

# **MALARIA ERADICATION**

**IN  
INDIA**



सत्यमेव जयते



India's biggest public health enemy malaria killed as well as maimed

## THE PROBLEM

Among all the diseases that have afflicted mankind, malaria was for centuries one of the most formidable problems of the human race, both because of its world-wide distribution and its evil effects on the vitality and the physical development of the populations. The World Health Organisation has estimated that before the anti-malaria programmes were launched in the various countries in the last few years, there were about 1,150 million people in the world at risk from malaria—more than one fourth of them being in India alone. The approximate number of malaria cases occurring in the world each year, as estimated by some workers in the field in 1946, was at least 300 million out of which nearly 3 million people died as a direct result of the disease. Undivided India had a lion's share in this universal misery, the country accounting for nearly one-third of the world's malaria morbidity and mortality figures. In the post-partition period the morbidity rate in India was computed at 20 per cent. of the total population, i.e., 75 million cases per year with 0·8 million deaths. India was thus probably one of the worst malaria affected countries in the world.

The vast territories, the complex topography, the hydrography and climates of the various regions account for the great variety of physico-geographical condition in India. The country presents as great and striking contrasts in meteorological conditions, and furnishes the typical large scale example of the alternation of seasons as any area of the similar size in the world.

India is the seventh largest country in the world covering a total area of 12,66,900 sq. miles. The 1951 census placed the population figure at 360 million. With the natural increase, in 1960 the population of the country is estimated to be 390 million. The great mass of the population is rural, only about 10 per cent. living in towns and about three-fifths of the population is actually engaged in agriculture. In spite of the fact that India has the largest railway system in Asia and the fourth largest in the world, communications are insufficient for her needs. The country has only about 10 miles of all weather roads per hundred sq. miles of territory.

India has 15 States and 6 Centrally administered territories and the population density varies from state to state. In some parts like desert area of Rajasthan or the hill tracts of the North East Frontier Agency or Orissa, the population is widely dispersed and the density is very low, whereas in the Indo-Gangetic plains population density is fairly high. While the overall density of population per sq. mile is estimated at 312, the range variation in the country is as wide as 901 to 51 in the different States. Further, there are various tribal races in isolated areas having quite different traditions, customs and living conditions than the rest of the country. Many of them live in highly inaccessible parts in dense forests. There are also parts at high altitude where no malaria transmission can occur but

since quite often people from these areas come down to the plains and valleys, either for cultivation or for marketing or shopping, for weeks for months at a time, many of them contract malaria during that period and carry it back with them.

As stated above, malaria presented one of the most serious public health problems to India. Whether from the standpoint of view of enhanced mortality, sickness and individual suffering or from the effect of sapping the vitality of population or the paralysing effect on industry and the exploitation of the mineral or other natural resources of the country or in the direct losses to Government in a variety of ways, it had no compeer in the list of diseases that prevailed in this country. To cite an example, it may be mentioned that regular output supply of coal, the most important fuel in India, were seriously jeopardised by the high incidence of malaria and continuous turn-over of labour population in coal mines. In spite of immense potentialities, expansion of the industry was held in abeyance until malaria control programme was initiated in the entire coal-field areas.

Malaria control operations were initiated in the major coal-fields of Bihar and Bengal in 1945 although the work actually started from 1946. The population protected in 1946 was about 5 lakhs. With the gradual expansion of the activities taking up new coal-field areas, by 1959-60, 1.13 million people were afforded protection. The population protected, malaria cases recorded and the morbidity rate per mille are given below.

Year	Population protected	Malaria cases	Rate per mille
1946	5 lakhs	1,24,211	284.4
1959-60	1.13 million	9,243	8.2

Per cent reduction — 96.7 per cent

On the basis of 248.4 malaria cases per mille in 1946, the total malaria morbidity in 1959-60 is 1.13 million people which would come to 2,80,692 cases. Thus 2,71,449 cases may be estimated to have been prevented during the year 1959-60 as a result of the Malaria Control/Eradication Operations. It is difficult to estimate the actual number of workers who have been saved from malarial attacks, but the proportion of workers in coal-fields industry is much more than in an average population. Thus not only there has been considerable saving to the labour population in the shape of their wages, but the loss to the colliery authorities in the shape of loss of production has also been prevented in addition to the savings on account of treatment to malaria cases. Additional factors to be taken into consideration are the debility caused by malaria attacks, incapacitating the patient for full application to his work for a considerable length of time, thus impairing the efficiency of the industry as a whole.

As such not only the production in the coal-fields areas has been increased, but the whole machinery is able to function more efficiently and profitably.

Some other examples of how malaria has impeded important projects are the construction of Alexandra Docks in Bombay, the Sarda

Canal Headworks in Uttar Pradesh and the Raipur-Vizianagram Section of the then Bengal-Nagpur Railway, works which were delayed for long periods on account of this disease.

Conservative estimate placed the annual economic loss caused to the country by malaria on various accounts at Rs. 1,000 crores. This does not take into account the vast sums of money spent in importing quinine and providing medical aid and hospitalization services to the sufferers.

Thus the disease was one of the most important causes of economic misfortune, engendering poverty, diminishing the quality and the quantity of the food supply and presenting a tremendous stumbling block in the economic development of the country.

The size of the country, the wide variety of topographical and meteorological conditions, the ethnic composition of the people and the insufficient communications constituted by themselves a very complicated background for any fight against the malaria scourge. When we add to these complications the fact that there are in India seven primary anopheline vectors of malaria along with a number of secondary vectors, the problem becomes extremely challenging.

In order to fight this scourge a nation-wide malaria control programme was launched in 1953. But it was not till 1958 when the campaign was switched over to one of eradication of the disease that the country accepted a formidable and unprecedented challenge, the biggest venture in the field of Public Health in the entire world.

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## THE PROGRAMME

### *Background*

Prior to the World War II, the main activities for the control of malaria in the country were restricted to a few urban areas only and the attack was directed against the aquatic stages (larvae) of the malaria carrying mosquitoes (vectors) by the use of larvicides like oil, and paris-green. Periodical application of space spray with pyrethrum as a measure against adult stages of the mosquitoes were also tried in a few areas. However, on account of the frequency and precision with which such measures are to be initiated and of necessity the heavy financial implications, these methods could not be extended to rural areas in the country.

The Health Survey and Development Committee appointed by the Government of India in 1943 were greatly concerned by the high morbidity and mortality rate due to malaria and recommended in its report of 1946, the establishment of a net work of anti-malaria organisations all over the country. However, for a number of reasons, these recommendations did not get implemented in the indicated manner.

Meanwhile with the advent of synthetic residual insecticides like D.D.T., B.H.C., etc., and the technical knowledge available, that application of such insecticides on the wall surfaces and roofs of houses resulted in the interception of transmission by reducing the longevity of the anopheline vectors and that the effect of these insecticides lasted for months, showed an effective and economical way for the control of the disease.

Residual spray with D.D.T. for civilian use was first initiated in Delhi in 1946, under the technical guidance of the Malaria Institute of India. At the same time, the Malaria Institute of India was actively engaged in standardising various formulations of insecticides, determining dosage schedules and the frequency of application necessary for effective control of malaria under local conditions. For the demonstration of an economic method of malaria control, the Institute also initiated a pilot control scheme in a beetle-nut industry area, which had been having serious adverse economic repercussions due to high incidence of malaria. Similar parallel projects were also taken up in Tea Estates using residual insecticides or latest synthetic drugs, alone and in combination of both methods. These investigations furnished volumes of technical information regarding the effective dosage schedule of insecticide, frequency at which spray operations were required under the varied malariogenic conditions in the country and formulations of insecticides best suited for local conditions.

By 1947 several states like Mysore, Bombay, West Bengal, Uttar Pradesh, etc., had also initiated large scale pilot projects using D.D.T.

Besides, a few W.H.O. Teams were also available to undertake demonstration control projects in some of the highly malarious areas in the country. It was estimated in 1952 that about 30 million people in the country were being afforded protection against malaria at a cost of Rs. 15 million meaning an annual *per capita* expenditure of only half a rupee.

The initial achievements made were so encouraging and the spray operations so readily acceptable to the public, not only for the control of malaria but also from the standpoint of other collateral benefits, that a nation-wide campaign began to be considered feasible and one well within the financial resources of the country.

Reviewing the health programmes in the country in 1951, the Planning Commission realised the immense importance of malaria control and endorsed the recommendations of the Health Survey and Development Committee, that a nation-wide malaria control campaign should be initiated early and the programme should receive top priority. The Indo-American Point-Four programme offered an opportunity of meeting the urgent and immediate foreign exchange requirements. Also, fortunately there were in the States as well as in the Centre a number of well-trained and experienced malariologists ready to undertake the work and the Malaria Institute of India provided an effective nucleus to build the Programme. The plan for a nation-wide control operation as drawn up by the Malaria Institute in collaboration with the State authorities and international agencies like U.S.T.C.M., W.H.O., U.N.I.C.E.F., Rockefeller Foundation, etc., was approved by the Planning Commission and the Government of India. The plan was to operate in the first instance during the last 3 years of the First Five Year Plan period.

