c. provide a summary of the reported malaria situation in Nepal by region.

Table 3c. indicates that there has been a decline in ABER in all the regions. A reduction in slide collection in all the regions was noted, with a maximum reduction of 29.1 percent. An increase in the total number of cases and API was noted in the Eastern and Far-Western Regions, whereas there has been a decline in these indices in the other three regions. SPR increased in all the regions except the Mid-Western region. SFR has decreased in all the regions except the Eastern Region. Indigenous *Plasmodium vivax* increased in the Central and Far-Western Regions. Indigenous *P. falciparum* increased in the Eastern Region, whereas in all other regions, there has been a substantial reduction. All the regions except the Mid-Western Region recorded increased numbers of imported cases (NMEO 1989 Annual Report).

Table 3a.

Basic Epidemiological Status of Malaria 1986–1989*

	1986	1987	1988	1989
Total Country Population	17043391	17469476	17906212	18353867
Population by Malaria Risk	10308200	10605651	10954451	11300223
Covered by Anti-Malaria Activities	9693739	9931831	10203903	10530911
Not Covered by Anti-Malaria Activities	735760	743117	750548	769312
Total Slide Collection	1451044	1453250	1295588	1068290
Total Slide Collection from (ACD+ APCD +PCD)	1209868	1252851	1181895	1015309
Total Positive Cases	36351	26866	25061	22333
Total Indigenous Cases	22005	16758	17344	14778
Total Imported Cases	6932	5006	3494	4635
Total *P. falciparum* Cases	3587	3890	3555	2320
Total Indigenous P.F. Cases	1677	2410	2272	1337
Total Imported P.F. Cases	1141	736	604	624
Total *P. vivax* Cases	32705	22922	21476	19962
Total Indigenous P.V. Cases	20313	14322	14326	13407
Total Imported P.V. Cases	5759	4254	2793	4004
Annual Blood Examination Rate	12.48	12.61	11.61	9.64
Annual Parasite Incidence	3.75	2.71	2.46	2.12
Excluding relapsed & imported cases		1.93	1.91	1.48
Slide positivity rate	2.51	1.85	1.93	2.09

**Data extracted from NMEO Annual Reports.*

Table 3b.
Malaria Profile 1988–1989

Region	Year	Total Slides	Total Positives	Ind. P.V.	Ind. P.F.	Imp 'A'*
Eastern	1988	316773	3312	898	120	1504
	1989	291427	3564	870	146	1831
Central	1988	475522	8418	4374	1414	965
	1989	396583	7988	4394	960	1432
Western	1988	294051	3036	1356	97	830
	1989	221549	2550	973	18	1016
Mid-Western	1988	125519	3771	3126	56	63
	1989	88992	1510	1262	28	36
Far-Western	1988	83420	6524	4562	585	112
	1989	69739	6721	5908	185	320
Nation	1988	1295538	25061	14326	2272	3494
	1989	1068290	22333	13407	1337	4635

*Category of imported cases from other countries. Totals include other categories.

Table 3c.
Malaria Profile 1988–89

Region	Year	ABER	SPR	SFR	%Pf	API
Eastern	1988	10.12	1.04	0.18	17.78	1.19
	1989	9.47	1.23	0.22	18.07	1.24
Central	1988	12.19	1.75	0.41	23.21	2.36
	1989	10.14	2.04	0.33	16.33	2.1
Western	1988	10.97	1.08	0.07	7.08	1.46
	1989	8.03	1.21	0.04	3.69	1.19
Mid-Western	1988	11.76	3.00	0.06	2.12	3.8
	1989	8.51	1.71	0.05	2.71	1.46
Far-Western	1988	10.47	7.81	0.88	8.68	8.53
	1989	8.55	10.30	0.36	3.50	8.59

Approximately 60 percent of all malaria cases were detected in seven of the 50 malarious districts of the country. Table 3d. provides a summary presentation for the seven problem districts of Dhanusha, Sindhuli, Mahottari, Nawalparasi, Surkhet, Kanchanpur and Dadeldhura for 1986-1989.

Table 3d.

Specific Malaria Data from Problem Districts in Nepal 1986–1989

Cases of Malaria

District	1986	1987	1988	1989	Region
Dhanusha	1957	1616	1671	1574	Central
Sindhuli	824	1071	1409	1662	Central
Mahottari	1543	1317	1042	1063	Central
Nawalparasi	1320	1603	1089	681	Western
Surkhet	1945	1956	1879	505	Mid-West
Kanchanpur	6141	1979	2298	3486	Far-West
Dadeldhura	2883	1323	1802	993	Far-West
Kailali	3633	1328	989	781	Far-West
Kavre	371	608	981	1229	Central
Jhapa	1425	1420	899	880	East

In summary, the malaria situation has remained generally under control over the last four years. The data presented show a decrease in ABER, but this rate remains within satisfactory bounds if the slides are being collected correctly. The Slide Positivity Rate (SPR) has remained relatively static over the four years while the Annual Parasite Incidence (API) has slowly decreased.

The longer-term view is not as encouraging. It appears that a "stairstep" increase in incidence has been occurring during the last decade or so, with levels starting at 2,500 to 3,000 cases per year in the 1970s and rising to 12,000 to 16,000 in the early 1980s (Graph, Annex 3). *P. falciparum* containment has been accomplished by the program, but with the rise of imported cases from abroad in 1989, this aspect will require careful observation.

Little or no malaria mortality has been reported by the program for several years. However, reports during the epidemic in Kanchanpur in 1985 indicated that a number of deaths had occurred and could, indeed, be expected during future epidemics. Malaria will remain a serious threat to the health and welfare of the nation for the years ahead, but with proper support and interest, the disease can be controlled with a minimum of funding and manpower support.

3.3 Operational and technical efficiency

It will be shown below that NMEO, as a component of Nepal's Basic Health Services, continues to be a cost-effective and technically efficient organization. However, the members of EAT-90 feel that the NMEO could be even more operationally and technically efficient if the information system network established by the NMEO functioned more effectively, whether with a surveillance mechanism or a computerized system. Currently, much of the essential epidemiological information (age, sex, location of the village, population movement, elements of human behavior and other characteristics) is often lost in the process of communication from the lowest observation unit to the district, region or national headquarters. Therefore, improvement of the program's information system in the program is very important.

3.3.1 Operational efficiency of different case detection mechanisms

Cumulative comparative data on the operational efficiency of different case detection mechanisms are given in Table C, Annex 4. Though there was a slight upward trend observed for the last

two years in collecting blood slides through PCD activities in Nepal, including by PCD(V), a tremendous number of slides still were collected through ACD activities. About 68 percent of the total slides in the country were collected through ACD. In the Central Region, the collection of the slides by ACD constituted more than 73 percent. Though one of the recommendations of the EAT-88 was to eventually replace the ACD blood collection with PCD, the actual number of blood slides collected by ACD in 1989 (67.2) remained unchanged as compared with the previous year (68 percent).

As expected, the SPR by ACD was the lowest (19.7 percent in 1986 and 23.3 percent in 1988), while SPR through PCD was considerably higher (53.1 percent in 1988 and 60.4 percent in 1989). There was an encouraging increase in malaria cases detected by PCD(V), as judged by the SPR (19.7 percent in 1986 and 25.1 percent in 1989). In the Central Region during 1989, the SPR attained by PCD(V) collections was even higher -- 37.4 percent.

In some Central Region villages visited by the members of EAT-90, the PCD mechanism already had become an element of the Epidemiological Early Warning System (EEW). Thus, in village T. Ranibas of Sindhuli District in 1990, slides collected by ACD constituted 25.1 percent of positives of the total collection, and the SPR was 18.7 percent. APCD collections constituted 19.5 percent of slides collected, and the SPR was 30.1 percent. In comparison, PCD collections were 55.4 percent of all total slides, and the SPR was 55.9 percent. Similar observations were made in the villages of Tulsichaura, Bishambarpur and Bahunmara under the Dhalkewar Health Post of Dhanusha District.

Therefore, EAT-90 reiterates the recommendation of the previous EAT-88 to further expand the network of PCD(V) activities at the village level so that ACD collection of blood slides will eventually cease. Considering that the accomplishment of this recommendation may require considerable effort to retain the ACD agents (VHWs), the whole process should be gradual. The first step could be the reorientation of the VHWs to collect slides only from the fever cases during their village visits, according to a developed fever protocol. The time saved might be utilized by VHWs to replenish PCD(V)s with new stocks of drugs, spirit, cotton wool and slides. Eventually, VHWs' anti-malaria activities could be switched over from exclusively collecting blood slides to motivation of PCD(V)s, health education, replenishment of supply of drugs and collection of epidemiological data.

In addition to the above, efforts should be made to involve Community Health Volunteers (CHVs) in malaria case detection and treatment, though malaria activities are not included in their current responsibilities.

3.3.2 Time-lag of collection, investigation, and radical treatment of cases

Comparative regional data on the time-lag of collection, investigation, and radical treatment of malaria cases are presented in Table D, Annex 5. It can be seen that though the caseload in the country decreased by about 18 percent in 1989 as compared with 1987, the commencement of radical treatment within seven days or less did not decrease, as would have been expected. Only a slight improvement in investigation of cases within seven days was observed in 1989. This improvement occurred only in the Eastern, Mid-Western and Far-Western Regions, whereas in the Central and Western regions, deterioration in this activity was observed.

3.3.3 Relapse and recrudescence rates

The relapse rate of indigenous cases of *P. vivax* dramatically decreased in 1989 compared to 1988, dropping by 86 percent. The highest rate of decrease was observed in the Western Region (108.5 percent) and the Far-Western Region (106.3 percent). In the Eastern Region, reduction was 61.1 percent. Only a marginal decrease in the relapse rate was observed among cases imported from abroad, whereas, in the Western Region, it had increased by 35.7 percent. The reasons for such a sharp decrease in indigenous *P. vivax* cases are not clear. It may be due to better coverage by radical treatment of indigenous cases as compared with imported ones.

Similarly, the recrudescence rates of indigenous and imported *P. falciparum* cases declined in 1989 by 131.3 percent and 59.3 percent, respectively. The decline might be attributed to the introduction of sulfadoxine-pyrimethamine drug combination (S/P) for treatment of *P. falciparum* cases throughout the country in April 1988. It also probably shows that local strains of *P. falciparum* in Nepal are still less resistant to antimalarials than those imported from India.

3.3.4 Impact of decentralization of the district laboratories to Ilaka/health post in relation to the diagnosis and treatment of malaria cases

Although the decision to set up Ilaka health post laboratory services in most of the plain and inner terai districts was made in 1988, the decentralization process is still going on for various administrative and operational reasons, of which the shortage of trained personnel and microscopes are the most important. However, laboratory decentralization had taken place in the majority of districts and health posts visited by Team members, therefore, our observations relate exclusively to those areas.

The most important indicator of the performance of each decentralized laboratory appears to be the time-lag between collection of a slide and its examination by the laboratory. Using this criterium, it was found, as shown in Section 3.3.2, that there had been only marginal improvement in the time-lag between the collection of slides and their laboratory examination. This lack of improvement is probably determined not by poor performance of decentralized laboratories but by the shortage of couriers at the health posts. The courier system that was functioning effectively under NMEO has not been maintained under the present integrated set up, where the courier post no longer officially exists in the staffing pattern of health post. Couriers are assigned to the peon category and by and large need orientation, training, and guidance from the Health Post-In-Charge. The latter very often does not appreciate the necessity of these services because he has not been trained in malaria himself!

3.4 *P.falciparum* malaria, its temporal and spatial features with particular reference to drug resistance

Conditions for mosquito transmission of *P. falciparum* malaria are more exacting than those for *P. vivax*, for the following reasons:

1. A higher temperature (70^{0}F) is required for successful completion of the extrinsic cycle in the vector mosquito.

2. After the appearance of asexual parasites in the circulation there is a delay of seven to 10 days before gametocytes appear, whereas with *P. vivax*, gametocytes are produced from the start. Also, with *P. falciparum* the patient may well have taken a drug that could sterilize gametocytes before they appear.

3. Similarly, patients with *P. falciparum* are more likely to have clinical symptoms even if they are semi-immune, which would cause them to seek treatment.

For these reasons, the incidence of *P. falciparum* could be a sensitive indicator of the success of control measures, as it has been in other control schemes.

Table 3e.

Recent Figures for the Incidence of Indigenous *P. falciparum* Cases in Nepal

	1987	1988	1989
Total indigenous cases of malaria	16758	17344	14770
Total indigenous cases of *P. falciparum*	2410	2272	1337
% *P. falciparum*	14.4	13.1	9.0

Although there must be many imponderable variables, these figures suggest that control is being maintained. However, there continues to be a steady stream of imported *P. falciparum* cases from abroad. For the three years in the table above, the numbers found were 736, 604 and 624.

