

INDIA
ENVIRONMENTAL MANAGEMENT PLAN
FOR THE VECTOR BORNE DISEASE CONTROL PROJECT
UNDER
WORLD BANK

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Directorate of National Vector Borne Disease Control Programme
(Directorate General of Health Services)
Ministry of Health & Family Welfare
22, Sham Nath Marg, Delhi 110 054

www.nvbdc.gov.in

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Acronyms

ANM	:	Auxiliary Nurse Midwife
API	:	Annual Parasite Incidence
CHC	:	Community Health Centre
CIB	:	Central Insecticide Board
CPCB	:	Central Pollution Control Board
DDT	:	Diethyl Dimethyl Trichloroethane
DDC	:	Drug Distribution Centre
DMO	:	District Malaria Officer
EMP	:	Environmental Management Plan
FTD	:	Fever Treatment Depot
HW	:	Health Worker
IRS	:	Indoor Residual Spray
ITMN	:	Insecticide Treated Mosquito Net
ITM	:	Insecticide Treated Material
IVM	:	Integrated Vector Management
MoEF	:	Ministry of Environment & Forests
MC	:	Municipal Corporation
NEERI	:	National Environmental Engineering Research Institute
NIOH	:	National Institute of Occupational Health
NRHM	:	National Rural Health Mission
NVBDCP	:	National Vector Borne Disease Control Programme
NGO	:	Non-governmental Organization
NIMR	:	National Institute of Malaria Research
POP	:	Persistent Organic Pollutants
PPE	:	Personal Protection Equipments
RC	:	Registration Committee
SMI	:	Senior Malaria Inspector
TAC	:	Technical Advisory Committee
VBD	:	Vector Borne Disease

Executive Summary

Vector-borne diseases are a cluster of infectious diseases transmitted by mosquitoes and other vectors. India's population suffers from a significant disease burden from these diseases, in the form of morbidity and mortality from malaria, kala-azar (VL), filariasis, Japanese encephalitis, and dengue. To address this burden, the National Health Policy (2002) set a goal of reducing malaria, dengue and Japanese encephalitis mortality by 50 percent by 2010; eliminating kala-azar by 2010; and eliminating lymphatic filariasis by 2015. Besides treatment of malaria cases by appropriate drugs, Indoor residual spray by DDT, Malathion and Pyrethroids are used for vector control in Malaria and Kala-azar in rural areas. In urban areas larvicides are introduced in water bodies for control of larvae population and fogging with Malathion (Technical) is done in urban areas during outbreak situation. In some areas, where settlements are scattered and it is not feasible to undertake IRS due to difficult terrain, Insecticide treated mosquito nets are used. It is a well known fact that chemical insecticides are toxic to human beings. If not used as per recommendations, they cause adverse health impact to the persons involved, community and contamination of environment.

After the successful implementation of Enhanced Malaria Control Programme in 100 districts in India, National Vector Borne Disease Control Programme, (the central agency responsible for guidelines, policy and implementation of vector borne disease in India) envisages to launch Vector borne disease control project in the country with assistance from World Bank. In order to ensure that the insecticides and insecticide treated material (ITM) used in the project does not cause threat to health of persons involved, community and environmental contamination, it was proposed to undertake environmental assessment of the use of insecticides and ITM for development of Environmental Management Plan (EMP).

NVBDCP has already developed guidelines for safe handling and disposal of insecticides; however, there were reports of the presence of insecticide in blood of spray workers and contamination of soil and water. As desired by World Bank, National Institute of Malaria Research (NIMR) was engaged for carrying out detailed visit to the states of Orissa (low capacity state) and Karnataka, Maharashtra (high capacity states) to understand the gaps in implementation of guidelines, scope of improvement and to prepare EMP for environmentally sound project. The programme is affected in some areas due to vacant posts of health workers, which are key supervisory posts at community level, and lack of awareness and training to some categories of stakeholders. Some spray workers were not adhering to use of protective gears particularly while spraying DDT and Malathion. An EMP incorporating legal framework, procurement, storage & transport, application activities, occupational health and safety measures, environmental impacts related to treatment for VBDs, capacity building, IEC, intersectoral collaboration, reporting & monitoring has been developed for implementation at centre, State/District level. Recommendations/actions required at various levels for mitigation measures, occupational health and safety measures, remedial measures for storage & transport etc have been emphasized. Constitution of national surveillance system for effective reporting and monitoring of various aspects has been proposed. Constitution of village level committees for social

participation and monitoring at central, state and district level has been suggested for effective auditing of the insecticide use operations. Training plan for different categories of personnel has been suggested. Implementation schedule for various components of EMP has also been provided. With the implementation of EMP, it is hoped that health and environmental related hazards due to use of insecticides and insecticide treated materials would be reduced to negligible level.

The EMP has designed a framework, with guidelines and standardized formats for incorporation and adaptation at the state level. It recommends state level actions which will focus on enhancing training and supervision of workers and provision of protective equipment and their maintenance. States will draw up training and supervision action plans and prepare inventories for storage and equipment. During the implementation of the project, NVBDCP will discuss with manufacturers of insecticides on issues such as packaging, collection of empty containers, provision of protective gear etc. The plan also includes a framework for augmenting the existing institutional at state and central levels for monitoring and evaluation. With the implementation of EMP, it is hoped that health and environmental related hazards due to use of insecticides and insecticide treated materials would be reduced to a negligible level.

1. Introduction:

Vector borne diseases (VBDs), viz., Malaria, Filariasis, Kala-azar, Japanese Encephalitis (JE) and Dengue are major public health concerns in India. There are considerable variations in epidemiology of these vector borne diseases on account of ecology, vector bionomics, economic, socio-cultural and behavioral factors. The high incidence of VBDs is an indicator for deficient health & well being of the community, resulting in personal and national economic loss due to disease burden in terms of disability adjusted Life Years (DALYs). The direct costs of VBDs include a combination of personal and public expenditures on both prevention and treatment. The indirect costs include productivity or income loss due to illness or premature death. These diseases are mostly prevalent in the hardcore endemic pockets inhabited predominantly by the rural population including tribes with limited access to quality health care, communication and other basic facilities, although risk factors exist in many parts of the country. These diseases are major public health concern and impede socio-economic development. The high risk areas for VBD are generally rural, tribal and urban slums inhabited by the poor, marginalized and vulnerable groups.

The National Vector Borne Disease Control Programme (NVBDCP) is an umbrella programme for prevention and control of vector borne diseases. To achieve preventive, promotive and curative care services for a healthy nation, the National Health Policy (NHP) [2002] has set goals for achieving reduction of mortality due to malaria, dengue and JE by 50% by the year 2010 along with efficient morbidity control; elimination of Kala-azar by the year 2010 and elimination of Lymphatic Filariasis by the year 2015. To consolidate the efforts for achieving such goals, the Government of India has launched National Rural Health Mission (NRHM) in 2005 with the Action Plan of augmenting and ensuring appropriate public health focus; peoples' orientation and ownership of public health programmes; community-based approaches; public-private partnership; involvement of local bodies and Panchayati Raj Institutions; gender equity, improved access to primary health care, prevention and control of communicable diseases including vector borne diseases, reduction of infant mortality rate and maternal mortality ratio by 50% by the year 2012 and promotion of healthy life styles.

The NVBDCP Programme Vision of well informed and self-sustained, healthy India free from VBDs with equitable access to quality health care and the Programme Mission are in tandem with the NHP and NRHM goals as well as the objectives of Millennium Development Goal of halting and reversing the incidence of malaria and other diseases by the year 2015 towards reduction of poverty. The epidemiology of malaria has been changing over the years due to rapid changes in the eco-system. According to these changes, the intervention strategies have been revised by NMP from time to time. The revisions in the strategies are printed as guidelines, manuals and operational instructions to the implementing agencies which are States and districts (including PHCs).

The NVBDCP has evolved new policies for effective case management, including use of rapid diagnostic kits and artemisinin combination treatment for malaria and rK 39 test kits and introduction of new drugs like Miltefosine for kala-azar. Vector control is one of the important components of malaria control programme. The NMP has in the recent years shifted from its approach of indoor residual spray in large areas to more selective areas for indoor residual

spray. Insecticides in the malaria control programme constitute about only The Hazardous Waste (Management and Handling) Rules (1989) is applicable for the disposal of unused insecticides and empty containers.

In addition to the legislative measures, a National Conservation Strategy and the Policy Statement on Environment and Development was formulated which envisages several measures including development of pesticides and insecticides policy for the country; development of integrated pest management and nutrient supply system and phasing out and stoppage of persistent and toxic pesticides and substituting them with environmentally sound and appropriate pesticides. However this is not a legally enforceable policy. 8.5% of the total usage of pesticides in the country. These policies are based on evidence and global experiences and introduction of these policies helped to significantly reduce the burden of malaria and kala-azar.

At the time of independence, malaria was responsible for an estimated 75 million cases and 0.8 million deaths annually. To check the disease, the National Malaria Control Programme was commenced in 1953 followed by the launch of National Malaria Eradication Programme in 1958. Due to concerted implementation of strategies, particularly spraying with DDT, the number of annual cases was successfully brought down to 100,000 and deaths were eliminated by 1965-66.

In the following years, the Programme faced various technical obstacles as well as financial and administrative constraints, which led to countrywide increase in malaria incidence to 6.47 million cases in 1976. In 1977, the Modified Plan of Operation (MPO) under NMEP was launched as a contingency plan to effectively control malaria by preventing deaths, reducing morbidity so as to improve the health status of the people. With the adoption of the MPO strategy, the total malaria cases decreased significantly. Presently, about 2 million cases and 1000 deaths are being reported in the country annually, about half of which are *P.falciparum* cases. In 1997, the name of the programme was changed to National Anti Malaria Programme. In 2003, an umbrella programme for prevention and control of Malaria and other vector borne diseases as Filariasis, Dengue, Japanese Encephalitis, Chikungunya and Kala-azar was envisaged and the programme was renamed as National Vector Borne Disease Control Programme. The annual parasite incidence (API) has declined from 11.2 in 1975 to 1.43 in 2006 (>87% decline).

The proposed Vector Borne Disease Control project (VBDCP) will support Government of India (GOI) in achieving its stated goal of reducing mortality and morbidity from VBDBs. The project aims to support activities focused on control of malaria and visceral leishmaniasis. The project will consolidate the gains and build on lessons learnt from the previous Enhanced Malaria Control Project, and support GoI in achieving the above mentioned goal.

The project aims to expand access and enhance quality and performance of VBD control services - prevention, care and treatment of VBDBs, integrated vector management, strengthened surveillance, monitoring & evaluation (M&E), and operational research. It would have a national scope, and will cover both rural and urban areas; the proposed operation is aimed to support the National Program in following three areas of intervention:

1. Increasing access and quality of care and treatment through strengthening capacity of health facilities, medical and health personnel in public and private sectors, village level

- functionaries, ensuring adequate supplies of drugs and laboratory supplies, and introducing ACT.
2. Preventing VBDs and improving Integrated Vector Management (IVM) which will result in scaling up of source reduction, increased utilization of insecticide treated bed-nets, and targeted continuation of indoor residual spraying (IRS). This would be further facilitated by implementation of community based education programs which also includes behavioral change communications, advocacy with local and community leaders, public-private partnership with NGOs and informal health service providers, and inter-sectoral collaboration between health and other departments.
 3. Strengthening institutional and information systems for improved surveillance, M&E, and Operational Research.
 4. Introduction of a dedicated cadre of new staff for malaria and kala-azar in identified endemic districts, whose terms of reference will also include implementation and monitoring of the EMP.