### *National Malaria Control Programme*

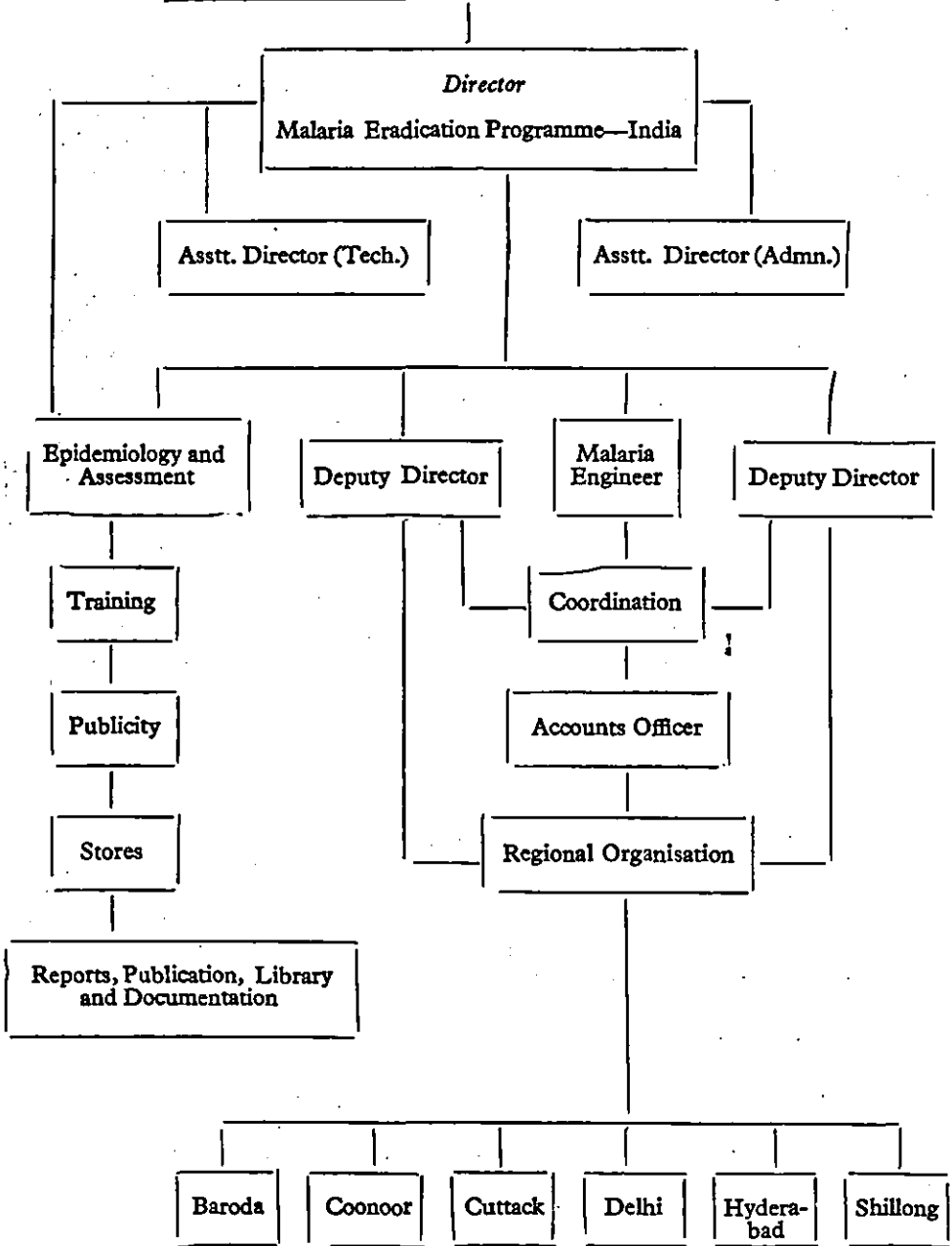
The National Malaria Control Programme launched in April 1953, envisaged affording protection to a population of 200 million people residing in highly malarious areas of the country. The aim was to reduce the malaria transmission to such a low level that the disease would cease to be a major public health hazard. This work was to be carried out in a phased manner over a period of 5 years.

The main activity under the control programme was to spray the wall surfaces and roofs of all the houses and cattle sheds in the areas of operations twice a year with a dose of 100 mg. of D.D.T. per sq. ft., per application. The time for spraying programme was to be adjusted according to the local transmission season, the interval between the two sprays being 2½ months. Anti-malaria drugs were to be used mainly for establishing good public relations.

It should also be mentioned here that among other developments intensive investigations in the field of Chemotherapy which had been initiated as early as 1947, clearly demonstrated the important role which the anti-malarial drugs had to play in the later stage of the control or eradication programme, the effective dosage schedules and frequency of drug administration under local conditions.

MINISTRY OF HEALTH, GOVERNMENT OF INDIA

DIRECTOR GENERAL OF HEALTH SERVICES



Note :—

Each of the cells has an Asstt. Director, Deputy Asstt. Director and staff.

Note :—

Each Regional Headquarter has a Deputy Director, two Asstt. Directors and staff.



In order to assess the efficacy of the spraying programme epidemiological investigations comprising determination of child, spleen and parasite indices as well as infant parasite index were to be carried out after the completion of spraying. Besides, data from hospitals, dispensaries, etc., in the various States were to be collected and analysed to estimate the ratio of cases clinically diagnosed as malaria to all cases reporting to these places for all diseases.

The Programme was to operate through the establishment of 200 units during the 5 year period, each unit designed to afford protection to nearly a million population. The staff recommended for each unit was one Medical Officer, 8 Inspectors, 4 Superior Field Workers and 10 Field Workers on 12 months basis besides ministerial staff, drivers, etc. For spray operations, an *ad hoc* provision was made for 110 field workers and 20 superior field workers. Transport, insecticides and initial supply of equipment were to be made by the Centre, and the operational costs were to be incurred by the States. The training and research activities at the Malaria Institute of India were to be geared up to the needs of the Programme and to meet this contingency the staff of the Institute was to be expanded in certain directions.

During the first year of the operations, 75 malaria control units were due to be allotted to the various states, priority being given to areas where the incidence of malaria was of the highest order. However, on account of the heavy demand 90 units were actually allotted, of which 84 functioned. With the allotment of further units in the subsequent years, the total number of units stood at 200 by the end of 1957-58. Out of this total of 200 units, 193.5 actually functioned and the population protected was nearly 165.16 million.

Taking the available epidemiological data for 1953-54 as the base line it was observed that by the end of 1957-58 the overall reduction in the epidemiological indices was as follows:

	1953-54	1957-58	Percentage of reduction
1. Spleen Rate	15.7	4.2	73
2. Child Parasite Rate	3.9	0.8	79
3. Infant „ „	1.6	0.6	63

The reduction in the proportional case rate was 10.8 to 4.4, i.e. by 60 per cent.

The total cost incurred during the 5 years period on the operations of the programme was Rs. 237.1 million (23.71 crores).

Although it is difficult to compute in monetary terms the economic benefits which accrued during the five years of the operation of the National Malaria Control Programme, calculated on the basis of the fact that there was reduction in the morbidity rate by 60 per cent at the end of the five year control operation some estimates can be drawn. The pre-control estimated annual morbidity rate being 75 billions, it would be reasonable to assume that there were 45 million malaria

# STATE ORGANISATION

STATE GOVERNMENT

(Department of Health)

Director of Health Services Director of Public Health }  
Assistant Director of Public Health (Malaria)\* }

In case of States having 20 or more units, there will be at headquarters a Deputy Director of Public Health (Malaria)\* between the Director of Health Services and the A.D.P.H. (Malaria).

Assistant Director of Public Health incharge of 5-10 Units.

Malaria Officer  
I/C of Unit

Assistant Unit Officer

Executive

Administrative

Senior  
Malaria  
Inspectors

Technicians

Mechanic

Accountant

Store  
Keeper

Upper  
Division  
Clerk

Malaria  
Inspectors

Super or  
Malaria Field  
Workers

Malaria Field  
Workers

Driver

Cleaners

\*In some States the head of the Malaria Section is designated as State Malariologist.

cases less in 1957-58. Assuming that each attack of the disease incapacitated a worker for 3 days only during one year, in the absence of control programme, the total man-days lost should have been 225 million instead of 90 million. Computing the wage per man per day at Rs. 2 it would be reasonable to assume that during a single year in 1957-58 there would have been a saving of Rs. 270 millions or 27 crores. This does not take into account the overall improvement which would have taken place throughout the country in fields of agriculture, commerce, industry, large scale engineering projects like the expansion of the Railways, irrigation, power supply, reclamation of land etc.

It has also been reported that in 1955 as a result of malaria control in the Punjab for 2 years only there was an increase of 1,30,562 acres in the cultivated area of three tehsils of Karnal district. Further, from a survey of the economic status of villages in a malarious tract of Mysore State, as a result of residual insecticide spraying, it was estimated that for every rupee spent on malaria control in the area there was a return of Rs. 97 in the shape of increase in agricultural output and earnings as well as saving on account of reduction of malaria morbidity and mortality. In another study carried out to compare the economic status of villages in malarious irrigated tracts in Mysore State, it was determined that during one year *per capita* gain of Rs. 29.25 resulted in villages under malaria control as compared to the villages outside the ambit of malaria control operations.

#### *From Control to Eradication*

The change in the concept from control to eradication of malaria was first discussed at the 4th International Congress of Tropical Medicine and Malaria in 1948 at Washington, and later during the Second Asian Conference of the World Health Organisation at Baguio, Philippines Islands, in 1954. In 1955, the VIII World Health Assembly passed a resolution requesting member Governments to intensify plans of nation-wide malaria control with eradication of the disease as the ultimate objective. This was necessary because of the possible threat of development of resistance to insecticides in anopheline vector species.

Meanwhile, the experience of large scale malaria control programmes in different parts of the world over a period of years brought out several important factors. The first of these was that malaria eradication was a feasible proposition and the same has been achieved in some countries like U.S.A., Argentina, major parts of Venezuela etc. The second factor was that in the long run a malaria eradication programme was far more economical than a continued control programme though initial cost of operation in the former was somewhat higher. While these two factors indicated the desirability of eradicating malaria, a third and the most vital issue was that prolonged use of residual insecticides could bring about the phenomena of resistance in malaria carrying mosquitoes to such insecticides, as had been observed in several countries. This, therefore, spelt the urgency for switching over the control to an eradication programme. Further it was also appreciated in all quarters that once malaria was eradicated from the country, the entire national resources like the trained technical personnel, funds etc., utilised for the campaign could be available for diversion to meet other public health problems.