Chloroquine-resistant *P. falciparum* malaria has been known to be present in Thailand, India and other Southeast Asian countries since the 1960s and 1970s. There is also known resistance to sulfadoxine/pyrimethamine and possibly to mefloquine. Because of the fear that resistance could spread in Nepal through imported cases, the NMEO has tried to conduct drug sensitivity tests using standard WHO kits. Progress has inevitably been slow because only a few falciparum cases may be found on a field trip, and of those only a proportion may be suitable for *in vitro* and *in vivo* tests. In 1987 and 1988, a total of 62 *in vitro* tests for chloroquine sensitivity were done, of which 19 (39 percent) showed R1 resistance, with a few possibly to

R2. Fourteen *in vitro* tests for mefloquine and seven tests for S/P showed full sensitivity. There have been problems with growth medium used for the latter. A total of 69 *in vivo* tests for chloroquine were done, mostly on subjects different from those used for *in vitro* tests. In the *in vivo* tests, 31 (45 percent) showed R1 resistance but none showed higher levels of resistance.

The NMEO now uses three tablets of S/P as standard treatment for *P. falciparum* malaria. The incidence of recrudescing *P. falciparum* infections has fallen from five percent in 1988 to two percent in 1989.

3.5 Exacerbation of malaria focal outbreaks

A number of malaria outbreaks have been reported in various strata of the country during the period under appraisal. In 1988, a few outbreaks of malaria were located in the Central Region in the moderate receptive areas of Dhanusha and Sindhuli Districts, with a considerable number of indigenous *P. falciparum* cases. *P. falciparum* outbreaks were also reported in Bogata of Dadeldhura and in Kanchanpur Districts of the Far-Western Region. There has been a sharp rise in malaria in the Darchula District of the same region. Focal outbreaks of malaria also were recorded from areas outside the NMEO malaria control operation: Lakayel in Dadeldhura and adjacent areas of Doti District.

In high altitude areas of the Western hills, malaria cases have been reported from the Mugu, Humla and Jumla Districts, where there were no regular malaria control activities.

A few focal outbreaks were reported in the Central Region and Far-Western Region in 1989 (Tables 3f and 3g). Malaria outbreaks occurred in different malariogenic strata with various receptivities, indicating that the malaria potential in the country is still very high.

There were two categories of villages in which malaria outbreaks occurred. One group consisted of villages where persistent transmission had existed on a low level for the last few years. Another group represented villages where no malaria cases were recorded in previous years. It appears, therefore, that the process of dissemination of malaria takes place in those areas. The disturbing factor is the preponderance of *P. falciparum* cases in newly established foci in the Sindhuli and Sarlahi Districts of the Central Region.

The EAT-90 concurs with the views of the NMEO staff that contributing factors to the malaria outbreaks mentioned above were as follows:

- o persistence of malaria transmission in certain areas for long periods;
- o illegal activities in the forests, where prolonged malaria transmission is possible;
- o large-scale uncontrolled population movement, both within and outside operational areas;
- o resettlement programs;
- o developmental projects;
- o inadequate insecticidal coverage;
- o changes in the recent malariogenic potential of the area;
- o inadequate knowledge of the changing pattern of local malaria transmission;
- o inadequate surveillance coverage due to frequent turnover of staff;
- o non-involvement of the community in malaria control activities;
- o absence of Epidemiological Early Warning Systems (EEWS).

NMEO has developed a strategy to contain malaria outbreaks. It includes: 1) deployment of available insecticides; 2) establishment of diagnostic and treatment facilities at the peripheral level; 3) the introduction of S/P drug combination for the radical treatment of all microscopically diagnosed *P. falciparum* cases; 4) addition of 45 mg. of primaquine (adult dose) to the regular presumptive treatment with chloroquine during the transmission season and 5) mass drug treatment.

Table 3f.

Focal Outbreaks of Malaria
1987 - 1988

Region: Central

District	Ilaka Health Post	Village affected	Year	Pop.	No. of Total Positive	No. Ind. Cases	No. of Ind. P.F.	Total Ind. Mx
Kavre	II,	-	1987	21389	481	420	0	0
LOW. H.	Panchkal		1988		806	692	0	0
ST-IV			1989		1026	951	1	0
Sindhuli	I,	1	1987	1048	280	232	126	3
	Bhiman		1988		374	374	363	2
			1989		510	486	83	15
Mod. ST I	VIII,	1	1987		0	0	0	0
	Ambote		1988	241	1	1	0	0
			1989		33	29	17	0
	IX,	2	1987		0	0	0	0
	Balajor		1988	566	0	0	0	0
			1989		111	50	42	1
Sarlahi	VII,		1987	-	3	2	0	0
	Sasapur	1	1988	-	2	1	0	0
			1989	-	21	19	18	0
Mod. St II	VIII,		1987		14	5	0	0
	Bhaktipur	1	1988	3499	7	1	0	0
			1989		25	22	18	0

Table 3g.

Focal Outbreak and Exacerbation of Malaria 1987–1989

Region: Far-West

District	Ilaka Health Post	Village affected	Year	Pop.	No. of Total Positive	No. Ind. Cases	No. of Ind. P.F.	Total Ind. Mx
Kanchanpur	I,	3	1987		44	41	0	0
	Jimuwa		1988	3134	46	46	3	0
			1989		468	448	1	0
	II,		1987		170	154	6	0
	Daiji	-	1988	23884	128	121	5	0
Mod. ST I			1989		299	292	8	0
	V,		1987		62	53	1	0
	Baise	-	1988	20388	87	83	6	0
	Bichuwa		1989		313	310	14	0
	VII,		1987		12	10	0	0
	Shreepur	3	1988	-	30	30	4	0
			1989		229	185	1	0
Dadeldhura	Sakayal	Nava	1988					
	Dewal	Durga	1989	-	8	8	0	0
Mod.	Kailali	Mandi	1988		175	175	0	0
ST I.		(market)	1989	-	307	307	5	0

This strategy proved to be efficient, particularly during the flare-up of malaria in Far-Western Region in 1985. Deployment of the above strategy brought down the caseload from 3,756 cases in the Kanchanpur and Kailali Districts in 1985 to 167 cases in 1987. However, it was also noticed that some of these malaria foci retained their endemicity.

Therefore, the success of the containment of malaria outbreaks and prevention of malaria dissemination in Nepal will depend on implementation of complex anti-malaria measures, including development and introduction of EEWs, deployment of insecticides, the rational use of antimalarials and sustained community participation.

4.0 Term B:

To analyze the current objectives and approaches to malaria control and provide guidelines for further sub-stratification of the malarious areas with the view to planning and developing appropriate control strategies

According to recent NMEO documents (Plan of Action for FY 1989/90 and Annual Report 1989), the general current objectives for malaria control appear to be set in some aspects, namely: prevention and control of malaria epidemics and containment of *P. falciparum*. The other two objectives -- prevention of mortality due to malaria and reduction of malaria morbidity to a level that will not hinder the socioeconomic development of the country -- are relevant to the public health and Government policy. The Team noticed with satisfaction that the recommendation of EAT-88 to develop specific objectives for each stratum had been implemented.

The national Annual Parasite Incidence (API) obtained for the last four years was less than projected by the operational target of 5.0 per thousand population. This might be considered encouraging, except that certain operational and technical constraints are facing the program. The values of API for different malariogenic strata obtained in 1989 (Table 4a.) also demonstrate achievement of optimal results against the targeted figures. But Stratum III is an exception. An analysis of this index for 1987-89 showed that the malaria situation in hilly areas (Stratum III), considered areas with low malariogenic potential, had been underestimated. In most regions, the API in hilly areas is equal to the incidence in areas of moderate or even higher malariogenic potential. These data should draw special attention to the need to revise the objectives and the approach for this stratum (see map, Annex 8).

The present approaches seem to be more realistic in relation to the operational and technical problems facing the program. Approaches have been developed for each of the five strata.

The present approach to stratification of Nepal's malarious areas has an advantage over the previous stratification schemes. It takes into account not only endemicity and receptivity of the area, but its vulnerability as well. Previous approaches were mainly based on the former two factors. Current stratification reflects not only the potential of malaria transmission, but the actual level of risk of malaria transmission in different ecozones.

However, criteria proposed for stratification of malarious areas have yet to be clearly defined. First, a base has to be formed on the background of physiogeographic factors (temperature, humidity, precipitation and orography) in different areas of the country. Division of the areas according to natural climatic zones, keeping in view the abiotic factors favoring malaria transmission, should be considered basic malariogenic stratification. This will take some time. It will be a great help in solving operational problems, but probably will not substitute for operational stratification, especially considering constraints such as a insecticide shortages and malaria outbreaks, which require more concentrated (focal), and hence more realistic, approaches.

Sub-stratification of malarious areas should also be done on an operational basis since the antimalarial activities are to be carried out in different problem areas. Sub-stratification requires periodic review according to the changing malaria situation and epidemiological findings after anti-malaria measures have been taken.

The following factors should be taken into consideration for sub-stratification of the malarious areas:

1. Persistence of transmission.
2. Potential areas of exacerbation of malaria (malaria outbreaks).
3. High prevalence of *P. falciparum*.
4. Population migration.
5. Vector species and bionomics.

1. **Persistence of transmission.** This problem can be attributed to any of the factors listed above or to a combination of these factors. After identification of these areas, the cause of the persistence should be determined, and an appropriate malaria control activity should be proposed.

2. **Potential areas of exacerbation of malaria.** For the choice of criteria for delineation of strata, the patterns of outbreaks should be considered. Identification of such areas is followed by monitoring of epidemiological and entomological data, which should be available for application of an early warning system. It should be stressed that the system is justified only when prompt information can be obtained. It is advisable to have a ready operational team and proper supplies. Elimination of outbreaks requires implementation of complex remedies for at least another malaria season.

3. **High prevalence of P. falciparum.** The existence of indigenous cases and the persistence of falciparum malaria despite implementation of control measures should be taken into account in the process of delineating areas with a high prevalence of *P. falciparum*. It is advisable to obtain more information on clinical manifestations of falciparum cases, as well as on resistance status.

4. **Population migration.** This complex problem requires further investigation to differentiate the objectives and approaches according to the pattern of migration in certain strata. Such sub-stratification is expected to lead to selection of more rational control measures.

5. **Vector species and bionomics.** In many instances, our knowledge of the bionomics and vectorial capacity of proven malaria vectors is not sufficient to explain their role in malaria transmission. This results in unsubstantiated hypotheses about the alteration of vector bionomics or involvement of other *Anopheles* species in transmission. Sub-stratification concerning the bionomics of *Anopheles* assumes further detailed studies of certain species in problem areas.

Table 4a. Annual Parasite Incidence, 1987–1989

Region	Receptivity	API 1987	API 1988	API 1989
Eastern	Low (Terai)	0.82	0.52	0.58
	Low (Hills)	4.24	3.48	3.57
	Moderate	2.83	1.79	1.86
Central	Low (Terai)	1.26	1.12	1.00
	Low (Hills)	2.38	3.04	3.47
	Moderate	3.42	4.21	3.51
Western	Low (Terai)	3.06	1.90	1.02
	Low (Hills)	1.52	1.26	1.37
	Moderate	2.09	1.31	1.07
Mid-Western	Low (Terai)	3.27	1.68	1.02
	Low (Hills)	10.92	11.81	0.72
	Moderate	5.23	4.52	1.71
Far-Western	Low (Terai)	-	-	-
	Low (Hills)	9.38	13.46	10.34
	Moderate	6.29	6.15	7.80
National	Low (Terai)	1.47	1.04	0.85
	Low (Hills)	3.83	3.67	3.33
	Moderate	3.91	3.64	3.13

5.0 Term C:

To evaluate the present entomological activities and suggest further strengthening of the entomological activities with reference to the recommended strategies of malaria control

5.1 General review of entomological activities

Nepal is located on the southern slopes of the Himalayan Mountains and is divided into three topographical regions spreading longitudinally from east to west. These regions are the Northern Mountain Region (altitude range 6,000 -8,800 meters); the Hill Region lying between the Mahabharat Ranges (up to 4,877 meters in altitude) in the north and the Siwalik Range (610 - 1,524 meters in altitude) on the south (the valleys between these two ranges are known as the Inner Terai); and the lower Terai Region, which lies in the southern part of the country bordering India (known as the Outer Terai). The climate and topography of these three regions greatly influences the mosquito fauna, including the vectors of malaria, both spatially and temporally.

Out of 36 *Anopheles* species that occur in Nepal, four have been incriminated as malaria vectors: *An. annularis*, *An. fluviatilis*, *An. maculatus* and *An. minimus*. Although *An. culicifacies* occurs in large numbers in the Outer Terai and is a malaria vector in India, no sporozoites have been detected in more than 150,000 specimens. *Anopheles annularis* is found mainly in the low parts of the Terai. *An. fluviatilis* occurs in low numbers in this situation but in high numbers in the forested Inner and Outer Terai and the foothills (up to 1,400 meters in altitude). *Anopheles maculatus* occurs in low and high foothills (up to 2,100 meters in altitude), breeding in sunlit seepages on the forest fringe. *Anopheles minimus* was prevalent in the forested foothills (up to 800 meters in altitude) of the Inner Terai, but has apparently been eliminated by indoor residual insecticides.

