Report of the

WORKSHOP ON INTEGRATED MOSQUITO CONTROL

Using Community Participation and Environmentally Acceptable Techniques for South Asian Countries

SRI LANKA 5–11th November, 1986

SACEP – SARVODAYA – SOUTHAMPTON UNIVERSITY AND THE EEC

Director of SACEP Mr Kazem greeting the Minister of Health Dr Atapattu and the President of the Sarvodaya Movement Dr Ariyaratne for the Opening Ceremony

Dr Ariyaratne cutting his Birthday Cake at the Opening Ceremony

Contents

GOALS OF THE WORKSHOP

I. To promote the broad goal of empowering local communities to contain dangers arising out of their environment.

II. To exchange among workshop participants lessons they have learned from field research and field experience designed with the following objectives to:

a) involve existing communities during endemic malaria and liable to serious malaria epidemics, to develop approaches and methods to contain their own malaria by continuous surveillance and timely action against malaria and other diseases when indicated.

b) determine policies arising out of definitive field experiences which can be confidently extended to broader areas liable to serious epidemics.

c) determine techniques in control of village communities so that they can maintain surveillance of vectors and limit vector breeding particularly to avert or control epidemic malaria.

III. Provide an opportunity for professionals from South Asia interested in these approaches to consider establishing collaborative activities.

SACEP

The South Asian Co-operative Environment Programme (SACEP) was founded in 1981 to promote regional co-operation in sound environmental management. Based in Colombo, Sri Lanka, it brings together the seven nations of South Asia (Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka) with Afghanistan and Iran. It works closely with the United Nations Environment Programme (UNEP) and has permanent observer status with both the Food and Agriculture Organisation (FAO) and the United Nations Industrial Development Organisation (UNIDO). Its activities include the conservation of mangrove, coral and island ecosystems, reafforestation, an integrated energy-saving project and the promotion of a South Asian Regional Seas Programme. SACEP's particular interest in vector control and its relationship to environmental management was reflected in 1982 with the selection of Sri Lanka as an area for pilot studies to assess the magnitude of vector-borne disease problems and the effects of ecological changes resulting from small-scale water resources development projects. The current director of SACEP is Mr. Mohamad Jafer Kazem, from Afghanistan.

SARVODAYA

For nearly 30 years the Sarvodaya Movement in Sri Lanka, founded by Dr. A.T. Ariyaratne, has been fostering self-awareness and community development, especially in the island's villages. The fundamental concept of the Sarvodaya Movement is the awakening (udaya) of all (sarva) so that human potential and the resources of nature can be harnessed for individual and collective welfare. Sarvodaya draws many of its principles from Buddhist concepts, such as Dana or Giving without expecting any material benefits in return. The basis of much of its success is the mobilisation of village communities – with the assistance of local and outside volunteers – for projects of collective self-help, using appropriate technology. In some areas this has included programmes of integrated mosquito control using community participation. An essential element of Sarvodaya's development philosophy is the awareness that many natural resources are non-renewable. Whether renewable or not, however, it is seen to be of the utmost importance that all natural resources are utilised in a way that will ensure the maximum sustainable benefit to the present generation, while conserving them for use by the countless generations to come.

Sarvodaya has an international conference centre (the Vishva Samadhi Complex) at its headquarters at Moratuwa, just south of Colombo, which is where most of the formal sessions of the Workshop were held.

WOLFSON MOSQUITO CONTROL PROJECT

Funded in recent years by the Wolfson Foundation in Britain, this small group of scientists at the University of Southampton aims to improve and expand the use of non-toxic and/or highly specific mosquito control agents, especially the monomolecular and bilayer systems originally discovered in 1971 by its Director, Prof. A.I. McMullen. Members of the Project have been involved in the Community Participation Programme instituted by the Sarvodaya Movement in Sri Lanka and were instrumental in obtaining the interest and financial backing of the Commission of the European Communities (E.C.) in Brussels, whose funding made this workshop possible.

Programme

Wednesday 5th November	SARVODAYA HEADQUARTERS Opening addresses by the Sri Lankan Health Minister, Dr Ranjit Atapattu; the President of the Sarvodaya Movement, Dr A.T. Ariyaratne; the Director of SACEP, Mr M. J. Kazem and others. Evening reception
Thursday 6th November	SARVODAYA HEADQUARTERS Country reports Outline of the Sarvodaya Project and its development by Mr. H. Navaratne, Dr. Tudor Silva, Mr. Rao and Dr. J. Wyon. Presentation of summary of papers by foreign experts, Mrs. G.M. Roberts, Dr R. Rose and Dr. N. Becker. Historical Introduction to the Anuradhapura District and its water systems – Peradeniya University Lecture by Professor Siriweers
Friday 7th November	Travel to Anuradhapura. Site visit to Sarvodaya project office at Olukaranda.
Saturday 8th November	Field visit to Athungama. Group visits to Sandankulama and Maniniyawa.
Sunday 9th November	Group discussion and preparation of recommendations.
Monday 10th November	Travel to Colombo SARVODAYA HEADQUARTERS Presentations on Sri Lanka's specific malaria control programmes, by Dr P.R.J. Herath and Dr M.B. Wickramasinghe.
Tuesday 11th November	SARVODAYA HEADQUARTERS Conclusions and Closing Session.
Chairman of the Workshop:	Dr Lionel Samarasinghe Director, Anti Malaria Campaign Sri Lanka.

Extracts from the Opening Speech by the Sri Lanka Health Minister, Dr. Ranjit Atapattu

I have had the pleasure of participating in several international seminars in the health field, where the Sri Lankan experience of community participation has always been viewed with a great deal of favour. I have basked in the reflected glory of something that is essentially running in the veins of our village people. Sri Lanka has a proud history of some 2,500 years, where Buddhism has basically played a predominant part in fashioning our ideas. Other religions have been equally accepted and a harmonious blend of the religions, particularly in our villages, has resulted in a very strong community participation movement.