*Staff of each Unit*

	<i>Unit of each type</i>		
Malaria Officer . . . . .	..	..	1
Assistant Unit Officer (non-medical in-charge of spraying logistics) . . . . .	..	..	1
Senior Malaria Inspectors . . . . .	..	..	4
Malaria Inspectors . . . . .	..	..	4
Technicians . . . . .	..	..	2
Accountant . . . . .	..	..	1
Store Keeper . . . . .	..	..	1
U. D. Clerk . . . . .	..	..	1
Mechanic . . . . .	..	..	1
Motor Drivers . . . . .	..	..	5
Motor Cleaners . . . . .	..	..	5
Peons . . . . .	..	..	4
Chowkidar . . . . .	..	..	1
Sweeper . . . . .	..	..	1
Sup. Field Worker for 12 months . . . . .	..	..	4
Field Worker for 12 months . . . . .	..	..	10
	Endemic Unit in plains	Endemic Unit in hills	Hypoendemic Unit
Sup. Field Worker for 5 months* . . . . .	32	44	..
Sup. Field Worker for 2.5 months* . . . . .	...	...	32
Field Worker for 5 months * . . . . .	170	230	..
Field Worker for 2.5 months* . . . . .	..	..	170

\*Exclusive of staff employed for 12 months.

Taking into consideration the above factors the Government of India in consultation with the State Authorities and International Agencies like U.S.T.C.M., W.H.O. etc., decided to switch over the National Malaria Control Programme which was operative for five years, to one of eradication. Accordingly the National Malaria Eradication Programme was launched in April, 1958.

### *The Plan in Brief*

The plan for the National Malaria Eradication Programme as originally drawn had to undergo some changes in the light of certain developments and experience gathered, although the basic plan of operations still remains the same.

Essentially the plan envisages an operational phase of 8 years during the 2nd Plan period and 5 years during the 3rd Plan period.

While under the control programme 200 million people were to be afforded protection under the eradication programme it was necessary to include the entire population of the country. Projecting the likely increase in the country's population by 10 per cent over the 1951 census it was computed that by 1960 the total population of the country would be about 390 million. The Plan, therefore, included the establishment of 390 units, each unit designed to afford protection to about a million population. 230 units which were to operate in hyper-mesc-endemic areas were to be established in 1958-59 and the balance of 160 units for operation in hypo-endemic areas were to come in existence from 1959-60.

In the light of eradication requirements, the spray staff were to be augmented by 100 per cent in 40 endemic units functioning operationally difficult areas and by 50 per cent in the rest of the units. The composition of each category of unit has been shown opposite. Compared to the pattern followed under the control programme, provision was also to be made for certain categories of supervisory staff at the State Headquarters, Zonal and Unit levels. In addition six Regional Coordinating Organisations were to be established with headquarters at Shillong, Cuttack, Delhi, Baroda, Coonoor and Hyderabad under the Centre and some augmentation of staff was also to be made at the headquarters N.M.E.P.

To ensure the smooth working of the programme and coordinate its activities the Centre was to be responsible for the procurement and distribution of insecticides, transport, anti-malaria drugs, equipment etc., the Malaria Institute of India was to intensify its training activities to meet the heavy demand for technical personnel like Medical Officers, Microscopists and Inspectors; and the States were to be responsible for the actual execution of the operations.

The main activities under the eradication programme envisaged were:

- (i) *Intensified Spray Operations* in every roofed structure, twice in endemic areas and once in hypo-endemic areas, throughout the country for a varying number of years.

- (ii) *Epidemiological and Entomological Evaluation* of the work, until such time surveillance operation had been fully initiated.
- (iii) Initiation of surveillance operations in 364.5 out of 390 units beginning from the third year of the attacks phase i.e. 1960-61. Surveillance operation was to be both active and passive. For active surveillance purposes each unit was to be provided with 25 surveillance Inspectors and 100 surveillance workers. Passive surveillance was to be initiated through the agency of primary health centres, dispensaries, hospitals, medical practitioners etc. In the matter of withdrawal of spraying operations the approach was to be cautious and in a phased manner, to be based primarily on the data available from surveillance operations.
- (iv) To meet the requisite demands of an eradication programme total coverage was to be ensured both in respect of spray and surveillance operations.

### *Targets Reached*

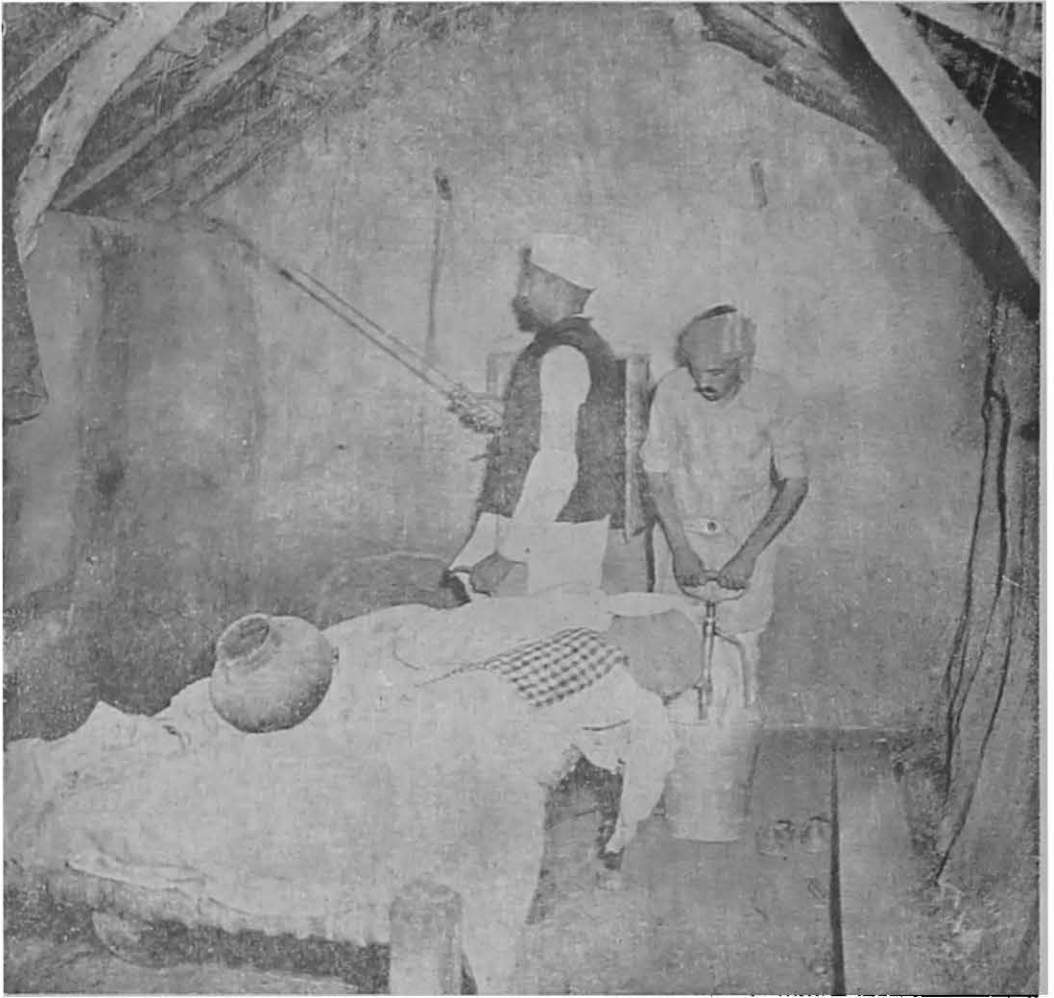
During the three years period, i.e. 1958-60 during which the eradication programme has been operative the work is progressing according to Plan. A broad overall picture shows that all the 390 units have been established and are functioning; that necessary augmentation of the field staff for spray operations have been provided in all the units; that full complement of supervisory staff have been provided in 13 States and Union Territories and partially so in 7 States and Union Territories and that the six Regional Coordinating Organisations have also been functioning.

### *Logistics*

As is natural, in a campaign of the magnitude of Malaria Eradication Programme there are bound to be some shortcomings. One such thing observed was a large gap that had to be bridged between the demand and the supply of various items.

For instance, against the estimated total requirements of 28,800 tons of insecticides (in terms of 78 per cent DDT w.d.p.) during the 1960-61 only 17,560 tons were originally available through U.S.T.C.M. and 3,700 tons from indigenous sources. This includes BHC and DDT 50 per cent supplied from Delhi and Alwaye factories. Thus there was a shortage of about 7,500 tons of insecticides. This deficiency was met by the Government of India who purchased 3,733 tons of DDT at a cost of Rs. 1.2 crores. The T.C.M. has helped the programme by effecting a further supply of 3,822 tons of DDT subsequently.

To obviate some of the difficulties that in the past had been experienced by some units regarding the supply of DDT in time, it has been so arranged now that a part of the supply for the coming year will be obtained and supplied to the States in advance. This would enable the States to arrange distribution of insecticides where



**Under the Eradication Programme every roofed structure in the country has to be sprayed once or twice a year**

monsoon sets in early presenting the problem of transportation of materials. In areas like N.E.F.A., DDT has to be air dropped in certain selected areas and thereafter every ounce has to be carried by porters. Suitable packing has been arranged for the purpose. Provision has also been made for building up 15 per cent buffer stock in every state.

### *Spray Operations*

Since the launching of the Malaria Eradication Programme in 1958 the entire country has been brought within the ambit of operations of the National Malaria Eradication Programme units for spraying operations, even though due to certain administrative difficulties and delays in most of the States, the recommended augmentation of the spraying staff for the N.M.E.P. units could not actually materialize before 1959-60. The spraying staff was augmented by 50 per cent for the plain area units and 100 per cent for the difficult area units.

Under the Indian Programme the spraying squads in each unit generally function under four sub-units, the number of spraying squads and the sprayers being deployed according to the population involved. Each sub-unit is provided with a transport, mainly for the transportation of the insecticides and spraying equipment and the sprayers from camp to camp. Spray operations are carried out from such camps mainly by pedestrian approach. Suitable camps in each sub-unit are selected in advance and insecticides are distributed in sub-depots to such camps for which institutions like schools, panchayat-ghars, police stations, hospitals and dispensaries are utilised. This enables the spray teams move from camp to camp and carry out the assigned spraying operations in each camp area.

