

# Sonapur (Assam)

First insecticide-treated bednet trial (ITN) was carried out in Sonapur. This led to the expansion of bednet programme to Mandla and Rourkela and finally the bednet technology was transferred to the WB/NVBDCP. Other studies undertaken were:

- In-depth studies on the biology and ecology of malaria vectors in the forests in Assam
- Situation analysis and malaria control in tea gardens and situation analysis of one district in NE region for the WHO's Roll Back Malaria initiative
- Epidemic investigations and participation in malaria control with the Assam Government Health Department
- The entire health staff of 7-states was trained in the insecticide-treated bednet programme. This has facilitated the introduction of ITNs in NE states

## Background

Assam is a hard-core malarious area of the country. There is persistence of malaria due to very efficient vectors, *An. minimus* (the perennial species), *An. dirus* (the monsoon species) and *An. fluviatilis* (the winter species), the latter acts as a relay transmitter in foothill areas. The environment is conducive for both mosquito proliferation and active malaria transmission. The relative humidity varies from 60 to 80%, and except November to February (minimum temperature 9°C) most part of the year is hot and humid (22 to 33°C) which makes the environmental conditions conducive for malaria transmission throughout the year. Most districts of the state are malaria endemic and many pockets in forest, forest-fringe, foothill villages located along the inter-country/inter-state border are vulnerable to focal outbreaks. Indoor residual spray is not operationally feasible everywhere as the human settlements are scattered in hilly terrain. The problem of drug resistance of *P. falciparum* was also rampant. Under these circumstances there was a need to find alternate strategy for malaria control.

With this background, a field unit was established in Sonapur PHC in Kamrup district of Assam in May 1986 when API was 76 and *Pf* was 90%. The sole

objective of this field unit was to field evaluate the alternate technologies for malaria/vector control with special focus on "insecticide treated nets". Sonapur PHC is typical malaria endemic area located on the south bank of the Brahmaputra river bordering Meghalaya. It contributes more than 50% of the malaria cases of the Kamrup district and is known for persistent transmission of the disease associated with enhanced morbidity and mortality. Since its inception, many research projects have been completed with primary focus on "insecticide-treated nets", technology transfer on the subject and allied investigation on the disease epidemiology.

## Activities, Progress and Achievements

### Bionomics of malaria vectors in NE region

Detailed entomological investigations were conducted in malaria endemic pockets and *An. minimus* was re-recorded in many districts of Assam and adjoining states. The species was recorded throughout the year, yet peak densities were observed during the months of March till August, corresponding to the wet season. Sporozoite infection rate in *An. minimus* was lowest (0.7%) in March and highest in October (8.5%). *An. minimus* was found to be highly anthropophilic

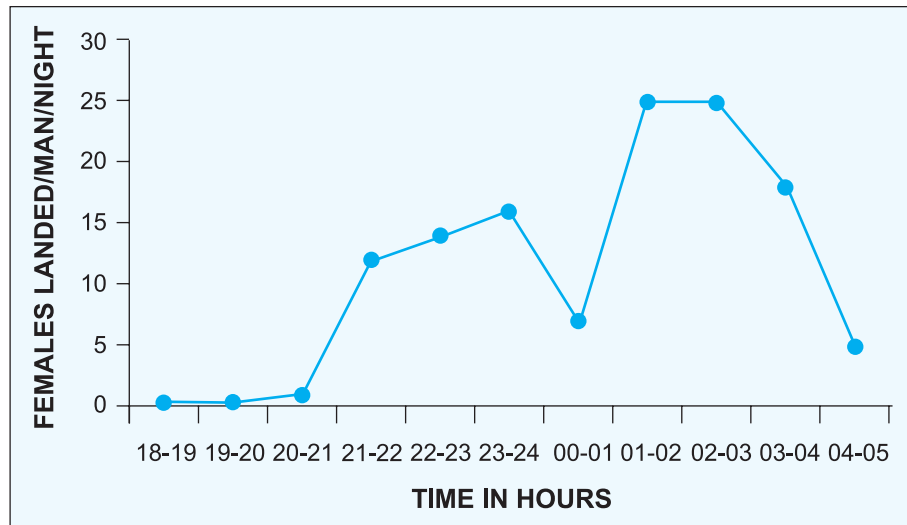


Fig. 1: Human landing rates of *An. minimus* in Assam

(AI 93%) and landing on human host was more pronounced between 1200 and 0400 hrs and biting rate per person per night was 13.72 (Fig. 1). Breeding of *An. minimus* was recorded throughout the year in slow-flowing seepage water with grassy banks. Besides, studies on bionomics of *An. fluviatilis* and *An. culicifacies* were also carried out and both these species were incriminated in this region. The sibling species composition of both *An. fluviatilis* and *An. culicifacies* was also studied in addition to other parameters like geographic distribution, seasonal prevalence and host feeding preference, etc.