Very few people have realised the value of this movement or feeling and Sarvodaya is one of the pioneers in trying to tap these resources. Since 1977 this Government has particularly realised the value of non-governmental organisations and that it is in fact only through these non-governmental organisations that we can tap the immeasurable volume of human resources that is available to us. The Health Ministry itself is very proud to have trained over 65,000 young girls and boys in the villages to help us in our task of health service delivery. Life in the villages depends a great deal on community participation, whether it comes to thatching the roof of somebody's house or transplanting paddy or whatever; there has always been this attitude of co-operation.

Specific Problem

Now, malaria is a very specific problem in our country. In 1945 we thought we had eradicated malaria, with the advent of DDT – with one stroke of the pen, as it were. We suddenly found that we had no malaria at all. The death rate, which was 21 per thousand in 1945 dropped to 14 per thousand in 1946, which was the biggest fall in the death rate in one year in any part of the world. The authorities were so taken up with their success that the Anti-Malaria Campaign was more or less disbanded. Even the vehicles were distributed to other departments. But in the 1960s again, with the advent of new agricultural schemes – the period of the Green Revolution, which affected the Asian region particularly – malaria again raised its ugly head and since then, though we have had periodic successes, the substance of those successes has not been all that laudable.

Eternal Vigilance

What is the reason for the failure to contain malaria in Sri Lanka? I personally do not think that we will ever come to a state of eradication now in tropical countries, judging by the resilience shown by the mosquitos and the malaria infections, that is, both resistance to drugs and resistance to insecticides. Therefore there has to be eternal vigilance on our part to see that we keep malaria under control in our region. In my view, the main reason for the failure of our region to contain this problem is the inability to supervise the work at village level. As long as we consider this as some sort of government activity – the spraying of houses, the taking of blood, the clearing up of breeding places and so on – and we entrust that government activity to a specific group of paid government employees and expect them to give us the results we want, then I do not think we will be successful. There is only one answer to this and that is that the community must be completely drawn into our campaign. If we do not get their participation and we do not make them realise that they are part and parcel of the campaign, then there is no point in just telling them that we are doing it for their benefit. We must make them feel that **they** are doing it for their benefit.

Community Participation

Furthermore, given the environmental hazards involved in the use of insecticides, pesticides and so on, we could minimise the use of such substances by community participation in the eradication of mosquito breeding places. This kind of simple activity should be promoted in our South Asian region, to counter the problem of vectorborne diseases such as malaria. If we are going to contain these diseases – and contain them we must, if our development programmes are to be of value to the villagers involved in them – then it is very necessary that we get the maximum co-operation of the village.

Extracts from the Opening Speech by the Founder of the Sarvodaya Movement in Sri Lanka, A.T. Ariyaratne

Sarvodaya is an integrated rural development programme. In the course of our work we come across all kinds of problems. Every time anyone went to Anuradhapura District or similar rural areas then our workers got malaria. I felt we should see how people could participate in doing something about the eradication of malaria. We have been working at this for many years. So when SACEP suggested we participate in this seminar, we were very happy because that gave us the opportunity to look within ourselves and see how far we had progressed.

Empower the people

We believe that the primary task in our work is to empower the people, that is the local communities. We have about 23,000 villages in Sri Lanka and about 80 per cent of the total population still lives in these villages. These are the people who have to be assisted if we are to achieve any degree of national devlopment. So the Sarvodaya Movement is concentrating on those communities, with programmes in about 8,000 of the villages.

In the area where we are experimenting with malaria control we began with primary health care programmes, which are integrated with economic and other activities. We start working in the village. We try to create what we call a psychological infastructure in the village, where people begin to think as a community and then look at their problems. Then they can try to satisfy one or more of their basic needs by their own self-reliance, community participation and a certain planned programme of action.

The people are organised into various kinds of groups: the children, the youth, fathers, mothers and others. Then we try to get whatever technical leadership and knowledge we can to those particular groups. We have organised quite a number of nutrition workers and what we call pre-school teachers, who are responsible for the children's nutrition, health-care and their psycho-social development. Also help from people who know about construction work, water management and other technical services.

Central Support

Within this village awakening programme, whenever some kind of special input is needed, we form what we call a central support service group at the headquarters or at a district or divisional centre. So in the malaria project in Anuradhapura District, for example, we have formed such a unit. With this we try to co-operate with the Anti-Malaria Campaign and other experts, with the Health Ministry generally, Oxfam America, Oxfam U.K., the WHO and the Ford Foundation.

Extracts from the Opening Address by Mr. M.J. Kazem, Director of the South Asia Co-operative Environment Programme

SACEP's interest in integrated vector control dates back to 1982, when the consultative committee of SACEP expressed its willingness to co-operate in the conduct of pilot studies in the member countries of SACEP to test the efficency of the non-toxic monomolecular film for mosquito control, based on the principle of community participation. The main concept of this trial is to develop methods for the control of epidemic malaria, which will be implemented by the affected communities in response to malaria surveillance, carried out by the people themselves. The results of the trial, which has been carried out with the co-operation of the Sarvodaya-WHO-Oxfam project in the Anuradhapura District of Sri Lanka, seem very encouraging. It is our conviction that this workshop is the best forum for discussion of the results achieved and will provide ample opportunity to the participants to discuss and critically evaluate all pros and cons of the methodology adopted and defined.

Scientific Report

In addition to the collaboration which SACEP has with the Wolfson Project of the Southampton University in the area of vector control, it has been closely associated with the panel of experts of environmental management of WHO in conducting pilot studies in the assessment of the magnitude of vector-borne disease problems and the effects of ecological changes resulting from small-scale water resources development projects in Sri Lanka. The study project, which is successfully completed now, consisted of the preparation by the SACEP secretariat of an inventory of the small-scale water resources development projects in Sri Lanka, an assessment of the magnitude of the vector-borne disease problems resulting from water resources development projects and the preparation of a scientific report on the inventory and on the results of the field studies with relevant recommendations. The scientific study and the preparation of the final report was undertaken with the collaboration of the Anti-Malaria Campaign, the Medical Research Institute, the Anti-Filiarisis Campaign, the Mahaweli Authority and the Ministry of Land and Land Development of Sri Lanka, with overall co-ordination by SACEP. We have now examined the launching of similar studies in other member countries of SACEP.