As a result of the augmentation of the spraying staff and spraying equipment together with improved planning and distribution with more satisfactory supervision for the eradication programme, the coverage of spraying in houses and other structures have improved considerably since the inception of the Eradication Programme. The data from hyper-meso-endemic units regarding coverage and range of coverage in the first and second rounds is given below:

Year	Ist round		IInd round	
	Coverage	Range	Coverage	Range
1958-59 . . .	89.0%	68.6 to 99.7%	70.3%	14.7 to 92.3%
1959-60 . . .	90.0%	79.7 to 100%	87.9%	49.5 to 99.6%
1960-61 . . .	94.5%	86.3 to 100%	95.3%	74.1 to 99.4%

(upto Oct. 1960)

In the initial stages the main reasons for shortfall in coverage were inadequate approach and inability to cover the assigned population within the spraying period indicated. There were also some locked houses and refusals on the part of the householders. With



the augmented and intensified spraying operations the approach and coverage have improved considerably, but recently in some pockets in the country the refusal rate has gone up to some extent. The main reason for the refusals appear to be ineffectiveness of the DDT spraying against other pest insects, specially the bed-bug, even though the malaria transmission has been effectively controlled by such spraying. The problem appear to be disturbing in some pockets on account of bed-bug nuisance in Maharashtra, Orissa and Madras. The problem is being tackled through intensified public relations and health education drive by the National Malaria Eradication Programme staff. Consequently the position has improved considerably in many areas and the matter is under constant attention. Similar higher refusal rates in some pockets of Rajasthan and Gujerat on account of religious sentiments have also been tackled satisfactorily.

In addition to the quantity of spraying, i.e. the percentage of houses sprayed with insecticide, the very important question of quality of spraying as also the total coverage in each and every structure is also receiving constant attention. It may, however, be mentioned here that sometimes it is not possible to spray all the structures in a house inspite of the best efforts and mainly these unsprayed structures involve the prayer room, the kitchen and the shop establishments. This does not, however, mean that these structures are never sprayed, but usually there are higher refusal rates so far as these structures are concerned.

In addition to the normal rounds of spray by the regular spray squads, mopping up operations by teams have been organised to follow the regular spray teams to take up the houses and structures that could not be treated with insecticides during the routine visits. As the mopping up teams concentrate on the unsprayed houses only, this method has considerably improved the final coverage in the different N.M.E.P. unit areas.

### *Epidemiological Data*

A study of the epidemiological data given below indicates a considerable overall reduction in spleen and parasite indices throughout the country, during 1959-60 as compared to 1953-54 when the National Malaria Control Programme became operative.

	1953-54	1959-60	Percentage of reduction
(a) Spleen rate	15.7	1.4	91
(b) Child parasite rate	3.9	0.2	95
(c) Infant parasite rate	1.6	0.1	94

However, even though the overall reduction has been spectacular, there continues to exist some small pocket areas in the country where even today the spleen rates are fairly high. This is mainly due to either inadequate or untimely spraying and in some instances

because of recent inclusion of the area within the ambit of the programme. The States are taking active steps to combat this situation by conducting necessary investigations and taking remedial measures to attend these foci.

Viewed in the light of eradication requirements a very important outcome of the epidemiological investigations has been the emergence of the fact that nearly 20 million people classified to be living under the 160 hypo-endemic units were in reality residing in areas of hyper-meso endemic conditions. Various readjustments of units areas have, therefore, been made to ensure that such hyper-meso endemic areas could be sprayed twice a year.

#### *Proportional Case Rate*

Proportional case rate is the percentage of cases diagnosed as clinical malaria, compared to the total number of cases due to all diseases, that report to the hospitals, dispensaries etc. From the data available in 1953-54, this rate for India as a whole was 10·8 per cent (i.e. for every 100 patients, there were 10·8 malaria cases). In 1959-60, this rate has come down to 2·4 per cent showing a reduction by 78 per cent.

#### *Entomological Evaluation*

The importance of entomological evaluation during the various phases of malaria eradication need not be emphasised here. The Indian programme has been aided a good deal by entomological information already available in the country regarding the distribution of mosquitoes, their vectorial capacity and bionomics and response to insecticides etc. During the attack phase routine mosquito collections have been made in all the 390 units and it is evident from the data collected that in most states the vector population has shown a gradual decline during the past 5 years, so much so that in many areas the vector densities have decreased to a level where it is often extremely difficult to find the vector species.

The other factor which needs to be constantly studied, if the success of the nation-wide Malaria Eradication Programme has to be assured, is the question of the development of resistance in vector species to insecticides used against them. Investigations relating to susceptibility status of vectors are, therefore, being carried out both at the state level and by the Regional Coordinating Organisations and the Centre. Although recent observations have indicated that in a few small foci in the States of Gujerat and Maharashtra, *A. culicifacies* has developed resistance, *per se* this does not pose a serious problem at the moment. However, since the possibility of development of resistance in vector species in wider areas cannot be ignored, it is obvious that the eradication operations have to be accelerated.

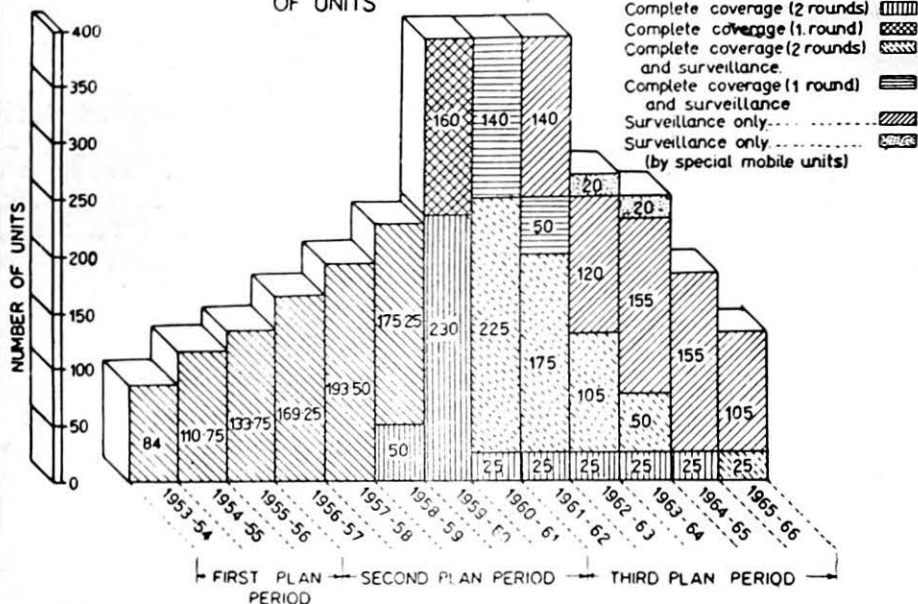
Besides the two above mentioned major activities, other correlated investigations on the following problems have been carried out:

- (a) correlation between the time of DDT application and the peak density of mosquitoes and transmission of malaria.

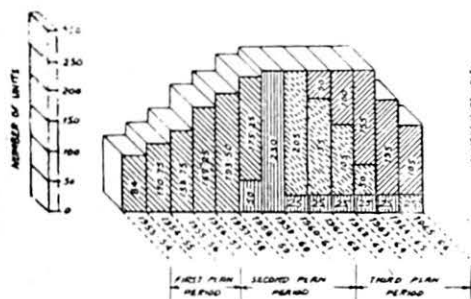
# NATIONAL MALARIA ERADICATION PROGRAMME INDIA

## REVISED PLAN OF OPERATIONS

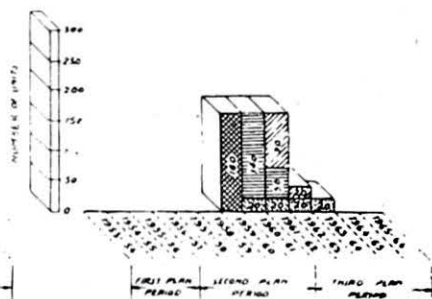
### PLAN OF OPERATIONS FOR ALL TYPES OF UNITS



### PLAN OF OPERATIONS FOR HYPER-MESO ENDEMIC UNITS



### PLAN OF OPERATIONS FOR UNITS IN HYPO-ENDEMIC AREAS



- (b) Role of secondary vectors.
- (c) The effect of replastering of surfaces on the persistence of DDT.
- (d) Resistance of bed bugs to DDT.

The objective of entomological evaluation in the ensuing surveillance phase would tend to be more of fundamental value than applied. After spraying is withdrawn the vector population is likely to be build up in varying intensity. It would not only be of interest to know the rate of build-up of vector population and the behaviour characteristic etc., but this would also be valuable in determining the transmission potential in case there appears a focus of infection. It has, therefore, been recently decided to reorganise the entomological evaluation and concentrate at zonal, state and central level by raising competent teams to undertake these investigations rather than at the unit level practised hithertofore.

### *Surveillance*

The question of withdrawal of spraying and surveillance operations was considered during the National Malaria Control Programme period, at a time when the policy regarding withdrawal of spraying and surveillance operations was not available in a crystallized form, as at present. As indicated earlier, malaria control operations with DDT insecticidal spraying have been in operation in a few states since 1945|1946 in some of the highly malarious areas. One such block area in Mysore State with a population of 1.5 million was selected for withdrawal of spraying and institution of surveillance operations in 1956 as a pilot project. Spraying in these areas had been in operation for nearly 10 years (in 1946) and the malariometric indices were extremely low or nil for a period of two years previous to 1956.

Active surveillance operations with intensified passive (institutional) surveillance operations were instituted in this area from 1956, as a pilot project to provide data for surveillance operations in the country.

According to the plan of operations of the National Malaria Eradication Programme, surveillance operations were to commence early in 1960-61 in 365 out of 390 N.M.E.P. Units allotted and functioning in the country. On account of various administrative delays and problems, surveillance operations were delayed in most of the states and by the end of 1960 only about 340 units in the country had initiated|instituted such measures. It is expected that surveillance operations will commence in the rest of the 25 units at an early date.