### Malaria transmission and entomological risk factors in Assam

Fever surveys were conducted in several districts of Assam state to ascertain the prevalence of malaria in relation to vector abundance, entomological inoculation rates (EIR), and geographical location of human settlements. *An. minimus* were incriminated but their relative abundance and biting rates varied among districts, and no significant correlation was observed between these two indicators ( $r = 0.43$ ,  $p = 0.34$ ). *P. falciparum* was the predominant parasite species except in two districts where *P. vivax* was the major parasite. The entomological inoculation rates per person/night was 0.46–0.71 in *P. falciparum* predominant areas and 0.12 in the district where *P. vivax* predominated. The correlation of percent of fever cases positive for malaria infection in each district with corresponding EIR was not significant ( $r = 0.6$ ,  $p = 0.21$ ). Malaria cases were detected in all the months of the year but peaked during May–June corresponding to months of heavy rainfall. Maximum cases of

*P. falciparum* were recorded in all age groups of both sexes. There was clustering of cases in villages near the vector-breeding habitats (perennial seepage streams), and foothill villages. Malaria incidence was consistently lower in villages within 5 km of the nearest health care facility. The data presented are indicative of moderate to high levels of malaria transmission by *An. minimus*, and would be of value for evolving future intervention strategies.

### Insecticide-treated bednet trials

For the first time in India, insecticide-treated nets (ITNs) were field tested to study the impact of ITNs on malaria transmission. This work was started in a few villages in Sonapur PHC and was expanded to nearby PHCs of the district. Mosquito nets were treated with synthetic pyrethroid (SP) insecticides and these pre-treated nets were distributed in the villages. There was a clear demonstration of the role of ITNs in the control of malaria (Fig. 2 a and b). In later phases nets were subsidised and also the available nets were treated free. Results of ITN programme was later included in the Enhanced Malaria Control Project (EMCP) of the National Anti Malaria Programme. ITNs are currently under distribution in 108 EMCP districts in northeastern India.

Malaria outbreaks are of frequent occurrence especially in forest-fringe areas along the inter-state and inter-country borders under the influence of *An. minimus* (the major vector) which is a highly anthropophilic species, thus an efficient transmitter of the deadly parasite. Malaria control has become a difficult proposition despite antimalaria measures