Irrigation Seminar

Another activity of SACEP in this area was the co-ordination of the seminar last year on irrigation and its impact on vector-borne disease transmission. The seminar mainly focussed on the present state of vector-borne diseases and vector control and examined the status of vector biology and control research in Sri Lanka. It also dealt with the links between irrigated agriculture and disease-vector propagation and the role of water management as an environmental management measure for vector control.

It is our earnest hope and desire that the deliberations of this workshop would result in a greater awareness in the SACEP member countries of the significant role the community would have to play in the eradication of all vector-borne diseases. We also expect that the results of the trials and the outcome of this workshop would enable SACEP to formulate an integrated community-based vector control programme for the South Asian countries.

General Comments on Mosquito Control in the Region
(Extracts from a tabled paper by Robert Rose)

The Control of mosquito vectors of human disease has been principally based on residual wall sprays of DDT and other insecticides done by government public health workers. With the development of insecticide resistance by mosquitoes in many countries and the resurgence of malaria it has become evident that traditional vector control programmes should be reviewed and the methods of control diversified to place increased emphasis on alternative methods and integrated vector control. Public education and information programmes are encouraged, to help make people more aware of the importance of the disease vector mosquitoes and what village and community residents can do to reduce or eliminate vectors as a measure to improve their standard of living through better health.

The total incidence of malaria for the world has been estimated at roughly 90 million cases a year. About 2,600 million people live where there is a risk of malaria transmission. 70% of malaria cases reported in 1981 by the WHO were in the South and South East Asian and West Pacific regions.

Residual insecticide wall sprays continue to be the major means for the control of most malaria vectors. Space sprays are also used but to a much lesser degree and in specialised circumstances of urban or residential areas. Larviciding has not been significantly used for *Anopheles* spp. control, primarily because of the diverse and often scattered larval habitats, which may require extensive labour to find and treat. However, there has been some habitat modification or source reduction for malaria vector larval control. Fish are valuable predators that could be used more widely in integrated vector control programmes.

After malaria, dengue and DHF come next in widespread importance in the region. The *Aedes aegypti* and *Ae. albopictus* vectors are often best controlled by community-level removal or covering of larval habitats. Larviciding, space sprays and reduction in man-mosquito contact with screens and nets are also important to prevent disease spread by these vectors. Although effective medical treatment exists for filariasis and has become a primary means of disease control, *Culex, Anopheles* and *Mansonia* spp. mosquitoes continue to vector filarial nematodes. Protection of latrines from adult mosquito oviposition and drainage of polluted water are important for *Culex* control and potent larvicide measures are useful where polluted water cannot be properly disposed of. Japanese encephalitis *Culex* vectors are controlled by various methods including insecticides used for the other mosquito human disease vectors but control efforts are not usually focussed on vectors of this disease.

Biological control agents for mosquitoes are among the alternatives to residual chemical insecticides for which resistance has developed from excessive use. However, they are not a complete replacement because they usually allow some adult emergence, accompanied by disease transmission. *Bacillus thuringiensis*, Serotype H-14 and *Bacillus spaericus* actually act somewhat like non-residual insecticides, since their toxicity to mosquito larvae is due to protein toxins formed during bacterial cell growth and maturation in fermentation culture. Fish are important larval predators in the region but are subject to mortality from agricultural pesticides, especially in rice.

Additional knowledge of vector species biology, ecology and their vulnerabilities have increased control method options. More widely available public education has made it possible to make vector control an activity of village or community residents. As people become more aware of the role of mosquito vectors in disease transmission and what can be done to control them, they will have motivation to practise vector control at the community level as a means of further improving their standard of living through better health.

Community participation activities include:

- reduction of man-vector contact by screened houses, use of mosquito bed-nets, mosquito insecticide coils and aerosol sprays.
- sanitation, including drainage of polluted water, covering of drinking water containers, construction of mosquito-proof latrines and cesspools.
- filling in surface depressions
- waste container disposal
- disposal of broken coconut shells
- modification of irrigation practices, i.e. intermittent irrigation
- public health education
- community breeding and distribution of predatory fish
- application of residual, space and larvicidal insecticides, under supervision
- interposition of cattle shelters between human settlements and breeding sites
- removal of brush and undergrowth from river banks and canals, and dredging of canals and ditches
- use of permethrin-impregnated bed-nets and clothing
- preventing seepage from irrigation and drainage canals and ditches
- open drainage to large ponds in which fish are reared
- periodic clean-up campaigns – improvement in housing codes and regulations
- clear brush around houses and villages
- used automobile and truck tyre disposal or treatment with larvicides
- use of mosquito repellents
- proper disposal of domestic animal waste products.

COUNTRY REPORTS

Throughout the workshop there was an exchange of information and experience between participants from the six countries represented (Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka). Expected participants from Bangladesh were unfortunately prevented from attending by practical reasons. External funding which would have enabled representatives from Afghanistan and Iran to attend was not available. Much of the exchange between participants was on an informal basis, though most countries presented brief oral and written reports, from which some salient points have been extracted.

BHUTAN

The main malaria zone is the southern region along the border with India, where rainfall is excessive. A malaria eradication programme was launched in 1964, using residual spraying of DDT. The parasite load reduced considerably over the next five years but that trend was subsequently reversed with the API rising steadily, particularly from 1979. There was an epidemic of malaria in 1984. There are considerable logistical problems of DDT and drug distribution and it is difficult to get all spraying done within a month. Some people resist spraying, because of damage to chickens, ducks etc. There are plenty of volunteers to help but insufficient training and supervision. Local people use smoke as a mosquito repellent and rub themselves with ointments from plants.

