



ment and washing liquids. In order to avoid adverse impacts on non-target species, the project recommended burial or pit latrines, in which pyrethroids degrade quickly.

Financially independent Village Mosquito Net Committees were the core components of the project. Appropriate selection of committee members, with community input and attention to traditional healers, was important for success. The committees helped plan, implement, and administer program activities and were responsible for bednet sales, distribution, and re-treatment. Sales of an initial project donation of nets and insecticide created an operating fund for each committee. Interest earned on the funds then paid for committee members' services and for further supplies of nets and insecticide. Most of the costs and management of malaria control activities were thus assumed by the beneficiaries. ITN can be inexpensive compared to house spraying with DDT, because nets are treated with a very low dose of insecticide and operations are simple and quick. Relative cost figures vary and may be influenced by the availability of inexpensive mosquito nets.¹²

Bednet coverage varied from 69 percent to 89 percent of households. Children in communities with bednets had 60 percent fewer episodes of malaria-related fever, 50 percent less malaria infections, anemia, and treatments for malaria, and grew more than unprotected children. As of 1997, Village Mosquito Net Committees were still functioning, with active revolving funds.

The Philippine National Malaria Control Program¹³

Malaria is primarily a rural problem in the Philippines, where disease incidence varies, from zero to high risk, depending on the region. The Philippine national Malaria Control Service (MCS) started using DDT for residual spraying of house interiors after World War II. Chemical vector control measures were later complemented by stream clearing and shade elimination close to settlements in order to deprive the main malaria vector of breeding sites, and stream seeding with guppies for reducing populations of mosquito larvae. These are considered relatively minor, supplementary activities.

Although malaria death rates in the Philippines have been low since the 1950s, the number of annual cases has fluctuated. Shifts in the organizational structure and administrative policies of the malaria control program, as well as changes in available financial support, have strongly influenced the success of malaria control over time. From 1959–1965, and again from 1983–1987, malaria control was decentralized operationally to the regional or provincial level and integrated fully with general health services. Periods of decentralization saw malaria control deteriorate, reflecting the low priority it received from some regional health administrators, a lack of coordination between national and regional deployment of workers, money, and goods,



as well as between regions, and inadequate re-orientation and supervision of local health personnel with malaria control responsibilities. At present, the organizational structure of the malaria control program is semi-vertical – a compromise between vertical service delivery and decentralization that is meant to provide adequate coordination, monitoring, and support of local anti-malaria activities. Devolution of responsibility for malaria control to local governments has been gradual since the decision was last made in 1992, and is still in progress.

In 1993, DDT use was banned in the Philippines for environmental reasons, no significant malaria mosquito resistance to the chemical having been documented. The Malaria Control Service replaced DDT with alternative insecticides that proved equally effective: fenitrothion, deltamethrin, cyfluthrin, lambda cyhalothrin, and bendiocarb. These chemicals were used in rotation to delay the development of insecticide resistance. In order to simplify logistics and training, however, these

Larvivoous Tilapia are farmed in streams for both malaria vector control and as a source of income for community members.

five chemicals are now being phased out in favour of a single insecticide. The synthetic pyrethroid ethofenprox was chosen because it is safer, cheaper, and as effective, and has a longer residual effect.

Also in 1993, and for similar economic and logistic reasons, the MCS reduced its dependence on residual house spraying by turning to bednets impregnated with deltamethrin or permethrin as its primary vector control measure. The MCS is working with communities to find acceptable and effective cost-sharing schemes. House spraying is further minimized through stratification of target areas according to disease transmission pressure, geographic and socio-economic factors, and population stability.

Although alternative insecticides are more expensive than DDT, bednets require less insecticide and application expense than house spraying. Average annual Philippine



expenditures for malaria control insecticides have dropped over 40 percent since DDT was banned in 1993. That decrease might have been less but for the termination in the same year of a World Bank support project, which reduced the malaria control budget from a 1991-92 average of US\$5.62 million/year to a 1993-96 average of \$2.04 million. Reduced resources have hampered operations and led to the allocation of scarce insecticides among provinces according to malaria case numbers.

