

# **A Century of Vector Control in India: Lessons that have been Learned**

## **(Vector Control Milestones)**

**APMEN**  
**XChange**

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Former Joint Director & Head Vector Control NVBDCP  
*Former Co-Chair APMEN Vector Control Working Group*



# Beating Malaria Means Understanding Mosquitoes

In Africa, 20 percent of the children get 80 percent of the bites from malarial mosquitoes, and an understanding of this could be central to controlling the deadly disease.

Researchers have developed a mathematical model that describes the complex relationship between the proportion of people who are infected with *Plasmodium falciparum*, the parasite that causes malaria, and the rate at which people are bitten by the mosquitoes that carry it.

Nature, Nov. 24, 2005

# Presentation Structure

- History of mosquito control & Challenges
- Key events in India over the past century
- Outstanding people in Vector Control Programme

# Vector Control Milestones in India

- 17th century: Entomology began to develop as a science
- Middle of 18th century: Studies of Danish scientist Johan Fabricius, led to medical entomology in other parts of world.
- 19th century: Scientists speculated disease transmission by insect.
- 1879: Patrick Manson-a physician in China discovered filariasis transmission by mosquitoes
- 1887: Dr Vandyke Carter, the first Medical Man in India to confirm Laveran's discovery of malaria parasite by seeing pigmented organisms in malarious fever cases
- 1897- (20 years later): great physician Sir Ronald Ross in India (Secunderabad) showed the relationship between Malaria and Anopheles mosquitoes
- These discoveries led to development of discipline of "Medical Entomology".

# Vector Control Milestones in India

- 1898-1903: Royal Society of London and other eminent scientists like Christophers, Stephens, Norton, James etc. initiated vector incrimination studies, and vector control aspects of malaria
- 1903: Police Surgeon Dr S A Powel confirmed 2542 +ve against 3413 cases in Bombay
- 1906: A committee of Govt Medical services, Sanitary Service and "Mosquito Experts" was constituted for cause of malaria in Bombay
- By the end of the first decade three more Anopheline species i.e., *An. culicifacies*, *An. annularis* and *An. fluviatilis* were incriminated as malaria vectors.
- Central Malaria Bureau at Kasauli was established in 1909 to undertake studies on entomological aspects of malaria.
- 1911: Dr C A Bentley recommended separate malaria department with vector control experts and team for Bombay (Major G Coovel-Malaria in Bombay)

# Vector Control Milestones in India

## ➤ After Establishment of Central Malaria Bureau at Kasauli in 1909

- Central Malaria Bureau was converted to Malaria survey of India
- Anti-malaria activities by environmental management got momentum
  - **Published** Experience of successful control of mosquito breeding by
    - Channelizing the seepage of Sarda Canal and
    - Control of rural malaria in Mysore by Paris green as larvicides
- **Christopher in 1924** Prepared: First provisional list and reference catalogue of Anopheline mosquitoes
- **1929**: Records of Malaria survey of India published as first journal in India
- Taking the Legacy from Heer 1927, Bentley 1925 & Christopher 1930. Treaties written by Centre in 1935 on "What Malaria Cost India"

# Vector Control Milestones in India

- **Middle of third decade:** Kala-azar Ancillary Enquiry financed by Indian Research Fund Association
  - led to appointment of Kala-azar Commission by Govt. of India and
  - **by 1930**, the enquiry was terminated due to decline of kala-azar
  - Initial studies on entomological aspects of kala azar was completed
  - Man to man transmission was not established in forties
- **1938:** Malaria Survey of India was shifted from Kasauli to Delhi and **renamed as Malaria Institute of India (MII)**
- **1938:** Haffkine Institute, Bombay established department of Entomology
- **1938:** Entomology Laboratory was established in Malaria Institute of India.
- **Training in Entomological, Epidemiological and parasitological** aspects was initiated since inception of Central Malaria Bureau and continued regularly by **NICD** now known as **NCDC**.

## Vector Control Milestones in India

- **Covell and Afridi** in **thirties** did field trial of Pyrethrum for anti-malaria operation in Delhi.
- Aero plane dusting with Paris green in the riverine belt of Yamuna was also piloted for the control of mosquito larvae.
- **Paul F. Russel** and his team-mate during fifth decade of the 20th century collected useful information on entomological aspects of malaria in Southern Peninsula.
- Also, an important discovery was made by **Swaminathan** confirming the man-to-man transmission of kala-azar by sandfly ***Phlebotomus argentipes***.
- In the same decade, DDT was, first time, used in India by Armed Forces in 1944.



# Vector Control Milestones in India

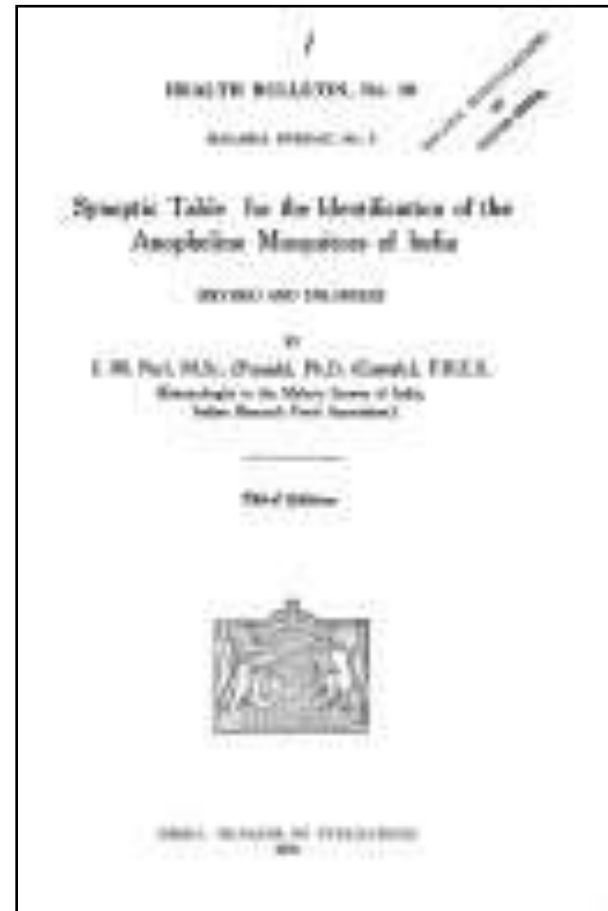
## Synoptic Tables for the Identification of the Full-grown Larvae of the Indian Anopheline Mosquitoes 1949