In accordance with the World Bank's Operational Policies on Environmental Assessment, this project has to be environmentally sound and sustainable by recommending measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. This proposed project is categorized as Category B from the viewpoint of environmental risk, as provision of preventative and treatment services under this project involves the use, storage, transportation, and disposal of insecticides and pesticides in various applications. The management of these insecticides requires stringent and systematic cradle to grave management, otherwise there could be direct environmental and public health implications. There are environmental impacts associated with treatment of vector borne diseases such as disposal of infected syringes, pricking needles; used blood slides, used ACT packs etc which will need to be managed properly. There are no expected issues related to construction, as there are no civil works envisaged.

Under the Pest Management Policy, the Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. It emphasizes that the pesticides used in Bank financed projects must have negligible adverse human health effects, must be effective against the target species, must have minimal effect on non-target species and natural environment and their use must take into account the need to prevent the development of resistance. The Policy requires that pesticides procured under this operation be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the Bank. The Bank also assesses the capacity of the country's regulatory framework and institutions to promote and support sound, effective, and environmentally viable pest management.

This Environment Management Plan subsumes a Pest Management Plan, and defines the measures needed to prevent, minimize and mitigate the adverse impacts of VBD control activities and improve environmental performance related to this project.

2. Regulatory Framework:

National:

In India, the principle objective of the primary legislations on pesticide use is to regulate the import of insecticides with a view to prevent risk to human beings and animals. There

are two principle legislations (Insecticides Act 1968 and Destructive Insects and Pests Act 1914) and at least two other cognate Acts which relate to pest management and control.

The Insecticides Act (1971) grants license to manufacture or to sell stock or exhibit for sale or distribute any insecticide. It lays down a detailed procedure for regulating the use, manufacture and sale of insecticides and pesticides and also has a penalty clause for violations. The Central Insecticides Board (CIB) and Registration Committee (RC) are government agencies entrusted with the task of registration regulation and usage of pesticide in the country. The CIB has been constituted under the Insecticides Act, to advise Central Government and State Governments on technical matters, including safety measures necessary to prevent risk to human beings or animals in manufacture, sale, storage, distribution and use.

The Registration Committee (RC) registers insecticides after scrutinizing formulae, verifying claims of efficacy and safety to human beings and animals and also specifies the precautions against poisoning and any other function incidental to these matters. It has wide powers and there is a system in place which is highly regulated, which provides enough safeguards for the insecticides sector. To assess efficacy of the insecticides and their safety to human beings and animals, the RC has evolved guidelines/data requirements which inter- alia includes residue in crops on which the insecticides are intended to be used. While the RC registers pesticides for their usage, their Minimum Risk Levels (MRL) in food and commodities are prescribed by the Ministry of Health and Family Welfare under the prevention of Food Adulteration Act (PFA), 1954. The MRL is established taking into account the toxicological data of the pesticide as well as the trials on crops under good agricultural practices.

As per the findings of a Joint Committee¹ report published in 2004, of the 181 pesticides registered in India, MRLs for only 71 pesticides have been fixed under the PFA Act. The report also states that residues of certain pesticides like DDT and Lindane , which are totally banned for use in agriculture and permitted for restricted use in health programs only, were found in food and vegetable products. It is recognized that that the health departments of various State Governments have the ultimate responsibility of managing the flow of pesticides and insecticides for use in public health purposes. Additionally, the report states, that neither the Ministry of Agriculture nor the Ministry of Health & Family Welfare have any data about the usage of banned pesticides in the States.

The NVBDCP determines insecticide use based on certain epidemiological and entomological criteria like vector resistance. Before procurement, the technical specifications of Insecticides are approved by Technical Advisory Committee (TAC) headed by Director General of Health Services, MOHFW, for application and only those insecticides approved by the Central Insecticide Board (CIB) are used in the programme. They refer to the WHO's "Recommended Classification of Pesticides by Hazard and Guidelines". NVBDCP also ensures quality control certification of insecticides at HIL before distribution to states, through an institutional set-up at HIL, headed by a scientific officer. As per Bank Policy that

¹ Report of Joint Parliamentary committee of the Lok Sabha on pesticide residues in the safety measures for soft drinks, fruit juice and other beverages: dated February 14, 2004

procurement of pesticides (i.e. No class I pesticides or POPs) should be undertaken in compliance with and within the framework of the Stockholm Convention.

The Prevention of Food Adulteration Act (PFA Act) deals specifically with the adulteration in food articles. Though it lays down norms of minimal residual presence of pesticides in food items, it does not have any provision on the assessment and mitigation of impact of these pesticides on human health and environment. While the RC registers pesticides for their usage, the MOHFW under PFA (Act) prescribes their Minimal Residual Limit (MRL) in food and commodities.

The Manufacture, Storage and Import of Hazardous chemical Rules, 1989 (amended in 2000) applies to the manufacture and use of DDT and is thereby applicable to this project. However these Rules are still much weaker than the standardized guidelines established by FAO as per the "International Code of Conduct on the Distribution and Use of Pesticides". The National Vector Borne Diseases Control Program, (NVBDCP) has framed prescriptive guidelines on safe handling and storage of insecticides and for promoting IVM in public health. There are model civic by-laws in urban areas for creation of breeding habitats instituted by Municipal Corporations. However, the implementation of these guidelines and their efficacy in improving work conditions has not been rigorously assessed.

There is a need for a comprehensive pesticide and insecticides policy for the country to include mechanisms for assessment of pest management issues, impacts and risks and to promote the use of demand driven ecologically based biological or environmental pest management practices especially IVM in public health. There is need for better implementation of the registration process of insecticides and better adherence to set standards, by central and state governments, and users². India has considerable legislation for protection of workers rights and health. But despite this, India has a very poor health and safety record because of poor implementation of regulations and of occupational health and safety measures. In general, the workforce is abundant, unskilled, but easily available due to the high rate of unemployment with greater importance being given to obtaining work than to the health risks involved³.

International:

The revised FAO International Code of Conduct on the Distribution and Use of Pesticides (2003) establishes a set of global standards of conduct for all public and private entities engaged in or associated with the distribution and use of pesticides. It reflects the responsibility of governments, industry, international organizations and traders in reducing the health and environmental risks associated with pesticides. The Code is designed for use within the context of national legislation as a basis whereby government authorities, pesticide manufacturers, those engaged in trade and any citizens concerned may judge whether their proposed actions and the actions of others constitute acceptable practices. The Code calls upon Governments to enforce laws related to pesticide distribution and use, undertake health surveillance programs of those who are occupationally exposed to pesticides and implement programs to monitor pesticide residues in food and the environment.

² "Equivalence Assessment of World Bank's Objectives and Operational Principles with India's legal framework on Health Sector": Draft report by Sanjay Upadhyay, 2006

³ Asian Labour Update – India: health and Safety at work: 2001

While many prescriptions of this Code such as registration of pesticide for use and manufacture, record keeping, collection of data as regards import and export have been addressed under the Insecticides Act, there is need to update the Act which was promulgated in 1971, so as to meet minimum essential international standards.

The GOI also applies the FAO Pesticides Guidelines on Storage, Labeling, and Disposal (1985), which have been amended as part of the International Code of Conduct on the distribution and use of pesticides. But the national guidelines need to be revised according to the three new guidelines issued by FAO in July 2006, which include - Guidelines on monitoring and observance of the revised version of the Code of Conduct; Guidelines on efficacy evaluation for the registration of plant protection products; and Guidelines on compliance and enforcement of a pesticide regulatory program.

The Global Strategic Framework for Integrated Vector Management (IVM), issued by the WHO in 2004 stipulates that IVM provides a basis for strengthening vector control in a manner that is compatible with national health systems. India is also adopting integrated vector control strategy and monitoring the results on IVM strategies.

India is committed to the WHO Pesticide Evaluation Scheme (WHOPES), whose primary objective is to facilitate the search for alternative pesticides and application methods that are less harmful to humans and the environment and cost-effective. The trials are conducted by various research institutions to determine the safety, efficacy and cost-effectiveness of chemical larvicides and adulticides before introduction into the program. Based on the details of the trial, national and international data available in respect of the product, approval of CIB is sought through a valid registration by the manufacturers.

The Government of India has signed and ratified the Stockholm Convention on Persistent Organic Pollutants (POPs). India, as a party to the Convention, is obligated to restrict DDT production and use for disease vector control in accordance with WHO recommendations and guidelines on the use of DDT and when locally sound, effective and affordable alternatives are not available. For emission standards due to incineration of obsolete insecticides bags, the Convention requires the parties to reduce the total release of unintentionally produced POPs. The Convention advocates the use of "best available techniques" and "best environmental practices" when dealing with pesticides such as DDT. "Best available techniques" are the most effective and advanced operational activities and methods for reducing the release and subsequent environmental impact of pesticides whereas "Best environmental practices" are the most appropriate combination of environmental control measures and strategies that can be applied. The latest decisions on the use of DDT under the Stockholm Convention are given in **Annexure-I**.

3. Baseline Data:

The following section is based on findings from an Environmental Assessment report and from consultations with relevant stakeholders:

3.1 General findings of environmental assessment report:

In 2004, the NVBDCP commissioned NEERI to undertake an assessment of Impact of Pesticides used under Public health program in a selected number of states. The main findings of the study showed that systems for insecticide storage, use and disposal are inadequate and worker practices are poor. Precautionary measures to ensure worker safety are not in place and use of protective gear is inadequate. The NEERI report found that there is significant increase in the concentration of pesticides in the blood, milk, animal tissue and environmental samples which is also reflective of continuous use of pesticides in agriculture. In general the report indicates that inadequate practices in the use of insecticides may be causing contamination of the environment and may pose threat to health of service providers and community as well. The NEERI report also mentions one of the weaknesses as being the sound management of pesticides. Storage of the stocks is a challenge, and pesticides are often stored alongside food items or drug storage areas, or in houses.

- Field visits were undertaken to the states of Orissa, Maharashtra and Karnataka. Consultations and discussions were held with SPOs, District Malaria Officers, Store keepers, senior malaria inspectors (Health supervisors), Medical Officers and Health workers of Primary Health Centres, junior health assistants, Auxillary Nurse & Midwife (ANM), teachers, Villages chiefs, Shop keepers, spray workers and community. 313 opinion leaders and community persons and 18 health staff were contacted and information was elicited through structured questionnaires meant for different categories.

A brief discussion on the current vector practices will provide an understanding of their potential adverse impacts on environment and health based on which an Action Plan can be defined.

3.2 Current vector control practices:

3.2.1 Procurement of DDT & other insecticides:

In the program, three types of insecticides namely organo-chlorine (DDT), organophosphate (Malathion) and Synthetic pyrethroids (Deltamethrin, Cyfluthrin, Lambdacyhalothrin etc.) are procured by GoI for indoor residual spray. The procurement of insecticides are based on vector resistance criteria, technical requirement on the basis of more than 2 malaria cases per 1,000 population, numbers of houses/ rooms in village to be covered. On the basis of state's action plan, the national agency i.e NVBDCP places the orders to procurement agency for supply of insecticides other than DDT. For DDT procurement, NVBDCP places orders directly to Hindustan Insecticide Limited (HIL), Govt. of India enterprises. This factory is a single manufacturer of DDT in the country. The insecticides are supplied directly by manufacturer(s) to consignee (district) after pre dispatch quality check by the approved agencies. For DDT 50 % wdp, NVBDCP has in built quality check control units located at Kerala and Maharastra state. The DDT samples are checked at manufacturer factory site. States, if wishes can undertake post dispatch quality sampllelling. The Bags/ container are kept either at district Godowns or at panchyat's store room in village. The quality of spray, discharge rate of insecticide is being checked regularly by the Malaria Inspectors and District Malaria Officer. The monitoring of spray is

being checked during spray season by National Institute of Malaria Research (Indian Council of Medical Research), Regional Office for Health & Family Welfare located at different places in the country and by NVBDCP Officers.