INDIA

The National Malaria Eradication Programme was started in 1958. Indoor residual spraying with DDT/BHC etc brought down incidence to under 50,000 in 1961 but the number of positive cases increased to a peak of nearly six-and-a-half million in 1976. A modified plan of operations was introduced. Static level of malaria of around two million cases per year 1982-1985. Though resistance to DDT has been a problem, the failure to reduce the incidence of the disease has also been due to poor coverage and inadequate supply of insecticides and other logistic problems. The strategy for urban malaria control is now based largely on larval control and source reduction.

The risk of infection from filariasis has increased 12-fold during the past 13 years, partly due to the rapid and unplanned growth of cities and towns without a proportionate increase in arrangements for waste water disposal and sanitation. A further factor is the migration of susceptible rural populations towards urban areas, seeking employment. Japanese Encephalitis is endemic in many places. Vector control is not a solution to J.E.; environmental management, coupled with efficient pig management would greatly help.

If a vector control programme has to be sustained it must be a multi-departmental affair, where community participation is involved and where the programme is linked to the overall developmental activities of the different departments. Strategies have to be evolved for each area separately, depending on the peculiarities of the vector, the terrain and the socio-economic and cultural aspects of the people of the area.

MALDIVES

Of the Republic's 1,100 islands, only 201 are inhabited. There are three related units under the department of health: malaria control filariasis control and vector disease control,(DF and DHF). Regular anti-malaria activities started in 1965. Over the next ten years all the inhabited islands underwent a preliminary malario-metric survey and entomological investigations. One round of DDT spraying was given to all available structures and houses. One dose of mass drug treatment using chloroquine and primaquine was given. Subsequently, malaria incidence decreased gradually and the vector practically disappeared. There has been no indigenous case since September 1984 and no vector has been seen for two years.

There has been limited larviciding in the capital Male against filaria vector.

The principal methods of vector control are:

1) DDT residual spraying if needed

2) ULV space spraying with malathion at airport and on other important islands

3) Larviciding with abate

4) Source reduction and environmental management, through community participation

5) Deployment of larvivorous fish, including locally available species

6) Use of safe biological agents like *bacillus spaericus* and expandable polystyrene beads

7) Community use of Dichlorvos in its aerosol formulation

8) Use of mosquito repellents like coils.

NEPAL

A phased programme with the ultimate aim of eradicating malaria was launched in 1959. Progress was commendable during the first decade but from 1972 the programme met with several setbacks, especially inadequate financial and logistic support and the preponderance of the vector A. annularis, which developed resistance to DDT and Dieldrin. In 1975 the strategy of the programme was changed from eradication to control. About 9 million of the country's 16½ million population is covered by anti-malarial activities but the incidence of malaria is increasing. About three-quarters of the cases are in the southern plain area. Usually, two rounds of insecticide spraying are applied each year. Recently, for the first time, the Nepal Malaria Eradication Organization undertook a small study on mosquito control by simple environmental manipulation, e.g. deweeding of water bodies, drainage, filling etc. This is being carried out in an area of about 20,000 people, who are being trained to carry out the tasks which subsequently they will do voluntarily.

PAKISTAN

Pakistan has the advantage of having no filariasis, no Japanese encephalitus (being a Muslim country, pig breeding is not practised) and a very low incidence of other viral diseases. However, malaria is a continuing problem. Eradication is probably not possible but through control methods it can be kept at an acceptable level. For 11 years malathion has been used very selectively and appears to have worked. Multi-pupose health workers go regularly to every village but there is still a lot of health education to be done among the people. Some of them are resistant to the spraying of their homes. Community participation is not something which is very easy to achieve effectively, particularly as traditions of collective self-help are waning in some rural areas. The large number of refugees in Pakistan (mainly from Afghanistan) poses a particular health problem, as they move around at will.

SRI LANKA

Sri Lanka has a long history of malaria, which is thought by many experts to have been a direct cause of the decline of the ancient civilizations at Polonnaruwa and Anuradhapura. There have been ten major epidemics in this century, the last being in 1968. The worst was in 1934–35 when about 80,000 people died. This prompted the inauguration of a malaria control and health scheme which was inaugurated by the British colonial authorities in 1937. The discovery of DDT and the wide availability of anti-malarial drugs led to a rapid decline in the disease. In 1963 there were only 17 cases reported of which 11 were imported from the Maldives. This led to a certain complacency. The phased withdrawal of residual spraying, unsatisfactory case surveillance, a severe drought during 1967–68 and the migration of workers to open gem-mines at Elahara led to an explosive outbreak in 1968. This was followed by the emergence of vector resistance to DDT. Recent migration, particularly of semi-immune or non-immune people into the irrigated new settlement areas of the Mahaweli scheme led to a rise in the number of cases. The emergence of incipient chloroquine resistance in 1984 further complicated the situation. Sri Lanka has experienced an explosive outbreak of *p. falciparum* malaria in 1985–86. Details of the control methods used in the country are discussed in some of the technical and field reports.

SUMMARY OF TECHNICAL REPORTS

Robert Rose: History and Development of *Bacillus Thuringiensis* H–14. Its Suitability and Safety for Community Use

Bacillus thuringiensis was first reported from Japan in 1901 and later described by Berliner in Germany in 1911. It was developed commercially for caterpillar control in North America, Asia and Europe. About two dozen H serotypes or varieties of *B.t.* have been characterized but only a few offer serious possibilities for the control of insect pests. One of these is H–14 which was discovered by Dr Joel Margalit and colleagues in the Negev Desert of Israel in 1976. It was found to be toxic when ingested by a variety of mosquito larvae, because of the action of its delta-endotoxin component. Mosquito larvae are paralyzed by it before death. It is also effective in the control of black fly larvae.

H–14 is produced by aerobic, submerged liquid fermentation. It is a non-fastidious organism which grows and sporulates well on a variety of media such as those based on soybean or fish meal flour or cottonseed flour. Any production of serotype H–14 must ensure against contamination by other micro-organisms, because the final products will enter aquatic environments and could potentially contaminate animal or human drinking water. However, exhaustive tests in the United States showed that *B.t.* serotype H–14 is itself non-toxic and non-infectious to almost all non-target organisms, both vertebrate and invertebrate, including human beings.