During the past four years, entomological teams from the NMEO Headquarters, the Hetauda Research and Training Center, and the five regions have conducted routine, spot and longitudinal surveys. The general objectives of these surveys have been to study the impact of residual insecticide indoor spraying, to study the behavior of *An. annularis*, *An. fluviatilis* and *An. maculatus*, and to watch for the possible resurgence of *An. minimus*. Routine surveys have focused on a few villages in each region that seemed to have a high malariogenic potential. Sprayed and unsprayed villages were surveyed each month

(total of 18 days/month) using a variety of collection techniques, including morning indoor hand catches, outdoor resting collections, night biting collections, and animal baited net trap collections. Captured mosquitoes were identified and the vector anophelines were dissected for salivary gland and ovary examinations.

Periodically, insecticide susceptibility tests were conducted when high numbers of vectors were captured. Spot surveys were conducted occasionally in villages that might have been experiencing unusual indigenous malaria transmission. These surveys incorporated the same collection techniques as the routine surveys but were only conducted once and for only four days. Two longitudinal surveys (one in the Far-Western Region and one in the Central Region) were initiated in 1987 and conducted through 1989.

An 18-month longitudinal study in the Far-Western Region, Kanchanpur District (villages Badaipur and Musepani) was initiated to determine the epidemiology of malaria in an area with annual attack rates of 39 and 42 per 1000 during 1985 and 1986, respectively. The following specific objectives were addressed:

1. Comparatively describe the bionomics of the anopheline fauna inhabiting the three ecological zones of Kanchanpur District where malaria is endemic: deforested agricultural zone, newly formed agricultural/forest ecotone and forested foothill zone;

2. Determine the potential vectorial role of each *Anopheles* species in the maintenance of the ongoing malaria epidemic; and

3. Determine the susceptibility status of the common *Anopheles* to DDT, Malathion and Ficam.

In the Central Region, Sindhuli District, two representative Inner Terai villages (T. Ranibas and T. Khutepani) on the southern bank of the Kamal Nadi River were selected for an 18-month longitudinal study. Despite Ficam spraying in 1986, the malaria case rate in T. Ranibas was 42/1000. During the study, T. Khutepani continued to receive spray, but T. Ranibas did not. Objectives for this study were as follows:

1. Determine the importance of outdoor transmission by forest anophelines, including *An. fluviatilis* and *An. maculatus*, in the maintenance of malaria at representative villages in Sindhuli District;

2. Evaluate the impact of DDT residual house spray on anopheline behavior and susceptibility status; and

3. Elucidate the role of possible secondary vector species in malaria transmission.

Mosquitoes in the two longitudinal study areas were collected by a variety of methods, including indoor and outdoor biting and resting collections, human and bovid bait collections, and larval collections. Anophelines were identified and vectors were dissected. Attempts were made to isolate sporozoites by the sporozoite concentration method, and species identification of positive glands was attempted using the ELISA. (Neither technique worked.) Mosquito aging techniques were used, and human blood meals were determined using the gel diffusion technique. Standard WHO insecticide susceptibility tests were used.

A number of routine surveys were conducted during 1986 through 1989 (Table 5a). The results indicated that high numbers of vectors were collected in the villages selected. Usually, anopheline populations were higher (66 percent of 74,462 mosquitoes captured) in unsprayed villages. Although villages were to be visited monthly during the year, many villages were only surveyed a few times and sometimes only once, much like a spot survey. Because of this, the data were difficult to interpret. It appeared that spraying had had some impact, but the ecology of the unsprayed villages may also have been less suitable for vector breeding and survival.

Table 5a.

Summary of Anopheline Mosquitoes Collected During Routine Surveys, 1986–1989

	Number Collected		
Species of Anopheles	Unsprayed Villages	Sprayed Villages	Total (%)
aconitus	2,469	1,839	4,308 (5.8)
aitkeni	18	0	18 (0.02)
annularis	16,278	6,061	22,339 (30.0)
barbirostris	100	48	148 (0.2)
culicifacies	4,914	4,409	9,323 (12.5)
fluviatilis	2,795	816	3,611 (4.8)
gigas	20	0	20 (0.03)
jamesii	58	55	113 (0.2)
jeyporiensis	38	49	87 (0.1)
karwari	3	9	12 (0.02)
maculatus	4,275	2,634	6,909 (9.3)
majidi	2	13	15 (0.02)
nigerrimus	115	404	519 (0.7)
pallidus	247	222	469 (0.6)
sinensis	1,092	931	2,023 (2.7)
splendidus	214	162	376 (0.5)
stephensi	0	3	3 (0.0)
subpictus	6,879	4,927	11,806 (15.8)
tessellatus	239	486	725 (1.0)
vagus	9,362	2,059	11,421 (15.3)
varuna	205	12	217 (0.3)
TOTAL	49,323 (66.2%)	25,139 (33.8%)	74,462

Results from the longitudinal surveys were easier for the Team to interpret. In the Far West, Kanchanpur District, more than 4,800 anophelines were collected from August 1987 to April 1988. *Anopheles culicifacies* was the most abundant, followed by *An. subpictus* and *An. maculatus* However, most were collected from animals and not from man. During the monsoon, only low numbers of vectors were collected, yet malaria cases were most prevalent during July and August. More than 3,500 female anophelines were dissected, but no sporozoites were detected. In 1989, *An. culicifacies*, *An. subpictus*, and *An. maculatus* again were the most abundant species. Human biting rates remained extremely low, and another 3,000 dissections failed to detect any infected salivary glands.

In the Central Region, Sindhuli District, a total of 4,971 anophelines were collected at the two villages and at two cattle goths (temporary hut and corral) located some distance away in the forest. During the period from August 1987 to April 1988, *An. maculatus* was the most common species, constituting almost 50 percent of the total. About eight percent of the total were *An. fluviatilis*. The human biting rate was very low in the village but increased at the cattle goths in the forest, particularly that of *An. fluviatilis* (80 percent of 215 females collected on humans in April 1990). Five of 20 suspected sporozoite-positive mosquitoes were captured in the village, the remainder were biting at the cattle goths. Except for two *An. maculatus*, all positive mosquitoes were *An. fluviatilis*. (See Table 5b for a summary of all dissections.) The data at T. Ranibas indicated that *An. maculatus* may have been important in malaria transmission in the village, and that *An. fluviatilis* was definitely important in the cattle goths located in the forest.

The data obtained from insecticide susceptibility tests were quite variable. Information was provided to the Team for four out of five regions. No information was obtained for the Far-Western Region. Only one test was conducted in the Eastern Region, whereas 29 tests were conducted in the Western Region. The results of 50 tests conducted during 1988 through 1989 are summarized in Table 5c. DDT-resistant individuals were detected in populations of *An. fluviatilis* (Western and Central), *An. maculatus* (Western and Central), *An. annularis* (Western) and *An. sinensis* (Western). Dieldrin resistance was detected in populations of *An. fluviatilis* and *An. aconitus* in the Western Region. Bendiocarb killed only 89 percent of *An. annularis* and 79 percent of *An. fluviatilis* in the Mid-Western Region.

Thus far, the important malaria vectors, *An. fluviatilis*, *An. maculatus* and *An. annularis*, have shown complete susceptibility to Malathion, Fenitrothion and Actellic. Interpretation of the test results obtained from the various regions was hampered by small sample sizes

and lack of replication. Also, some tests were conducted against non-target species or were not utilized to predict the effectiveness of a particular insecticide that was to be used in the spray program.

Selection of resistant vector populations may occur because of the agricultural use of pesticides rather than their use in malaria control. In Nepal, more than 20 different pesticides are used on various crops such as cotton, paddy, maize, jute, sugarcane and fruit trees (Table E, Annex 6). Because paddy cultivation is increasing dramatically in Nepal, the use of pesticides is likely to increase as well. *Anopheles annularis* is found mainly in rice growing areas of the Outer Terai, and it has shown a high level of resistance to DDT. Agricultural insecticide use may maintain this resistance pattern and may lead to cross-resistance with other pesticides, including those used in malaria control. Therefore, it is important to systematically monitor the response of vector populations to the various insecticides used in the program.

5.2 Staffing of Entomology at NMEO

The NMEO includes an Entomology Unit at the National Headquarters. This unit is headed by an officiating senior entomologist who reports directly to the Chief of NMEO. The overall entomology program is planned at the national level. Technical guidance for the regional entomology teams is provided by entomologists from Headquarters. Administrative and managerial aspects are the responsibility of the Regional Directorate.

Entomology teams have been assigned to each of the five regional malaria offices, and one entomology team has been assigned to the Research and Training Center at Hetauda, Central Region. Teams from the Eastern, Western and Mid-Western Regions have been involved in routine entomological surveys and spot checks. From 1987 through 1989, the Central and Far-Western Regional teams were involved in the special longitudinal entomological studies discussed earlier. Additional technical guidance was provided by Dr. William Reisen, VBC consultant for USAID. At the Hetauda RTC, the team is involved in mosquito colonization and spot check surveys. The HQ team also is involved in spot check surveys and assists the regional teams whenever necessary.

Unfortunately, the Entomology Unit remains understaffed despite a recommendation from the 1988 External Assessment Team that the unit be fully staffed. Seventy sanctioned posts are listed for the Entomology Unit, but 20 (28 percent) remain vacant (Table 5d). The

Table 5b.

Summary of Dissection Results For Detection of Malaria Sporozoites, 1987–1989

Species of Anopheles	Number dissected (No. positive)			
	Far-Western Region		Central Region	
aconitus	1	(0)	9	(0)
annularis	528	(0)	1,127	(0)
culicifacies	2,969	(0)	265	(0)
fluviatilis	246	(0)	1,359	(18)
jamesii	0		267	(0)
jeyporiensis	0		135	(0)
karwari	0		1	(0)
maculatus	1,194	(0)	3,991	(2)
nigerrimus	250	(0)	0	
pallidus	0		427	(0)
sinensis	13	(0)	28	(0)
splendidus	76	(0)	792	(0)
subpictus	1,108	(0)	0	(0)
tessellatus	0		564	(0)
vagus	194	(0)	0	
varuna	2	(0)	3	(0)
TOTAL	6,581	(0)	8,968	(20)

Table 5c.

Summary of Insecticide Suceptibility Test Results, 1988-1989

Region	Species of Anopheles	Insecticide	Number Tested	% Mortality
Eastern	annularis	Fenitrothion	25	100
Central	fluviatilis	Bendiocarb	15	100
		DDT	80	87.5
		Dieldrin	20	85
		Fenitrothion	40	100
		Malathion	40	100
	jamesii	Bendiocarb	60	100
	maculatus	DDT	15	46.7
		DDT	80	95
		Dieldrin	40	100
		Fenitrothion	15	100
		Fenitrothion	20	100
		Malathion	20	100
Mid-Western	annularis	Bendiocarb	100	79
		Dieldrin	100	31
		Malathion	100	100
	fluviatilis	Bendiocarb	100	89
		DDT	50	100
		DDT	50	100
		Dieldrin	100	53
		Malathion	100	100

Table 5c. (continued)

Region	Species of Anopheles	Insecticide	Number Tested	% Mortality
Western	aconitus	DDT	60	96.7
		DDT	34	29.4
		DDT	60	96.7
		DDT	20	60
		Dieldrin	20	100
		Dieldrin	20	65
		Fenitrothion	18	100
		Malathion	20	100
	annularis	Actellic	100	100
		DDT	38	5.2
		Dieldrin	20	15
		Fenitrothion	20	100
		Malathion	100	100
		Malathion	100	100
		Malathion	20	100
		Malathion	100	100
	fluviatilis	DDT	60	93.3
		DDT	100	100
		DDT	39	84.6
		DDT	100	93
		DDT	77	88.3
		DDT	100	100
		Dieldrin	19	94.7
		Dieldrin	40	80
		Fenitrothion	20	100
		Malathion	16	100
		Malathion	20	100
	maculatus	DDT	11	90.1
	sinensis	DDT	35	68.5

Table 5d.

Status of Entomological Staff, 1990

Position Title	NMEO HQ	RTC Hetauda	Eastern Region	Central Region	Western Region	Mid Western	Far Western Region
Senior Entomologist	1 (1)*	0	-	-	-	-	-
Entomologist	2**	1***	1 (1)	1***	1 (1)	1 (1)	1****
Assist. Entomologist	0	2 (1)	-	-	-	-	-
Malaria Assistant	1 (1)	4 (3)	1	1	1 (1)	0	1 (1)
Malaria Inspector	6	4	5	3	3	1	1
Insect Collector	0	9 (1)	2	5 (1)	5 (4)	4 (1)	4
Laboratory Aid	1	2	1	1	1	1	1
TOTAL	11 (4)	22 (5)	10 (1)	11 (1)	11 (6)	7 (2)	8 (1)

* Number in ( ) indicates Vacancy.
** One has gone for a 2-year study program in USA.
*** Returned from Thailand, Jan. 1990.
**** Returned from Philippines, Jan. 1990; posted to Central Region (May 1990) or Far-Western Region (Jan 90)

lack of qualified and fully trained staff is reflected in the discrepancies found in much of the routine data discussed above, including insecticide resistance testing and response of vectors to residual insecticides.