The main period of the incidence of malaria extends from April to November /December. In North eastern states due to vector bionomics the transmission starts much earlier from January to October / November. Considering the persistence of insecticidal action and the variation of transmission period from area to area, two rounds of spraying with insecticides such as DDT, Malathion, Synthetic Pyrethroids depending upon vector susceptibility status are being undertaken in areas which are above 2 cases per thousand population.

3.2.2 Transportation:

Insecticides are transported from manufacturers to District headquarters (HQ) by road. The frequency of delivery varies from 1 - 3 times in a year. The transportation of insecticide from district HQ to different primary health centres (PHCs) is done by official vehicle of District Malaria Officer. From PHCs to sub-centres and villages, the insecticide is transported either by official vehicle of the PHC or by the spray workers on their own bicycles. Leakage of insecticide bags has been noticed and reported. While there has been no reported incidences affecting health of workers during transportation of insecticides, there is need to strengthen safe transportation system and monitoring mechanism.

3.2.3 Storage:

Insecticides are stored at District HQ, PHCs, sub centres and villages. However none of these places have dedicated storage areas for insecticides and items like drugs, insecticides, bed-nets etc are all stored in general stores. Owing to scarcity of storage areas, it has been found that facilities not suitable for storage are being used as store by district authorities. There is little knowledge about storage protocols for insecticides.

3.2.4 Disposal of empty containers/obsolete insecticides:

In the NVBDCP program there are clear-cut guidelines for disposal of empty bags/containers, which are not usually followed due to lack in awareness among the workers and community at large. However, the implementation of guidelines is to be made effective by workers and needed to be strengthened.

NVBDCP has a policy of Vector Management and uses a range of different approaches in its program dependent on the specificity of the area and vector to encourage a balance usage of cultural and insecticidal methodologies and habitat manipulations. Indoor Residual Spraying (IRS), use of insecticide treated bed-nets (ITN), larviciding and thermal fogging and environmental manipulation methods are all utilized. In the new project it has also been envisaged to use long lasting insecticide nets (LLINs). Brief description of each component is provided below:

(i). IRS

Vector control for malaria and other vector borne diseases depend upon the use of IRS in India. IRS is the easiest and most cost effective approach for breaking man vector contact. There are different categories of insecticides used for the control of vector-borne diseases. Wettable powder (WP) formulations are used for indoor residual sprays while emulsion concentrate (EC) formulations are used for larval control⁴.

- Organochlorine (chlorinated hydrocarbon) insecticides such as DDT (50%WP)
- Organophosphates, such as Malathion (25%WP), , Fenthion, Pirimiphos-methyl, and Temephos
- Synthetic Pyrethroids such as Deltamethrin (2.5%WP), Cyfluthrin (10%WP), Lambdacyhalothrin (10%WP), Alphacypermethrin (5%WP), Etofenprox (10%WP) and Bifenthrin (10%WP). Synthetic pyrethroid insecticides are also used for impregnation of bed nets.

Dosage and annual consumption of different insecticides used for IRS are given in **Tables 1 and 2**.

Table 1: Insecticide Formulations and their dosages for indoor residual spray in India⁵

Insecticide	Preparation of suspension in 10 Lit water	Dosage per Sq Meter of active ingredient	No of spray rounds per annum	Requirement per million population per round	Area to be covered by 10 lit of suspension
DDT 50% WP	1 kg	1 gm	2	75 MT	500 Sq m
Malathion 25% WP	2 Kg	2 gm	3	300 MT	250* Sq m
Deltamethrin 2.5% WP	400 gm	20 mg	2	30 MT	500 Sq m
Cyfluthrin 10% WP	125 gm	25 mg	2	9.38 MT	500 Sq m
Lambdacyhalothrin 10% WP)	125 gm	25 mg	2	9.38 MT	500 Sq m

**To be sprayed in two coats*

Table 2: Annual allocation of insecticides for IRS (metric tons)⁶

Insecticides		2002-03	2003-04	2004-05	2005-06
DDT	for malaria	5800	6000	6000	6000
	for Kala Azar (in MT)	1180	2500	2650	2560
Malathion	25%	-	50	45	50
	Technical	-	25	25	25
Synthetic Pyrethroids	2.5%WDP (in MT)	433	257	673	477
	Syn. Flow (in Lts.)	6100	35000	103500	155250

⁴ Wettable powder formulations. All data from "Indoor Residual spray (IRS) in Malaria Control" by NAMP

⁵ MAP, NMEP, 1995

⁶ NVBDCP, Delhi

Synthetic pyrethroids are fast-acting insecticides and produce a quick knockdown effect against vectors and have been used for IRS in some high-risk areas and areas with triple resistant (DDT, HCH and Malathion) vectors and also in some areas to tackle malaria outbreaks and epidemic situations. Synthetic pyrethroids are also used to impregnate bed-nets, which protect populations from malarial mosquito bites at night. These pesticides are less toxic to wildlife and biodegrade far more efficiently.

The choice of insecticide for areas is done based mainly on the vectorial influence of *Anopheles culicifacies*, the main rural vector of malaria in India and its epidemiological impact.⁷ In areas with *An fluviatilis*, *An minimus*, *An philippinensis*, *An dirus* and *An sundaicus*, DDT is used as these vectors continue to be susceptible to it. DDT on house walls shortens the longevity of mosquitoes coming in contact with wall surface and also prevents adult mosquitoes from entering houses due to excito-repellency action. A recently published probability model shows that of these three actions, the repellent and irritant actions are more important in breaking man-vector contact inside houses. Spray operations are to be carried out in all areas with API 2 or above, though priority is given to high-risk areas. Epidemiological data of preceding 3 years is considered for selecting the population to be sprayed.

During the field visits, 27 spray workers were interviewed to understand practices related to making of suspension, spray methods, wearing of protective gears and disposal of empty containers and leftover insecticides. The spray workers are usually temporary labourers, many of whom are illiterate and who are hired regularly every year during spraying season. The workers do not use protective gear while spraying DDT and Malathion. The field visit showed that spray workers, who had no access to protective gear, had to cover their faces with cloth while spraying. Many were seen to be using local non-standardized products such as face masks made of thick nylon material, completely unsuitable for respiratory protection. It should be noted that workers wear protective gear when using synthetic pyrethroids, because these come included in all insecticide packages.

All spray workers were diligent about washing their hands after spraying operations. The community is not involved in spray operations and there is no little notification or advice on post spraying actions. Additionally the community seems to be against IRS using DDT and Malathion and there have been instances where people have denied access to their homes. According to the findings during the field visits, the enormous work load assigned to the field health workers and the inadequate traveling allowance is a key factor hindering supervisory work in spray operations.

Due to the special requirements for DDT, this document includes separate sections on various aspects of DDT usage:

⁷ MAP, 1995

DDT

In India, DDT has been used for malaria control operations since 1946. The introduction of DDT in public health, first as a larvicide and later as an adulticide through IRS, brought about a revolution, and Malaria eradication was thought to be an achievable task. Spraying of DDT, particularly as IRS, almost eradicated malaria in difficult areas. India has utilized 350,000 tons of DDT since 1985, mainly for agricultural and public health purposes. However, since 1989, GOI banned the use of DDT in agriculture and restricted its use in public health to 10,000 metric tons a year. It is used only in rural areas in indoor spraying applications. There has been gradual reduction of DDT use for IRS. **(Table 3)**

However, continued and extensive use of DDT over the past 40 years has led to the development of physiological resistance in certain vectors while a behavioral change to avoid contact with insecticide was noticed among other vectors. *Anopheles culicifacies* s.l., the main rural vector of malaria in most parts of the country, has developed widespread resistance to DDT, Dieldrin/HCH, and also to Malathion in several districts. *P. argentipes* is resistant to DDT in some districts of Bihar, though it is still susceptible in West Bengal and some of the districts of Bihar. Most of the *Culex vishnui* groups of mosquitoes which transmit Japanese encephalitis (JE) have been reported to be resistant to DDT in most parts of the country.⁸ In areas with *An fluviatilis*, *An minimus*, *An philippinensis*, *An dirus* and *An sundaicus*, DDT is used as these vectors are still susceptible. **(Fig 1)**.

As per WHO expert Committee on Malaria in 2000, it has been recommended that DDT may be used only for IRS, if it is effective, and if the material is manufactured to the specifications issued by WHO and necessary safety precautions are taken into its use and disposal. One of key intervention strategies for the elimination of Visceral Leishmaniasis (Kala-azar) is IRS with DDT, as the vector continues to be sensitive to DDT. Kala-azar is endemic in 52 districts in Bihar, Jharkhand, Uttar Pradesh and West Bengal and puts an estimated 165.4 million people at risk, mostly those from poor socio-economic groups living in rural areas. The National Health Policy goal is to eliminate Kala-azar by 2010, which requires targeted intervention through IRS with DDT up to 6 feet height from the ground twice a year in conjunction with early diagnosis and treatment;

The Govt. of India is a party to the Stockholm convention on Persistent Organic Pollutants (POPs) and has signed and ratified the convention. As per the Protocol, the GOI procures all its DDT from the state-owned enterprise, Hindustan Insecticides Limited, which is a member of International Chemical Manufacturing Association and follows international specifications. It is the sole supplier of DDT to 24 states in India, except Gujarat, Jammu & Kashmir, Maharashtra, Tamil Nadu and Haryana.

Discussions with HIL officials revealed that quality control of insecticide is done by NVBDCP staff deputed with HIL. During the field visit, it was informed that monthly checks are undertaken of all employees. However, according to a Greenpeace report, production of DDT at the HIL factory in Eloor, Kerala has resulted in severe pollution of the endangered Periyar waterways, due to the unabated release of toxic and persistent organic pollutants.⁹

⁸ Status of Insecticide Resistance of Malaria, Kala-azar and Japanese Encephalitis Vectors in Bangladesh, Bhutan, India and Nepal: Activity report 129

⁹ Toxic Hotspots: Investigation of HIL and other factories in Kerala, Greenpeace 1999

Insecticides are transported by trucks and drivers are provided with Manufacturers Safety and Distribution Schedule. DDT is packed in 50 Kg gunny bags which are double lined with thick paper in between the two layers. The supply is made directly to various districts as per NVBDCP instructions on the order forms. An examination of the procurement process by NVBDCP from HIL was undertaken. The quantity and choice of insecticides (based on susceptibility status of local malaria vector and epidemiological impact on malaria) are determined by the states and sent to NVBDCP by March/April of each year. After compilation of all state requirements, NVBDCP send out the request to HIL in June/July.

Table-3: Annual allotment of DDT for IRS in metric tons¹⁰

DDT	2002-03	2003-04	2004-05	2005-06	2006-07
Malaria	5800	6000	6000	6000	6450
Visceral Leishmaniasis	1180	2500	2650	2560	375

(ii). Larviciding

Use of larvivorous fish in identified water bodies is being promoted as a cost-effective environment-friendly vector control measure towards control of malaria. In all, 1193 district level hatcheries and 25644 sub-district level hatcheries are functioning in EMCP states. One of the most successful and widely used biological control agents against mosquito larvae is the larvivorous fish like, top water minnow or mosquito fish *Gambusia affinis* and *Poecilia reticulata*, the common guppy. It has been demonstrated that use of larvivorous fish resulted in reduction of malaria in Karnataka¹¹. Guidelines on use of larvivorous fish has been circulated to states. The chemical methods by use organophosphates such as Fenthion and Temephos have been used as larvicides under the urban malaria scheme on weekly basis. Further Bti, a bacterial insecticide has also been used as a larvicide during the past decade to control malaria and the mosquito nuisance in some towns. In cities and towns under Urban Malaria Scheme in India Temephos (Abate) and Fenthion (Baytex) insecticides are sprayed for larval control (**Table-4**) and their annual consumption for the year 2004-05 was 35,000 and 61,970 Litres respectively.