Inder Mohan Puri



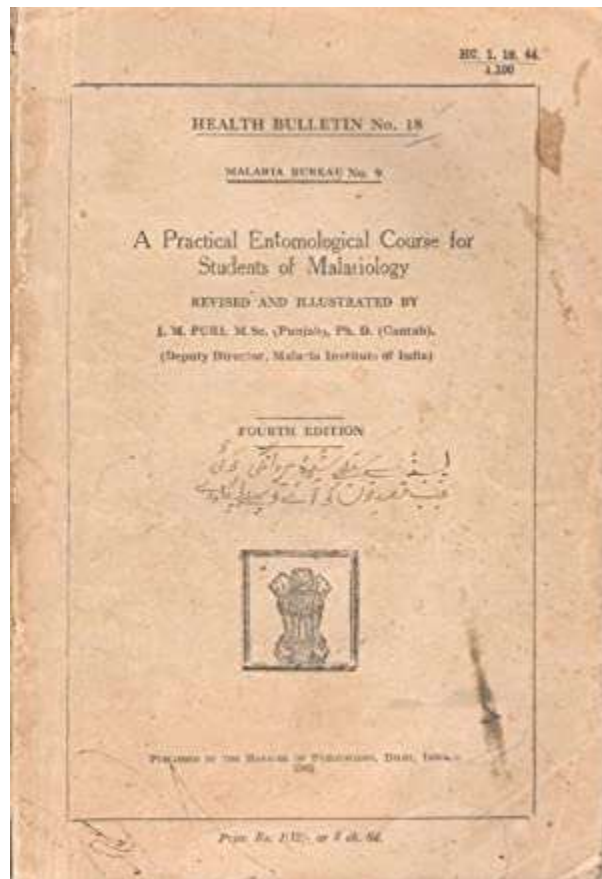
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Inder Mohan Puri

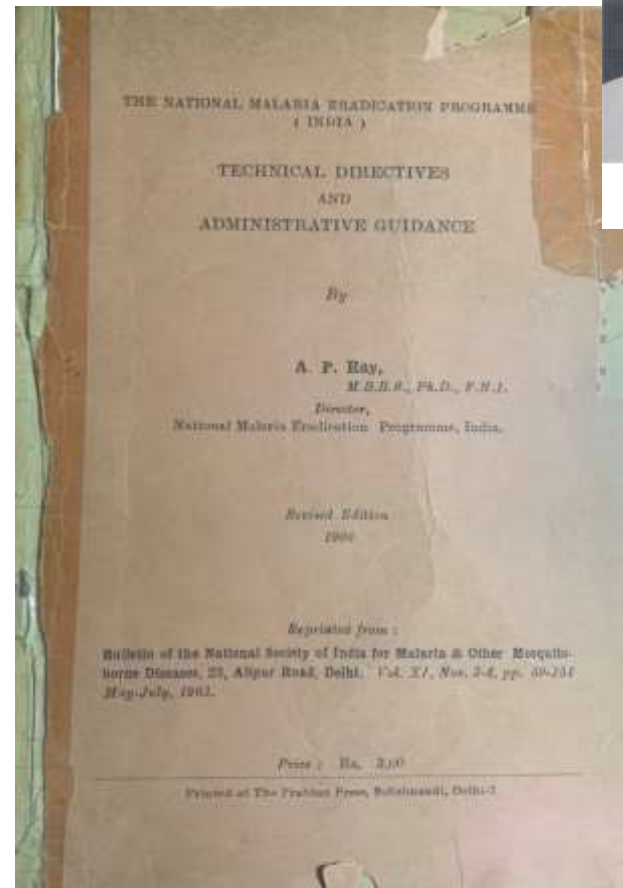


# Vector Control Milestones in India

## A Practical Entomological Course for Students of Malariology Puri, I.M. 1948



## Famous Technical & Administrative Guidelines Dr A P Ray (Reprinted in 1966)



Dr. A.P. Ray  
1959-1967

# Vector Control Milestones in India

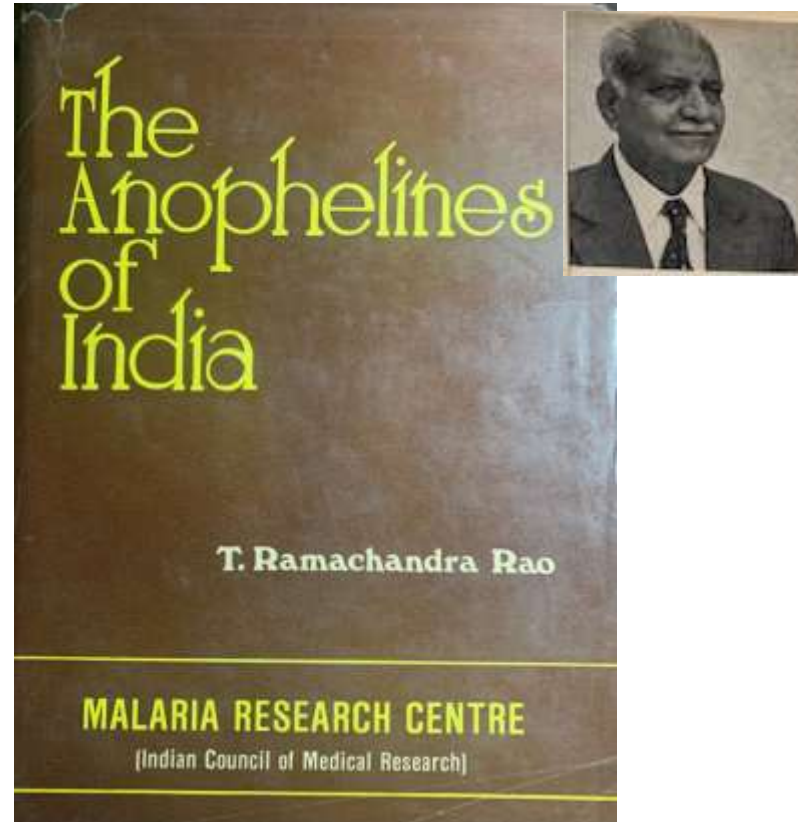
Late Dr S Pattanayak  
Former Director NVBDCP