5.3 Other vector control problems

Japanese encephalitis (JE) first became apparent in Nepal in 1978 and its prevalence has steadily increased. The peak was in 1986, when there were 1,194 reported cases. Fewer cases were reported in 1989; results are summarized in Table 5e. Despite much concern about this disease, very little has been learned about the epidemiology of JE in Nepal. The Entomology Unit needs to build some expertise on the control of this disease, particularly since NMEO has been asked to apply ULV spray in certain villages. Unfortunately, there is no mandate or budget for this program at NMEO.

Table 5e.
Summary of JE Cases* in Nepal, 1989

Region	No. of Districts	Total Cases	Total Deaths	Case Fatality Rate (%)
Eastern	8	466	107	23
Central	5	147	32	22
Western	3	153	43	28
Mid-Western	4	83	39	47
Far-Western	2	19	6	32
Total	22	868	227	26

**Data provided by S.P. Pradhan, HFP/USAID*

Another disease of concern to the Entomology Unit is visceral leishmaniasis (Kala-azar). Although this disease virtually disappeared from Nepal in the 1960s following intensive indoor spraying with DDT for malaria control, it has recently reappeared. The Entomology Unit lacks expertise on the bionomics of the sand fly vector(s), yet NMEO is being asked to spray certain villages with indigenous cases, again with no available budget or extra manpower. Unfortunately, cases are occurring in areas unlikely to need anti-malaria measures.

5.4 Recommendations to strengthen entomological activities

It is apparent that the Entomology staff has worked very hard during the past few years with very limited resources in terms of trained staff, equipment, transportation and budget. These limitations have obviously hampered the collection and analysis of data that can be used for decision-making in malaria control. The data collected during the routine surveys, spot surveys and susceptibility tests apparently have rarely been considered in deciding what insecticide to use, where to use it, and how to use it. Data gathered during the longitudinal surveys should have proved more beneficial in this respect, but for a number of reasons, they provided no clear-cut answers.

The primary question facing the Entomology staff is: Why do sprayed villages continue to have malaria cases year after year? To answer this basic question, the staff needs to determine where transmission is occurring, when transmission is taking place, what *Anopheles* species is (are) primarily responsible for transmission, and what it is about the bionomics of the vector that is susceptible to control strategies. In other words, where, when and how is infective contact between humans and vectors taking place, and how can that contact be prevented or controlled? The Entomology staff should focus its efforts to provide these answers by working in today's problem area; namely, the highly malarious villages in Stratum I and II. Simple, well-planned and well-supervised longitudinal studies are most likely to provide meaningful data.

6.0 Term D:

To review the resource requirements for the adequate management of malaria control through the District Public Health Offices based on PHC concepts

6.1 Manpower

According to the Chief Officer of the NMEO, the organization's main concern at present is the manpower requirements for the adequate management of malaria control through integrated health services based on a primary health care (PHC) approach.

With integration of malaria control services into the Basic Health Services, problems immediately arose when some of the erstwhile malaria staff, while being adjusted into the BHS, were posted in non-malarious areas. On the other hand, there is an urgent need for intensified training of the health services personnel at regional district and health post levels in malarious areas, since the majority of them have never been oriented to malaria control activities.

The Hetauda Research and Training Center offers various courses in malariology and basic microscopy. Health Posts-in-charge, malaria inspectors, auxillary health workers and laboratory technicians are usually trained there. VHWs and a few other categories of staff deployed at the Health Post level are usually trained at the Regional Training Centers, where they are given orientation in some elements of malaria control activities.

The normal capacity of each course at the RTC is 22 persons and the maximum number of courses a year is probably 12. Thus, a maximum of 264 persons a year can be trained at the Hetauda R&T Center.

Table 6a shows how many persons in each staff category should be trained in the various aspects of malaria control. The most important issue is that all the District Public Health Officers should receive training not only in malaria control, but also in other communicable diseases. On many occasions during their field visits, the members of EAT-90 observed that other categories of personnel in health posts, including VHWs, were not trained in malaria control activities. Likewise, erstwhile malaria field workers retained under DPHO were not trained in other components of PHC.

Table 6a.

Categories of Staff to be Trained

1. Health Post I/C (Health) Assistants/SV. (Auxillary Health Workers)	233
2. Health Assistant/SV AHW(District)	47
3. Health Education Techn./Assist.	25
4. Auxiliary Health Workers	50
5. Auxiliary Nurse Midwives	25
6. Laboratory Assist.	100
TOTAL	480

Table 6b.

Tentative Projection of Training (1990/91)

A. Hetauda Training and Research Center

	Category	Number	Course	Venue of Training
1.	DPH Officers	48	Malariology	?
2.	HP/IC/HA	176	"	RTC, Hetauda in 8 batches
3.	HE/Technical/ Assistant	25	HE in Malaria	RTC, Hetauda in 3 batches
4.	Lab. Assist.	66	Basic Microscopy	RTC, Hetauda in 3 batches
	TOTAL	315		

B. Proposed Regional Training for AHW/ANM

2 batches, 18 persons each batch per Region

2 X 18 X 5 = 180 persons

VHWs are responsible for all components of PHC. There has been an increase in the workload of the VHWs, which has resulted in the adjustment of each VHW's work schedule according to the population of the Panchayat and the accessibility of the area. However, on many occasions the latter was not taken into consideration, with the result that the VHWs posted in hilly areas have a disadvantage in workload compared with their colleagues posted in the plains. In addition, a considerable number of posts in various categories of personnel are vacant.

The tentative projection of the training program for FY 1990/91 is shown in Table 6b, which indicates that it will not be possible to meet trained manpower requirements in only one year. If teaching and learning equipment, adjustment of per diem for various categories of trainees, additional trainers at the Hetauda Center and better training facilities are provided, it will take at least two years to train the staff engaged in malaria activities in the country.

Apart from the training of regular Health Services staff engaged in malaria control, there is a need for training and orientation of personnel from the curative side of the Health Services. Physicians and auxiliary staff at hospitals need to be trained in the clinical diagnosis of malaria and in the management of severe malaria.

6.2 Workshops and seminars

The potential contribution of the PCD system to malaria control largely depends on the provision of adequate training to the PCD(V)s. However, until now, adequate resources have not always been available to provide this requisite support. EAT-90 appreciates the contribution made by USAID/Nepal in providing financial support for regular (twice a year) workshops for the volunteers. It was found that the PCD(V) meetings can help maintain the volunteers' interest in participating in malaria control and boost the morale. Members of EAT-90 (Team B) observed one such meeting in Bhadrapur (East Region) attended by more than 40 PCD(V)s. They were particularly impressed by the fact that on average, each PCD(V) had been involved in malaria activities for more than five

PCD(V) had been involved in malaria activities for more than five years. USAID/Nepal plans to further strengthen and continue the malaria PCD(V) program for a few years, at least until CHVs are fully capable of assuming a significant role in malaria control activities. When all CHVs are fully engaged and performing well in malaria control activities, the malaria PCD(V) program may be phased out.

A new development in the field of malaria in Nepal was NMEO/WHO's invitation to all the District Public Health Officers of the malarious districts of the country to participate in the 9th National Annual Malaria Control Seminar, held in Pokhara, in 1989. This type of seminar proved very useful for the District Public Health Officers and malaria workers because for the first time, they jointly discussed the progress and problems encountered during the process of integrating the malaria control program into the Basic Health Services.

7.0 Term E:

To review the insecticide requirements and logistic support, including transport, necessary for anti-malaria activities on a long-term basis

7.1 Present situation

The present spray operation strategy is to give first priority to Stratum I and second priority to Stratum II areas. Other areas of the country would only be considered for possible spray protection during epidemics. Spray programs are scheduled for two cycles per year. In 1990, the summer cycle was carried out from April 4 - May 2, 1990. The autumn cycle is planned for July 22 - August 23, 1990. Each cycle is approximately one month long and is timed to protect the population during the peak periods of malaria transmission.

The Team was informed that studies in Nepal indicated an effective residual life for Malathion, 50%, WDP, FICAM-W and Actellic, 50%, EC, at approximately 12 weeks if dosages of 2.0 gms, 0.4 gms and 1 gm, respectively, are properly applied to sprayable surfaces. Although malaria transmission does occur in some areas beyond the operational time frame selected for residual spray protection, the current schedule appears to be the most cost-effective malaria control approach to insecticide application. In projecting its future needs, the NMEO has used the present schedules and insecticide application rates for programing its 1990/91 to 1994/95 requirements.

The Team carried out in-depth reviews of the 1988-1989 spray operations in the four regions visited through the use of a proforma and discussion. In brief, there was a considerable difference between the target spray program and the actual spray operation due to lack of insecticides. The 800,000 population target for spraying has not been achieved, and the actual population targeted in 1989/90 is approximately 500,000 (Pg. 38, Plan of Action). In preparing for the autumn cycle, large differences in coverage appear, as shown in Table 7a below:

Table 7a.

NMEO Spray Operations Projections and Targets (Stratum I) FY 2047/48 (89/90)

Region	Population Projected	Population Now Projected for Autumn Cycle, 1990
Eastern	72,000	68,000
Central	116,000	80,000
Western	70,000	40,000
Mid-Western	80,000	60,000
Far-Western	212,000	106,000
Total	550,000	354,000

The Stratum II spray program is planned for an additional 250,000 population, but insecticides will only be provided by NMEO when urgently requested by the regions because of valid outbreaks or identified focal malaria problems. The Team was informed that NMEO does have enough insecticides of various types to protect the new target population figure of approximately 350,000 in Stratum I and to cover Stratum II needs. Depending upon the demands from the Stratum II areas, the insecticides remaining after the autumn cycle, 1990, will protect up to 200,000 population in 1991, but we anticipate outbreaks that will require additional spraying. The remaining post-autumn cycle insecticide stocks would best be considered emergency stocks if no other insecticides become available for use in 1991.

The NMEO will have to rapidly distribute and redistribute insecticides within the newly projected populations. The spray equipment situation is considered adequate, but spare parts are required to repair damaged or out-of-order spray pumps. The transportation aspect of the operations is very marginal at best. The National Headquarters and regions will need to support the districts if supplies and manpower are to be provided on schedule. The recent addition of three new Landrover pick-ups from British ODA is more than welcome and will help remedy the serious shortage of transport. However, the NMEO needs at least five large, load-carrying trucks to move its supplies. Transport for district supervision should be provided through the use of motorcycles.

7.2 Evaluation of present spray operations

The Team recognizes that the lack of a consistent and adequate supply of insecticides over the 1988-1989 period has resulted in a number of ad hoc decisions that might not have been made under other circumstances. NMEO senior staff are to be congratulated for their skill in balancing a multitude of demands against varied and limited resources in both manpower and materials. The epidemiological evidence for the 1988-1989 period indicates that malaria has been reasonably controlled and, more important, *P. falciparum* has been contained within the country. Such achievements are a credit to the operational skills and scientific abilities of NMEO in maintaining a flexible, focused effort in the face of great difficulties.

In reviewing past activities, the Team found that a mix of insecticides had been applied (Malathion, ICON, Actellic, Demon, FICAM-W) in situations where proper entomological studies had not

been completed for the suspected or actual malaria vectors. While trials have been completed with some of these insecticides on the susceptibility status of some species of *Anopheles* (at Lumbini and Nawalparasi), in some cases the insecticides have been applied operationally against different *Anopheles* and in different ecological settings without knowledge about susceptibility.

Understanding the insecticide susceptibility characteristics of the anopheline vector to the insecticides being applied is a basic requirement in field operations. The interlinkage of operations and entomology is extremely important if a cost-effective program is to be completed. It appears to the Team that the urgencies of field efforts overshadowed proper scientific studies. Such hurried actions have resulted in serious operational failures in other parts of the world.

The Team was disturbed at the use of a large number of different insecticides in NMEO's operational program because of their various dose rates, safety requirements and training needs for spray personnel. It is recognized that NMEO had little choice but to use available material. However, forecasts for future requirements should not continue these questionable practices. The Team urges the NMEO to keep the spray operation as simple as possible. The availability of new insecticides for public health is limited and will become more so in the future; every effort is required to preserve the effectiveness of existing compounds. Pilot studies or small-scale field trials of new compounds in a variety of operational settings are encouraged, but widespread field applications of a variety of compounds should be carefully considered from economic, scientific and safety/environmental points of view before an insecticide is applied.

In the field areas, the Team found a number of defects in the storage of insecticides -- at Bhairahawa, Hetauda, Birendra Bazar -- that need immediate attention. The stored concentrated Malathion should be securely confined under lock and not lying in driveways or in office halls. The Team believes the NMEO is more than aware of the safety requirements needed to protect insecticides because it has an admirable safety record of proper handling and storage of such materials. In the Team's view, these problems in the field have developed from a lack of supervision. Also, sensitivity to the environmental implications of such poor practices may have decreased because accidents have not occurred.