Table- 4: Insecticide based Larvicides formulations and their dosages¹²

Larvicide	Commercial formulation	Preparation of ready to spray formulation	Dosage per		Frequency of application
			Sq metre*	Hectare	
Temephos (Abate)	50% EC	2.5 cc in 10L of potable water	20 c.c.	200 L	Weekly

¹⁰ NVBDCP, New Delhi

¹¹ (Ghosh et al 2005)

¹² MAP, NMEP, 1995

Fenthion (Baytex)	100% EC	5 c.c. in 10 L of potable water	20 c.c.	200 L	Weekly
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* The doses may be doubled or tripled in case of water bodies having more than 50 cm. depth

(iii). Insecticide treated bed-nets

Insecticide treated bed-nets (ITN) are being used as an alternate strategy for malaria control. Since 1998, there has been gradual increase in supply of ITN in high-risk malaria endemic states (**Fig 2**). The impregnation of bed-nets is done by synthetic pyrethroids (Deltamethrin 2.5% flow) and Lambdacyhalothrin (10%) and Cyfluthrin (10%) (**Table5**). Schemes on bed-net distribution, insecticide impregnation of community owned bed-nets have been developed for involvement of civil society organizations (NGOs/Faith Based Organizations/Community Based Organizations/Local Self-Governments). During 2006, 17,95,000 bed-nets have been supplied to the high risk areas of endemic states.

Table-5: Insecticides used for impregnation of mosquito nets¹³

Insecticide	Formulation	Dosage	Frequency of re-impregnation
Deltamethrin	2.5%	25 mg per sq m	6 months
Lambdacyhalothrin	10%	25 mg per sq m	6 months
Cyfluthrin	10%	50 mg per sq m	6 months

In order to facilitate impregnation of bed-nets, vials of deltamethrin in packs of 10 ml are being produced, which is required for impregnation of one single size bed net dosed at 25mg/sqm). This system of packaging of 900ml is expected to negate the problem of unused insecticide arising from impregnation of bed-nets.

The community has been trained in impregnation of bed-nets through village level demonstrations though regular monitoring remains weak. The impregnation of mosquito nets was observed in SIDCO, Navi Mumbai area. The supervisory staff was well versed with impregnation techniques and precautionary measures.

(iv). Thermal Fogging

For space spray, thermal fogging by technical Malathion (5 parts of Malathion in 95 parts of diesel oil) is done in urban areas. This is not a routine measure and is used only on outbreak situation. The workers involved are exposed to Malathion and generally do not use protective gears while operating the machine.

(v). Integrated Vector Management

Under NVBDCP all the components of IVM, i.e. IRS, larviciding, ITN, use of bio-larvicides in urban areas, larvivorous fishes and environmental management by manipulating the sources of breeding of mosquitoes have been attempted at field level. The National

¹³ NVBDCP, Delhi

Institute of malaria research has demonstrated the environmental management techniques through source reduction, use of expanded polystyrene beads (thermocool beads to prevent egg laying in aquatic habitats by creating a physical barrier) and minor engineering interventions in different scenarios, rural, urban, industrial, forest and island ecosystems¹⁴ Seven point action plan for malaria control and a brochure on rainwater harvesting and ways to mitigate mosquito breeding in Chennai were prepared. Municipal byelaws were amended and made more stringent for Chennai city¹⁵. NVBDCP has also adopted the use of larvivorous fishes particularly in Karnataka, Gujarat, Orissa, Madhya Pradesh and Maharashtra etc. Biolarvicides have also been introduced in some urban areas in Maharashtra and metropolitan cities.

4. Potential environmental and health impacts in the vector control program:

Use of pesticides can result in increase in contamination of soil and water, if precautionary guidelines are not adhered to. In many developing countries, the use of pesticides remains a major risk. The WHO estimates that each year there are 25 million cases of pesticide poisoning and as many as 20,000 unintentional deaths, primarily in developing countries. Long-term effects of regular exposure to pesticides often cause chronic illnesses, including cancer, reproductive and neurological effects.

The interrelationships of organisms within an ecosystem are complex. For instance, the food of many marine organisms consist of small arthropods or organisms which are similar in size to mosquito larvae, and such organisms differ greatly in their susceptibility to pesticides. Some may be more sensitive to pesticides than mosquitoes. Many marine, estuarine, and freshwater species often share the same habitat as mosquito larvae. Impacting any portion of this food web may affect other parts or even the entire web. Impacts on fish, wildlife, and native plants are some of the risks. The NEERI report states that there has been a decline in fish populations in some areas. There is also growing concern about the risks to humans from exposure to pesticides in general. These potential impacts to both natural communities and to humans need to be sufficiently understood to help risk/benefit analysis that can result in informed decision making.

It would be apt to keep in mind WB's key preamble¹⁶ that, i) all insecticides harm the environment to some extent and ii) environmental risk from insecticides use in agriculture far outweigh those of spraying for malaria control.. There is no doubt that the risk of increased death and morbidity from not using insecticides exceeds their potential negative public health and environmental impacts. Nevertheless, it is as important that these impacts are reduced as much as possible, especially in the rural areas.

Organochlorines such as DDT are environmentally stable compounds which are highly soluble in lipids, making it possible for them to accumulate in the body fat of non-target organisms. DDT is also a Persistent Organic Pollutant (POPs), which has distinct properties, making them among the most dangerous pollutants released into the environment. They are bioaccumulative – being accumulated through ingestion and retained in organisms at concentrations higher than in the food and water by which they were transmitted. POPs

¹⁴ Sharma et al 1985; Sharma and Sharma 1986,1989; Dua et al 1997

¹⁵ MRC Tech Information series No 003/92 and 96

¹⁶ The World Bank and DDT use in India, 2000

can be transported over long distances through air and water, and concentrate in the environment and biota of regions far removed from the original source of emission. DDT is a known endocrine disruptor, which has the potential for causing reproductive failure in wildlife. It is a probable human carcinogen and is suspected of causing liver damage, developmental disorders and disorders of the central nervous system. It is classified as a Category II pesticide by WHO, i.e. being moderately hazardous. Indian dietary intake of DDT is amongst the highest in the world, estimated at 231 μ g/person/day as compared to the allowable daily intake of 35 μ g/person/day, as specified by the Agency for Toxic Substances Disease Registry.¹⁷

It is internationally recognized that DDT usage for public health is essential, but effective safeguards need to be put in place to protect human health adequately and to prevent insecticide release into the environment. However, its use in public health vector control should meet the three basic criteria: effectiveness, safety and acceptable cost. As per international norms, DDT spraying in India is restricted to IRS.

Although Organophosphates (OPs) are generally less persistent than organochlorines, some have higher acute toxicities, both for mammals and other organisms.¹⁸ Currently recommended OP compounds are the adulticides, Malathion and Fenthion and Temephos as larvicides. These compounds have relatively low mammalian toxicity and most usually break down rapidly; however, some breakdown products are also toxic. Malathion used appropriately in public health mosquito control programs does not pose unreasonable risks to the general population or to wildlife and the environment. It degrades rapidly in the environment, especially in moist soil, and it displays low toxicity to birds and mammals. However Malathion is highly toxic to insects, including beneficial insects such as honeybees¹⁹. According to EPA estimates, due to the small amount of active ingredient released per acre of ground, exposures to Malathion are much below an amount that might pose a health concern. However, at high doses, Malathion, like other OPs, can overstimulate the nervous system causing nausea, dizziness, or confusion. Severe high-dose poisoning with any OP can cause convulsions, respiratory paralysis, and death.

Synthetic Pyrethroids, such as Permethrin are broad-spectrum toxicants that are very toxic to fish, aquatic organisms and most other cold-blooded animals. Due to their high and broad range of toxicity to insects, they may affect beneficial species, thereby lessening natural controls, and for some pests may actually increase the need for further chemical control (Edwards 1993). However, to date, a need for increased chemical control because of pyrethroid use for mosquito control has not been demonstrated. Carbamates are broad-spectrum, tend to be more persistent than OPs in soil, and thus have the potential for considerable environmental impact (Edwards 1993)

Handling of insecticides from stores to places of use involves transportation, spraying and disposal of empty containers and unused insecticides. Spray workers are often the most exposed by contact during making of the suspension and by inhalation while spraying. When empty containers are used for storing water and food, pollutants get a direct entry

¹⁸ (Pimentel & Lehman 1993).

¹⁹ Chapter 9: Mosquito control benefits and risks from Florida Mosquito Control: Florida Coordinating Council on Mosquito Control

into the human body. If insecticide is not sprayed accurately or if left-over insecticide solution is spilled, it can contaminate environment and result in potential health impacts. Inaccurate collection of water for making suspension of insecticides may contaminate the water source, resulting in wider and long-term contamination and health impacts.

The Synthetic Pyrethroid insecticides used for impregnation of bed-nets are also toxic and may cause irritation in eyes and skin if not properly used. While Deltamethrin on ITNs can be a relatively high chronic risk (beyond the US EPA standard of 100) was shown to exist for newborns sleeping under ITNs.²⁰ The toxicity of pyrethroids is due to their affinity for, and intrinsic effect on, receptors or targets within the sodium channels for nerve conduction. Given that pyrethroids are highly lipophilic, they pass through cell membranes and are absorbed through the skin, by inhalation and by ingestion. Thus, individuals are at risk of exposure to pyrethroid insecticides through accidental swallowing or drinking of the product, inhaling solvent vapors, splashing the product into the eyes or onto the skin during net treatment and insecticide residues during bed-net use. Correct doses of insecticides, accurate angle of spray pump and discharge rate of insecticide are important points of application efficacy in IRS.

Organophosphates do not persist or recycle in the environment but prolonged use of some them has also resulted in the development of resistance in some vectors. Larvicides' management also involves constant exposure of health workers to insecticides and poses health risk.

Acute toxicity refers to the adverse effect that may result from single or multiple exposures to a chemical over a relatively short period of time and may occur through treatment and handling of insecticides for treatment of nets. As would be expected, individuals involved in dipping large numbers of nets are most at risk, whereas those who occasionally treat their own nets are less exposed to this level of risk. Acute effects reported by net dippers include tingling and burning sensations, eye pain and irritation, swelling of the face, headache and dizziness. Transitory side effects have also been reported by householders mainly during the first few days after net treatment, including skin itching, eye burning, nasal irritation and sneezing.