Among the advantages of *B.t.* H–14 for use in community-level mosquito control are:

- safety for people using it as well as livestock, pets, honey bees, silkworms, insect predators, parasites, other beneficial insects and aquatic animals.
- safety for agricultural crops and plants in water and on land
- can be stored safely without hazard to children
- controls a wide variety of mosquito larvae including those of mosquitoes resistant to chemical insecticide
- no toxic residues; non-corrosive
- fits ideally into integrated pest management programmes
- quick-acting and cost-effective
- environmental acceptability based on true natural occurrence and absence of harmful side effects.
- Can be formulated with monomolecular films to produce enhanced activity.

There are, however, some disadvantages among which are:

- the active ingredient (delta-endotoxin) settles to the bottom and is biodegraded in sediment. Activity usually persists only for 24 hours
- it is less effective in water with suspended fine particles of organic and inorganic matter. Mosquito larvae are filter-feeders and consume most fine particles which compete with those of the toxin particles.
- does not recycle in water to produce persistence of residual control
- some water-based liquid and vegetable oil-bound granular formulations are generally not as stable as chemical insecticides
- does not kill mosquito pupae, adults or late-stage larvae that have stopped feeding
- no contact activity; must be eaten to be effective
- less toxic to *Anopheles* spp. than to *Aedes* and *Culex* spp.

Jill Roberts: Larviciding Trials In Project Area In Sri Lanka

When a community becomes involved in vector control an insecticide has to be chosen that fulfils essential safety requirements. It must not harm the villagers involved in the application nor should they need special equipment or clothing when spraying. An accidental overdose must not be harmful to the environment nor, preferably, to natural predators. At least two very safe larvicides exist, which unlike most adulticides are not toxic synthetic chemicals and these have been introduced into this programme.

The first is *Bacillus thuringiensis* var. israelensis *(B.t.i.)*, which kills mosquito larvae and closely related Diptera. It acts as a stomach poison and has to be ingested by the mosquito larvae. The other is a harmless monomolecular film (monolayer) which alters the surface tension of the water. This wets the breathing trumpets of the mosquito pupae and the larval siphons of the older larvae, allowing water into their respiratory systems, causing them to drown.

In most instances in the field, these two larvicides have been combined for reasons of efficiency and economy. The monolayer both spreads the *B.t.i.* over the water surface and holds it up so that it remains in the feeding zones of the larvae. Three field trials using different combined formulations have been carried out in the project area since 1984. The second of these, in August of that year, saw the start of larviciding in the villages. Field workers were trained to map the breeding sites and to dip for mosquito larvae. The children are particularly useful in locating pools and often do the spraying under the guidance of the pre-school teacher and the field worker. The monolayer-*Bt.i.* mixture appeared to be effective in discouraging the breeding of anophelines at this time. This trial effectively started a longterm project and is to continue.

Among the problem areas which need larviciding are overflow traps from the tanks which are difficult to drain and water which collects in pools round tube wells. The latter are often in the centre of a village with the pump in continual use; the overflow forms an ideal breeding ground for mosquitoes.

During this work we had an impressive example of the spreading of *B.t.i.* by the monolayer, involving a breeding site about 15m long, going under the road through a culvert to a small pond on the other side. The dosage was applied in one location at the far end of the pool. Four days after treatment the larvae count was zero in the pools on both sides of the road.

The third field trial in March 1986 tried to establish a comparison between the combined *B.t.i.*-monolayer with the performance of each ingredient on its own.

Before DDT was introduced in 1945, larviciding and the removal of breeding places where possible was common practice in most mosquito control programmes. Now the spiralling costs of chemical insecticides, their toxicity to predators and other harmless insects, as well as the increasing resistance of the mosquito to their use, have once again promoted interest in control by larviciding. It would be ideal if mosquitoes could be controlled only by source reduction and the use of larvivorous fish but it is unlikely that the balance of nature will continuously hold down mosquitoes to low numbers. It is essential to have other means of controlling population explosions. The *B.t.i.*-monolayer mixture is ideal because it does not harm the build-up of natural control agents.

Norbert Becker: The use of *Bacillus Thuringiensis* H–14 in an Integrated Mosquito Control Programme in West Germany

Since 1976 about 70 towns and communities on both sides of the River Rhine in West Germany have worked together in a mosquito control programme at community level, using environmentally compatible methods. Though mosquitoes are not dangerous vectors in West Germany they have considerable nuisance value in summer. The control programme usually involves about 200 field workers, both people from the community and well-trained students.

The high efficacy and the outstanding environmental compatibility of *Bacillus thuringiensis* H–14 *(B.t.i.)* resulted in the use of commercial *B.t.i.* products in routine treatments against the pest species *Aedes vexans* and *Culex pipiens*. When pupae occur we also use an organic suface film, which is a mixture of soyabean lecithin and paraffin. For ground application we mix *B.t.i.* wettable powder with pond water. The mixture is adjusted according to circumstances, e.g. to treat shallow breeding sites and when first and second instar larvae occur, we mix 250g *B.t.i.* powder with 10 litres of screen-filtered pond water, while in deep water and when third and fourth instar larvae occur, we need 500g of wettable powder to treat one hectare of breeding sites.

The fluid concentrate Teknar HP–D (an asporogenic mutant) yields sufficiently high mortality rates when we apply 1 litre of Teknar HP–D per hectare mixed with 9 litres of pond water.

Since 1982 more than 16,000 hectares of breeding sites were successfully treated with 8 tonnes of Bactimos WP, 8,000 litres of flowable concentrates, e.g. Teknar HP–D and 114 tonnes of *B.t.i.*-sand-granule, whereby the mosquito population was reducd by over 90%.

B.t.i. offers us high efficacy against target organisms and safety for all other organisms, such as the natural predators of mosquitoes. The non-toxicity of *B.t.i.* and the surface film make these materials suitable for use by unskilled personnel in village programmes and high-light the way in which integrated vector control technology in future must be adapted to encourage community participation.