Dr. S. Pattanayak

- Modified Plan of Operation (MPO) in 1977 with Revised objectives and
- First time creation of 72 Entomological zones in country
- Institutionalization of strengthened entomological structure under Programme

Late Dr T R Rao  
For his Best Contribution



# Vector Control Milestones in India

- End of seventh decade: Genetic Control of Mosquito Unit (GCMU) was established with the collaboration of ICMR and WHO with the main objective of
  - Study the feasibility of mosquito control by introducing laboratory reared sterile male in a defined natural ecosystem
  - GCMU was established where first time only entomological and vector control aspects were given prominence in the realm of Public Health
  - GCMU was disbanded in 1975
  - All experienced Scientists and staff were absorbed under ICMR viz. Malaria Research Centre at Delhi and Vector Control Research Centre at Pondicherry for studies on Malaria including entomological/Vector Control aspects
- VCRC engaged in vector control research with special reference to filariasis
- VCRC running M.Sc Public Health Entomology since 1982
- Centre for Research in Medical Entomology (CRME) was created by ICMR in 1985 (Now part of VCRC)
- RMRCs were created by ICMR at Jodhpur, Jabalpur, Bhubaneswar, Dibrugarh etc. with sufficient entomological infrastructures to carry out entomological surveillance of Vector Borne diseases prevalent in those regions

# Mosquito Species

Genus	World		India	
	No. of species	Major vector	No. of species	Major vector
Anopheles	422	60	58	6
Aedes	888	25	111	2
Culex	715	12	57	3
Mansonia	23	7	4	2
Total	> 3000 species under 38 genus		255 species under 15 genus	

# History: Control of *Anophelines* as Malaria Control

- 1902 – Minor and inexpensive Methods Suggested by Ross
- 1904-1909 – Study on Behaviour and Habit of Anophelines
- 1904 – Christopher's work treatment of Breeding sites with Kerosene Oil
- 1911-12 Pyrethrum Flowers (Extracts)
- 1920-29 – Use in Sarda Canal
- 1930 – Major use was Explored
- 1933-34 – Recognized
- Next Major Development was DDT
- Introduced in 1944
- Used as residual spray
- First introduced by British and American Army in India
- Based on 8 years Experience, NMCP was launched
- DDT was used as Main tool

# National Vector Borne Disease Control Programme

- **1953** as NMCP: Two rounds of IRS with DDT as mainstay
- **1958** as NMEP with malaria eradication goal *due to dramatic reduction in malaria mortality and morbidity*
- **1971** :**Urban Malaria Scheme (UMS)** to tackle malaria in urban areas with main vector *An. Stephensi*
- **1977**:“MPO” Launched to sustain and structured entomological component with 72 zones introduced
- **1978**: NFCP though started in 1955 brought under NMEP and operational component merged with UMS
- **1990-91**: **Organized Kala-azar** Control Programme (centrally sponsored) launched in endemic areas
- **Dengue and JE** were also looked after
- **2003 -04** : Programme renamed as **NVBDCP**

# Milestones in Vector Management

- **Pre-DDT Era:** Larviciding and environmental approach
- **1950s:** Large-scale use of DDT followed by OC and OPs
- **1970s:** Resurgence of malaria-(technical and operational)
- **1980s:** WHO proposed **Integrated Vector Control (IVC)**- “utilization of all appropriate technological and management techniques to bring about an effective degree of vector suppression in a cost-effective manner”
- **1992:** Global Malaria Control Strategy: Planning & implementing sustainable preventive measures including **vector control**
- **Late 1990s:** **Selective vector control** approach (alone or in combination) to reduce man-vector contact
- **1997:** WHA (50.13) recommended integrated pest (vector) management through safe alternative methods
- **2001:** Stockholm Convention on **Prevention of Organic Pollutants (POPs)**- Phasing out DDT and 11 other POPs



# Milestones in Vector Management

- 2001: Stockholm Convention on POPs- Phasing out DDT & 11 other POPs
- 1995: From all structures to Human dwellings (DDT, Malathion, Synthetic Pyrethroids used for IRS selectively only in high-risk areas)
- 1996: Synthetic Pyrethroids introduced in programme
- 1997: BHC **banned** and Overall shift from indoor residual spraying to a broader mix of vector control measures
- 1997: BTI introduced
- 2007-08: Plan Bed Nets to ITNs and now LLINs brought in & Vector control logistics mainly decentralized
- 2010: Fenthion (larvicide) **banned**
- 2012-13: ECoP emphasized and widely circulated
- 2012-13: Source reduction emphasized
- 2014-15: Breeding Checkers engaged and incentivized
- 2015: IGR introduced
- 2016: IVM along with NFME Released

# MALARIA CONTROL/ERADICATION/ELIMINATION IN INDIA: MILESTONES

- Pre-independence estimated malaria cases 75 million & deaths 0.8 million
- 1953 – Launching of *National Malaria Control Programme*
- 1958 – Launching of *National Malaria Eradication Programme*
- 1965 – Cases reduced to less than 0.1 million
- 1976 – Malaria cases 6.46 million and 59 deaths
- 1977 – Revised policy as modified plan of operation introduced
- 1997 – World Bank assisted *Enhanced Malaria Control Project*
- **Eradication concept was changed to Anti-Malaria Programme**
- 2016 – Launch of
  - ✓ National Framework for **Malaria Elimination** (2016-2030),
  - ✓ Operational Manual for **Integrated Vector Management-2016**
  - ✓ Operational Manual for **Malaria Elimination**
- 2017 – Launch of **National Strategic Plan (2017-22) for Malaria Elimination** by 2030



# National Policies and Guidelines for Malaria Elimination



## National Framework for Malaria Elimination in India (NFME): 2016- 2030

Launched by Hon'ble Health & Family Welfare Minister on  
February 11, 2016

## Operational Manual for Malaria Elimination in India- Version 1

Launched by Director General of Health Services (DGHS) on World Malaria Day- April 25, 2016