### *Active Surveillance*

Active surveillance operations are to be carried out by the N.M.E.P. Units concerned all over the country except for the Defence Organisations which have initiated surveillance operations from April, 1960. On the basis of the experience gained in the pilot surveillance operations in Mysore State, each unit with approximately

one million population has been provided with 100 surveillance workers and 25 surveillance inspectors. Each surveillance worker has been allotted approximately 10,000 population with 2000 houses and he is expected to visit about 200 houses a day to complete one round of visit in each house, once every fortnight or twice a month. This is only a general plan and cannot be feasible in each and every area. In actual practice population allotted to the surveillance workers varies from 2,500 in difficult areas with sparse population to 12 to 14 thousands in urban and compact areas. Thus there has been a judicious deployment of the surveillance workers with necessary adjustments made in each unit as also from unit to unit in a State. The surveillance worker during his fortnightly visit to each house makes enquiries regarding any fever case at the time of his visit as also since his last visit. Blood smears are collected from each and every fever case as also from those with history of fever. A single dose of presumptive treatment with 4-aminoquinoline is administered at the same time. The blood smears thus collected are forwarded to the N.M.E.P. Unit Hq. where each unit has been provided with two Laboratory Technicians (Microscopists) for the examination of blood smears.

One Surveillance Inspector has been provided to organise and supervise the work of 4 Surveillance Workers, in addition to carrying out radical treatment of all microscopically positive malaria cases and their epidemiological investigation under the guidance of the Unit Medical Officer.

The present set up of Surveillance Organisation is mainly based on the pilot surveillance operation in Mysore State and necessary amendment and augmentation of staff where essential will be provided on the basis of experience of the working of the present surveillance operations. The augmentation of the surveillance staff, i.e. 2 Technicians, 25 Surveillance Inspectors and 100 Surveillance Workers will not only depend on the density of population, terrain and communication etc., but also on the fever rate in different parts of the country, which can be estimated from the surveillance data that are being collected at present.

#### *Passive Surveillance*

Initially greater emphasis perhaps was given to the initiation and institution of active surveillance in different units. With the initiation/institution of surveillance operations in most of the units in the country, proper stress is being given for the organisation of intensified passive surveillance operations in each unit area. Close cooperation and liaison is being organised with the hospitals and dispensaries, medical practitioners, Community Development Blocks and Gram Panchayats, as also with voluntary organisations and private individuals who may be interested in carrying out passive surveillance operations for the National Malaria Eradication Programme. However, radical treatment for the microscopically detected positive cases by the passive surveillance agencies will be mainly carried out by the Surveillance Inspectors of the National Malaria Eradication Programme units.

A comprehensive note on surveillance operations under the National Malaria Eradication Programme together with necessary pro-

formae, forms and instructions has been distributed as an Operational Guide on Surveillance Procedures.

### *Training*

One of the problems that had posed a challenge to the successful implementation of the programme of malaria eradication was the paucity of adequate number of trained personnel to take charge of operational work. This was overcome by intensifying training activities. From 1958-59 the following categories of personnel have been trained at the Malaria Institute of India, the Regional Co-ordinating Organisations and the State Training Centres.

Medical Officers	—	301 at M.I.I.
Malaria Inspectors	—	1527 at M.I.I. and Regional Coordinating Organisations and State Training Centres.
Technicians	—	658 at M.I.I.

In addition training in surveillance procedures was provided at Mysore by the Malaria Institute of India to 94 Senior Malaria Officers belonging to the Central and the State Governments.

### *Expenditure*

According to the information available, it is estimated that an expenditure of Rs. 42.62 crores is likely to be incurred out of Rs. 43.5 crores that was projected during the three years of the Second Plan Period. Out of these the Government of India's share is Rs. 8.83 crores, the State Government's Rs. 15.01 crores and the balance of Rs. 18.78 crores is being shared by the W.H.O. and T.C.M. to the extent of Rs. 17.77 crores and Rs. 1.01 crores respectively.

## THE CONCLUSION

### *The Task*

The residual insecticidal spraying is the most essential feature during the early stage of a Malaria Eradication Programme, and it demands infinite and meticulous attention to detail. Every roofed structure and sprayable surface has to be sprayed thoroughly, with the correct dose of insecticide, within the time schedule specified. The magnitude of the task is colossal in that at least about 78 million houses have to be sprayed all over India every year and most of them twice. If the magnitude of the programme is so stupendous the quality of the work in terms of efficiency and completeness of spraying is also equally important.- Just as complete coverage is essential under the spraying programme, so is complete coverage of the population most essential during surveillance operations to be initiated during the later stages of the attack phase and throughout the consolidation phase of the work. Under this programme every house has to be visited, the aim being not to leave even a single parasite carrier undetected and untreated. On a rough estimate each individual of the huge army of 39,000 surveillance workers has to go round a population of 10,000 covering the entire population of the country. With the possible increase of population as estimated by the Planning Commission, the number of surveillance workers may swell upto 42,000 or even more. There can be no question that the proper deployment of the personnel has to proceed in a perfectly well-planned manner. Another formidable problem on this score is that at least a minimum of 100 blood slides will have to be examined daily in every unit, that is, about 39,000 slides per day in all the units.

The logistics of supplies are equally awe-inspiring. About 18,000 tons of insecticides are required for only one round of spray and areas where two rounds of spray have to be given another 50 per cent to this huge quantity has to be added to it. Elaborate arrangements have to be made for procuring, stocking and distributing these huge quantities of insecticides. Also arrangements have to be made for supplying equipment, vehicles, slides and drugs. Periodical reinforcement of the transport has become a necessity. Since the success of the programme depends on organisational efficiency, as in conducting a military campaign, meticulous attention to timing is of the prime importance.

We acquitted ourselves creditably well under the National Malaria Control Programme, before it was switched over to Eradication Programme. Our experience from the past should enable us to be circumspect when the risk is so heavy, because in the context of our present day knowledge "Malaria Eradication is Now or Never".



Examination of children's blood is an essential feature of malaria surveys



## *Administrative*

In a Malaria Eradication Programme, although the technical procedures are of paramount importance, the administrative problems predominate. With all the technical knowledge available, if right means are not made available at the right time, the entire operation becomes meaningless. Application of insecticide, however, complete and efficient it may be, if undertaken after the transmission season is over, is mere waste.

Under the Indian Programme there are other administrative problems which are of an unusual type. Health is a decentralised autonomous subject in the States, which are responsible for the actual implementation of the programme under the technical guidance from the Centre. The Centre is responsible for planning, imparting technical guidance and help, co-ordinating the activities, procurement and supply of materials and equipment as well as for training the technical staff. Besides, the Centre provides subsidy towards the operational costs. This divided responsibility and a dual financial control have at times posed some serious problems.

There is also the problem of shortage of medical personnel in many of the States. This makes the available candidates gravitate towards assignments which are more profitable and where the duties are less arduous. Sometimes the terms offered by the States to the field officers of the Eradication Programme are unattractive. As a result there is a paucity of qualified officers for the programme in certain sections. To obviate this handicap the Central Council of Health recommended that suitable provision be made for allowances for the field officers.

## *Operational Problems*

The size of the country and difficult terrain in some areas pose serious problems, and poor communications further aggravate the situation. To this may be added another important hindrance on account of the increasing population in the country, and their moving out to hitherto undeveloped areas. These factors tend to dislocate the spraying schedules.

In the tribal areas which are sparsely populated, these difficulties assume serious proportions. There are quite a number of areas where nomads abound making the surveillance operations in such areas complicated. From the operational point of view the staff had to be augmented in all such areas and more transport and equipment have had to be provided to the units operating there.

Refusals to get the houses sprayed at the right time create another problem. These refusals mainly originate from several factors like religious and caste prejudices or the ineffectiveness of the insecticides in use against pests as bed-bugs. Moreover, in recent years the mental attitude of the people towards disappearing malaria, due to the low incidence of the disease, is presenting another problem. The fact that spraying does no longer free the residents from all the pests that might be tormenting them, dampens

their interest in spraying, with the result that it is not unusual for them to turn a deaf ear to the pleadings of the malaria workers that spraying is an essential feature for the success of eradication of the disease. Although attempts are being made to carry out health education of the public, the programme needs intensified efforts to meet the situations. As things stand, much remains to be done in this direction.

### *Technical Problems*

A formidable hurdle in the way of Malaria Eradication achievement is the development of resistance in the vector mosquitoes to the insecticides in use. Fortunately, this problem has not assumed any alarming proportions in India. The weapon that the scientific advances have placed in the hands of man to strike at the roots of malaria, i.e. the residual insecticides, is still effective in this country, with only one exception where there have been signs of lower susceptibility in vectors to DDT, indicating the possibility of resistance in some pockets in Gujerat State. This development has not, however, made any impression on the course of the Eradication Programme as malaria transmission in such areas is still under control. The authorities are on the alert and the situation is receiving requisite attention in the shape that a number of investigations have been instituted in such areas. Meticulous vigilance is, however, being maintained all over the country to catch the development of resistance in its early infancy.

### *The Future*

It has been projected that out of 230 endemic units established during the Second Plan, spraying operations will be withdrawn in 50 units in 1961-62 which would have had concurrent surveillance during 1960-61. Thereafter, the sphere of activity of these units will be limited to only surveillance. This process of withdrawal of spraying has to be phased, and in every subsequent year the number of units in this category increases, until the entire lot of units achieve this status by 1965-66, excepting 25 units in the border and some difficult areas where it is proposed to continue spraying without surveillance, and spraying and surveillance during 1965-66.

According to the plan during 1961-62, out of 160 hypo-endemic units spraying and surveillance were to continue in 70 units and in 90 units surveillance only. The implementation of these proposals, however, depends entirely on the actual assessment data which the units will provide and which will be further confirmed by the surveillance operations. As things have progressed, the withdrawal of spraying from all the 50 endemic and 90 hypo-endemic units during 1961-62 may not materialise as envisaged. Some of the units operating in Mysore, Madras and other States might be ready for withdrawal of spraying in the year.