The Team suggests that the NMEO immediately make a concentrated effort to correct faults in storage. The primary purpose in correcting these conditions is to protect the health and welfare of personnel and other people who could come in contact with these compounds. In addition, the donor community is extremely sensitive

to any questionable environmental practices. Such conditions as observed by the Team could be enough to halt negotiations for insecticide support from external sources.

Supervision of the spray operations, or rather the lack of supervision of spray operations, was a recurrent theme when the Team discussed the field programs in the districts and regions. It makes little sense to apply expensive insecticidal chemicals to target areas unless the operation is carefully supervised. The reported lack of available travel/per diem funds for supervisory personnel does not make sense economically, especially given the limited periods of actual spray operations in Nepal (2.0-2.5 months). While the problem is the result of strict fiscal budget containment by the Government, the Team encourages the offices concerned to ensure that funding for malaria control supervision is made available to its staff and not diluted by other non-malaria program activities, especially during the spray operation period.

7.3 Evaluation of long-term insecticide and logistic support

The NMEO has projected the following requirements for insecticide over the next five years in its proposal to the World Bank (p. 47 of World Bank Assignment Report):

Table 7b.
Estimated Cost of Insecticides ($ US in million)

1990/91	1991/92	1992/93	1993/94	1994/95	Total
4.5	3.15	3.30	3.47	3.64	18.06

The 1990/91 estimate is based on spending US $3.0 million for insecticide to be used during that period and the remaining $1.5 million for procurement of buffer stocks. Estimates for the remaining years have been adjusted for inflation. The NMEO presented its insecticide usage patterns in the World Bank Assignment Report (Pg. 43). The specification, frequency of application, and amount required for one year if the insecticide is used alone are as follows:

Table 7c.

Insecticide	Formulation	Dosage/m^2	Rds. of	Amt. Required
Malathion	50%, WDP	2.0 gms	2	800 MT
FICAM	80%, WDP	0.4 gms	2	56 MT
Acetellic	50%, EC	1.0 gms	2	288,000 MT
ICON	10%, WP	0.025 gms	2	32 MT

The NMEO has projected that approximately 50 percent of the required amount should be kept for buffer stock. Stratum I spraying under this projection will cover approximately 800,000 population, with focal and regular spraying carried out to protect approximately 200,000 population in selected areas of Stratum II. Focal spraying will be carried out only in areas where there was no regular spraying and will be depend on 1) focal outbreaks; 2) newly emerged indigenous *P. falciparum* foci; 3) newly resettled villages; 4) project area settlements and aggregation of immigrant laborers from malarious areas.

The Team supports the view that residual spraying remains the most effective and cost-efficient method of vector control to control malaria in Nepal. Bio-environmental methods are at best supplementary measures and to date have not been particularly effective or useful in malaria control in most of Asia. Bed nets to reduce human-mosquito contact have been discussed as another possible intervention, but there are a number of cultural and social problems connected with their use. Larviciding may have a place during a very limited period of the dry season when water sources are scarce, but such operations demand strict supervision and intensive epidemiological inputs to be effective.

The Team's review of the estimated insecticide requirements revealed that the NMEO apparently had not fully considered the impact of the PCD and other treatment programs. If the past is a reflection of the future, the requirements for future insecticides cannot be met at the end of the next five-year period any more than the Government can fully meet these needs now. Insecticides will be required, but considerably more thought and planning is required in order to support the present projection of the NMEO for the next

five years. A series of targets by year may provide a more realistic presentation of insecticide demand.

The logistic situation is poor at best, and almost non-functional at worst in many of the districts with malaria control responsibilities. If a vehicle is available at the district that is not in need of repair, it must be shared with personnel from Family Planning, EPI and many other programs. It may be possible for two or more program officers to share a vehicle, but this may not always be planned or favored by the concerned officers. The Team also recognizes the strict limitations put on vehicle use by government policy, making recommendations to increase the fleet impractical. However, it does appear that this government limitation might be eased to permit more motorcycles for supervision and to allow larger load carriers for the program.

8.0 Term F:

To review the present manpower development for adequate management of malaria control and training resources requirements

8.1 Manpower resources

The staffing pattern for 1989/90 of the Nepal Malaria Eradication Organization (NMEO) is listed in detail in the "Plan of Action and Staffing Pattern, FY 2046/47 (1989/90)." Table 8a. summarizes the total manpower involved in the malaria program at present and what is anticipated in the next year. Approximately 11 percent of the authorized staff positions are unfilled this year; however, a 46 percent increase in staff is anticipated next year. In 1990, 13 out of 129 staff positions at the NMEO Headquarters are vacant (Table 8b.). Training capabilities at the Hetauda Research and Training Center have been greatly reduced by staff shortages, as noted in Table 8c. There are eight vacancies (22 percent) at the Center and half are in professional level positions.

Table 8d summarizes the malaria staff positions in the Eastern Region, which has 34 percent of its position vacant. It is anticipated that 12 percent of these positions will be vacant next year. Vacancy rates and other problems with staffing at the district level are discussed in section 6.0 of this report on Term of Reference D. As noted above, high vacancy rates exist throughout the organization. If the NMEO is expected to function efficiently, positions need to be filled with properly trained personnel as soon as possible. If these positions are not filled, the resulting reduced supervision and training are bound to have a negative impact on the national program.

Table 8a.
Summary of Total Manpower Involved in Malaria Program

Location	Authorized Staff	Present Staff	Anticipated Staff Next Yr.
HQ, NMEO	129	116	130
Hetauda RTC	36	28	35
Regional Officer	221	174	105
District Offices	1,775	1,610	2,880
TOTAL	2,161	1,928	3,150
		(11% Vacant)	45% (Increase)

Table 8b.
Summary of Staffing Pattern, NMEO HQ, 1990

Section	Authorized	Present	Vacancy
Direction	3	1	2
Administration Section	20	19	1
Supply & Procurement Unit	5	5	0
Transport Section	28	26	2
Fiscal Section	3	3	0
Account Unit	5	5	0
Audit Unit	7	7	0
Field Program Div., Spray Opn. Soc.	4	3	1
Equipment Maintenance Unit	3	3	0
Parasitology Section	9	8	1
Epidemiology Section	8	7	1
Entomology Section	10	8	2
Health Education Section	6	5	1
Malaria Clinic	2	2	0
Plan, Research and Travel Division, Section	4	3	1
Library Unit	1	1	0
Plan., Eval., & Stat. Sec.	9	8	1
Cartographic Unit	2	2	0
TOTAL	129	116	13

Table 8c.
Summary of Staff Positions, Hetauda RTC, 1990

Staff Position	Authorized	Present	Vacancy
Sr. Malaria Officer	1	0	1
Entomologist	1	0	1
Parasitologist	1	1	0
Health Educator	1	1	0
Malaria Officer	1	0	1
Assist. Entomologist	2	1	1
Malaria Assistant	4	1	3
Accountant	1	1	0
Head Clerk/Typist	1	1	0
Store Keeper	1	1	0
Malaria Inspector	4	4	0
Sr. Mechanic	1	0	1
Insect Collector	9	9	0
Mechanic	1	1	0
Driver	1	1	0
Laboratory Aid	2	2	0
Watchman	1	1	0
Gardener	2	2	0
Peon	1	1	0
TOTAL	36	28	8

Table 8d.
Summary of Malaria Staff Positions, Eastern Region, 1990

Staff Position	Authorized	Present	Anticipated
Senior Malaria Officer	1	0	1
Malaria Officer	1	0	1
Malaria Assistant	5	4	6
Malaria Inspector	9	8	4
Entomologist	1	0	1
Insect Collector	2	2	2
Surveillance Aide	2	0	0
Laboratory Aide	2	2	2
Laboratory Assistant	8	4	8
Supervisory Recorder	1	1	1
Senior Mechanic	0	0	1
Junior Mechanic	0	0	1
TOTAL	32	21	28
	(34% Vacant)	(12% Vacant)	

8.2 Training

Because the NMEO faces reduced resources in the next few years, particularly of insecticides, proper training of personnel at all levels is even more important now than in the past. Improperly or inadequately trained staff make mistakes, fail to make critical observations, suffer job dissatisfaction, and generally perform at a lower level of efficiency. Regular staff training, both in Nepal and abroad, will boost morale, stimulate enthusiasm and lead to a more effective control program.

NMEO staff have received training at several levels: locally, at regional and district offices, at the Hetauda RTC, at the NMEO Headquarters and abroad. Local training is given in a variety of subjects, including insecticide safety, cholinesterase testing, microscopy, basic case detection and spraying. Problems with local training are discussed in previous sections of this report.

8.3 Hetauda Research and Training Center (RTC)

Training courses at the Hetauda RTC began in 1979. Since then, more than 14 different courses have been given and more than 1,600 people trained. Currently, more than 30 weeks of training are provided each year (Table 8e.). At the request of USAID/Kathmandu, a detailed evaluation of the training and facility needs at the Hetauda RTC was conducted in 1987 by Drs. Service and Lacey, financed by VBC/AID (VBC Report AR-024). Most of their findings and recommendations are still valid, namely the lack of good facilities and the need to improve all physical aspects of the center. However, the 1990 Assessment Team was more troubled by the lack of professional staff (only one person was handling all of the training courses) and the lack of proper teaching materials. For example, the Center did not have reference microscope slides or a taxonomic collection.

The Team feels strongly that vacancies at the Hetauda RTC should be filled immediately. Also, the staff should spend less time doing spot entomological surveys, which produce data that are not utilized in malaria control decision-making, and more time on the production of good teaching specimens. If these two problems are not corrected, the Team sees little point in constructing new facilities. This center needs to be fully supported so that the students receive the best training possible, whatever the condition of the lecture and laboratory rooms.

A list of courses taught at the Hetauda RTC from 1988 through 1989 and their target audiences, is presented in Table 8e. With sponsorship from WHO and USAID, certain NMEO headquarters staff members have received short- or long-term international training (see Annex 7, Table F). This training should prove very beneficial to the malaria program in Nepal, except when trained persons have been transferred outside the program (e.g., to the Public Health Division). This type of training should continue not just for the headquarters staff, but also for regional and district level staff for the reason noted in the first paragraph of section 8.1. Long-term Ph.D. training at a recognized university abroad is suggested for the head of the research component at the Hetauda RTC. This individual should already have an M.Sc. in parasitology or entomology.

To fulfill its research mission at the Hetauda RTC, the staff needs to be expanded and well-trained in the scientific method. Long-term Ph.D. training should be considered for the research head, as mentioned earlier. With a scientist leading the research, the NMEO could apply to WHO/TDR for a Research Strengthening Grant. Specific assistance for individual research projects could by provided by international consultants, funded by WHO, VBC or USAID. (These agencies might also assist in providing teaching and library materials, such as slide sets from WHO.) NMEO staff will need to supervise operational research in the field closely to ensure that meaningful data are collected and analyzed, leading to new and more effective methods of malaria control.

Table 8e.

Courses taught at the Research and Training Center (Hetauda) 1988-1989, Target Audience and Number of Individuals Trained

1988 Course	Audience	Duration of course	No. trained
Basic Malariology	Malaria Assistant	7 weeks	30
Vector Control Orientation	Malaria Assistant Dist. Mal. Officers	8 weeks	18
Malariology Orientation	Malaria Inspector	6 weeks	22
Basic Parasitology	Lab Techs (ICHSDP)	8 weeks	16
Malariology Refresher	Malaria Inspectors	2 weeks	24
Parasitology Refresher	Lab Tech (2 sessions)	2 weeks	28
Malaria Orientation	Senior Auxiliary Health Worker (Health-Post-In-charge) ICHSDP	1.5 week	21
	TOTAL	36.5	159

Continued Table 8e.

1989 Course	Audience	Duration of course	No. trained
Basic Malariology	Malaria Assist. and Malaria Inspectors	7 weeks	35
Basic Parasitology	Malaria Inspectors	5 weeks	17
Basic Parasitology	Lab Techs.	7 weeks	21
Malariology Refresher	Malaria Inspectors	2 weeks	8
Parasitology Refresher	Lab Techs.	2 weeks	11
Statistical Orientation	Malaria Assists. and Malaria Inspector	2 weeks	20
Malaria Orientation	Sr. Aux. Health Worker (Health-Post-In-Charge) ICHSDP (4 Sessions)	1.5 weeks	126
Malaria Orientation	Health Inspector and Training Officers (ICHSDP)	1.5 weeks	129
	TOTAL	32.5 weeks	267

9.0 Recommendations

9.1 Case detection

9.1.1 Active case detection

The Active Case Detection (ACD) mechanism used by NMEO is now recognized as a marginally productive activity in the malaria control program. EAT-90 observed that its effectiveness for the last two years had decreased. As such, it constitutes one of the obstacles to orderly development of the program.

While appreciating possible administrative and operational problems involved with the immediate discontinuation of this activity, the Team believes that it can be done in several phases. During the first phase, all VHWs should be directed to collect slides only from cases with recent fever at the moment of patient interview. The VHWs should use the balance of time thus saved to supervise PCD(V), replenish PCD(V) supplies of slides, spirits, drugs and cotton wool, collect epidemiological information, and for health education. The second phase, discontinuation of ACD by VHWs, should occur if and when the CHV network takes over from the VHWs, having received additional training in malaria blood slide collection.