# IVM Manual in 2016



**Operational Manual for IVM: 2016**

Launched by Hon'ble Health & Family Welfare Minister on February 11, 2016

# MVCR in 2020



**MVCR: 2020**

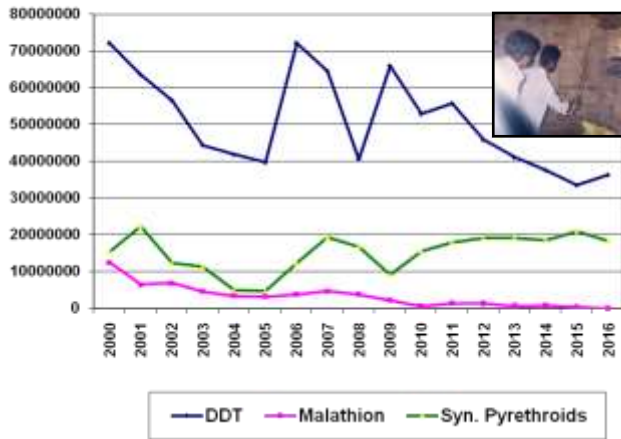
Released Virtually on July 23, 2020

# Milestones in Vector Management Institutional Mechanism

- Technical collaboration with ICMR and NCDC enhanced
  - Expert group
  - VBS forum now known as VBDS Forum
- 2011 : Entomological monitoring gaps highlighted at highest level
- 2014: Evaluation of new products initiated under a common protocol for Uniformity
- Expert group & TAC to review and guide the programme
- Functionality of Zones: emphasized and financial support provided through State PIP under NHM. 40 out of 84 are functional

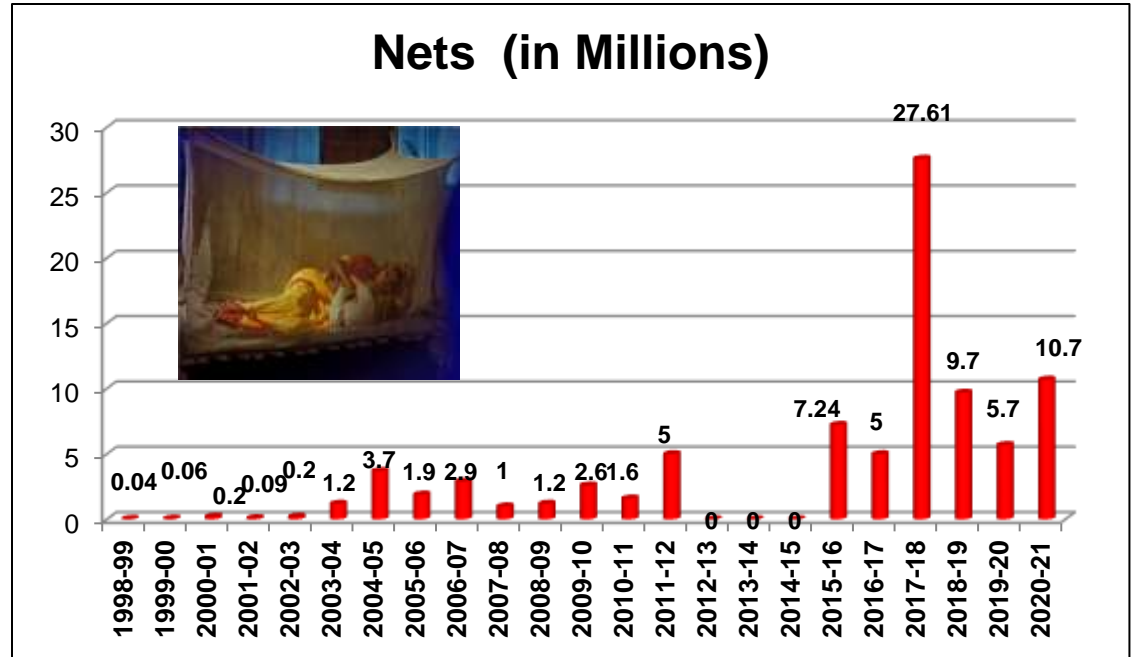
# IVM: IRS ↓ Nets/LLINs ↑

Population targeted for IRS in India



Larvivorous Fish-Promotion

Nets (in Millions)

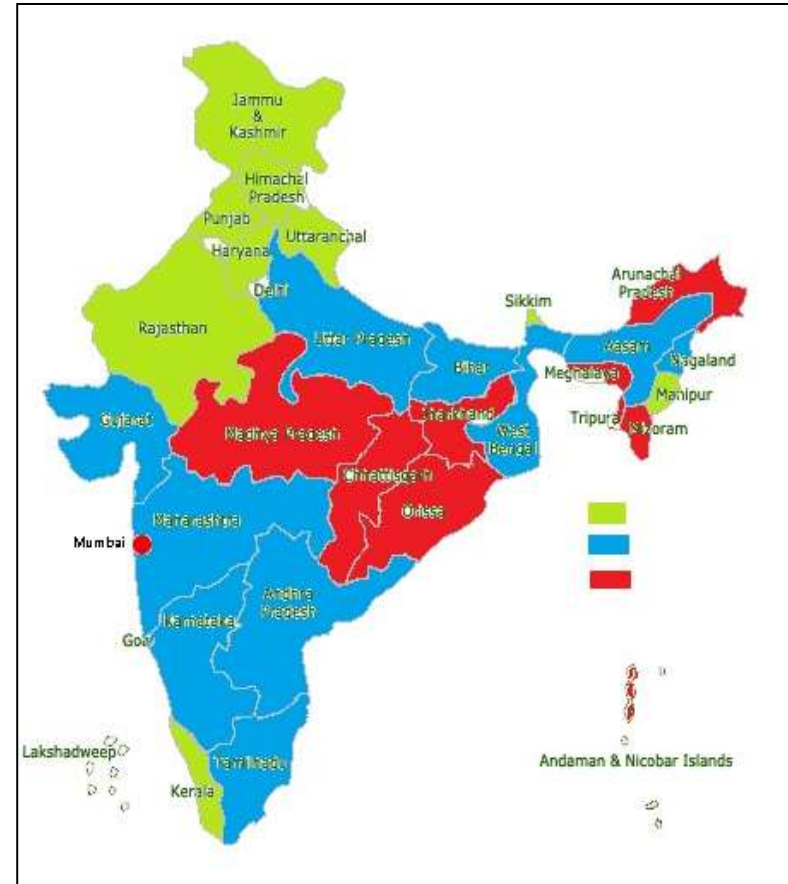


Plain Bednets

LLINs

# Challenge: Legal Measures in Vector Control

- **Public Health Act**
- **Building bye-laws**
- **Adequate**
- **Uniform**
- **Quick disposal**
- **Health Impact Assessment**
- **Emergency control**
- **IHR**