### *Conclusion*

Malaria is a stubborn disease, and it will be entirely unrealistic to imagine that it is easy to free the country from its scourge. The need for increasing co-operation between the Centre and the States

cannot be over-emphasized. In fact, it is high time to consider whether a programme of such warlike emergent nature is capable of sustaining the strategy of dual control and responsibility.

There is another danger. As malaria eradication comes closer to reality, the disease becomes less and less evident leading to a sense of false security on the part of the country's administrators. The enthusiasm gets dampened and proposals begin to appear aiming to curtail the resources for the programme. It is forgotten that the crux of the problem is the intensive work in the final stages to stamp out the least pockets of the disease.

Besides, the united efforts of the Central and State Government, every man, woman and child throughout the entire length and breadth of the country has a part to play, for no single house or hut, howsoever, large or small, can be left unsprayed and not a single case of malaria must remain undetected and untreated. The task is undoubtedly difficult and perhaps unprecedentedly arduous. It is only a spirit of dedication that can win the hurdles. We have already reached a point from where retreat is unthinkable. Let not posterity say that in our endless struggle for a healthier life, we lost the crucial opportunity of freeing our country from the curse of malaria, that has been paralysing our social and economic life, from times immemorial.

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*Statewise Distribution of Units*

Name of the State	*Population (millions)	Units allotted		Units proposed to be allotted		Total Number of units
		Plain area units	Difficult area units	Plain area units	Hypoendemic units	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Andhra Pradesh	33.50	9.00	..	..	24.50	33.50
2. Assam . . .	9.90	9.75	3.5	..	..	13.25
3. Bihar . . .	42.90	15.00	5.00	..	22.00	42.00
4. Bombay . . .	52.60	28.50	..	7.00	17.00	52.50
5. Delhi . . .	2.00	2.00	..	..	..	2.00
6. Himachal Pradesh	1.20	..	1.25	..	..	1.25
7. Jammu & Kashmir	4.80	..	1.00	..	1.00	2.00
8. Kerala . . .	15.00	1.50	1.00	1.00	11.00	14.50
9. Madhya Pradesh	82.70	15.50	7.00	3.00	3.50	29.00
10. Madras . . .	33.00	2.70	1.00	..	27.75	31.45
11. Manipur . . .	0.70	2.00	..	..	..	2.00
12. Mysore . . .	20.90	13.63	1.00	..	4.50	19.13
13. Orissa . . .	14.60	6.50	4.00	..	4.00	14.50
14. Punjab . . .	17.40	7.00	2.00	2.00	7.00	18.00
15. Rajasthan . .	17.60	6.67	2.00	1.00	7.00	16.67
16. Tripura . . .	0.90	..	1.00	..	..	1.00
17. Uttar Pradesh .	69.50	19.00	6.00	15.00	27.00	67.00
18. West Bengal . .	28.80	20.00	3.00	..	3.00	26.00
19. NEFA . . .	0.60	..	0.25	1.00	0.75	2.00
20. Sikkim . . .	0.15	..	0.50	..	..	0.50
21. Coalfields . . .	..	†1.00	..	..	..	1.00
22. Naga Hills . . .	..	..	0.75	..	..	0.75
23. Andamans . . .	..	..	0.25	..	..	0.25
<b>TOTAL . . .</b>	<b>394.05</b>	<b>160.00</b>	<b>40.00</b>	<b>30.00</b>	<b>160.00</b>	<b>390.00</b>

\*Includes estimated natural increase over 1951 Census figures.

†Included in states concerned.

# PROGRESS OF MALARIA ERADICATION PROGRAMME IN THE STATES

## ANDHRA PRADESH

The State has an area of 1,06,052 sq. miles with an estimated population of 33.5 million. Out of 33.5 units functioning in the State 9 are endemic and 24.5 hypo-endemic.

### *Spraying Coverage*

Compared to 82 and 84.2 per cent coverage in spray operations in the 1st and 2nd round respectively during 1958-59, the corresponding figures were 94 per cent in the 1st round and 86.1 per cent during the 2nd round in 1959-60. The position improved very considerably in 1960-61 when during both rounds in endemic areas the coverage was 94 per cent. The coverage in hypo units was similar during the single application.

### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 8.2 and 7.9 per cent respectively as against 2.1 and 0.14 per cent in 1959-60. Infant parasite rate was brought down to 0.45 in 1959-60 from 1.6 in 1958-59. The proportional case rate during 1958-59 was 7.1 as against 4.9 per cent in the year 1959-60. Compared to the picture in 1953-54 when the control programme was initiated the overall reduction in the proportional case rate during 1959-60 is 43.6 per cent.

### *Surveillance*

The State has instituted surveillance operations in 32.5 units as per plan from the current year.

## ASSAM

The State with an area of 84,899 sq. miles and an estimated population of 9.9 million has 13.25 endemic units functioning in the State.

### *Spraying Coverage*

During spray operation 68.6 per cent of houses were reached in the 1st round and 92.3 per cent during 2nd round in 1958-59. Corresponding figures for 1959-60 were 79.7 per cent and 94 per cent. During 1960-61 the position improved very considerably when in first round the coverage was 98 per cent and that during second round was 97.3 per cent.

### *Epidemiological Data*

Child spleen and parasite rates were reported to be 24.2 and 4.3 per cent respectively in 1958-59 as against 8 and 2.33 per cent in 1959-60. Infant parasite rate was brought down to 1.02 per cent in 1959-60 from 4.2 per cent in 1958-59. The proportional case rate during 1959-60 was 10.9 as against 23.2 per cent in the year 1958-59. Compared to the picture in 1955-56 when the control programme was initiated in the State the overall reduction in the proportional case rate during 1959-60 is 69.2 per cent.

### *Surveillance*

The State has instituted surveillance operations in 10.75 units as per plan from the current year.

## **BIHAR**

The State has an area of 67,198 sq. miles with an estimated population of 42.8 millions. 42 units are functioning in the State of which 20 are endemic and 22 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 96.6 per cent of the houses were reached during spraying operations in the 1st round and 91.1 per cent during 2nd round. In 1959-60, the coverage for 1st round was 96.4 per cent and that during 2nd round in respect of hyper-endemic units was 95.2 per cent. During 1960-61 there was considerable improvement when in the first round the coverage was 96.9 per cent and that during second round of the endemic unit was 99.4 per cent.

### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 2.9 and 0.1 per cent respectively as against 1.2 per cent and 0.05 per cent in 1959-60. Infant parasite rate during 1958-59 was 0.1 per cent and during 1959-60 no infant was encountered positive for malaria parasite. It may be mentioned here that infant parasite rate was as high as 4.2 per cent in state in 1955-56. The proportional case rate during 1959-60 was 3.8 as against 6.7 per cent in the year 1958-59. As compared to the picture in 1955-56, i.e., the 3rd year of the Control Programme for which data on proportional case rate are available there would appear to be an overall reduction by 81.5 per cent during 1959-60.

### *Surveillance*

The State has instituted surveillance operations in 40 units as per plan from the current year.

## **GUJERAT**

The State with an area of 72,138 sq. miles and an estimated population of 18.3 million has 19.5 units functioning of which 12.5 are hyper-endemic and 7.00 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 81·3 per cent of the houses were reached during spraying operations in the first round and 71·2 per cent in the second round. In 1959-60 the corresponding figures for the first round was 81·6 per cent and during the second round for the endemic units 89·1 per cent. The position improved considerably in 1960-61 when during first round 91·8 per cent of the houses were covered and the coverage during second round for the endemic units was 92·5 per cent.

### *Epidemiological Data*

The child spleen and parasite rates in 1958-59 were 0·59 and 0·1 per cent respectively as against 0·2 and 0·0 per cent in 1959-60. The infant parasite rate during 1959-60 was nil per cent as against 0·4 per cent reported in 1958-59. The proportional case rate was reduced to 2·8 per cent in 1959-60 from 4·1 per cent in 1958-59. As compared to the picture in 1953-54 when the control programme was initiated there has been an overall reduction by 79·1 per cent in the proportional case rate during 1959-60.

### *Surveillance Operations*

The State has instituted surveillance operations in 19 units as per plan from the current year.

## **JAMMU & KASHMIR**

The State has an area of 86,024 sq. miles with an estimated population of 4·4 million. Out of 2 units functioning one is endemic and other is hypo-endemic.

### *Spraying Coverage*

In 1958-59, the coverage was 91·1 per cent during first round and 61·8 per cent during second round. In 1960-61 there was considerable improvement when the coverage was 90·0 per cent during first round and 94·8 per cent in second round in the endemic unit. In the hypo-endemic unit where single application was given the coverage was 96·2 per cent in 1960-61.

### *Epidemiological Data*

During 1959-60, child spleen and parasite rates observed were 0·6 and 0·0 per cent respectively as against 1·5 and 0·0 per cent in 1958-59. No infant was found positive during 1958-59 and 1959-60. The proportional case rate was 1·9 per cent in 1959-60 as against 3·9 per cent in 1958-59. The overall reduction in the proportional case rate in 1959-60 was by 81·4 per cent as compared to the picture in 1955-56 when the unit started functioning in State under the Control Programme.

### *Surveillance Operations*

The State has instituted surveillance operations in 1·5 units as per plan from the current year.

## **KERALA**

With an estimated population of 15 million and an area of 15,003 sq. miles. The State has 14·5 units functioning of which 3·5 are endemic and 11 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 94·9 per cent of the houses were reached during the spraying operations in the first round and 70 per cent during second round. In 1959-60 the coverage in the first round was 91·0 per cent and that during the second round in respect of hyper-endemic units was 93·4 per cent. Since the spraying operations for the current year have started from November 1960 the complete data are not so far available.