9.1.2 Passive case detection

PCD must eventually replace ACD in Nepal. At present, the performance by one of the PCD institutions, that of PCD(V)s, is commendable. EAT-90 found that the PCD/V network was highly cost-effective. However, its present strength in the country is still inadequate to completely replace the ACD mechanism and also to serve as an element of the Epidemiological Early Warning System (EEWS). Therefore, the Team believes that the expansion of the PCD(V) network is urgently needed. To facilitate expansion and make the network's services even more technically efficient, there is a need to improve the quality of the blood slides collected by PCD(V)s, as well as to ensure regular provision of supplies. Having higher quality blood slides collected by volunteers will improve the efficiency of decentralized laboratories considerably.

The Team strongly recommends that the NMEO/BHS urgently develop an appropriate mechanism for suitably recognizing and

distinguishing the services of volunteers who have served the cause for five or more years, thereby boosting their morale.

As PCD replaces ACD, it is also important that other PCD institutions be more actively involved in the detection, reporting and treatment of cases.

9.2 Treatment of malaria

9.2.1 Presumptive treatment

EAT-90 considers the current presumptive treatment policy by NMEO satisfactory, and therefore does not have any recommendation to offer on this subject.

9.2.2 Radical treatment

EAT-90 observed with satisfaction that a revised unified regimen was being used throughout the country for the medical treatment of *P. vivax* and *P. falciparum* malaria, as recommended by EAT-88.

9.2.3 Mass drug administration (MDA)

EAT-90 wishes to state that the effectiveness of MDA in villages where malaria focal outbreaks occur and where insecticidal spraying has not been done, can probably be achieved only if population coverage in the MDA is more than 80 percent in each of two prescribed rounds.

9.3 Drug resistance

See Operational Research recommendation (9.10.3a).

9.4 Stratification

9.4.1 Revision of stratification

The malariological stratification of Nepal needs revision and further improvement. It is recommended that the basic stratification based on the geographical and climatic background and sub-stratification in respect to priority problems, according to the

guidelines provided in this report, be carried out by applying the following criteria.

For basic stratification:

1. Bionomics of vectors and their distribution;
2. Seasonal patterns of transmission of vivax and falciparum malaria;
3. Incidence levels for recent years and their dynamics (degree of stability);

For sub-stratification:

1. Involvement of vectors in transmission in problem areas; impact of spraying operations;
2. Impact of control measures on *P. falciparum* transmission;
3. Vulnerability;
4. Capability of health services to provide adequate case detection and treatment.

9.4.2. Implementation of stratification

Stratification should be implemented in stages. At the initial stage, it is necessary to elaborate a protocol of the project, work out an inventory of proper data, define sources of information, begin gathering and analyzing data, and identify requirements for additional information.

9.5 Entomological activities

9.5.1 Routine activities

Since the Entomological Unit has very limited resources in terms of manpower, transport, equipment, and finances, it is critical that routine entomological activities be well-planned, essential and well-supervised. The Team recommends that spot surveys be discontinued because they have not provided enough meaningful data for making malaria control decisions. Instead, more intensive focal investigations should be conducted at a few selected villages in different receptivity areas. These surveys

should include the necessary procedures to determine vector densities, host preferences, vector biting habits, vector resting habits and vector responses to insecticides, including susceptibility.

Insecticide susceptibility tests should be conducted, at a minimum, once a year in each of the problem (current malaria transmission) districts for each of the indigenous vector or suspected vector species. To ensure that at least 100 females of each actual or suspected vector species are tested in each location, peak populations should be sampled. In other words, sample *An. fluviatilis* and *An. maculatus* in November/December or February/March, and sample *An. annularis* after the monsoon in September/October.

Since supervision is the key to making the surveys mentioned above meaningful, NMEO may want to consider combining the Entomology Teams from the Far-Western and Mid-Western Regions for the time being. In addition, national entomological resources could be used to supplement regional and district entomological activities as demands require.

9.5.2 Longitudinal

It is evident that recent studies and surveys by the Entomology Unit have not provided an answer to the following question: Why do communities that have been sprayed annually continue to have indigenous malaria cases year after year? The Team recommends that the Entomology Unit conduct simple, well-planned and well-supervised longitudinal studies in a few highly malarious areas. Each study should be carried out for at least seven days each month for 24 months. Methods that will produce the necessary data to determine where malaria transmission is occurring, when transmission is taking place, the vector(s) responsible for transmission and vector bionomics should be used. These include experimental huts, ELISAs, monthly cohort surveys and gel diffusion techniques. Once these factors have been determined, bed nets or other alternative control methodologies might be tried, if appropriate. Technical assistance funded by WHO or A.I.D. could be helpful in carrying out these longitudinal studies.

9.6 Management aspects

9.6.1 NMEO under integration

EAT-90 wishes to state that the maintenance of achieved results in malaria control for the last few years was possible only because of the technical and operational efficiency of NMEO at various levels. Therefore, the retention of a technical specialized unit under complete integration is justified. To enable the unit to become even more cost-effective, the Team feels that NMEO should be assigned not only advisory responsibilities, but also should be authorized to exercise supervisory functions to make its staff more accountable. Given its high efficiency in the field of malaria control, it is logical that the unit, with some strengthening of staff, equipment and transport, assume responsibility for all vector control activities in the country, in addition to malaria.

If the HMG sanctions the retention of this unit, the Team recommends further strengthening of the automated data management system in terms of hardware, software, maintenance and training. Donor support and technical assistance may be needed to strengthen the initial attempts of the NMEO in this endeavor. Purchase of equipment from a local firm would provide the advantage that maintenance and training could be part of the contract package.

9.6.2 Training health post couriers

The other staff that should be utilized and trained immediately are the health post couriers. Their posting and training should be a high priority because improvement of the performance of centralized laboratories greatly depends upon the couriers' efficiency.

9.7 Insecticide usage and planning

The use of insecticides in the national malaria control effort is both cost-effective and environmentally acceptable. The Team offers the following recommendations to improve the existing program operations.

9.7.1 Limit the number of operational insecticides

Given the limited number of available insecticides for use in worldwide malaria control activities, the Team recommends that NMEO limit the number of insecticides used in the program for residual spray operations to the minimum possible.

9.7.2. Operation to be based on entomological studies and recommendations

Insecticides should not be applied in the field operation program unless the basic entomological activities have been completed and the insecticide of choice has been found to be the most cost-effective and scientifically acceptable. The insecticide used should lend itself to safe, environmentally sound application by properly trained and supervised spray personnel.

9.7.3 Future planning for insecticide requirements

Future projections of insecticide use are difficult to estimate due to a number of variables, such as the establishment of the early treatment mechanism, passive case detection in its many forms, and a sensitive epidemiological warning system. However, the Team believes that the present long-term insecticide projections do not accurately reflect the dynamic changes and developments taking place within the health infrastructure. It is recommended that NMEO urgently make additional studies of proposed insecticide projections to determine whether they reflect the minimum amount of insecticide required over the next five years.

It may be useful to present the insecticide requirements as three options. The three projections would consider health services development over the five years by rate of expected ability to control malaria and maintain the past gains. Such options should include the expected future role of the Government of Nepal to share the cost of procuring insecticides.

9.7.4 Insecticide safety and environmental considerations

The Team suggests to the NMEO that the following actions be taken to correct defects in its storage of insecticides:

a. Issue a circular to all regional officers advising them that incidences of unsatisfactory storage of insecticides were noted by the Team and that they must correct such conditions for safety and environmental reasons.

b. Require all national and regional officers on supervisory trips to check the status of insecticide storage during every travel assignment for the rest of 1990. Each trip report should include a note on activities and findings and the corrective action taken, if required, for inspected insecticide storage during the tour.

c. Ask all districts in the malarious areas to comply with proper storage procedures for insecticides, including security.

d. The National Headquarters should offer assistance to officers who have questions about proper storage.

9.8 Training

9.8.1 NMEO staff

To further strengthen existing technical and operational capacities of the NMEO, all sanctioned posts at the various levels should be filled and the utilization and mandate of the malaria staff in the BHS during the process of integration should be reviewed. This review may result in a more rational use of the services of seasoned workers in areas where malaria continues to be a major public health problem, thus completing the process of decentralizing laboratories. The NMEO's main concern is the great inadequacy of trained personnel engaged in malaria work in the BHS. The training facilities and capacities of the BHS' regional training centers also should be improved through deputation of professionals from the various units of the Department of Health.

9.8.2 Public health services

With the commencement of complete integration of the malaria program into the BHS, the District Public Health Officer's role in malaria control becomes crucial. Therefore, it is important that all District Public Health Officers posted in malarious districts receive training in basic malariology (except for the two officers already trained). The HMG might wish to explore the possibility of sending these officers abroad for training, preferably to India, through the possible support of USAID, WHO, UNDP or other donor agencies.

Since an appreciable number of categories of staff are earmarked for training in malaria control based on the PHC approach through the BHS, there is an urgent need to work out a detailed program of malaria training for the whole country. Preferably this could be done for the next few years in cooperation with the Regional Health Service Training Centers, Regional Offices of Health, Ministry of Health, Institute of Medicine, USAID, WHO and other appropriate institutions. For these purposes, the services of consultants may be sought.

9.8.3 Hetauda Research and Training Center (RTC)

A detailed evaluation of the training and facility needs at the Hetauda RTC can be found in the 1987 report by Drs. Service and Lacey (VBC Report AR-024). Their findings and recommendations are still valid. In addition, the Team strongly recommends that vacancies at the Center be filled immediately, and that the staff concentrate its efforts on training and the production of good teaching materials. Various donor agencies could assist in upgrading the facilities, teaching materials, professional training and research strengthening.

9.9 Health education

9.9.1 Promoting community participation

The Team believes that the main thrust in malaria surveillance in Nepal will be given to the eventual replacement of ACD activities with the PCD mechanism, primarily involving the malaria volunteers and CHWs. The role of health education during this transitional period will be particularly important. To stimulate active involvement of the community in the detection, reporting and treatment of cases, health education should be taken to the grassroots level. The village developmental councils, or their equivalent, should be made more dynamic and should oversee health education activities.

Workers engaged in health education activities at the village level should encourage communities to supervise these activities themselves with proper guidance from health post staff. To do so, health-related workers should be trained in various health education techniques for effectively disseminating the required information through village leaders, social workers, existing social institutions, schools, developmental agencies and other available media.

In addition, health workers should to be trained to develop skills in community organization to help communities participate in the decision-making process and to support self-reliance and self-care. Existing local voluntary organizations and religious, economic and other local social institutions should be supported to mobilize the community to assist in anti-malaria activities.

9.9.2 Promoting advocacy for malaria control

The role of health education appears to be very important, particularly at the present time, when Nepal's malaria control program faces an unprecedented inadequacy of resources, particularly for vector control activities. Therefore, the health education staff should develop a comprehensive crash program to advocate support for new approaches to malaria control as an integral part of primary health care. This program should be aimed at politicians, decision-makers, executives and the agencies that provide much-needed financial support. Creating advocacy for malaria control is particularly important at a time when the country has just embarked upon a multi-party system. National seminars and workshops organized for this purpose would be beneficial. Donor agencies might be able to assist in this activity.

9.9.3 Mass media

It appears that information and communication systems, such as radio, television, newspapers and other mass media, may be the best media for health education at the national and district levels.

9.10 Operational research

9.10.1 Topics

a. *In vivo* and *in vitro* testing of drug sensitivity of *P. falciparum*;

b. Closer follow-up of known cases of *P. falciparum* and of *P. vivax* cases treated with current standard drug regimens to see if these continue to be effective;

c. Testing of possible vectors for the presence of malaria parasites using the ELISA;

d. Sero-epidemiological studies in areas of persistent transmission;

e. Studies of the feasibility of a trial of impregnated bed nets.

9.10.2 Rationale

Over the past several years, a number of agencies (USAID, WHO, ODA) have funded overseas training fellowships in special techniques for various senior staff of NMEO. They also have provided special equipment and reagents to enable NMEO to do various research projects. However, very little has been achieved. The chief reasons given have been shortages of fuel and vehicles to travel to malarious areas. This situation is now much improved with the relaxation of fuel supplies and provision of some new vehicles by donors. There also have been visits by special consultants, funded by various agencies, who have recommended several small research projects, but again, very little has been done.