NOTES: A scheduled paper by Professor A.I. McMullen on "The Use of Monomolecular Films in the Control of Mosquito Larvae" was not presented to the Workshop because of lack of time.

As a most useful supplement to the Sri Lanka country report, two of the entomologists from the country's Anti-Malaria Campaign, gave presentations with visual aids on specific aspects of their work:

Dr P.R.J. Herath: "Experiences in alternative vector control Methods in Malaria Control Programme in Sri Lanka"

Dr Mervyn B. Wickramasinghe: "The potential in the use of larvivorous fish for malaria control in Sri Lanka"

FIELD TRIP REPORT

Three days of the Workshop were spent in the Anuradhapura District of North-central Sri Lanka, looking at various aspects of the Integrated Malaria Control Project being run in a number of villages there by the Sarvodaya Movement, using carefully selected, trained volunteers with community participation. The field trip enabled a two-way learning process between the visitors and the hosts, with several of the national delegations offering practical advice as well as having the opportunity to relate what they were seeing to their own local conditions and schemes. The visitors were deeply impressed by the enthusiasm and commitment of many of the volunteers and field workers involved in the Sarvodaya project but also felt that there were various technical and scientific deficiencies at present, which could be overcome with proper training and advice. This feeling is reflected in many of the recommendations which are printed later in this report.

The Sarvodaya Movement has identified several important aspects of successful community participation in vector control, which are reflected in the organization of the work in the project area:

1) The organization of communities is often complex. Therefore it is important to train one member of the community so that one has a trained worker who is intimately aware of the local situation.

2) The community has to be made aware of the fact that disease can be cured and is not an inescapable fact of life. Similarly, villagers must learn that mosquitoes carry disease and that controlling mosquitoes is consequently of benefit to the community.

3) There has to be community involvement in planning the organization, operation and control of health care. Action decided elsewhere may not be accepted.

4) There is an order of priority for basic human needs which have to be met: suitable environment, clean water, clothing, food, housing and health care. These are followed by communication, energy sources and education. Health care – of which vector control is a part – should be considered part of a complete community action programme and not in isolation.

5) Incentive schemes can be used to stimulate motivation.

A series of safe malaria control methods suitable for community use, has been instigated in the project area and is being monitored. Several of these techniques were demonstrated during the field trip. Statistical information and graphs were exhibited at the field H.Q. The methods include:

- the elimination of mosquito breeding sites
- the introduction of larvivorous fish (especially *nalahandia*)
- larviciding techniques, especially monolayers and *B.t.i.*
- the use of mosquito repellents
- the promotion of animal husbandry (especially cattle and goats) between breeding sites and human settlement, to divert the vector.
- the use of indigenous anti-malaria cures, involving local ayurvedic physicians in the testing of indigenous drugs

This last-mentioned activity is backed up by conventional drug administration and mass blood-film surveys. The first three methods are being evaluated separately in different villages.

A Biologist and Field Director of the project have been mainly responsible for the implemention of experiments in malaria control methods. Wherever necessary, laboratory-type studies have been carried out first and community studies on a sample basis have followed. However in some instances, such as studies involving the elimination of breeding places, the point of departure has been community action.

A high proportion of the village workers throughout Sarvodaya projects are women. All the pre-school workers are and most of the health volunteers. Often the village-level workers – male and female – are unemployed youths with between eight and ten years of formal education. The higher level workers who are paid a regular monthly allowance, depending on their experience and rank, have often previously been village-level workers. All Sarvodaya workers are trained from time to time through programmes conducted at national, provincial, District and Divisional levels.

Site Visit to Athungama

One optional part of the field trip was a visit to the village of Athungama. This is quite different from typical villages in the area in that it is a new settlement made up largely of refugees – Sinhalese – from the areas of Sri Lanka affected by Sri Lanka's continuing ethnic violence. There is neither tank irrigation nor paddy land in Athungama. Lacking any alternative income earning avenues, the community depends heavily on government subsidies and help from N.G.O.S. There was some initial resistance to the arrival of the refugees from people already living in the area and the Sarvodaya volunteers working with them had to help develop a community spirit of true co-operation. The free gift of labour (shramadana) concept was used, not only for building homes for the newcomers but also to improve the facilities and infrastructure of the community. Parallel to this was the attempt to introduce primary health care, and to use community participation to counter the problem of mosquitoes. In December 1985 a malaria epidemic broke out in the community and since then Sarvodaya anti-malaria work too has been in operation in this community. Athungama is the only community within the project area where all 3 interventions under the Sarvodaya malaria control project ie., source reduction through shramadana labour, monolayer with *B.t.i.* (Monti) and larvivorous fish are simultaneously used, bringing the epidemic successfully under control.

The community was taught the relationship between mosquitoes and malaria and how they could participate in controlling vector breeding sites. Some of the visiting experts were sceptical of the efficacy of some of the methods being used, highlighting an apparent need for more specialist advice and training. The group was impressed by a demonstration of blood-sampling by a village health-worker, as well as by her awareness that serious or lingering problems should be referred to a more specialist medical authority.

The Sarvodaya Malaria Control Research Project

(Extracts from a report by Mr M.A. Rao, U.N. volunteer with the Sarvodaya team)

In 1978 the Sarvodaya Shramadana Movement of Sri Lanka first considered developing and testing a "Popular Approach to Malaria Control". The proposal arose from a consultant's observation that the current approach to malaria eradication based on synthetic insecticides and anti-malaria drugs was proving unworkable. The suggested alternative was to engage local communities in continued surveillance of the local vector mosquitoes and to assign to them the prime responsibility for controlling the local vectors. Sarvodaya's presence in 6,000 villages in Sri Lanka and their self-help philosphy clearly might be an ideal partner in a joint venture, with appropriate scientific input. The sciences required include biological, behavioural and public health specialities.