### *Epidemiological Data*

Ch'ld spleen and parasite rates in 1958-59 were 0·9 and 0·0 per cent respectively as against 0·2 and 0·0 per cent in 1959-60. None of the infants examined during 1958-59 and in 1959-60 showed malaria parasite in their blood. The proportional case rate during the year 1959-60 was 0·1 per cent as against 0·3 per cent in 1958-59. As compared to the picture in 1953-54 when the control programme was initiated during 1959-60 the overall reduction in the proportional case rate was by 87·5 per cent.

### *Surveillance Operations*

Surveillance operations have been instituted in 14·5 units of the State as per plan from the current year.

## **MADHYA PRADESH**

The State has an area of 1,71,210 sq. miles with an estimated population of 29 millions. Out of 29 units functioning 25·5 are endemic and 3·5 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 93·4 per cent of the houses were reached during spraying operations in the first round and 62·8 per cent during second round. In 1959-60 the coverage for first round was 92·9 per cent and that during second round in respect of hyper-endemic units was 83·7 per cent. The position improved considerably during 1960-61 when the coverage during first round was 9·5 per cent and that during second round for endemic units was 96·4 per cent.

### *Epidemiological Data*

Child spleen and parasite rates during 1958-59 were 5·5 and 1·4 per cent as against 3·5 and 0·29 per cent respectively in 1959-60. The infant parasite rates during 1958-59 was 0·4 per cent and that for 1959-60 0·7 per cent. The proportional case rate during 1959-60 was 4·8 per cent, as against 5·5 per cent for the year 1958-59. The overall reduction in the proportional case rate as compared to the figures of



1953-54, when the control programme was initiated, was by 73·6 per cent during 1959-60.

### *Surveillance Operations*

The State has instituted surveillance operations in 27 units as per plan from the current year.

## **MADRAS**

The State with an area of 50,132 sq. miles and an estimated population of 33 millions has 31·45 units functioning of which 3·7 are endemic and 27·75 hypo-endemic.

### *Spraying Coverage*

In 1958-59, 91·7 per cent of the houses were sprayed during first round and 79·8 per cent during second round. The coverage for first round was 93·8 per cent and that during second round for hyper-endemic units was 96·6 per cent during 1959-60. In 1960-61, the position improved considerably and the coverage was 97 per cent during first round and 98·5 per cent during second round for the hyper endemic units.

### *Epidemiological Data*

Child spleen and parasite rates in 1958-59 were 1·9 and 0·4 per cent respectively as against 0·2 and 0·02 per cent in 1959-60. None of the infants examined during epidemiological surveys in 1958-59 and in 1959-60 was positive for malaria parasites. The proportional case rate during 1959-60 was 1·3 per cent as against 2·4 per cent record in 1958-59. As compared to the figures for 1954-55, *i.e.*, second year of control programme for which data on proportional case rate are available there was an overall reduction by 75 per cent in the proportional case rate during 1959-60.

### *Surveillance Operations*

The State has instituted surveillance operations in 30·45 units as per plan from the current year.

## **MAHARASHTRA**

With an area of 11,8,530 sq. miles the State has an estimated population of 34·2 million. Out of 33 units functioning 23 are hyper-endemic and 10 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 88·6 per cent of the houses were reached in the first round and 71·8 per cent during second round. In 1959-60 the coverage in the first round was 87·4 per cent and that during second round in respect of endemic units was 90·4 per cent. There was considerable improvement during 1960-61 when 95·1 per cent of the houses were covered during first round and coverage was 91·6 per cent during the second round in respect of endemic units.

### *Epidemiological Data*

The child spleen and parasite rates observed in 1958-59 were 1.9 and 0.9 per cent respectively as against 0.8 and 0.1 per cent in 1959-60. Infant parasite rate was brought down to 0.02 per cent in 1959-60 from 0.5 per cent in 1958-59. The proportional case rate was 4.7 per cent in 1958-59 as against 3.1 per cent in 1959-60. The overall reduction in the proportional case rate during 1959-60 was by 73.9 per cent as compared to the picture in 1953-54, when the control programme was initiated in the State.

### *Surveillance Operations*

The State has instituted surveillance operations in 32.75 units as per plan from the current year.

## **MYSORE**

The State with an area of 74,122 sq. miles and an estimated population of about 20.90 million has 19.13 units functioning of which 14.63 are endemic and 4.50 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 90.4 per cent of the houses were reached during spraying operations in the first round and 87.7 per cent during second round. The corresponding figures in 1959-60 were 87.8 and 70.2 per cent. In the year 1960-61, 86.3 per cent of the houses were covered during spraying operations in the first round and 91.8 per cent during second round in the endemic units. The coverage in this State has not been so satisfactory on account of the problem of rearing of silk worm.

### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 0.5 and 0.2 per cent respectively as against 0.4 and 0.07 per cent in 1959-60. Infant parasite rate was brought down to 0.03 per cent in 1959-60 from 0.1 per cent observed in 1958-59. The proportional case rate during 1959-60 was 0.9 per cent as against 1.5 per cent in the year 1958-59. The overall reduction in the proportional case rate during 1959-60 was by 87.3 per cent as compared to the picture in 1953-54 when the control programme was initiated.

### *Surveillance Operations*

The State has instituted surveillance operations in 18.63 units as per plan from the current year.

## **ORISSA**

The State has an area of 60,162 sq. miles with an estimated population of 14.6 million. 14.5 units are functioning in the state of which 10.5 are endemic and 4 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 92·3 per cent of the houses were reached during spraying operations in the first round and 63·4 per cent during second round. In 1959-60, the coverage for first round was 86·4 per cent and that during second round in respect of hyper-endemic units was 78·2 per cent. The coverage, during 1960-61 was 87·2 per cent in the first round and 74·1 per cent during second round of the endemic units functioning in the State.

### *Epidemiological Data*

Child spleen and parasite rates observed during 1958-59 was 13·1 and 1·3 per cent in 1959-60. Infant parasite rates during 1958-59 was 0·6 per cent and that during 1959-60, 0·88 per cent. The proportional case rate during 1959-60 was 5·3 per cent as against 8·3 per cent reported in 1958-59. As compared to the picture in 1953-54 when the control programme was initiated there would appear to be an overall reduction by 63·2 per cent in the proportional case rate during 1959-60.

### *Surveillance Operations*

The State has instituted surveillance operations in 13·5 units as per plan from the current year.

## **PUNJAB**

The State has an area of 47,084 sq. miles with an estimated population of 17·6 million. 18 units are functioning of which 11 are endemic and 7 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 95·2 per cent of the houses were reached during spray operation in the first round and 52·1 per cent during the second round in 1959-60, the corresponding figures were 92·9 per cent and 69·6 per cent. The position improved very considerably in 1960-61 when during the first round 94·8 per cent of the houses were covered and the coverage during second round of the endemic units was 96·8 per cent.

### *Epidemiological Data*

Child spleen and parasite rates during 1959-60 were 0·5 and 0·16 per cent respectively as against 1·1 and 0·04 per cent in 1958-59. The infant parasite rates during 1958-59 was reported to be nil per cent whereas that during 1959-60 was 0·1 per cent. The proportional case rate during 1959-60 was 2·1 per cent as against 2·9 per cent in 1958-59. The overall reduction in the proportional case rate during 1959-60 was by 72·7 per cent as compared to the picture in 1953-54 when the control programme was initiated in the State.

### *Surveillance*

The State has instituted surveillance operations in 17 units as per plan in the current year.

## **RAJASTHAN**

The state with an area of 1,32,150 sq. miles and an estimated population of 17·6 million has 16·67 units functioning of which 9·67 are endemic and 7 hypo-endemic.

### *Spraying Coverage*

81·8 per cent of the houses were reached during spray operations in the 1st round and 53·6 per cent during second round in 1958-59. During 1959-60, the coverage for first round was 84·4 per cent and that during the second round in respect of hyper-endemic units was 89·6 per cent. The position improved considerably in 1960-61 when during the first round coverage was 95·2 per cent and that during the second round was 96·7 per cent for the endemic units.

### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 5·6 and 2·7 per cent respectively as against 2·8 and 0·23 per cent in 1959-60. The infant parasite rate was brought down to 0·01 per cent in 1959-60 from 2·2 per cent in 1958-59. The proportional case rate was 5·6 per cent during 1959-60, as against 9·5 per cent in 1958-59. As compared to the picture in 1955-56, i.e., the 3rd year of the Control Programme the overall reduction in proportional case rate is by 59·5 per cent in 1959-60.

### *Surveillance*

Surveillance operations have been instituted in 16·17 units in the state as per plan from the current year.

## **UTTAR PRADESH**

The state has an area of 1,13,452 sq. miles with an estimated population of 69·5 million. 67 units are functioning of which 40 are endemic and 27 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 86·4 per cent of the houses were reached during spray operation in the first round and 71·9 per cent during the second round. In 1959-60, the coverage for first round was 93·6 per cent and that during the second round in respect of the endemic units was 91·2 per cent. The position improved considerably during 1960-61 when 94·7 per cent of the houses were covered during first round and coverage during the second round for the endemic units was 95·2 per cent.

### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 4·4 and 0·4 per cent respectively as against 1·4 and 0·1 per cent in 1959-60. The infant parasite rate was brought down to 0·09 per cent in 1959-60 from 0·3 per cent observed in 1958-59. The proportional case rate during 1958-59 was 5·5 per cent as against 3·3

per cent in 1959-60. The overall reduction in the proportional case rate during 1959-60 was by 78 per cent as compared to the picture in 1953-54 when control programme was initiated in the state.

### *Surveillance*

The state has instituted surveillance operation in 65 units as per plan from the current year.

## **WEST BENGAL**

The state with an area of 33,938 sq. miles and an estimated population of 28·8 million has 26 units functioning of which 23 are endemic and 3 hypo-endemic.

### *Spraying Coverage*

During 1958-59, 90·6 per cent of the houses were reached for spraying operation in the first round and 87·9 per cent during the second round. In 1959-60, the coverage was 93·3 per cent in the first round and during the second round for the endemic units that was 86·5 per cent. There was considerable improvement during 1960-61 when the coverage was 95 per cent during the first round and that during second round for the endemic units was 96·4 per cent.