Impregnation of mosquito nets with insecticides is carried out by dipping the nets in basins or plastic bags containing the insecticide mixed with water. The general procedures can be any of the following: i) Do-It-Yourself kits, where anyone can treat nets using treatment kits available through shops and health centers. Analyses by the WHOPES shows that ingestion of the contents of even a single application pack of permethrin 10% EC could be lethal to a child, and without adequate precaution, the potential for realization of this risk is high. ii) Pre-treated, long-lasting nets, which are treated by the manufacturer prior to packaging and sale. Since currently available pre-treated long-lasting nets lose their efficacy over time, and from washing, they require re-treatment every 6 months to one year to maintain their efficacy over their life span. Washing large quantities of treated nets in bodies of water increases the risk of acute toxicity among net dippers and could be hazardous to both humans and the aquatic environment. iii) Mass treatment of ITN are usually done by trained personnel at dipping centers, where people bring their nets for

²⁰ Mass use of insecticide-treated bednets in malaria endemic poor countries: Public health concerns and remedies John Ehiri, Ebere Anyanwu, and Henroy Scarlett

treatment and re-treatment. Persons who dip large quantities of nets are exposed to acute toxicity of insecticide products, especially if prescribed precautions are not followed.²¹

Controlling a brood of larval mosquitoes, when concentrated in the water, is easier and more efficient than controlling dispersed adults. Some of the environmental risks associated with the use of larvicides include both direct and sub lethal toxicity to non-target organisms, and in some instances, the loss of mosquito larvae as prey. However, using biorational materials (*e.g.*, *Bti*, methoprene) minimizes non-target effects because of the specificity of these materials.

5. Bank requirements:

Vector Management in public health projects is governed by the World Bank's Operational Policy 4.09 on *Pest Management* and Bank Procedures 4.01 Annex C: *Application of EA to Projects Involving Pest Management*. The OP and BP apply to all projects involving vector management, whether or not the project finances pesticides. The Bank requires that any pesticides it finances be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the Bank. It does not finance formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if

- (a) the country lacks restrictions on their distribution and use; or
- (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly.

DDT is in WHO class II, and its procurement and use are thus subject to the above criteria. The Bank discourages the use of DDT but can finance DDT in those countries, such as India, that still rely upon DDT for malaria control under agreements whereby these governments are exploring alternative chemicals or strategies²². For all aspects of vector management related to DDT use, the Bank refers to WHO recommendations and to the Stockholm Convention. With the goal of reducing and ultimately eliminating the use of DDT, party countries are encouraged to develop and implement an Action Plan which includes

- i) Developing regulatory and other mechanisms to ensure that DDT use is strictly restricted to disease vector control;
- ii) Implementing suitable alternative products, methods and strategies, including resistance management strategies to ensure the continuing effectiveness of these alternatives;
- iii) Measures to strengthen health care and to reduce the burden of the disease.

In collaboration with WHO, Ministry of Health and Family Welfare have developed a project entitled "Reduction in the use of DDT by Enhancing Capabilities for the implementation of Integrated Vector Management. This project, which builds on WHO's IVM multi disease strategy, is funded under the Global Environment Facility, and will enter its 12 month implementation phase in early 2007, after approval of the final official submission by India to GEF. WHO has also developed an "Action plan for the reduction of reliance on DDT in disease vector control" to support countries in this activity.

²² Guidance Note for Application of OP 4.09 in Malaria Booster Projects: Draft 2005

The procurement of any pesticide in a Bank- financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, the Bank refers to the WHO's "Recommended Classification of Pesticides by Hazard and Guidelines to Classification."

The following criteria apply to the selection and use of pesticides in Bank-financed projects:

- i) They must have negligible adverse human health effects.
- ii) They must be shown to be effective against the target species.
- iii) They must have minimal effect on non-target species and the natural environment.
- iv) Pesticides used in public health programs must be demonstrated not to cause ill health effects to inhabitants and domestic animals in the treated areas, as well as for personnel applying them.
- v) Their use must take into account the need to prevent the development of resistance in pests.

6. Institutional Arrangements:

The NVBDCP is the central body, which provides guidance for implementation of the program through an Operational Manual for Malaria Action Plan (MAP) prepared in 1995. The MAP provides guidelines for the all components of the vector management program and defines roles and responsibilities of the different institutional levels involved. The MAP is the basic document on which the EMP for the VBDC project has been based. The MAP defines the following institutional structure:

- At the *State level*, the program is managed by the Director, Health Services, with support from the Additional Director/ Joint Director (NVBDCP).
- At the *District level*, District Health Officer/Chief Medical Officer is the head of health services followed by District Malaria Officer and/or Assistant Malaria Officer and Senior Malaria Inspector (Supervisor).
- At *Primary Health Centre (PHC)* level, Medical officer is in charge, with one supervisor/Malaria inspector and Laboratory Technician. Each PHC has about 6 sub-centres with population of 5,000 each in plains and 3,000 in hilly areas.
- Each *Sub centre* has 2 health workers (one male - junior health assistant and one female- Auxiliary Nurse and Midwife (ANM)). Anganwadi workers, employed under the ICDS program are also available at village level. All the staff provides support in implementation of the vector control program.

IRS is usually undertaken in rural areas based on the criteria of 2 API or above. The program for spray operations is planned by the District Malaria Officer of District and sent to State Program Officer (Joint Director) for perusal and approval. After approval, the advance program is sent to Zonal officer, District collector, Block Development Officer, PHC medical Officer, MPW (Health worker) and Gram Panchayat. After making advance program, the seasonal spray staff is appointed on daily wage basis from villages at sub-centre levels.

The distribution system involves State Program officers (NVBDCP), District Malaria Officers, store keepers, senior malaria inspectors (Health supervisors), Medical Officers of PHCs, Health workers of PHCs, Junior health assistants, ANM), teachers, Villages chiefs, Shop keepers, spray workers and community. Medical officers of PHC make the plan for distribution of insecticides to various sub-centers.

Usually two squads of spray workers are deputed, each squad comprising a superior field worker, 2 workers for handling spray pumps, 2 for spraying and 1 for bringing water for making suspension. Spray operations are supervised by DMO/AMO/Sr MI/MO PHC and health supervisors. MPW supervises the spray program at community level. In the same way the impregnation of mosquito nets is supervised by Health workers who work at the level of community and are based at sub centres.

Trainings are organized at state, zonal and district levels and are targeted at Medical Officers, District malaria officers, Entomologists, District Surveillance Officers, supervisors and health workers. NVBDCP and states have developed IEC material in English, Hindi and especially in local languages about the spray doses and techniques but inadequate attention is provided on adverse impacts of unsafe handling and disposal of insecticides on the health and environment.

The MAP delineates basic steps for the sound handling and storage of insecticides. NVBDCP has also issued a number of guidelines which include the following: i) Insecticides Treated Bed-Net distribution; ii) Use of Larvivorous Fish for Vector Control; iii) Treatment and use of Insecticide-treated Bed Nets and iv) Indoor Residual Spraying for Vector Control. All these guidelines have been disseminated to all state governments for implementation. However, there is reported evidence that these guidelines are not been appropriately utilized. Additionally, the implications of poor handling of insecticides on human health and the environment is inadequately detailed and need highlighting. Establishment of a systematic system for implementation of these guidelines and monitoring is also necessary.

In India, there are two main institutions devoted to occupational health and safety:

- Central Labour Institute, Mumbai and Regional Labour Institutes in Kolkata, Kanpur and Chennai under Ministry of Labour;
- National Institute of Occupational Health (NIOH), Ahmedabad and regional institutes in Kolkata and Bangaur ere under the Indian Council of Medical Research (ICMR), Ministry of Health. The NIOH is quite active as a research institute but has no system for consultation with employers or trade unions.

7. Environment Management Plan:

Though the obvious benefits relate to public health protection, improved human comfort from mosquito annoyance, and economic benefits, vector control activities does entail important public health and environmental risks. The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring, and institutional measures to be taken during implementation and operation of the project to eliminate these adverse environmental and social impacts, offset them, or reduce them to acceptable levels. Many of these requirements are provided for in GOI's *Insecticides Act*, but the EMP defines the specific mitigation, monitoring, and capacity development measures and also includes an

implementation schedule and the capital and recurrent cost estimates for implementing the EMP. This budget estimated for the EMP will be integrated into the total project cost.

7.1 Legal framework:

NVBDCP, through this project needs to recommend and support the Government of India in updating the various regulations related to its activities (as referred to in Section II of this document).

Recommended Actions:

- i. Review of compliance of Insecticides Act to meet minimum essential international standards.
- ii. Coordinate with manufactures, Agriculture departments, FAO and other international organizations for safe use, disposal and import of hazardous chemicals.
- iii. Revise the national guidelines (based on FAO's Pesticides Guidelines on Storage, Labeling, and Disposal), to include - Guidelines on monitoring and observance of the revised version of the Code of Conduct; Guidelines on efficacy evaluation for the registration of plant protection products; and Guidelines on compliance and enforcement of a pesticide regulatory program. This will be done through consultation workshop with these agencies during the 1st & 2nd year of project and shall be discussed in details on implementation of guidelines during project mid course correction. This will be a basic component in the program

7.2 Procurement:

Pesticide procurement is highly specialized and complex. Because of the quantities involved and the necessary lead time to ensure timely inventory replacement, experienced and knowledgeable staff should be dedicated to procurement for vector control products. The GOI's Insecticide Rules provide specifications about packaging and labeling. Inaccurate or inadequate labeling of products can also cause a variety of application and safety problems. Industry also needs to review the feasibility and economic viability of changing packaging materials to environmentally sound and degradable ones. Involvement of the industry in post-sales activities can be an important support for the NVBDCP to ensure proper management and use of insecticides.

Insecticides of superior quality are essential for effectiveness and for minimizing any risk involved in their use. Quality control of pesticides to minimize risks associated with their handling and use, as well as their efficacy and stability in storage, is crucial in efficient and effective vector management.

Procurement is undertaken at the central administrative level of NVBDCP and WHO guidelines are used when planning pesticide procurement. The NVDCP will utilize the services of UNOPS as a procurement agent to supply these essential pharmaceuticals and medical supplies. While this is expected to address the important constraint of completing the procurement actions in time, the real challenge still remains in effective implementation of the program on the ground ensuring that quality services reach the most needy tribal populations in time and appropriate pesticide management practices are followed as per the agreed environment management plans.

Recommended Actions:

- i. Guidelines for pesticide application and disposal of used bags/containers should be included in tender specifications/contracts with insecticide producers, following a "Return to Sender" Principle.
- ii. NVBDCP should ensure quality control and proper and adequate labeling of products by manufacturers before dispatch, including translation in the local language of destination. The manufacturers should include instruction leaflets in local languages before dispatching the goods to destination. This will be one of the pre conditions in bidding document. Pre and post dispatch certification is necessary for all insecticide based products.
- iii. Materials and quality of packaging by insecticide manufacturers shall be reviewed periodically by NVBDCP to ensure efficacy, shelf-life, human and environmental safety as per Insecticide Act and GoI requirements. This will be monitored by Inspectors in states
- iv. Manufacturers should provide independent certification of chemical and physical analysis, product and formulation acceptability to NVBDCP. The NVBDCP will ensure that manufactures provide their independent certification for quality control and the insecticides are tested and the approved batches are dispatched.
- v. Given that use of protective gear is vital for this program, NVBDCP should stipulate all insecticide producers to provide protective gear along with their products, as is being done by synthetic pyrethroids manufacturers.
- vi. VBDCP may establish a list of pesticides authorized for procurement under this project, which should be finalized and submitted to the Bank. The Bank will be kept notified about the insecticides under use in the programme.

7.3 Storage and transport:

Field visits and report have shown that insecticides are stored inappropriately in many areas in many states. Additionally stockpiles of old and probably banned insecticide products and damaged bags resulting in spill-out of insecticide has also been observed and recorded. Not only does this have high potential for contamination of surroundings, but it can also encourage pilferage of insecticides into inappropriate applications. Presence of obsolete insecticides and their usage can result in additional public health risks (side-effects, inefficacy, vector resistance etc). As far as possible, storage areas for insecticides and insecticide-treated materials must be located away from food and drug storage areas and from water sources. Store areas should be secure and well ventilated, with minimum exposure to sunlight and moisture. Training in proper stacking and utilization is essential for minimizing damages, leakages and accumulation of stocks.