9.10.3 Specific projects

The following research projects should be started:

a. Screening of *P. falciparum* for drug sensitivity. This subject, and the difficulties involved, have already been discussed in section 3.4 above. Ample supplies of test materials are available at NMEO and more can be readily obtained from the WHO unit in Bangkok. It should be possible to obtain enough samples to conduct *in vivo* tests in carefully selected areas, such as highly endemic villages.

b. Complementary to "a", an effort could be made to follow up some known cases of *P. falciparum* and also *P. vivax* cases treated with the present standard radical treatments (See 9.2.2 above) to ensure that these regimens continue to be adequate.

c. USAID and WHO have provided overseas training and reagents, which are presently available at NMEO headquarters, for testing possible vectors for the presence of sporozoites or oocysts by an ELISA. Only a limited number of mosquitoes have been tested. It is recommended that this number be greatly increased to try to define the relative vectorial capacities of different species.

d. In 1987, ODA provided an overseas training fellowship and, with the help of some insecticide manufacturers, equipment (including a fluorescence microscope) in the hope that some serological surveys would be done. In other parts of the world, these surveys have helped define past malaria incidence and have been of use in the process of stratification. In Nepal, a few small surveys were done using the indirect fluorescent antibody test (IFAT) to compare the antibody profiles in some sprayed localities with those in localities left unsprayed, but the numbers were too small to yield significant results.

   At present, enough materials for 20,000 screening IFA tests, donated by WHO, are available at the headquarters laboratory. It is hoped that surveys will be done in some selected areas with persistent transmission (i.e., forest fringe and deep forest) to see if these data will help improve stratification.

e. A bed net trial was recently suggested to the ODA and refused. A modified scheme should be devised, which would start by trying to define the reactions of the people, in some different areas, to the use of nets. Perhaps a sociologist, recruited locally or as a short-term consultant, could be employed.

HIS MAJESTY'S GOVERNMENT OF NEPAL
NEPAL MALARIA ERADICATION ORGANISATION

Budget Allotted, Released and Expended during the F/F 2042/43 to 2046/47.

F/Y 2042/43			F/Y 2043/44			F/Y 2044/45			F/Y 2045/46			F/Y 2046/47			Remarks
Allotted	Released	Expended	Allotted	Released	Expended	Allotted	Released	Expended	Allotted	Released	Expended	Allotted	Released	Expended	
9,85,44,000/-	3,91,32,720/-	3,84,50,838/94	7,01,43,000/-	4,37,20,887/-	4,32,94,060/04	9,91,55,000/-		5,33,08,945/20	12,38,59,000/-	7,89,94,235/34		11,38,81,000/-			
Japan -	1,95,00,000/-		W.H.O. -	5,00,000/-		US/AID -	2,17,80,000/-		W.H.O. -	5,50,000/-		W.H.O. -	4,75,00,000/-		
US/AID -	1,89,00,000/-		US/AID -	1,50,00,000/-		U.K. -	1,70,00,000/-		U.K. -	4,35,00,000/-					
U.Kingdom-	1,99,50,000/-		U.K. -	1,00,00,000/-					U.K. -	65,00,000/-					
Commodity -	5,03,50,000/-		Commodity -	2,55,00,000/-		Commodity -	3,87,80,000/-		Commodity -	5,05,50,000/-					
			In Cash			In Cash			In Cash						
			US/AID -	14,60,000/-		US/AID -	18,00,000/-		US/AID -	11,60,000/-					

Donor Agent	F/Y 2042/43 Bud.Allotted	Released	Expended	F/Y 2043/44 Bud.Allotted	Released	Expended	F/Y 2044/45 Bud.Allotted	Released	Expended	F/Y 2045/46 Bud.Allotted	Released	Expended	F/Y 2046/47 Bud.Allotted
1.H.M.Govt. Nepal	4,02,94,000/	3,91,32,720/-	3,84,50,000/-!	4,31,83,000/-	4,24,86,887/-	4,21,59,473/-!	5,85,75,000/-	5,56,11,117/-	5,18,21,883/-!	7,15,49,000/-	7,72,34,235/-	8,17,19,897/-!	8,83,81,000/-
2.Japan -	1,95,00,000/-)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
3.US/AID -	1,89,00,000/-)*	1,32,94,155/-	1,32,94,166/-!	1,50,00,000/-)	1,54,69,922/-	11,96,107/-!	2,17,80,000/-)	1,44,08,674/-	1,44,08,674/-!	- -	- -	- -	- -
4.U.Kingdom -	1,99,50,000/-)	2,80,77,051/-	2,80,77,051/-!	1,00,00,000/-)*	3,35,79,703/-	2,55,84,250/-!	1,70,00,000/-)*	- -	- -	5,00,00,000/-	4,83,00,899/-	4,83,00,889/-!	4,75,00,000/-
5.W.H.O. -	- -	- -	- -	5,00,000/-)	- -	- -	- -	- -	- -	5,50,000/-	8,74,768/-	8,74,768/-!	- -
	9,86,44,000/-	8,05,03,937/-	7,98,22,053/-!	8,86,83,000/-	9,15,36,503/-	8,99,39,830/-!	9,73,55,000/-	7,01,19,791/-	6,62,30,557/-!	12,20,99,000/-	12,64,17,893/-	11,09,02,754/-!	11,38,81,000/-
In Cash				In Cash by US/AID			In Cash by US/AID			In Cash by US/AID			In Cash by US/
				14,60,000/-	12,34,000/-	11,34,587/-!	18,00,000/-	18,00,000/-	14,87,063/-!	17,60,000/-	17,60,000/-	15,35,069/-!	- -
				7,01,43,000/-	9,27,70,509/-	7,10,74,418/-!	9,91,55,000/-	7,19,19,791/-	6,77,17,620/-	12,38,59,000/-	12,81,77,893/-	11,24,38,823/-!	11,38,81,000/-

Note:- The marks (*) above indicate the grant in commodity.

Annex 2

Table B. Food Production Increases From Selected Malarious Districts in Nepal 1967/68 to 1987/88

COMPARISON OF SPECIFIC CROP OUTPUTS IN SELECTED MALARIOUS DISTRICTS OF NEPAL - 1967/68 and 1987/88

	1967/1968						1987/1988						
	PADDY		WHEAT		OIL SEED		PADDY		WHEAT		OIL SEED		
DISTRICT	AREA (HA)	METRIC TONS	AREA (HA)	MT	AREA (HA)	MT	AREA (HA)	MT	AREA (HA)	MT	AREA (HA)	MT	COMMENT
MAKWANPUR	9,900	22,028	2,550	2,550	4,000	1,800	12,600	31,070	6,200	10,040	1,770	1,070	Highly malarious area controlled to low endemicity by mid-1970.
CHITWAN	22,500	45,450	3,500	3,675	15,000	8,850	28,500	87,650	8,640	11,920	22,600	14,690	Rapti Valley area "Blackwater Valley" (Kali Pani)
NAWALPARASI	31,000	51,150	8,500	7,012	2,500	1,250	35,260	81,810	12,720	17,810	6,610	6,300	
KAPILBASTU	61,500	106,395	10,000	9,250	1,800	918	71,150	135,300	26,580	32,430	2,200	1,100	Endemic malaria. New settlements in mid 1960s. Forest fringe cleared
RUPANDEHI	64,000	105,600	17,000	9,600	3,900	1,872	69,100	158,410	23,480	28,170	4,400	2,640	Large scale settlement at forest fringe after malaria controlled specifically targetted by AID malaria assistance.
UDAIPUR	11,000	23,650	175	175	3,800	2,280	10,930	19,070	3,500	3,850	3,920	2,740	Highly malarious area controlled by mid-1970. Hilly terrain.
PARSA	36,000	59,040	5,000	4,500	930	474	46,320	137,780	14,540	17,160	4,400	2,420	Highly malarious forest fringe. large scale re-settlement and clearing.

NOTE: DATA PROVIDED BY ARD/USAID, MR. S.R. BAJRACHARYA JUNE, 1990. L.T. COWPER

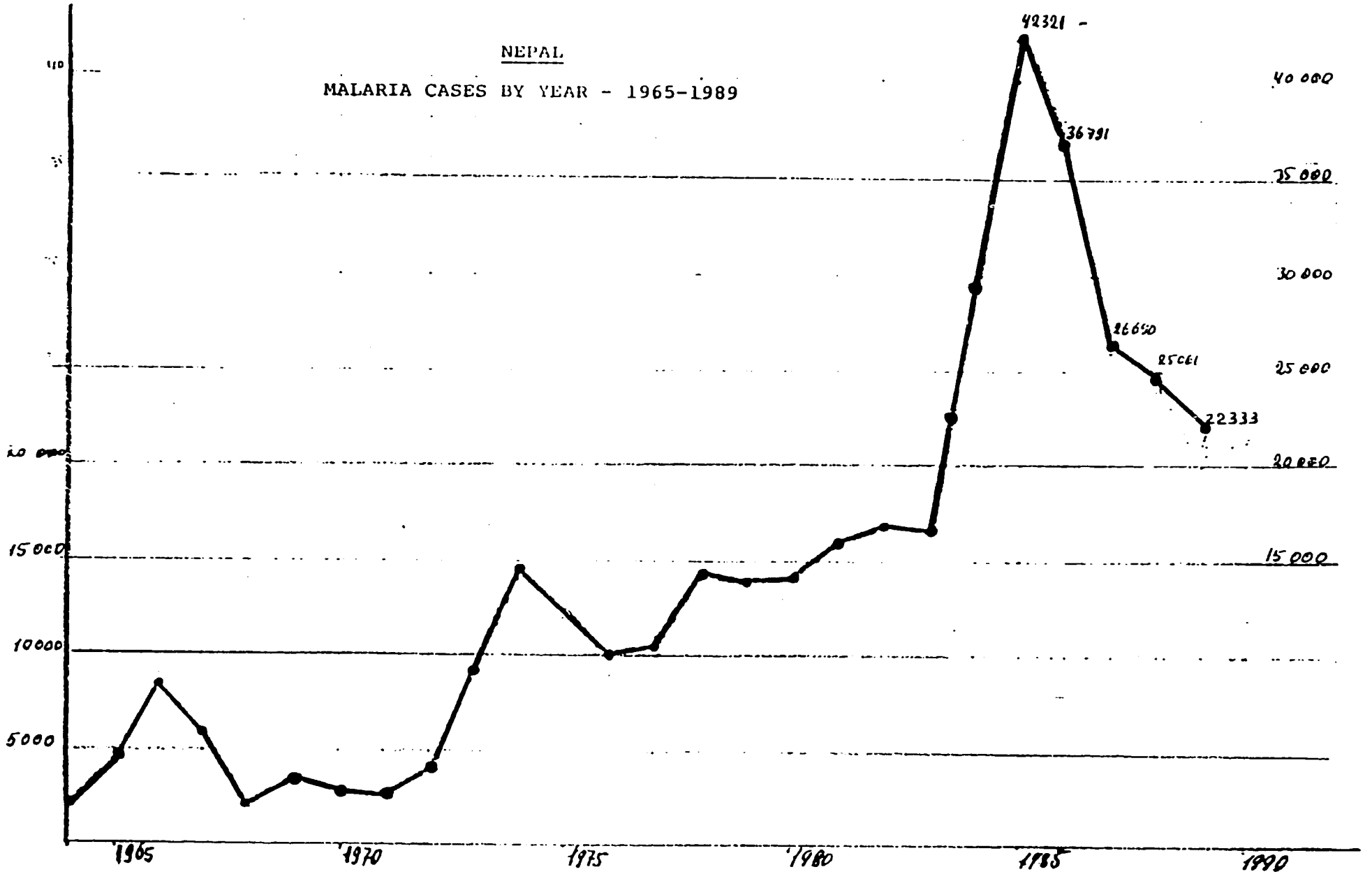
HFP:LTCowper:bnm

Annex 3

Graph of Malaria Cases By Year
1965–1989

NEPAL

MALARIA CASES BY YEAR - 1965-1989



Annex 4

Table C. Percentage Slide Collection and Positives, 1986–1989

Table-4. Percentage Slide Collection and Positives by Different Case Detection Mecnanism. 1986- 1989.

Region	Year	A C D Slide %	A C D +ve %	APCD Slide %	APCD +ve %	PCD Total Slide %	PCD Total +ve %	PCD(V) Slide %	PCD(V) +ve %
East	1986	58.86	20.77	5.97	16.3	10.06	47.7	4.53	15.73
	1987	59.46	20.74	6.14	13.5	12.35	51.15	5.34	16.42
	1988	66.0	19.59	6.58	13.4	16.54	58.5	10.06	24.7
	1989	67.16	13.36	8.12	14.81	17.89	64.20	9.84	22.7
Central	1986	68.62	18.19	4.4	9.61	13.17	60.38	6.02	29.97
	1987	70.45	22.03	4.47	8.02	15.30	53.82	6.88	30.21
	1988	72.57	21.31	4.0	9.6	14.98	55.3	9.14	33.4
	1989	73.37	19.08	5.15	11.24	16.29	63.46	8.84	37.4
Western	1986	62.61	20.97	8.32	10.35	13.79	56.80	6.70	20.27
	1987	62.62	20.35	8.72	14.51	14.66	51.87	7.96	19.14
	1988	67.24	16.5	9.91	9.47	29.29	60.7	13.48	26.7
	1989	65.13	12.0	11.63	11.57	19.48	71.33	9.89	21.3
Mid-west	1986	63.94	25.6	7.25	8.5	17.25	57.39	7.58	20.44
	1987	63.48	18.2	7.36	7.85	19.98	67.66	10.0	24.91
	1988	64.34	20.5	7.42	6.44	20.81	67.09	11.08	30.8
	1989	58.90	17.48	9.16	4.77	30.48	26.43	15.03	21.4
Far-west	1986	46.50	17.74	13.96	13.42	31.82	64.48	8.75	14.86
	1987	55.62	29.2	12.18	21.84	23.36	43.40	9.87	19.01
	1988	57.44	32.8	15.62	26.9	22.94	36.20	11.33	15.9
	1989	49.49	32.84	13.92	17.78	32.57	47.09	13.51	14.2
Nation	1986	62.53	19.70	6.63	11.99	14.22	59.14	6.10	19.67
	1987	64.35	22.90	6.57	13.33	15.29	54.48	7.17	22.60
	1988	68.0	23.3	7.0	14.1	16.0	53.09	9.15	26.4
	1989	67.20	21.39	8.20	13.38	19.63	60.43	10.15	25.1

Annex 5

Table D. Time-lag of Investigation and Radical Treatment, 1986-1989

Table-5 Time-lag of Investigation and Radical Treatment.