### *Epidemiological Data*

Child spleen and parasite rates in 1958-59 were 1·2 and nil per cent respectively as against 0·4 and 0·3 per cent in 1959-60. None of the infants examined during epidemiological surveys during 1958-59 and 1959-60 showed malaria parasites in their blood. The proportional case rate was 2·5 per cent during 1958-59 as against 1·6 per cent in 1959-60. The overall reduction in the proportional case rate during 1959-60 was by 94 per cent as compared to the picture in 1953-54 when the control programme was initiated in the state.

### *Surveillance*

In none of the units surveillance operations have so far been instituted in the State.

## **ANDAMANS-NICOBAR ISLANDS**

The Andamans consist of a chain of Islands stretching from Landfall Island in the north to Little Andaman in the South, in an arc extending over some 200 miles of sea. The Andamans and Nicobar Islands with an area of 3215 sq. miles and an estimated population of 0·035 million have 0·25 hypo-endemic units. In Nicobar group of Islands eradication of malaria and control of Filariasis will be the responsibility of the modified National Filaria Control Programme unit allotted to them.

Since the unit allotted to the Andamans has started functioning very recently, data in respect of spraying coverage and epidemic logical surveys is not available so far.

## **DELHI**

The State with an area of 573 sq. miles and an estimated population of 2·2 million has two endemic units.

### *Spraying Coverage*

During 1958-59, 95·6 per cent of the houses were reached in the first round and 86·2 per cent during second round. The corresponding figures in 1959-60 were 84·8 per cent and 95·5 per cent. During 1960-61 the position improved considerably when the coverage in both the rounds was a little more than 95 per cent.

### *Epidemiological Data*

Child spleen and parasite rates as reported in 1958-59 were 0·3 and 0·2 per cent respectively as against 0·1 and 0·02 per cent in 1959-60. None of the infants examined during 1958-59 and 1959-60 showed malaria parasites in their blood. The proportional case rate during 1959-60 was 0·1 as against 0·2 in 1958-59. As compared to the picture in 1953-54 when the control programme was initiated there would appear to be overall reduction by 88·8 per cent in proportional case rate during 1959-60.

### *Surveillance*

The State has instituted surveillance operations in both the units as per plan from the current year.

## **HIMACHAL PRADESH**

The State with an area of about 10,880 sq. miles and an estimated population of about 1·2 million has 1·25 endemic units functioning in the State.

### *Spraying Coverage*

During 1958-59, 94·2 per cent of the houses were reached for spraying operation in the first round, and 78·1 per cent during second round. In 1959-60, the corresponding figures were 95·6 and 87·7 per cent. During 1960-61 there was some improvement inasmuch as the coverage during first round was 94·7 per cent and that during second round of operations in the state is still continuing.

### *Epidemiological Data*

Child spleen and parasite rates for 1958-59 were 0·6 and 0·0 per cent respectively as against 0·2 and 0·0 per cent in 1959-60. Infant parasite rates during 1958-59 and 1959-60 were nil per cent. It is worth mentioning here that 7·3 per cent infant parasite rate was reported in 1956-57, i.e. the 4th year of the National Malaria Control Programme. The proportional case rate was brought down to 0·6 per cent in 1959-60 from 2·1 per cent in the year 1958-59. As compared to the picture in 1954-55 the second year of the Control Pro-

gramme for which data in respect of proportional case rate are available, the overall reduction is by 92·8 per cent during 1959-60.

### *Surveillance*

The State has instituted surveillance operations in 1·25 units as per plan from the current year.

## **MANIPUR**

The state with an area of 8,628 sq. miles and an estimated population of 0·7 million has 2 endemic units.

### *Spraying Coverage*

During 1958-59, 99·7 per cent of the houses were reached for spraying operations in the first round and 67·1 per cent in the second round. In 1959-60, it was possible to effect cent per cent coverage during first round and 95·8 per cent during second round. In 1960-61, 100 per cent coverage was given in the first round. The data for second round of operation is incomplete as the operation would continue during the month of December.

### *Epidemiological Data*

Child spleen and parasite rates in 1958-59 were 4·8 and 0·0 per cent respectively as against 1·7 and 0·01 per cent in 1959-60. Infant parasite rate during 1958-59 was 0·01 per cent and that during 1959-60 was 0·02 per cent. The proportional case rate was 6·2 per cent in 1957-58 for as against 1·7 per cent during 1959-60. The overall reduction in the proportional case rate during 1959-60 was by 86·5 per cent as compared to the picture in 1953-54 when the control operation was initiated in the state.

### *Surveillance*

The state has instituted surveillance operation in 1 unit as per plan from the current year.

## **TRIPURA**

The state has an area of 4,036 sq. miles with an estimated population of 1 million. One endemic unit is functioning.

### *Spraying Coverage*

During 1958-59, 94·2 per cent of the houses were reached for spray operation during the first round and 94·7 per cent during the second round. The corresponding figure was 95·5 per cent and 98·5 per cent. During 1960-61, 97·8 per cent of the houses were reached in the first round of spraying operation. Since the second round of operation in the state starts from September and continues till December, the data are incomplete.

### *Epidemiological Data*

Child spleen and parasite rates were 4·9 and 1·1 per cent respectively in 1958-59 as against 2·5 per cent and 0·0 per cent in the year

1959-60. The infant parasite rate was brought down to 0.24 per cent in 1959-60 from 3.3 per cent in 1958-59. The proportional case rate during 1958-59 was 8.8 per cent as against 2.8 per cent in 1959-60. The overall reduction in the proportional case rate in 1959-60 was by 90.6 per cent as compared to the picture in 1953-54 when the malaria control programme was initiated in the state.

#### *Surveillance*

No surveillance operations would be instituted in the state from the current year.

### **NORTH EAST FRONTIER AGENCY**

It is a hilly tract covering an area of 34,000 sq. miles with an estimated population of 0.6 million. Out of 1.5 units functioning in the Agency 1.00 is endemic and 0.5 hypo-endemic.

#### *Spraying Coverage*

In 1958-59, 90.7 per cent of the houses were reached during spraying operations in the first round and 62.7 per cent during the second round. The corresponding figures for 1959-60 were 97.1 and 71.9 per cent. The coverage for the first round in 1960-61 was 96.2 per cent and figures for the second round are not available so far.

#### *Epidemiological Data*

The child spleen and parasite rates during 1958-59 were 19.5 and 8.7 per cent respectively as against 9.5 and 5.6 per cent in 1959-60. Infant parasite rate in 1958-59 was 1.9 per cent as against 2.4 observed in 1959-60. The proportional case rate has been brought down to 3.6 per cent in 1959-60 from 12.8 per cent reported in 1958-59. As compared to the picture in 1957-58, when the Agency was brought under National Malaria Control Programme, the overall reduction in the proportional case rate was by 78 per cent in 1959-60.

#### *Surveillance Operations*

The Agency has not yet instituted the surveillance operations in any of the units as per plan from the current year.

### **NAGA HILLS**

This administrative unit has recently been taken out from the State of Assam and North East Frontier Agency. As such the area of this territory is not known yet. It has an estimated population of 0.35 million. One endemic unit is functioning in the territory.

#### *Spraying Coverage*

During 1959-60 when the unit started functioning in the territory 91.5 per cent of the houses were reached for spraying operations in



the first round. Second round of operations was not undertaken during the same year. In 1960-61, the coverage was 96 per cent during the first round. Second round data are not yet available.

#### *Epidemiological Data*

No epidemiological survey has been undertaken in the territory either during 1959-60 or 1960-61.

#### *Surveillance Operations*

Surveillance operations will not be instituted in the unit as per plan from the current year.

### **COALFIELDS**

Coalfield areas are scattered all over the country in the states of Bihar, West Bengal, Madhya Pradesh, Maharashtra, Gujerat, Andhra Pradesh, Assam and Orissa. Estimated population requiring protection under the National Malaria Eradication Programme in the Coalfield area is 1 million.

#### *Spraying Coverage*

During 1958-59, 93·8 per cent of the houses were sprayed in the first round and 73 per cent in the second round. Corresponding figures for 1959-60 were 94·2 and 85·5 per cent. The position improved considerably during 1960-61 when the coverage achieved during both the rounds was a little over 97 per cent.

#### *Epidemiological Data*

Child spleen and parasite rates observed in 1958-59 were 0·8 and 0·2 per cent respectively as against 0·6 and 0·02 per cent in 1959-60. The infant parasite rate was brought down to 0·0 per cent in 1959-60 from 0·3 per cent observed in 1958-59 as against 0·7 per cent in 1959-60. As compared to the picture in 1955-56 when the Coalfields were brought under the National Malaria Control Programme, the overall reduction in the proportional case rate was by 61·1 per cent in the year 1959-60.

#### *Surveillance*

No surveillance operation has so far been instituted in the Coalfields.

### **SIKKIM**

The state with an area of 2,744 sq. miles and an estimated population of 0·15 million has 0·5 endemic unit.

#### *Spraying Coverage*

In 1958-59, 93·7 per cent of the houses were reached for spray operation during the first round and 81·3 per cent during the second

round. The corresponding figures in 1959-60 were 94.4 and 99.6 per cent. The coverage during the first round in 1960-61 was 99.8 per cent. Data for second round of operation are not available so far.

### *Epidemiological Data*

Child spleen rate during 1957-58 was 27.5 per cent as against 5.7 per cent in 1959-60. No data are available in respect of child parasite and infant parasite rates for the years 1958-59 and 1959-60. The proportional case rate for 1958-59 was not available, but that for 1957-58 was 8.5 per cent as against 1.5 per cent in 1959-60. Thus there would appear to be reduction by 82.3 per cent in the proportional case rate of 1959-60 as compared to the picture in 1957-58 when control operation was started in the state for the first time under the National Malaria Control Programme.

### *Surveillance*

No unit in the state will institute surveillance operation as per plan from the current year.

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