# Challenge: Insecticide Resistance Management

- **Capacity Building of existing entomologists through ICMR Institutes, NCDC, Delhi & IVCZ Hosur, Tamil Nadu**
- **Availability of tools-**
  - **Susceptibility kits (through WHO)**
  - **ICMR standardized impregnated papers**
- **Execution in priority area targeted:**
  - **Pre-monsoon & Post-monsoon**
  - **By zones, districts, ROHFWs, ICMR & NCDC, Universities**



# Scope of Operational Research

- Entomological vigilance, suggestions and warning of consequences
- Area specific amendments for use of different integrals of IVM
- Impact of implementation of tools and scope of improvement-not general
- Change in behavior of vectors/ suspected vectors with reference to climatic change or ecological manipulations

# Strength

- **Infrastructure: State, Zonal (Entomologist-1, IC-2, LT-2 with Mobility**
- **Central & Regional**
- **WHO Collaborating Centres (ICMR)**
- **Guidelines: Available & widely circulated**
- **skilled experts**
- **Training institutions : NCDC, NIMR, VCRC, CRME, RMRCs and IVCZ, Hosur, some Universities and NVBDCP**

# Strength & issues for Entomological Surveillance & Vector Control

## ENTOMOLOGICAL ZONES IN INDIA

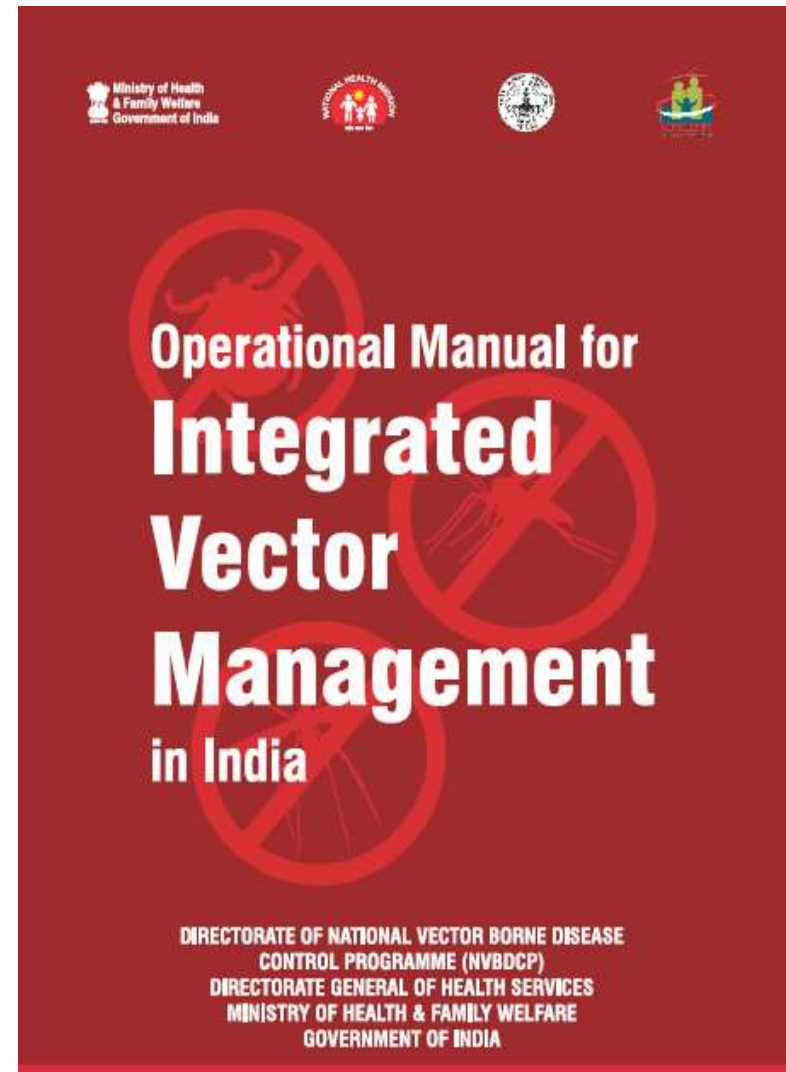
78 sanctioned  
40 functional



Organization	Status
1977: 72 Entomological zones were created which increased to 84 in 2019	<b>40 functional</b> <b>No separate vehicle</b>
Regional Offices (GoI) 19	<b>16 Entomologists sanctioned</b> <b>1 in position</b> <b>13 Consultants</b>
NCDC HQ + Branches	<b>3 Entomologist in position</b>
IDSP	<b>17 State Entomologist can contribute</b>
Indian Council of Medical Research (ICMR)	<b>30-35 Entomologist in position and can contribute</b>
Universities	<b>10 working on vector control – can be involved with financial support and orientation for programme</b>

# Integrated Vector Management (IVM)

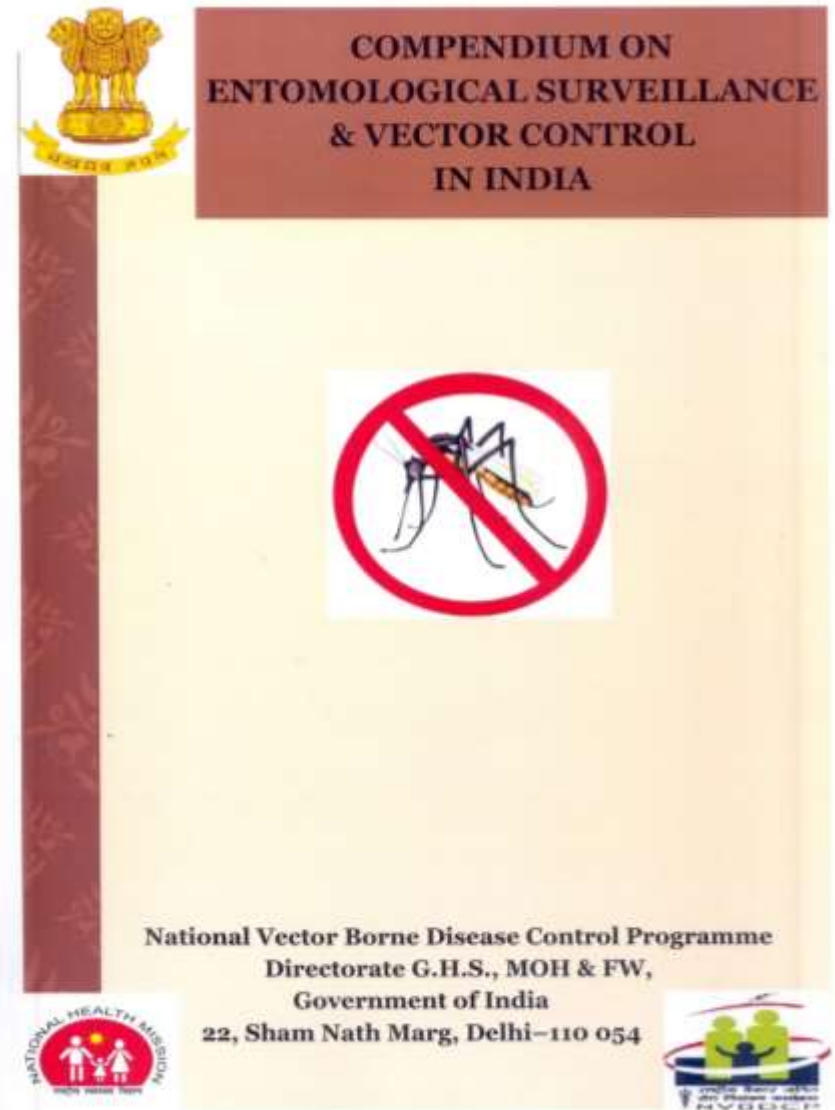
- **Glimpse of Major vectors for VBDs**
- **IVM component under NVBDCP**
- **Safe Handling & Disposal**
- **Roles of various stake holders**
- **Health Impact Assessment**
- **Legislation**
- **Community Participation**