Region	Year	Total Cases	% Invest.(in days) 7 or <	8-14	> 14	Tot. tr.case	% Rad.Treat.(in days) 7 or <	8-14	> 14
Eastern	1986	4802	41.34	26.41	31.62	4545	55.84	26.71	17.36
	1987	4275	55.42	24.42	19.35	4059	64.84	21.11	13.82
	1988	2967	56.35	19.18	23.93	2802	61.06	18.7	20.24
	1989	3090	61.91	16.57	20.55	2922	64.99	16.50	18.53
Central	1986	7323	25.90	29.58	44.48	6976	49.76	23.25	26.99
	1987	6654	33.78	33.33	32.85	6448	56.51	25.22	18.11
	1988	7453	43.02	26.46	30.49	7239	60.63	20.14	19.62
	1989	7290	36.34	26.89	36.53	7043	54.38	20.03	25.59
Western	1986	5111	47.23	24.32	25.34	4784	59.01	25.59	15.41
	1987	4315	42.30	29.57	24.33	4026	55.09	30.45	14.41
	1988	3036	43.81	21.51	26.55	2698	55.52	26.09	18.38
	1989	2551	39.36	19.25	39.00	2152	53.86	19.84	31.64
Mid-west	1986	4447	34.68	26.26	39.06	4001	40.06	31.14	28.70
	1987	4688	45.35	25.06	29.59	4417	51.62	24.75	23.64
	1988	3771	36.57	22.7	40.73	3474	43.84	26.45	29.71
	1989	1510	49.34	13.84	32.51	1424	50.07	13.76	32.16
Far-west	1986	13306	55.43	22.10	21.57	12984	61.59	20.39	18.08
	1987	5838	45.72	30.18	24.0	5770	46.4	30.35	23.0
	1988	5776	50.71	23.22	26.04	5720	51.31	23.44	25.28
	1989	6721	56.99	19.91	22.79	6652	55.89	21.42	22.68
Nation	1986	34989	42.48	25.12	20.52	33290	55.41	23.89	20.75
	1987	25780	43.63	29.01	26.73	24720	54.41	26.63	18.93
	1988	23000	45.73	23.46	29.63	21933	54.97	22.55	22.62
	1989	21162	47.92	21.31	29.95	20193	56.34	19.52	24.72

Annex 6

Table E. Agricultural Insecticide Use in Nepal

15A

Amount of different insecticide used in Agriculture 2042/43 to 2045/

Sl.No.	Insecticide	Total Consumption FY/045/46	FY/044/45	FY043/44	FY042/43	
1	Climphos	330.79	496.54	444.78	373.62	Kg.
2	Zinc Phosphete	376.82	661.109	285.85	381.8	
3	B.H.C. dust	1120805	489130.13	353180.22	858141.8	
4	Bhaitabhacus	1085.63	5271.05	3623.69	1273.77	
5	Zinc Sulphate	3038.2	7572.62	7589.51	12323.45	
6	Dithename 45	421.75	977.93	504.72	575.18	
7	Malathion dust	1301.75	15705.2	10999.56	14636	
8	Phiurine	331.325	118.55	227.14	568.68	
9	Shekphos	84.5	73.75	35.4	465.73	
10	Cupporsulphete	360.75	678.76	202.55	116.8	
11	Metacid Liquid					
12	Metacistacus Liquid					
13	Almunium Phosphite	6.49	1.29	44.47	32.13	
14	2.4 D.Sodium Salt	65.5	91.68	17.8	88.5	
15	Bebisteen	313.5	139.72	9.7	26.7	
16	Bepsilphos	31.16	52.84	142.63	147.85	
17	Choredine dust	475	1488	250	584	
18	Saithine dust	636.518	2038.18	8283.25	3201.25	
19	Lindren granule			15.2	24.5	
1	Metacid	257.15	1612	1900.35	2347.55	Ltrs.
2	Metacistucs	47.8	282.55	396.4	474.7	
3	Parathion	41.5	73.6	1161.7	979.2	
4	Kerathion	32	59.3	180.05	2.4	
5	Demochrone	57.7	148.4	113.1	188.2	
6	Hinoran	69.2	112.4	16	18.8	
7	Malathion (Liquid)	36.45	18.5	90.8	46.55	
8	Nepceltucs	3.1	16.2	7.2	1.8	
9	Roger	25.4	20	44.5	13.6	
10	Sumithion	2353.4	2876.3	129.5	132.6	
11	Thiodine	177.1	697.2	350.9	88	
12	Eldrine	0.5	0.1	2	0.1	
13	Nuban	45.5	100.3	39.9	42.4	
14	planophix	47.7	0.8	3.5	0.2	
15	Nibcilparathinr	5.6	511.81	2.2	23.7	

Annex 7

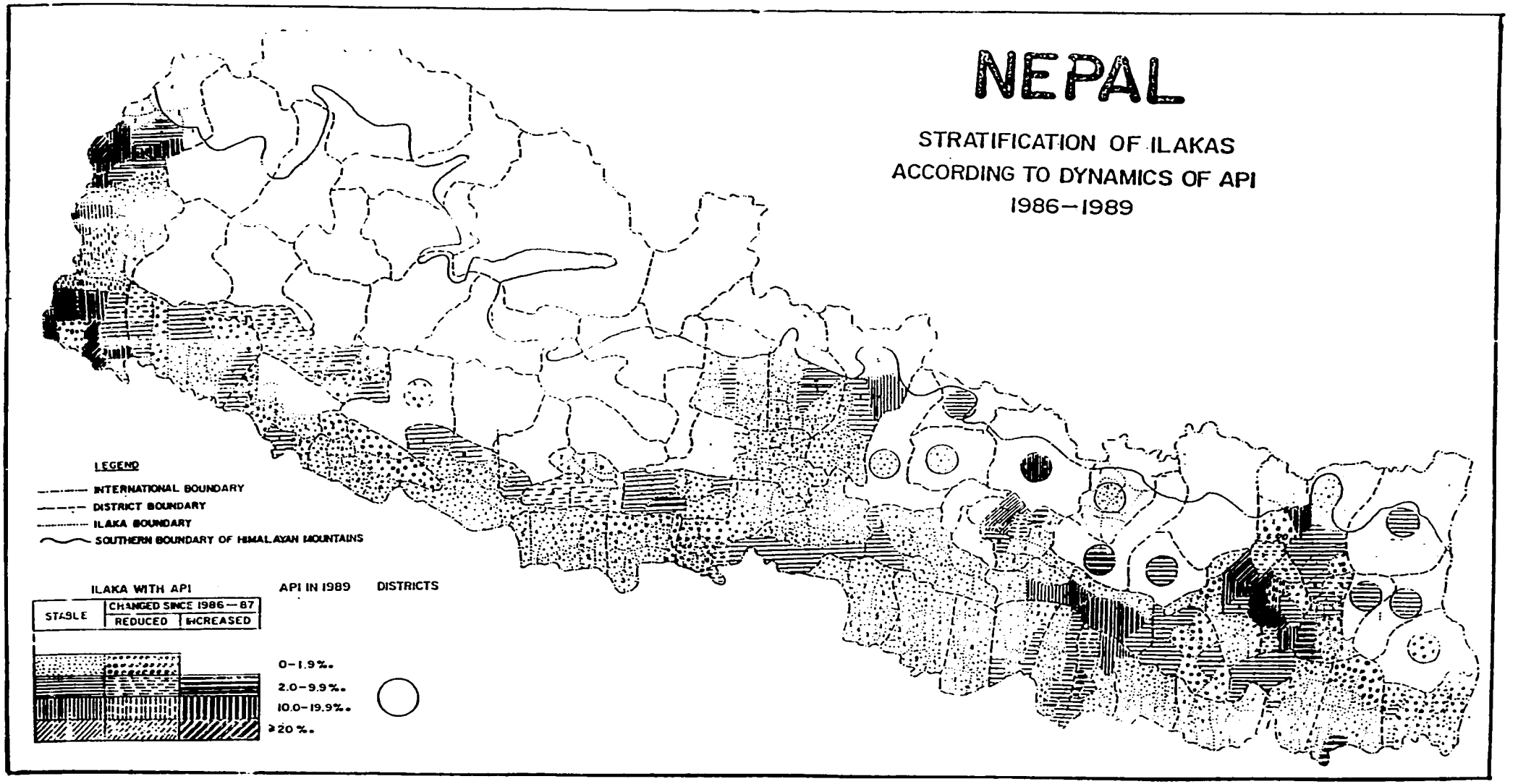
Table F. Long-Term Training

Table 8f. Summary of International Training Received by NMEO Staff, 1988 - 1990

Year	Title	Type of Course	Period	Country	Sponsored by	Present Location
1988	Epidemiologist	Malaria Control & Planning	3 months	Thailand/Italy	WHO	Deputized to NMEO, HQ
	Sr. Health Educator	Observation tour	4 weeks	Thailand/Indonesia	WHO	NMEO, HQ
	Sr. P.H Officer	Observation tour	4 weeks	Thailand/Indonesia	WHO	Pub. Hlth. Div. East Region, Morang District
	Sr. Entomologist	Observation tour	4 weeks	Thailand/Indonesia	WHO	NMEO, HQ
	Statistician	Observation tour	4 weeks	Thailand/Indonesia	WHO	Deputized to Pub. Hlth. Div., Central Region
	Health Educator	Observation tour	4 weeks	Thailand/Indonesia	WHO	Tulane University
	Entomologist	Observation tour	4 weeks	Thailand/Indonesia	WHO	NMEO, HQ
	Malaria Officer	Observation tour	4 weeks	Thailand/Indonesia	WHO	Epidemiology Division, Ministry of Health
1988-89	Entomologist	MS in Entomology	2.5 years	Philippines	USAID	Hetauda Research & Training Center
	Entomologist	MS in Entomology	2.5 years	Philippines	USAID	Regional Office, Far West Region
	Entomologist	MS in Entomology	2.5 years	Thailand	WHO	NMEO, HQ
	Entomologist	MS in Entomology	2 years	U.S.A.	USAID	Tulane University
	Malaria Assistant	DHE	1 year	India	USAID	Central Region, Chitwan District
	Malaria Assistant	DHE	1 year	India	USAID	Regional Office, Far West Region
	Malaria Officer	MPH	1 year	Thailand	WHO	NMEO, HQ
1989	Malaria Officer	Observation tour	4 weeks	Thailand/Indonesia	WHO	NMEO, HQ
	Pub. Hlth. Officer	Observation tour	4 weeks	Thailand/Indonesia	WHO	Public Health Division, MOH
	Epidemiologist	Observation tour	6 weeks	Thailand/Indonesia	WHO	Deputized to NMEO, HQ
	Sr. Entomologist	ELISA workshop	2 weeks	Thailand	WHO	NMEO, HQ
	Malaria Assistant	ELISA workshop	2 weeks	Thailand	WHO	NMEO, HQ
	Malaria Assistant	ELISA workshop	2 weeks	Thailand	WHO	NMEO, HQ
	Malaria Inspector	Microscope maintenance	3 months	India	USAID	NMEO, HQ
	Sr. Entomologist	Seminar	4 days	Geneva	WHO	NMEO, HQ
	Parasitologist	Seminar	3 days	Thailand	WHO	Hetauda Research & Training Center
1989-90	Health Educator	MPH	1 year	Bangladesh	WHO	Bangladesh

Annex 8

Map of Nepal – Stratification


NEPAL
STRATIFICATION OF ILAKAS
ACCORDING TO DYNAMICS OF API
1986–1989
LEGEND
INTERNATIONAL BOUNDARY
DISTRICT BOUNDARY
ILAKA BOUNDARY
SOUTHERN BOUNDARY OF HIMALAYAN MOUNTAINS
ILAKA WITH API
STABLE
CHANGED SINCE 1986–87
REDUCED
INCREASED
API IN 1989
0–1.9%.
2.0–9.9%.
10.0–19.9%.
≥20%.
DISTRICTS