In 1979 a project proposal was prepared to address the malaria problem programme. Implementation began in 1981, in 58 villages, once funding had been established. The following ideas were developed:

1) Concepts basic to long-term (perennial), community-based control of malaria, including:

   – a single vector in Sri Lanka transmits malaria: *anopheles culicifacies*
   – *an. culicifacies* employs only restricted and well-defined kinds of breeding sites.
   – in the dry zone of Sri Lanka malaria is typically endemic; usually two small epidemic seasons follow the rains
   – communities living in the endemic zone actually benefit from more or less continuous low-grade transmission of malaria, supplying them with an important level of immunity to the local stains of malaria parasites. This level of immunity is denied to persons and communities living outside the endemic area who visit or migrate into the endemic zone.

2) The project aims to reduce the amplitude of endemic malaria among the project communities and to maintain the basic level of malaria infection necessary to provide an important level of immunity against possible serious epidemic situations.

3) The objectives are to determine:
   – how village communities can learn to identify breeding sites of the vector throughout annual cycles
   – how traditional healing medicines and methods can help local communities resist malaria
   – how customary and cultural practices affecting income generation, acquisition and disposal of water for domestic and other purposes, clothing, eating, sleeping, travelling etc. help or hinder malaria frequency and seriousness
   –how community actions can effectively reduce vector breeding sites to levels which optimise the frequency of vectors capable of transmitting malaria.

4) On the basis of the above objectives the project directors envisaged several procedures to help village communities contain their malaria:

   – enable village communities to keep under surveillance vector breeding places and the parasitaemia affecting them
   – rely chiefly on simple and familiar methods of larval (source) control, including filling up, draining out and fouling vector breeding sites and possibly using larvivorous fish. Methods dependent on continuous supplies of materials introduced into communities, especially from abroad, should be avoided if possible
   – use cattle to divert vectors from human targets
   – learn how to call on malaria experts to apply methods beyond the villagers' competence when simple methods prove ineffective, especially when the chief malaria parasite is *p. falciparum.*

RECOMMENDATIONS FROM THE WORKSHOP

1. At the outset, the group of participants from Bhutan, India, the Maldives, Nepal and Pakistan and representatives of agencies like the World Health Organisation (WHO), the Wolfson Mosquito Control Project etc., wish to record their gratitude to the host country Sri Lanka and to the sponsors – the Sarvodaya Movement and SACEP for the excellent arrangements made to look after the delegates attending the workshop.

2. As part of our wide-ranging exchange of experiences relating to integrated mosquito control and community participation in the South Asian region, the group had the opportunity of visiting Sarvodaya's project area in Anuradhapura and seeing various activities there. The group was very much impressed with the work being carried out by the Sarvodaya Movement in the villages, particularly the work in educating and involving the community in several aspects of primary health care and mosquito/malaria control. We felt that this may have some lessons for other countries of the region, especially in view of our desire to promote greater self-reliance. The project appears to be a golden opportunity of utilizing the human potential available in the villages and of moulding them into a force which can demonstrate the feasibility of community involvemenmt in primary health care and malaria control in an area that is highly endemic for malaria.

3. We recognise that the breeding sites of the vector mosquitoes of Japanese encephalitis, dengue and filiarisis are different from those of malaria and that their control calls for other approaches. As these diseases are important health problems in the region, we recommend that suitable methods of integrated vector control with community participation be developed to tackle these other diseases.

4. While the group was very much impressed by Sarvodaya's activities in malaria control and records its deep appreciation, we would like to offer the following recommendations for consideration:

   a) There should be greater co-ordination of the activities and co-operation between the (government's) Anti-Malaria Campaign (AMC) and the Sarvodaya project. It is hoped that both of these would work towards the goal of alleviating human suffering in the true spirit of Sarvodaya.

   b) The medical aspects of the project, namely the detection of fever cases, dissemination of information, treatment etc., should be pursued further and improved, so as to avoid delays between detection of cases, blood-smear examination, diagnosis and treatment, to make the programme more effective. It is recommended that the AMC actively lend a helping hand to achieve this, with due consideration given to cost-effectiveness.

   c) The network of dedicated workers of the Sarvodaya project could also be used to combat other common ailments without affecting the quality and quantity of activities devoted to fighting malaria.

   d) With regard to entomological activities, the group felt that there is a great need for re-orientation and improvement in the quality of the work, which could be achieved by associating with the AMC and gradually getting the project staff trained by AMC in all aspects. This should be undertaken without delay.

   e) Regarding control operations, the group felt that any new control techniques should be tested first and their efficacy proved by the AMC. These techniques should relate to the local eco-epidemiological situation and to the Sarvodaya philosophy of self-reliance. New techniques should therefore be tested under the direct superivision of professional entomologists of the AMC before being introduced in the project. This is to ensure that there is no conflict with national policy-makers, particularly on aspects of efficacy, cost-effectiveness and operational feasibility and the utilization of such techniques on a national scale.

   f) The group felt that there is considerable room for improvement of the evaluation process and techniques of sampling to make the programme scientifically more acceptable and to ensure that the hard work put in by the project workers gets its due reward.

g) The group also felt that it would be beneficial to have a co-ordinating committee, consisting of representatives of the Sarvodaya project, the DDC Anuradhapura, AMC, the WHO and possibly also other experts, who should assist in developing protocols for activities related to vectors of malaria and other diseases and their control. Such protocols should relate to sampling, testing of new compounds/technologies, control of diseases, evaluation etc., so that the entire project work is carried out on a scientific basis. The group would like to emphasize that this should be achieved in a smooth manner and that the protocols so developed can be introduced into the present working of the project in such a way that the sincere work and enthusiasm of the project staff and local people are not affected or dampened in any way.

h) The group also felt that existing training facilities in Sri Lanka and other countries of the region where expertise on vector control and disease control is available should be utilised by the project.

5. The group strongly recommends that the pioneering work of the Sarvodaya project in enlisting community participation is given all assistance and encouragement, not only by the AMC but also by scientists, academic institutions such as universities and international organizations represented in Sri Lanka and elsewhere. The spirit of community participation behind the movement and the methodology and technique of inculcating a sense of involvement by the community, as well as the education of the future generation – particularly young women and children – give hope that the project will succeed in achieving its goals throughout the region.