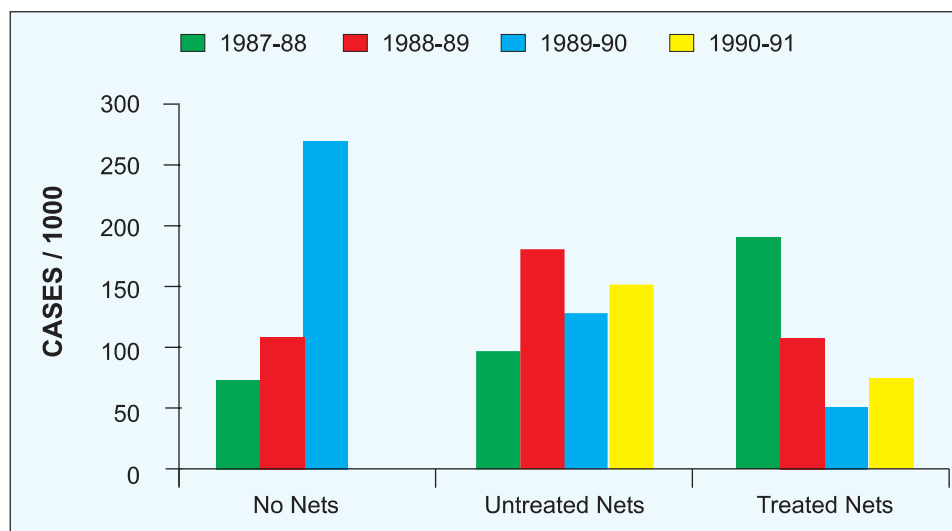


Fig. 2a: Impact of untreated and deltamethrin-treated nets on malaria in Assam

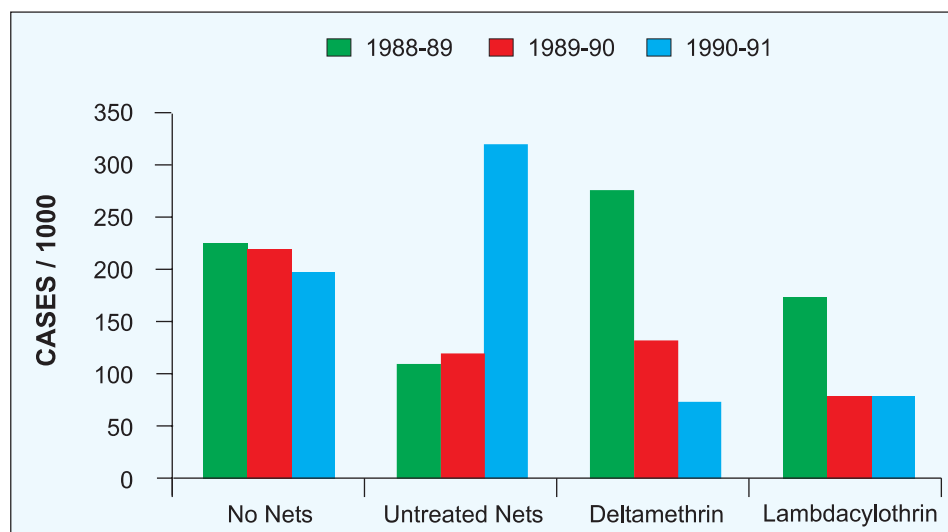


Fig. 2b: Impact of untreated nets and nets treated with lambdacyhalothrin and deltamethrin in Assam

taken by the NVBDCP. It is increasingly evident that it requires a more skilled and integrated approach based on local understanding of the disease epidemiology and community-based intervention strategies, which are appropriate and self-sustainable.

In this very context, insecticide-treated nets, a vital element of actions to roll back malaria were field evaluated against *An. minimus* transmitted malaria in endemic villages of Kamrup district (Dimoria Block) in the Brahmaputra valley of Assam. There was over 70% decline in number of *P. falciparum* cases over a two year study period with concomitant decline in man/vector contact. Much needed community participation was forthcoming so much so that Government

of India launched a pilot project in all seven sister-states of the northeast to test its operational feasibility, acceptability and sustainability as an alternative strategy for malaria/vector control. Under the centrally sponsored scheme, one lakh mosquito nets treated with synthetic pyrethroid were distributed free of cost in different ethnic groups in all seven states of the region through the primary health care system. In concordance with our earlier findings, there was a drastic reduction in malaria episodes as recorded by respective State Health Directorates along with collateral benefits—freedom from head lice, bedbugs, decreased nuisance due to other household pests, etc. Community response was overwhelming and additional demands are being generated by the respec-

tive State Health Directorate, to cover additional vulnerable population groups under ITNs. This intervention will be the main-stay for prevention from vector bites and to check the spread of multi-drug resistant malaria.

### Evaluation of malaria diagnostic tests

For diagnosis of malaria in remote and far-flung rural areas of Assam, popular brands of rapid test kits collectively termed as 'dipsticks' were subjected to field evaluation in northeastern India for their comparative sensitivity and specificity vis-à-vis conventional microscopic results. Dipsticks based on *P. falciparum* specific histidine-rich protein (*Pf*HRP-2) antigen capture assay revealed cent percent sensitivity and high specificity (94 to 100%), thus were concluded to be reliable tool for confirmed diagnosis of malarial infection. However, advanced version of the same kit having incorporated additional panmalarial monoclonal antibody, was recorded to be less sensitive (71%) for non-falciparum infections. Besides, *Pf*HRP-2 based-kits continued to show positive result up to Day 7 even after clearance of parasitaemia on account of persistent antigenaemia, this limitation seemed to have overcome by parasite specific lactate dehydrogenase (pLDH) enzyme-based kit. This kit was observed to have high sensitivity (81 to 89%) and specificity (100%) for both falciparum and non-falciparum malaria, but cannot distinguish mono-infection from mixed infections. It is concluded that the rational use of these kits would accord health benefits in terms of early detection and prompt treatment, reduce drug pressure, and possibly delay the emergence and spread of multi-drug resistant strains of malarial parasites. The successful result of dipstick test was the basis for the adoption of this method by the private sector.