Appropriate means of transportation of insecticides needs to be ensured, particularly at stages where the volumes being transported are larger and where the possibility of contamination (of worker and of the environment) is higher. At all times, insecticides should not be transported in proximity with agricultural produce, food, clothing, drugs etc. Vehicles transporting pesticides should carry prominently displayed warning signs. It is important that the pesticide load is checked during transit and at point of delivery. Any leaks, spills or other contamination should be immediately reported. The quality of packaging by insecticide manufacturers is critical, to ensure that minimal damage during handling and transportation. The NVBDCP has requested HIL to changeover DDT packaging from gunny bags to fibre-board drums to reduce ruptures, spills and also loss of efficacy during storage. There is discussion of shifting to long-life benders for more efficient

mosquito control and to reduce risks associated with regular impregnation of mosquito nets.

Licensing of insecticide manufacturers, distributors, retailers, and pest control operators is an important aspect of pesticide management. Industry should ensure that distributors are adequately trained and have access to sufficient information. Licensing is the responsibility of the regulatory authorities but active involvement and oversight by the NVBDCP, through the relevant ministry, is essential.

Recommended Actions:

- i. The FAO manual on "Pesticide storage and stock control" details the most appropriate methods of labeling, choice of site, design and structure of buildings, stacking positions, pesticide shelf life, record systems, spills, leakage and disposal of containers and use of protective clothing. The Consultant (Environment) at NVBDCP (national level) shall ensure that the guidelines of FAO are followed strictly by manufactures. Similarly the recipient at state /district /block level will ensure the safeguard policies. In the new VBD project, workshop for such issues will be held once in year by involving all the manufactures supplying insecticides, other stakeholders and focal point at state level for its effective implementation larvicides.
- ii. The NVBDCP should review and revise the annual procurement and distribution cycle and synchronize it to spraying cycles. HIL and other insecticide manufacturers should be required to distribute their products within a specified time-frame. This is critical to prevent stockpiling.
- iii. States should also provide information on amount of stockpiled insecticides in larger storage areas particularly at district and PHC levels. NVBDCP should also develop a plan of action for disposal of these stockpiles, in consultation with the Bank
- iv. During the 2nd year of implementation, a survey will be carried out on the quality and capacity of storage areas in the states. Based on the survey, funds should be allocated from the program for construction and/or up-gradation of appropriate storage areas for district HQ and PHC facilities.
- v. The manufacturers should ensure that their distribution network comprises of trained and licensed distributors with appropriate transportation vehicles. The NVBDCP will include this requirement into the contractual agreements with the manufacturers.
- vi. A systematic tracking system of volumes of insecticide from factory to point of delivery needs to be established by the manufacturers, along with a system for reporting spills and leakages during transit. NVBDCP should include this requirement in their contracts to be monitored by the consignee state governments.

7.4 Application activities:

Application of insecticides (space spraying and IRS, impregnation of bed-nets, larviciding etc) needs to undertaken in a safe and environmentally sound manner. The only way this can be achieved is by intensive training of all the workers and handlers in proper mixing of suspensions, use and disposal of insecticide and insecticide-treated materials and by easy and timely availability of protective gear. Equipment management to prevent rusting and leakages is also very important. Costly delays can be avoided if spray equipment are checked, maintained and calibrated before start of spraying season. Old and expired pesticides and unserviceable equipment needs to be disposed of in accordance with international standards for disposal of hazardous materials.

The NVBDCP has produced a number of guidelines, but as the field reviews and consultations have shown that these guidelines are not being fully utilized and effectively implemented. As most field health and spray workers either have demanding work schedules or are illiterate, simple and clear instructions and pictorial guidelines are essential for easy utilization. Close supervision of application activities are essential and district and PHC level officials should be provided adequate funds and training to ensure good practices are being followed. One way of reducing wastage and preventing environmental contamination is by provision of appropriately sized packages for spraying and impregnation activities.

Recommended actions are detailed below.

- i. NVBDCP should require manufacturers to provide instructions for disposal of pesticide containers including plastic wrappings as label requirements, consider inclusion in tender contracts provisions. Wherever possible, suppliers should be contracted to dispose off larger used containers. The empty containers shall be collected by field staff under the supervision of Malaria technical supervisor, Medical officer of Block level PHC keeping the safeguard measures while collecting such containers.
- ii. Malaria officers at district and PHC level and spray operators must review all spray equipment and protective gear before start of each spraying season and keep appropriate records. States should maintain these inventories of equipment, PPE and replacement parts.
- iii. NVBDCP will request states to monitor this activity and the records on an annual basis.
- iv. States should be asked to allocate resources (time and financial) for maintenance, repair and replacement of old equipment and protective gear.
- v. Funds should be allocated to develop clear pictorial instructions to health and spray workers on use, applications, preparation of suspension and disposal of insecticides, insecticide treated materials, insecticide containers etc. The malaria technical supervisor and multipurpose worker will train each spray worker for such works. States should develop schedule of training to ensure training is imparted to workers before commencement of indoor residual spray and use of larvicides in urban areas.
- vi. NVBDCP should discuss with insecticide manufacturers possibility of supplying insecticides in the appropriate sized sachets for impregnation of bed-nets. The introduction of such sachets shall be piloted in few districts in the state of Orissa and West Bengal for its feasibility keeping the safeguard policies and disposal of empty sachets.

7.5 Integrated vector management:

The NVBDCP proposes that the use of DDT will be reduced and the use of ITMN, biolarvicides, biological control agents like notonectid bugs, plant based larvicides and Insect growth regulators will be enhanced.

Recommended actions are detailed below:

- i. Piloting of IVM activities in 3 districts (malaria and Kala-azar) during first year of the project.
- ii. NVBDCP should chalk out annual plan for gradual decrease in DDT use and promotion of ITMN, biolarvicides and IGR compounds. This plan will be shared with the Bank.
- iii. Action plans, municipal byelaws to control mosquito menace in urban areas will be reviewed by NVBDCP on the lines of action plans developed by NIMR.

- iv. Sensitizing communities for up-scaling the use of fish in larval control through inter personnel communication by health workers and through village & health sanitation committee functioning under National Rural Health Mission (NRHM)
- v. Mapping of insecticide resistance status of malaria vectors and training staff in effective IVM procedures.

7.6 Waste management:

Provision of preventative and treatment services for VBDs is expected to generate infectious bio-medical wastes such as sharps (infected needles and syringes), laboratory and pharmaceutical wastes. These wastes, if not managed and disposed properly, can have direct environmental and public health implications. Healthcare workers are at maximum risk as most blood-borne occupational infections occur through injuries from sharps contaminated with blood through accidents or unsafe practices. Systematic management of such clinical waste from source to disposal is therefore integral to prevention of infection and sound environmental management.

The Ministry of Health and Environment, through its various programs, has developed a number of detailed guidelines for implementation of sound infection control and waste management practices. These include the following:

- Infection Management and Environmental Plan (IMEP) under the Reproductive and Child Health Program;
- Infection Control and Waste Management (IC-WM) plan under the National AIDS Control program
- Infection Management & Environmental Plan under the Second National Tuberculosis (TB) Control Program

In addition, states which have and are implementing State Health Systems projects, also have state specific healthcare Waste management Plans.

Therefore the VBDCP does not need to develop its own waste management plan, but instead utilize these existing national and international guidelines to institute proper infection control and waste management practices within its health service delivery activities. NVBDCP shall replicate standard protocols for waste management during the first year of the project. This will be developed by the Consultant (Environment). NVBDCP will ensure that these protocols are disseminated to the states and training is provided to its field staff. This should be incorporated into the training plan, as detailed in section 7.9 below.

7.7 Occupational health and safety:

Insecticides are toxic to both pests and humans. However, they need not be hazardous to humans and non-target animal species if suitable precautions are taken. Most pesticides will cause adverse effects if intentionally or accidentally ingested or if they are in contact with the skin for a long time. Worker health and safety is a critical issue in a program such as this one, which involves large amounts of insecticide use.

There are three principal routes that chemicals enter the body: through skin, eyes, mouth and nose while handling, inhaling and accidental/deliberate exposures. Of these, the most common risk is through dermal exposures, which can be minimized by the use of protective equipment, attention to personal hygiene by washing exposed parts of the body after work.

Spray workers and others who come in contact with insecticides must be trained in safety measures and be provided with personal protective equipment (PPE) to avoid hazardous exposures. The MAP specifies that cholinesterase level of all workers using Malathion should be monitored regularly, but these directions should be made more specific and need to be enforced. There seems to be no clear directives on the monitoring of health of spray workers who use DDT. It is important to ensure that PPE available in the program is made of appropriate material to prevent penetration of the pesticide, should be comfortable to wear and use and should be used in appropriate circumstances.

While the commonly recommended solution is to provide health education and training to promote the use of PPE and teach workers on good practices, there is no linear relationship between the transfer of knowledge and a change in behavior, as many of the factors that contribute to pesticide poisonings in developing countries are out of workers' control (e.g., use of backpacks to spray, hot and humid climate that makes it almost impossible to wear PPE.)²³

It is therefore proposed to constitute a National Surveillance Committee to review health and environmental impacts of vector control activities, which can review issues related to worker health and safety and recommend solutions which are applicable and feasible in Indian conditions. The reviews will include the following aspects including quality and content of guidelines and instruction manuals; implementation of good practices in accordance to the guidelines; status of spray equipment and availability of antidotes and first-aid; worker health and safety surveillance systems and their regular implementation; and systems for recording and monitoring pesticide poisoning. Systems for information collection from spray workers, village health committees, householders etc could also be instituted. These committees at national, state and district level will conduct periodic review on occupational health safety measures every year during malaria & other VBD transmission season. State and district has one such Task Force committee chaired by Secretary (health) at state level and District Collector at district level for observance of anti malaria month. The same members will monitor the safety measures at state and district level. State and district shall ensure that the recommendation of committee is followed at all level of the program implementation.

Recommended actions are detailed below:

- i. NVBDCP should provide specifications for PPE required for the program, which should be selected in accordance with the label recommendations²⁴.
- ii. As recommended above, NVBDCP should stipulate all manufacturers to provide appropriate PPE, which will be included with their products packages and maintenance of PPE and equipment should be mandated.
- iii. State authorities must undertake routine monitoring of health staff and temporary workers for pesticide exposure at frequencies and with methods recommended by WHO. NVBDCP should indicate clear time-lines for this activity and ensure reports are maintained;
- iv. The Medical Officers at PHCs and/or District Health Officer should maintain records of poisoning events and report such events to the NVBDCP. The IPCS INTOX Program

²³ Acutely Toxic Pesticides: IFCS

²⁴ Guidelines on Good Practice for Ground Application of Pesticides: Food and Agriculture Organization Rome, 2001

- provides guidance for diagnosis and treatment of pesticide poisonings, preventive measures, and decision-making for management of pesticides. WHO has developed a new database, and their support on this activity will be required.
- v. Recommended antidotes such as Diazepam for OP insecticides and Atropine Sulphate for pyrethroids such as Cypermethrin and Deltamethrin must be kept available at PHCs to address any untoward incidences of insecticidal poisoning.
 - vi. NVBDCP should commission a independent audit for impact of vector control activities after 2 years of project implementation. The study will include primary data collection and analysis. The study TOR should be prepared in close consultation with Bank and WHO and the report should be ready in time for the project's Mid-Term Review.
 - vii. NVBDCP will develop and finalize TOR for the National Surveillance Committee, in consultation with relevant stakeholders and the Bank. The Committee should be in place within first year of project implementation.
 - viii. NVBDCP will strengthen liaison with the Ministry of Agriculture for quality control and stocks management of pesticides.