CONCLUSIONS AND EVALUATION

The Sarvodaya Integrated Malaria Control Project, which provided the theme of the field trip as well as for some of the plenary discussions during the workshop at Moratuwa, deeply impressed the participants, both for its qualities and certain technical weaknesses. This is reflected in the workshop's recommendations. The Sri Lankan experience (including the work and aims of the governmental Anti-malaria Campaign), albeit predominant, was only one aspect of the Workshop's total input. The opportunity to share experiences from the six participating countries, both formally and informally, was much appreciated as was the possibility of hearing about some of the research being carried out in other parts of the world.

There was no attempt to draft a regional mosquito control strategy, let alone a global one. Yet there was a strong feeling that everyone had something to learn from the rest. It was felt that this kind of exchange of knowledge and experience would be invaluable at other levels within the community of people who are working in mosquito and vector-borne disease control. Technicians and trainees, entomologists and medical students, among others, could well benefit from experience abroad. This need not necessarily be in industrialised countries; India, for example, has some excellent training and research facilities in this field, notably at Pondicherry. Similarly, just as the participants at the Workshop had learnt a great deal about community participation from people working with Sarvodaya, so others hoping to generate a similar kind of genuine collective self-help in environmental management and vector control, might benefit from on-the-spot experience.

The Workshop itself registered successes in achieving its declared goals:

I **To promote the broad goal of empowering communities to contain dangers arising out of their environment.**

Specific environmental dangers recognised were mosquito-borne dieseases such as malaria, filiariasis etc and the unsafe, harmful and indiscriminate use of toxic and pollutive pesticides., The workshop emphasized the suitability of safe, non-toxic and non-pollutive agents, such as monomolecular surface films, *B. thuringiensis* H–14 and larvivorous fish as well as source reduction, in order to interrupt mosquito breeding. It examined how these methods may be used effectively at village level. It was noted, however, that the village user must be properly trained and authorised by the appropriate authority.

II **To exchange among workshop participants lessons they have learned from field research and field experience designed with the following objectives to:**

IIa **involve existing communities during endemic malaria and liable to serious malaria epidemics, to develop approaches and methods to contain their own malaria by continuous surveillance and timely action against malaria vectors when indicatd.**

Each workshop member from the participating countries described mosquito vector control in his or her own country, with particular regard to those activities conducted at the village or community level. It was found that, in general, these programmes did not emphasize community participation but rather relied heavily on spraying teams employed by the government. Sri Lanka appeared to be unique in the region in having developed such an extensive and effective community action movememnt as Sarvodaya, involving volunteer workers, and participants were able to learn from this.

IIb **determine policies arising out of definitive field experience which can be confidently extended to broader areas liable to serious epidemic malaria.**

Since most of the experience in the region has formerly been with programmes both administered and managed by the government (though perhaps sponsored and advised by international agencies such as the WHO), few examples of real community participation emerged from the country reports. Exceptions were the Sarvodaya programme and less extensive attempts at Pondicherry, India and in the Maldives. However, it was unanimously agreed by all workshop members that the involvement of the community, using non-hazardous techniques in an integrated programme was essential for any real progress to be made in mosquito vector control in the future. They noted that the Workshop took place at a transitional period when malaria has again become epidemic in some areas, indicating a need for serious reconsideration of control methods.

IIc **determine techniques in control of village communities so that they can maintain surveillance of vectors and limit vector breeding, particularly to avert or control epidemic malaria.**

It emerged from the Workshop field trips that the most important requirement for effective vector control at the village level is the extensive training of volunteers in surveillance, monitoring and vector identification. As volunteers are subject to turnover, this training must be of a continuous nature, with follow-up supervision to ensure that the proper methods are used effectively. The new role of mosquito control officers may thus become as extension workers/educators, rather than spray-team operators. This logical conclusion was a subject for considerable discussion and differences of opinion among participants, as it would inevitably involve considerable changes in the existing functions of the governmental officers concerned.

III **To provide an opportunity for professions from South Asia interested in these approaches to consider establishing collaborative activities.**

Several opportunities for international co-operation arose from the Workshop. One was an invitation for mosquito control trainees from the SACEP member countries to visit Europe for three-month periods of experience in methods of community-based mosquito control. It was recognised that the exact procedures used in Europe may not be directly applicable to South Asia but relevant aspects could be extrapolated, e.g. the use of environmentally-safe materials for larval control. Other offers of international assistance came from Pondicherry in India, to train volunteers and others requiring experience in vector control activities involving the community and from Sarvodaya in Sri Lanka, which was willing to provide training facilities in community organisation. Pakistan was interested in the training schemes but felt community participation at the present time, with the problems of refugees entering the country, could be difficult to organize. Participants from Bhutan, the Maldives, Nepal and the Sarvodaya team in Sri Lanka expressed great interest in such exchange and training possibilities. It was appreciated that some external funding would probably be necesary for such work to go forward. Also interest was expressed in a work study to examine the possibility of community participation in urban areas. These are causing increasing problems to mosquito control workers.

Though some of the issues raised at the Workshop proved controversial, there was a great deal of interesting discussion on the relative merits of methods employed in vector control, including the pros and cons of adulticiding, larviciding, the use of *B.t.i.* monolayers, chemicals etc, as well as of techniques – especially the advantages and disadvantages of projects involving community action and integrated programmes. There were certain tensions resultant on the novelty of community participation and the understandable resistance to it by some established governmental procedures. Nonetheless, the dynamic debate demonstrated the positive value of the workshop in bringing such problems to the forefront, underlining the need to solve them if insect-borne diseases are to be effectively controlled.

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Wyon, J.B. Sarvodaya Malaria Containment Project – Anuradhapura.

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The meeting with staff and volunteers at the project office

Participants outside the field headquarters

The Volunteers greeting participants at the Sarvodaya Project Office, Kekirawa, Near Anuradhapura

Field Visit: Demonstration of larviciding techniques

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Many other members of the Sarvodaya Movement worked hard to contribute to the success of the Workshop both at the Moratuwa HQ and at the field stations and in the villages.

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