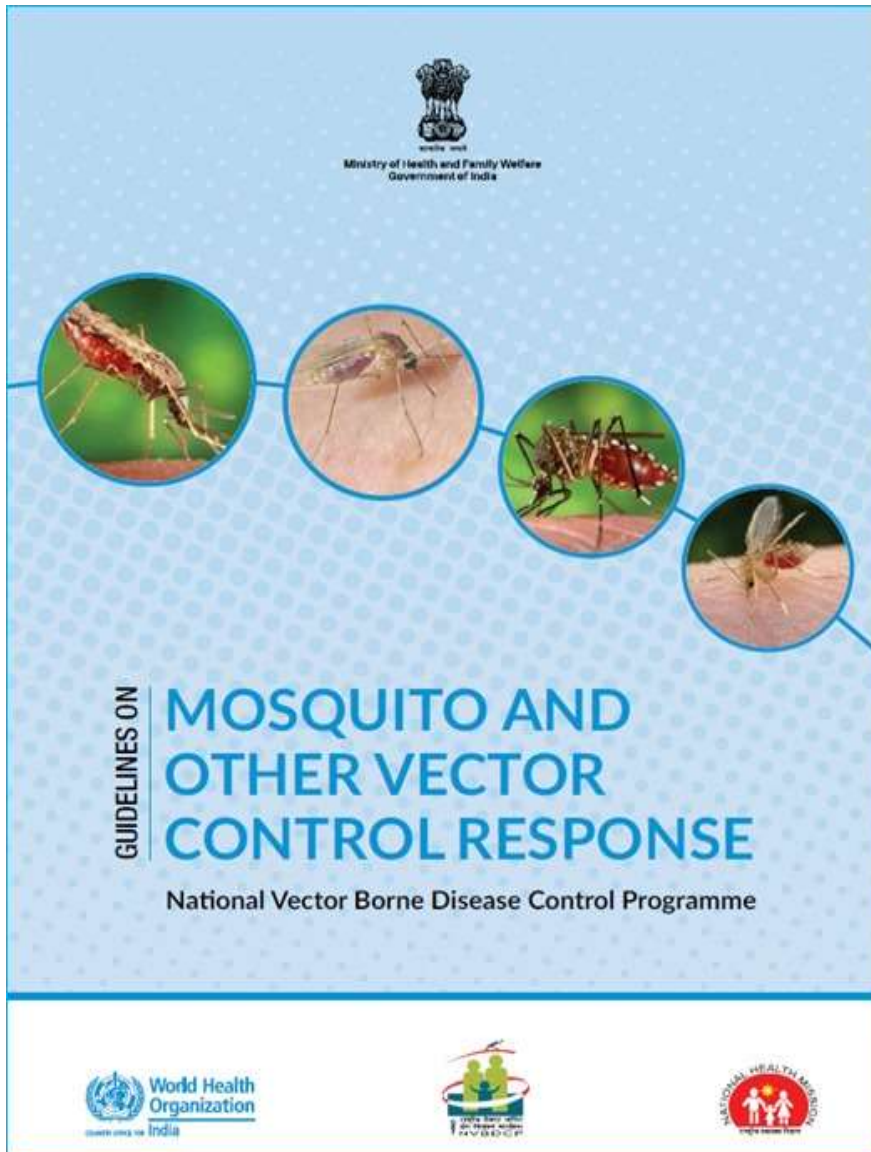
[http://www.nvbdc.gov.in/Doc/IVM10\\_March\\_2016.pdf](http://www.nvbdc.gov.in/Doc/IVM10_March_2016.pdf)

# Compendium on Entomological Surveillance & Vector Control India

- **Specific to Surveillance techniques under Programme**
- **Tools used under NVBDCP**
- **Tools available in Market**
- **Pesticide Management- use & safe disposal**



# MVCR-2020



## MVCR : Two Core Elements

- Enhanced HR, Infrastructural & Health System Capacity for continuous Monitoring **vector control & Vector Surveillance**
- Increased disease diagnostic facilities, basic and applied research to underpin **optimized VC & innovation for development of new tools**

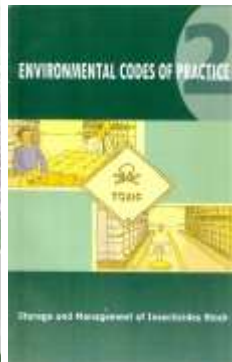
# Environmental Codes of Practice



<http://www.nvbdc.gov.in/Doc/1-ECOP%20Jacket.pdf>



<http://www.nvbdc.gov.in/Doc/6-ECOP%201-%20Transportation.pdf>



<http://www.nvbdc.gov.in/Doc/7-ECOP%202-%20Storage.pdf>



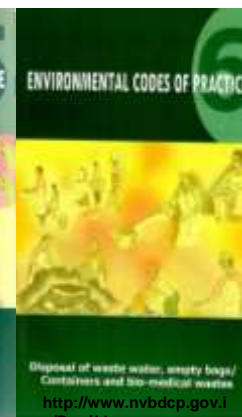
<http://www.nvbdc.gov.in/Doc/8-ECOP%203-%20Community.pdf>