7.8 Capacity building:

Capacity building for good worker practices is an integral and essential part of integrated vector management. Achievement of the necessary expertise and implementation of good practices at all levels of public health pesticide management requires formal and repeated training. Capacity building must include provision of rigorous and regular training for different levels and types of workers and certification of staff and operators in the following activities: stock management; good storage practices; proper handling of pesticides during transport and disposal; application of insecticides; surveillance methods; signs and symptoms of poisoning, emergency measures; PPE usage; accident reporting, data management and monitoring and reporting. Such capacity building should target those involved in the production, distribution, use and application of insecticides, householders and health personnel.

Recommended actions are detailed below:

- i. Generic training plan should be developed by NVBDCP, which ensures regular (annual) training is provided to all staff involved in VBD control activities and treatment activities. States will then need to submit their plans for implementation of the training plan. Funds have to be allocated from the program for implementing training and for monitoring. A generic training plan for different categories of staff is included in **Table 6** , but this will be developed further by the Consultant (Environment) and submit to World Bank for review within the first 3 months of project implementation.
- ii. Certification and refresher/update training should be required at all management and supervisory levels. In addition to good worker practices, training should include record keeping of application sites, amount and dosages of insecticides used, inventories of pesticides, equipment, and replacement parts, worker exposures, etc
- iii. Appropriate funds should be allocated for this training component.
- iv. Seasonal and part-time spray workers must be trained by supervisors and Multi purpose health Workers and District Malaria Officer of states before the start of the spraying season. The District Malaria Officer should be responsible for this activity and should submit reports of this activity to Director Health Services and to NVBDCP. The District Malaria Officer of concerned states will impart training to NGOs and Panchyati Raj Institutions for waste management guidelines. This shall be developed by National

- Consultant (Environment) in the first year of project. The training will commensurate prior to spray season in each district
- v. As stated above, NVBDCP should develop simple pictorial training and resource manuals for workers which should be translated into local languages at the state level.
 - vi. VBDCP will hire an OEHS expert for development of different guidelines on environmental safeguard policies and waste management.

Table 6: Generic Training Plan

Level	Education level	Training contents	Frequency of training
District Malaria Officer/ Entomologist	Medical graduate/ M.Sc./graduate	Storage, Transportation, perceived adverse impact on health and environment, disposal of empty containers	Every alternate year
Sr. Malaria Inspectors (Health Supervisors)	High school onwards	Toxicity of insecticides, importance of proper transportation, spray methods, sound handling and disposal	Every year
Junior health Assistant (Health Worker), ANM, Anganwadi worker	8 th class pass or above	Toxic effects of insecticides, proper transportation, adequate dose, spray methods, disposal of empty containers	Just before 1st round of spray
Spray Workers	Illiterate/Primary level	Toxicity of insecticides, importance of protective gears, correct doses, proper handling, place of making suspension, disposal of empty containers	Just before 1st Round of spray
Community (Village chief, anganwadi worker/ANM, Teacher and shop keepers etc.)	Illiterate to literate	Proper storage, toxic effects, usefulness of IRS and ITMN, how to use ITMN and importance of community participation	Before every Round of spray

7.9 BCC /IEC:

Public support for the use of public health pesticides is an important factor both for the effective management of vector-borne diseases and for control of pests of public health importance. Long-term health education and communication approaches are required to educate the community, create general awareness and provide accurate information to elicit support for sound and effective use of insecticides. Such approaches are absolutely vital for field level activities such as spraying and bed-net impregnation. A village level committee comprising of the village chief, Anganwadi worker/ANM, junior health worker and village teacher could be constituted to supervise the proper storage, spraying, environment management including disposal of used containers etc at sub centre/village. Community should also be educated to understand the importance of IRS and to take necessary steps to ensure maximum efficacy of spraying. Domestic and peri-domestic sanitation may be an important component where individual and community cooperation is essential. While these solutions require legislation and enforcement, the key ingredients are

public awareness, information and education. The NVBDCP has developed detailed guidelines on public private partnership and BCC strategy, which have not been adequately utilized on the field. It is now proposed that new guidelines on sound environmental and OHS issues will be developed and disseminated actively across all states. An Action plan will be developed before commencement of new project by the OEHS expert.

7.10 Intersectoral collaboration:

A key feature of IVM is the recognition that reduction in the burden of vector-borne disease cannot be seen as exclusively the responsibility of the health sector. This is primarily because major development programs (such as dam construction, forest clearance, road building, housing development, water and sanitation, solid waste management and industrial expansion) can all lead to increased transmission of vector-borne disease unless potential risks are addressed at the planning stage. There is need to engage and empower communities to ensure their active participation and foster collaboration within the health sector and with other relevant public and private sectors.

Such inter-sectoral (agricultural, industry, health water management, urban development, infrastructure etc) collaboration is currently not well-organized or well-structured. Lack of coordination of activities and inadequate delineation of responsibilities can result in considerable overlapping of activities and waste of resources. Additionally mobilization of vector control activities requires human and financial resources beyond those currently available in a health sector that is struggling with demands of other infectious diseases, particularly human immunodeficiency virus (HIV) and tuberculosis.²⁵

NVBDCP shall utilize GOI's guidelines on Intersectoral collaboration and modify them in the context of this program, to ensure IVM activities are successfully implemented.

7.11 Institutional framework:

To support the program in implement of the EMP, the GOI and NVBDCP have decided to strengthen the institutional framework at national and state levels. An Environment Consultant at the national level, one entomologist at district levels and Malaria Technical Supervisors at block level are to be newly recruited. The Accredited Social Health Activist (ASHA) under NRHM at village level is also being envisaged for supporting the implementation of the EMP. To monitor the surveillance outbreak and support the EMP activities, one multi purpose health worker per 5000 population will be assigned at sub centre levels. The Consultant (Environment) will not only provide technical guidance, supervision but also monitor the state level activities with regard to the EMP. **Table 7** summarizes the human resource inputs for implementing the EMP.

Table 7: Additional institutional support in program

Level	Functionary	Number	Key role envisaged	Supported by		
				Project	NRHM	State
Village	ASHA, AWW	One per 1000 population	Fever reporting, RDK/blood smear collection, motivation	Performance linked incentives	Yes	

²⁵ Exploiting the potential of vector control for disease prevention. Townson.H et al. WHO, Dec. 2005

			for treatment, use of LLINs, and treatment			
Sub Centre	Male Multipurpose Health Worker	One per 5000 population	Surveillance, outbreak investigations, case management, and vector control		Filling of vacant posts in malaria endemic districts	Yes
District level	VBD Manager, Entomologist	Approx. 1 -1.5 million	Strengthening Safe guard policies, monitoring of Indoor residual spray	Project		Yes
National Level	Consultant (Environ.)		Development of EMP guidelines, Safe guard policies, monitoring of Indoor residual spray	Project		National

All agreed actions defined will be appropriately reflected in the VBDCP PIP, project budget, legal agreements and contractual documents.

The NVBDCP will also hire an OEHS expert to review the occupational health and safety measure being implemented under the project.

7.12 Reporting and monitoring:

The key to effective monitoring is setting up of a national-level surveillance system that makes data available on insecticide production, sales, pre and post delivery volumes, application location, applications methods and stockpiles. In this program, such a data management system will need to inclusive of all levels of the insecticide chain – manufacturer, distributor village, primary, district, and state offices. Reporting systems for adverse health and environmental impacts and unsafe practices are also an essential part of the monitoring systems. Some of the recommended reporting requirements are mentioned in the Operations Manual for Malaria Action Program (1995), but implementation remains inadequate. Monitoring and supervision is often marred by vacancies and inadequate resources, including transportation. While it is recognized that data and information collection in such a decentralized program is quite difficult, but without effective monitoring of the insecticide chain and environmental and health issues, such a program can not be successfully implemented. NVBDCP will need to invest resources into establishing such a reporting and monitoring system and possibly also review PPP arrangements to support it.

Under NVBDCP, records of dispatches by Insecticides manufacturers, receipt by the consignee, and stock entry in the register are maintained. The formats have already been designed and are in practice. To strengthen this activity, an practice of regular audit will be included. The program also has formats for record keeping of spray equipments to be maintained at Block PHC and district level. There is also a regular system for monitoring of health of spray workers through annual checks of their cholinesterase levels.

While all the required processes are mostly in place under the earlier VBD control programs, it is noted that many were insufficiently implemented. The new project will

ensure that the reporting system for Monitoring and Evaluation is revised and successfully implemented in all states.

Recommended actions are detailed below:

- a) Records of insecticides dispatched by product name, amount, quality and point of destination must be maintained by insecticide manufacturers and submitted annually to NVBDCP.
- b) Records of insecticides as received at the District level by product name, amount, quality of delivery, date and condition of receipt should be submitted annually to the Director, Health Services for on-forwarding to NVBDCP. This should also include detailed records of insecticides as distributed by the district and received at the PHC levels.
- c) Records of insecticides utilized in various applications (IRS, spraying and larviciding), with details of amounts and location should be maintained at PHC levels and submitted annually to NVBDCP through the District office. Supervisors at village levels to monitor application methods should submit their findings to the PHC level for on-forwarding to the NVBDCP.
- d) Records of ITN procured, distributed and impregnated, amounts of insecticides used for impregnation should be maintained at PHC levels and submitted annually to NVBDCP through the District office.
- e) Monitoring for health impacts of spray workers (blood cholinesterase levels) and others handling insecticides should be done annually at the PHC level and submitted annually to NVBDCP through the District office.
- f) Records of spray equipment, PPE and other tools related to insecticide use should be maintained at PHC levels. The records should include inspection of spray pumps and equipment maintenance records. Information about distribution of PPE to insecticide handlers should also be included.
- g) The NVBDCP should review the state reports on conditions of storage and transportation facilities, and allocate funds as mentioned in earlier section.
- h) The states should report to NVBDCP on implementation of training plans for spray workers and availability of supervisory staff and involvement of NGOs for monitoring of activities.
- i) Records of accidental poisoning events and availability of antidotes should be maintained at PHC levels.
- j) The opinions and decisions of village health committees, householders, community concerning the management of pesticides and referring any adverse health impacts from insecticide use should be recorded at the PHC levels
- k) The state level surveillance committee should review the above records on an annual basis and recommend corrective measures where necessary. The National Committee should review the findings and recommendations of the state level committees
- l) As mentioned in earlier section, NVBDCP should commission an independent audit of impact of vector control activities after 2 years of project implementation.

7.13 Adaptation measures in view of impact of climate change on VBDs:

In view of global warming, the Intergovernmental Panel on Climate Change climate change in its Third Assessment Report (2001) projected that by 2080 the temperature rise would be around 3.8^o C and change in precipitation by 7%. Rise in sea level up to 0.88 m may submerge coastal areas. In Indian conditions, change in monsoon rainfall is projected up to 2050. However there is an overall decrease in the number of rainfall days over major

part of the country. This decrease is greater in the western and central parts (by more than 15 days) while near Himalayan foothills, Uttaranchal and in northeast India, the number of rainfall days may increase by 5-10 days. Increase in rainfall intensity by 1-4 mm/day is expected all over India except for small areas in northwest India where the rainfall intensities may decrease by 1 mm/day.²⁶

Under National Communication project of GOI, the Ministry of Environment & Forests, with support from UNDP/GEF undertook studies on vulnerability assessment and adaptation in various fields. NIMR also undertook study on Impact of climate change on Malaria in India during 2001-3²⁷ (**summary in Annexure II**). The GOI will address adaptation measures like strengthening of health infrastructure and better health care through NRHM.