### Clinical trials with new antimalarials

Arteether, an antimalarial drug, was tested in Sonapur PHC and CRPF Base Hospital in Guwahati as a part of the multicentric trials. The drug was found highly efficacious without any side-effects. Arteether is a safe and effective drug for the management of severe and drug resistant malaria. Field trials resulted in the registration of arteether and the drug is being manufactured in India and has tremendous domestic and international market. Another drug combination of azithromycin plus chloroquine was successfully tested.

### Therapeutic efficacy monitoring of antimalarials

The current therapeutic efficacies of commonly used antimalarial drugs for the treatment of uncomplicated *P. falciparum* malaria in Assam were assessed to help control programme. Subjects positive for *P. falciparum* malaria were treated with chloroquine, sulphadoxine-pyrimethamine (SP) and quinine in the given order (sequential therapy) at the prescribed dosages. The drug response was assessed using the WHO (*in vivo*) extended follow-up investigations for parasite clearance and clinical cure. The ratio of parasite density on Day 3 to Day 0 was considered as the determining factor to assess the therapeutic response. Of total 144 evaluable subjects, 109 (75.7%) were treatment successes after chloroquine (first line of therapy); six (4.2%) and 29 (20.1%) were early and late treatment failures, respectively. Among drug failure cases, 31/34 (91.2%) responded adequately to SP (second line of therapy), and 3 (8.8%) were treatment failures including 1 (2.9%) early treatment failure and 2 (5.9%) late treatment failures. Among SP treatment failure cases, 2/3 (66.7%) responded adequately to quinine (parenteral) except one case, which was assessed to be late treatment failure. The latter was treated successfully with artemisinin derivative.

### Treatment seeking behaviour

Cross-sectional surveys were conducted in population groups of malaria endemic districts of the state to determine parasite prevalence, and data were analysed retrospectively for the years 1991 to 2003 to ascertain the disease trends (Fig. 3). Structured questionnaire-based surveys were conducted to study the treatment seeking behaviour and practices of health care providers. *P. falciparum* and *P. vivax* were the only two parasite species encountered, the former being in the majority (>60%). Malaria transmission was persistent, and a seasonal peak of *P. falciparum* was consistently observed during the months of heavy rainfall (April to September). Among children (5–15 yr) there was a significantly higher malaria parasite rate as compared to that in <5 years age group and adults (>15 yr). There was a decline in parasite rates for all age groups over the years of the study that could not be attributed to vector control intervention intensities and/or meteorological factors. The persistence of *P. falciparum* was attributed to the emergence of drug resistance, inadequate interventions and treatment seeking patterns, and for its containment focused in-

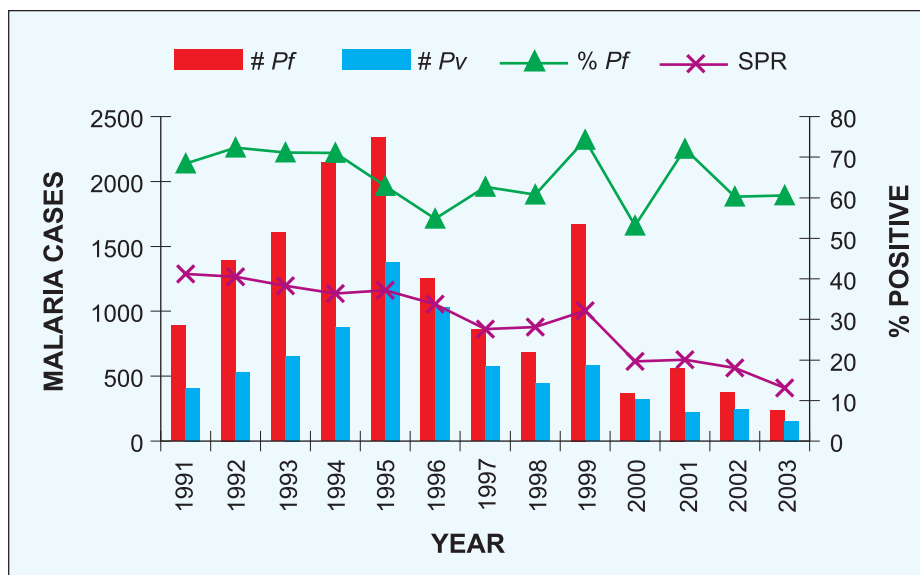


Fig. 3: Trend of malaria cases and species composition in the Sonapur Primary Health Centre, Kamrup district, Assam (1991–2003)

intervention measures were advocated in partnership with the communities.