<http://www.nvbdc.gov.in/Doc/9-ECOP%204-%20Use%20and%20Maintenance%20of%20Personal%20Protective%20Equipment.pdf>



<http://www.nvbdc.gov.in/Doc/10-ECOP%205-%20IRS.pdf>



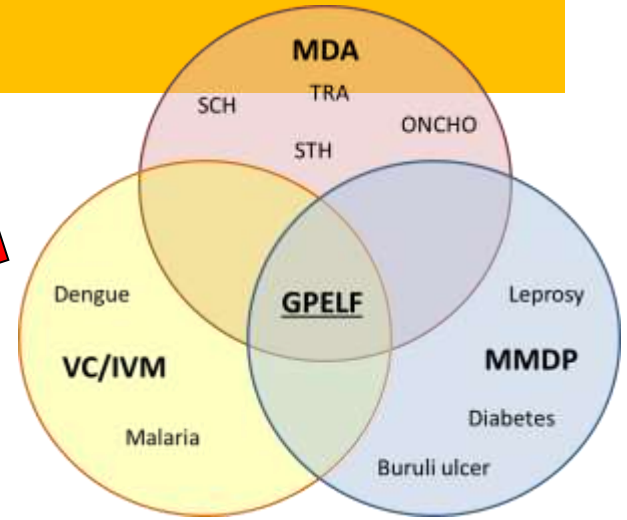
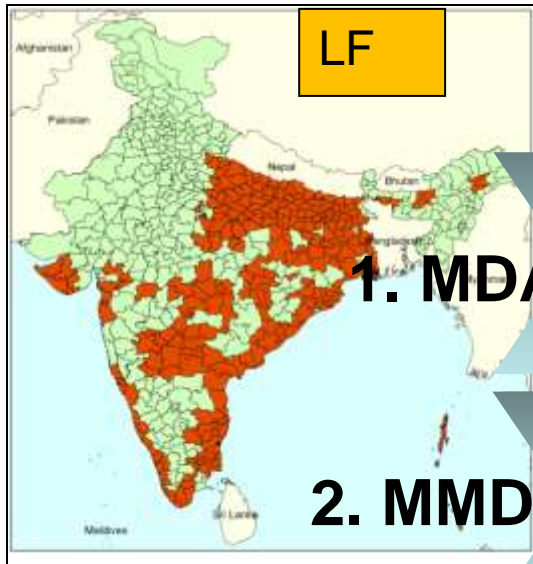
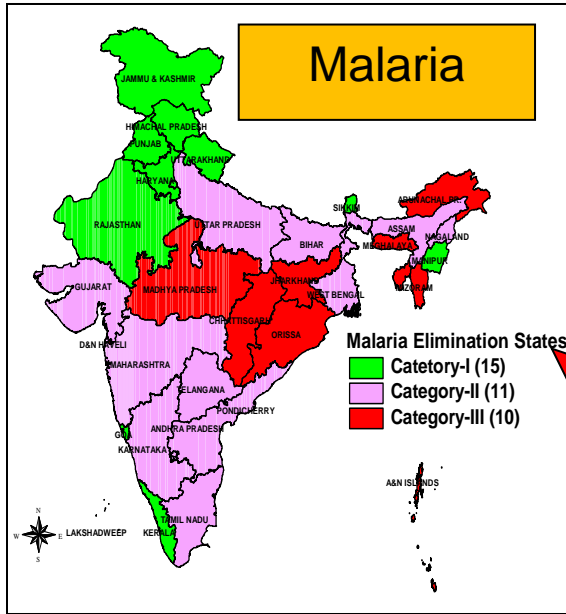
<http://www.nvbdc.gov.in/Doc/11-ECOP%206-%20Disposal.pdf>

# Weakness

- **Execution**
- **Multitasking**
- **Resource availability readily**
- **Planning skill**
- **Coordinating mechanism**
- **Priority to entomological surveillance**
- **Attitude towards Entomology**