Even in the face of that challenge, this new control strategy has reduced malaria incidence. From 1993-1996, the number of malaria cases per 100,000 population sank from 97 to 55. The program's continued success depends chiefly on community participation, including that of indigenous peoples in remote areas. Accordingly, the MCS is placing high priority on improving the social mobilization skills of field personnel. Community volunteer schemes have successfully compensated for personnel cutbacks in some provinces, and there appears to be scope for greater collaboration with non-governmental organizations (NGOs).

Apart from the hazards of DDT, environmental impacts of Philippine malaria vector control practices have received little attention. There are no special safety guidelines for malaria control activities in or near wildlife conservation areas. Significant harm from environmental management measures appears unlikely, but stream seeding with introduced fish is of greater concern, and deserves expert attention.

Collaborative research is presently under way between a university and a research institute, on family and local government empowerment for malaria control and on income generation for groups of anti-malaria volunteers. The project is investigating the farming of fish (*Tilapia*) in streams both for malaria mosquito control and as a new source of income for participating families. The MCS considers insufficient understanding of malaria vector ecology and distribution to be a significant technical limiting factor in the malaria control program, but these problems are not being addressed by researchers at the moment, and research capacity and resources are limited.

Mexico: In Transition to Malaria Control Without DDT¹⁴

Malaria control in Mexico is the responsibility of the Directorate of Prevention and Control of Vector-borne Diseases in the Secretariat of Health (SSA). The spraying of house interiors with DDT in malaria-endemic zones in order to kill mosquitoes that carry the disease has been the main vector control measure used since the late 1950s. A privatized corporation produces DDT for export and for malaria control, which has been the only lawful domestic use pattern for DDT since 1991. DDT spraying is just one aspect of an integrated disease control strategy that also includes case detection and treatment (largely by a network of community volunteers), epidemiological



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72. A full report on the development and run results of the mass balance model for indoor exposures, prepared by Katie Feitmate, Dr. Dori Mackay, and Eva Webster is available from WWF.
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- c. Malaria control in Pudukkuppam, Pondicherry, India through environmental management - algae cleared from ponds was used for village-level manufacture and sale of art paper, K. N. Panicker and P. K. Rajagopalan, A Success Story of Community Participation in Malaria Control (Pondicherry, India: Vector Control Research Centre Miscellaneous Publication No. 18, 1990);
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6. P. C. Matteson, R. Allsopp, and G. R. Mullins, "Trypanosomiasis Control in the Okavango Delta, Botswana," in P. C. Matteson, ed., *Disease Vector Management for Public Health and Conservation* (Washington, D. C.: World Wildlife Fund, 1998, in preparation).
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8. R. K. Khawere and P. Kumar, "Malaria Control in Kheda District, Gujarat, India," in P. C. Matteson, ed., *Disease Vector Management for Public Health and Conservation* (Washington, D. C.: World Wildlife Fund, 1998, in preparation).
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Part C

1. A full report on the projects briefly profiled here, prepared by Dr. Patricia Matteson and co-authors associated with the various projects, is available from WWF.
 2. In particular, Brazil has reduced malaria in the Amazon region by integrating intensified diagnosis and treatment, health education, and environmental management; see The Malaria Control Program in Brazil, presentation by Carlos Catao Prates at the UNEP/IFCS Subregional Awareness Raising Workshop on Persistent Organic Pollutants (POPs), Cartagena, Colombia 27-30 January, 1998.
 3. Unpublished documents, Servicio de Erradicación de la Malaria de la Secretaría de Estado de Salud Pública y Asistencia Social, Dominican Republic.
 4. Gambia implemented a national impregnated bednet program on the basis of a pilot study described by B. M. Greenwood and H. Pickering, A malaria control trial using insecticide-treated bednets and targeted chemoprophylaxis in a rural area of The Gambia, West Africa, *Transactions of the Royal Society of Tropical Medicine and Hygiene* 87, Supplement 2:3-11 (1993).
 5. C. F. Curtis, ed., *Appropriate Technology in Vector Control* (Boca Raton, Florida: CRC Press, Inc., 1989).
- Some individual programs are described in these references:
- a. Village-level production in coconuts of *B. thuringiensis israeliensis* for larviciding of malaria mosquitoes in Peru, in *Of Mosquitoes and Coconuts*, IDRC Reports, Vol. 19(1):17-19 (April, 1991);