7.14 Implementation:

Given the scope of the program and the complexity of the environmental and health issues related to insecticide use and IVM practices, it has been agreed between the GOI, NVBDCP and the World Bank that the EMP will be implemented in different phases. The first phase will be a pilot phase for about 18 months and will focus on 3 districts (both malaria and KA). The lessons learnt from this "pilot" phase will be reviewed after 18 months and then replicated in the remaining project sites, as appropriate.

The Action Plan prepared by NVBDCP focuses on the following main action items:

- Review of legislative framework
- Capacity building and development of guidelines
- Survey of stockpiles and storage facilities
- Pilot program in at least 3 districts

The timing, frequency and duration of mitigation measures and monitoring for the first 18 months is given in **Table 8**. The table also includes cost estimates for both the initial investment and recurring expenses for implementing all measures defined in the EMP, integrated into the total project costs and factored into loan negotiations.

Table 8: Action plan for EMP implementation, including 18 month pilot program in 3 districts

Action	Responsibility	By When	Cost (Rs)
Contracting of consultant agency for supporting the NVBCP in development and implementation of EMP	NVBDCP	April 2009	30,00,000
Review the existing legal framework including municipal bye-laws and international guidelines	NVBDCP (through consultant agency)	April 2011	20,00,000
Provision of PPE and pictorial instruction leaflets in local language in individual insecticide packages procured under the project	NVBDCP and Procurement Agent	April 2008 – Sept 2009	
Survey of current storage and disposal practices of insecticides in year I states and preparation of	NVBDCP through NIMR	April 2009	15,00,000

²⁶ India's Initial NATCOM to UNFCCC(MoEF, 2004)

²⁷ Dhiman et al 2003 ; Bhattacharya et al 2006

action plan to improve storage and disposal practices			
Survey of stockpiled insecticides in larger storage areas and development of plan of action for disposal of these stockpiles, in consultation with the Bank	States and NVBDCP	End 2009	
Piloting of EMP activities in 3 districts covered in first year of the project	NVBDCP through NIMR	April 2008-March 2009	25,00,000
Organizing workshops and meeting to update the national guidelines for all aspects of insecticide management (procurement, storage, use, disposal, OHS, monitoring, quality assurance and intersectoral coordination)	NVBDCP through the consultant agency	April – June 2008	15,00,000
Workshop for training of Trainers in the application of new national guidelines	NVBDCP	July-Aug 2008	5,00,000
Preparation of training Plan, Training modules and facilitator guidelines	NVBDCP through engaging a consultant	Aug-Sept 2008	5,00,000
Implementation of decentralized training activities at state and district levels	State and district Vector Borne Diseases Control Officers	Sept 2008 onwards	25,000 per district
Development of TOR and establishment of National Surveillance Committee	NVBDCP	June 2008-Nov 2008	5,00,000
Independent audit of impact of EMP	NVBDCP	MTR	5,00,000
Plan for DDT usage	NVBDCP	annual	
Replication and dissemination of Waste Management protocols	NVBDCP	July 2008	
Development of monitoring framework and monitoring the implementation of EMP	NIMR	Ongoing from project effectiveness	20,00,000
TOTAL(in INR)			1,45,25,000

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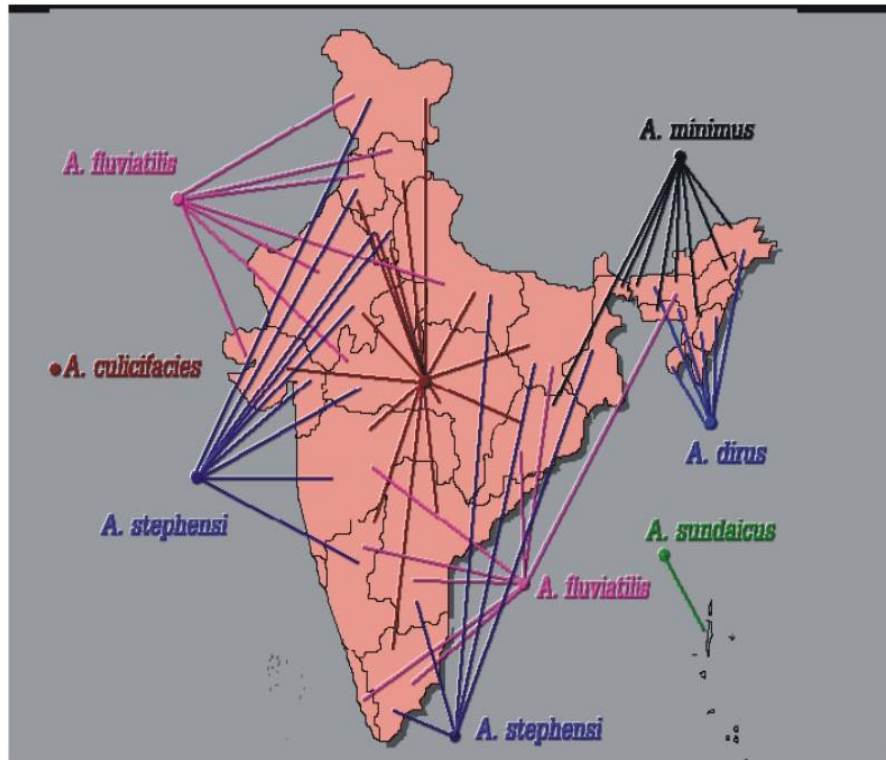


Fig 1: Sphere of malaria vectors in India

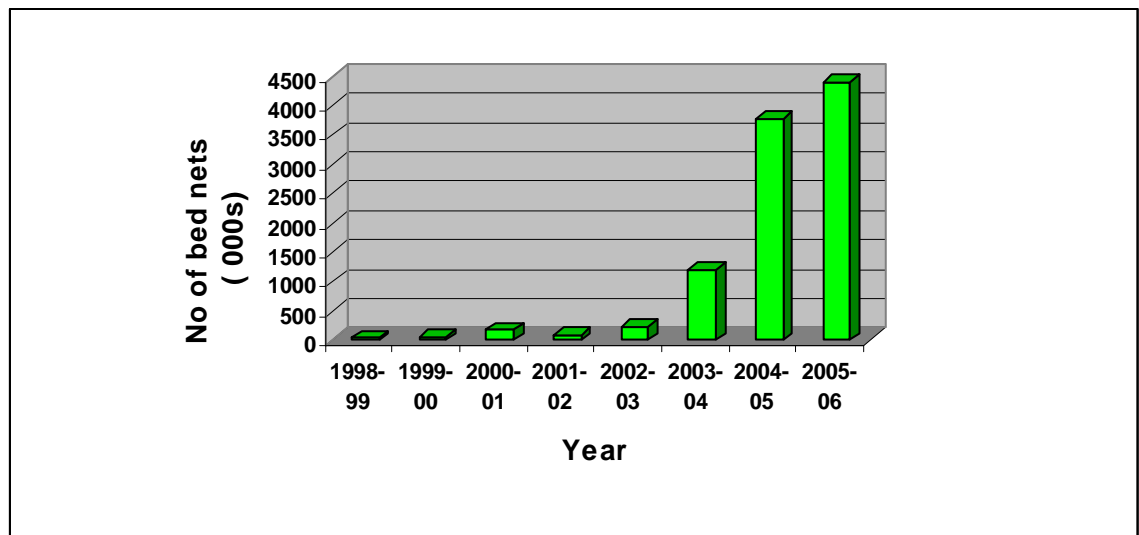


Fig 2: Supply of bed nets under EMCP (in 000s) (Source: NVBDCP)

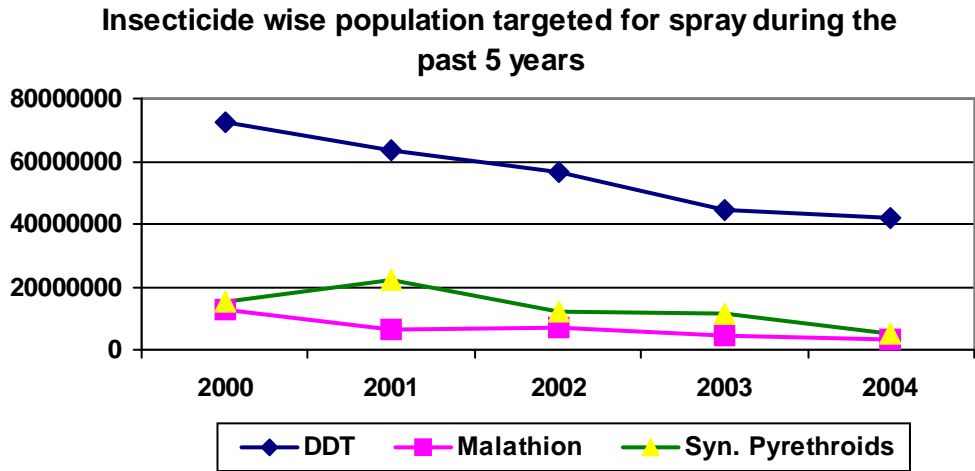


Fig 3: Phase wise reduction in target population for IRS (Source: NVBDCP)

Latest decisions on the use of DDT under the Stockholm Convention

Countries that are parties to the Stockholm Convention have agreed that DDT may be used for indoor spraying for control of malaria, subject to the following requirements

1. Listing in the DDT registry on the Convention website.
2. Notification to Convention Secretariat of present or planned production or use of DDT and disease vector(s) targeted
3. Triennial reporting to the secretariat on
 - Information on DDT stocks, production, import and export
 - Amounts used
 - Disease targeted, population at risk, incidence and mortality
 - DDT resistance in target species
 - Geographic coverage and selection criteria
 - Regulatory framework and management procedures
 - Cost and effectiveness
 - Biological, chemical and environmental alternatives in use and their efficacy
 - National Vector Management policy and strategy
 - Human and environmental health and safety
 - Targets and programs to strengthen disease vector control

Impact of climate change on Malaria in India

The focus in this paper is to understand the likely influence of climate change on vector production and malaria transmission in India. A set of transmission windows typical to India have been developed, in terms of different temperature ranges for a particular range of relative humidity, by analyzing the present climate trends and corresponding malaria incidences. Using these transmission window criteria, the most endemic malarious regions emerge as the central and eastern Indian regions of the country covering Madhya Pradesh, Jharkhand, Chhatisgarh, Orissa, West Bengal and Assam in the current climate conditions. Applying the same criteria under the future climate change conditions (results of HadRM2 using 1S92a scenario) in 2050s, it is projected that malaria is likely to persist in Orissa, West Bengal and southern parts of Assam, bordering north of West Bengal. However, it may shift from the central Indian region to the south western coastal states of Maharashtra, Karnataka and Kerala. Also the northern states, including Himachal Pradesh and Arunachal Pradesh, Nagaland, Manipur and Mizoram in the northeast may become malaria prone. The duration of the transmission windows is likely to widen in northern and western states and shorten in the southern states. The extent of vulnerability due to malaria depends on the prevailing socio-economic conditions. The increase or decrease in vulnerability due to climate change in the 2050s will therefore depend on the developmental path followed by India. Therefore it is important to understand the current adaptation mechanisms and improve the coping capacities of the vulnerable section of the population by helping to enhance their accessibility to health services, improved surveillance and forecasting technologies.