### Use of larvivorous fish for mosquito control

Guppy fishes were mass produced in village ponds in Sonapur and transported to Guwahati. Stocks of larvivorous fishes were developed in Guwahati. These fishes were distributed throughout the city as the main agent for mosquito control. Fishes were introduced in drains, ponds, wells, ditches and other stagnant water bodies. These fishes multiplied enormously. As a result, mosquito nuisance in Guwahati has been substantially reduced. Fishes are also being introduced in rural areas as a means to control mosquito breeding. This programme is currently under expansion as a NVBDCP sponsored activity to cover the entire Kamrup district by larvivorous fishes.

### Evaluation of DDT used in indoor residual spraying

Evaluation of the impact of DDT indoor residual spraying was carried out in 24 villages of PHC Sonapur. The population targeted for the study was 7,940. The major vector species, *An. minimus*, was found to be primarily an endophilic species and also completely susceptible to DDT in susceptibility tests. Complete absence of species in hand collections during the post-spray evaluation period in the interiors of the sprayed houses in the experimental villages for more than 16 weeks indicated the effectiveness of

DDT on *An. minimus*. Presence of *An. minimus* in habitats in unsprayed villages in contrast to its absence in habitats in sprayed villages further confirmed the efficacy of DDT spray on vector population in this region. This species was also reported susceptible to DDT in tests conducted in adjoining districts— Morigaon and Golpara. From the above results, it can be concluded that this insecticide can be continued for indoor residual spraying in northeastern states of the country where *An. minimus* is the major vector of malaria

### Situation analysis of malaria under RBM initiative

District Aizawl west of the Mizoram state was surveyed for malaria situation analysis. The health infrastructure of the district comprises of 2 government hospitals, 2 community health centres, 21 primary health centres, 98 subcentres and 22 drug distribution centres. The general health infrastructure was satisfactory. However, it was noted that the two key posts for malaria control, the District Malaria Officer and the Assistant Malaria Officer, were vacant and the entomology unit was non-functional. It was generally observed that over the years the endemicity of malaria in the district was decreasing. To sustain this, key posts be filled-up, distribution and use of insecticide-treated mosquito nets in the community be encouraged further. Observations on epidemiological factors, health infrastructure, surveillance mechanism, health seeking behaviour of the community were conveyed

to the Directorate of NVBDCP for making action plan for malaria control. Similar exercises were carried out in some malaria endemic districts of Assam.

### Epidemic investigations

Malaria epidemics were investigated in Districts Karbi Anglong (PHC Karagaon 1998), Darrang (PHC Orang 1998, 2001, 2002 and 2003), Tinsukhia (PHC Duamara 1998), Golaghat (PHC Bokakhat 1999), Morigaon (PHC Nellii 1999), Bongaigaon (PHC Bongaigaon 1999), Tinsukhia (PHC Longsoal 2002) and Sonitpur (PHC Gohpur 2002) for underlying causes resulting in rise in malaria incidence. Observations on epidemiological factors, malaria control operations, and entomological parameters in the affected areas were conveyed to the District Health Authorities.

### Training programmes/workshops organised

The field unit imparted training to health workers, microscopists, doctors, laboratory technicians, NGO's defence personnel etc on malaria microscopy, malaria control activities, parasite resistance, integrated vector control methods, etc.

### IEC activities

1. Booklet on "Pyrethroid impregnated mosquito nets, protection from mosquitoes and malaria". MRC Technical Information Series No. 002/96.
2. Video film on "Insecticide-impregnated bednets for malaria control" in English, Hindi and Assamese. Master video tape Nos. 2006, 2008, 2061; Malaria Research Centre, Delhi.
3. Malaria : Bednets—a TV spot (English and Hindi). Master video tape No. 2072 and 2013.
4. Pyrethroid-impregnated mosquito nets for malaria control in northeastern India : A success story by Vas Dev – displayed at RBM web site ([www.rbm.who.int](http://www.rbm.who.int)) during July/August, 2002 under partnership at work.
5. Malaria control activities in Kamrup, Assam (India). Image Gallery displayed at RBM website ([www.rbm.who.int](http://www.rbm.who.int)) during Feb/March, 2003 under partnership at work.