# Opportunity



**VC (IVM)**  
for active  
reduction of  
transmission

**VC (IVM)**  
for preventing  
recurrence of new  
infection

**Xenomonitoring**

**1. MDA**

Mapping

MDA

Post-MDA  
Surveillance

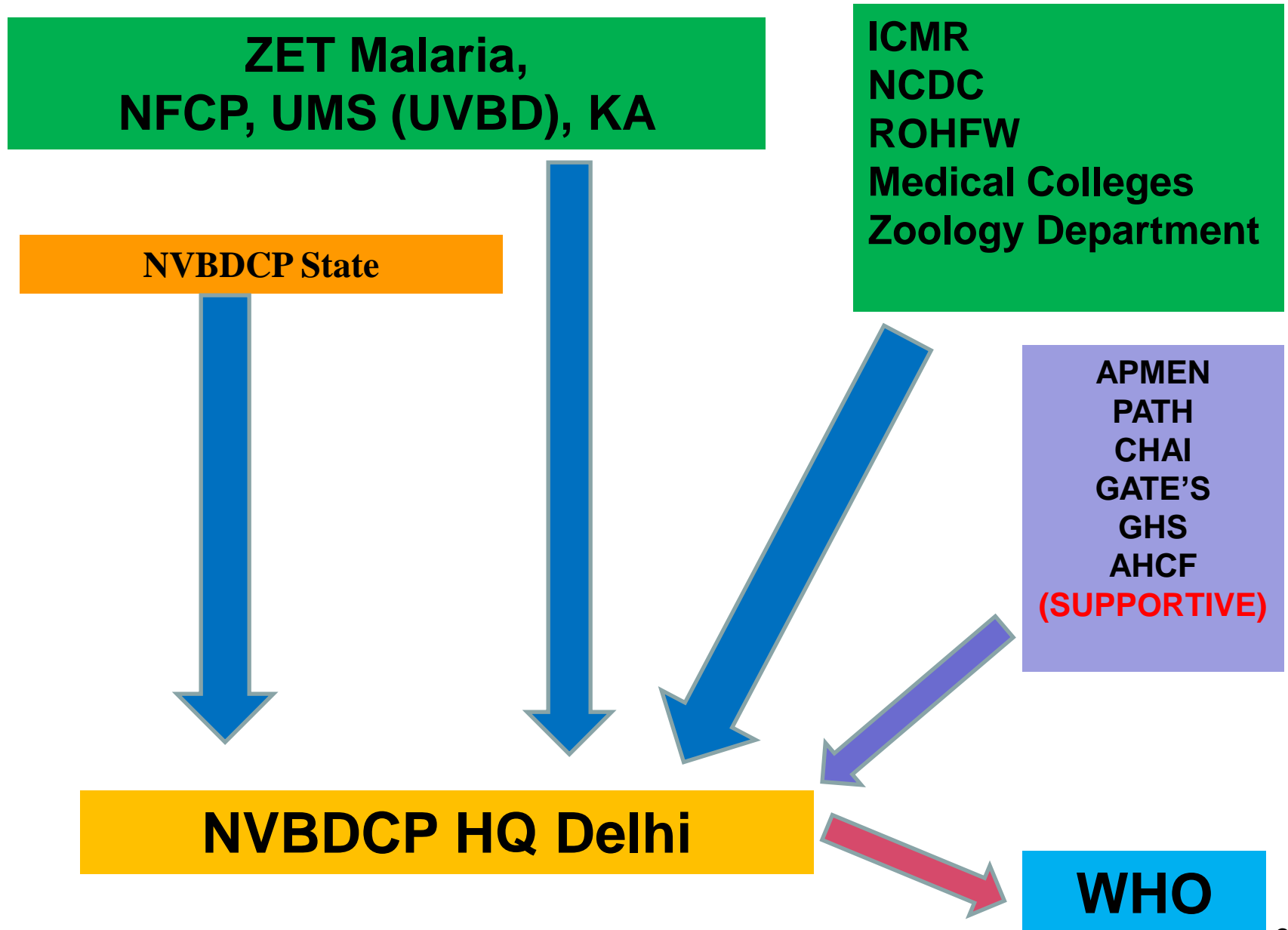
**2. MMDP**

Situation  
analysis

Plan

Minimum  
package of  
MMDP care

# Opportunity



# Threat

- **Vacuum** : Leading gap
- **Revival** : Needs more time (**almost Nil**)
- **Loss** : Institutional Memories (**almost Gone**)
- **Loss** : Skill & interpretation (**reducing**)
- **Loss** : Policy & quick decisions (**lacking**)
- **Adhoc** : Precedence to tradition (**Accountability**)

# Vector Control & Entomology: What more to do?

- **Adequate Staff**
- **Entomological surveillance in Local ecosystems to suggest appropriate Vector control**
- **Guidelines for architects to safeguard buildings from vectors**
- **HIA- a necessary requirement for all constructions**
- **Guidelines for hiring labor by contractors**
- **Operations and maintenance to be part of regular budget**
- **Focused approach in slums & re-settlement colonies**
- **Guidelines for Solid waste Management for Vector Control**
- **Feasibility of LLIRS & newer tools of vector control**
- **Expansion of Larval Source Management**
- **Entomological Surveillance & Insecticide Resistance Monitoring**

**To start GVCR/MVCR : support one Technical officer/Scientist with experience of programme implementation and one data analyst**

# Vector Control Milestones in India

Entomologists & Mentors  
who contributed for Vector Control in VBDs Programme



Late Dr Vinod Prakash Sharma  
D.Phil, D.Sc  
Former Director, NIMR-ICMR  
Padmashree in 1992



Late Sh N L Kalra  
Former Dy Director NVBDCP  
India



Padmashree Dr P K Rajagopalan  
Former Director  
ICMR-VCRC  
Puducherry, India



Professor A P Dash  
PhD, DSc  
Vice-Chancellor  
Asian Institute of Public Health  
University Bhubaneswar, India



Sh C Krishna Rao  
Former Dy Director NVBDCP  
&  
Former NPO WHO, India



Dr P K Das  
Former Director  
ICMR-VCRC  
Puducherry, India



Dr Rachel Reuben  
Former Director  
ICMR-CRME  
Madurai, India



Prof Dr A K Hati  
STM-Kolkata  
Kolkata, India



Dr S Subbarao  
Former Director  
NIMR-ICMR  
New Delhi, India



Dr B K Tyagi  
Former Director  
ICMR-CRME  
Madurai, India

# Vector Control Milestones in India

Entomologists who served more than 35 years & still contributing to Vector Control in VBDs



**Dr RS Sharma**  
Former Addl Director  
& HOD, CME&VM NCDC  
Delhi-India  
(Urban Malaria, Entomology)



**Dr P K Srivastava**  
Former Jt Director &  
Head Ento & VC  
NVBDCP Delhi, India  
(IVM, Malaria & LF)



**Dr S N Sharma**  
Former Jt Director &  
NVBDCP Delhi, India  
(Malaria, KA & LF)



**Dr Kalpana Baruah**  
Former Addl Director &  
Nodal Officer Dengue & VC  
NVBDCP Delhi, India  
(Vector Control &  
Dengue, Chick )



**Dr RK Das Gupta**  
Former Jt Director,  
NVBDCP, Delhi India  
(Malaria & KA)



**Dr ATS Sinha**  
Ex State Entomologist I/C  
Jharkhand- India  
(Malaria & KA)



**Dr JC Paliwal**  
Ex State Entomologist  
Madhya Pradesh  
(Malaria, LF)



**Dr K Raghavendra**  
Former Scientist G  
ICMR-NIMR  
New Delhi India  
(Insecticide Resistance)



**Dr SK Ghosh**  
Former Scientist G  
ICMR-NIMR  
Bangalore India  
(Malaria Biological Control)



**Dr K Krishnamoorthy**  
Consultant  
ICMR-VCRC  
Puducherry, India  
(LF Monitoring & Evaluation)



**Mr S Sridharan**  
Ex Chief Entomologist  
Tamil Nadu India  
(Malaria, JE, LF)



**Mr George Kurien**  
Ex State Entomologist  
Gujarat-India  
(Malaria, LF)

# Vector Control Milestones in India

Working Entomologists contributing to Vector Control in VBDs



**Dr Ashwani Kumar**  
Director  
ICMR-VCRC  
Puducherry, India  
(Malaria Research)



**Dr Himmat Singh**  
Scientist D,  
ICMR-NIMR,  
Delhi, India  
(Malaria & Zika)



**Dr (Mrs) Rina Tilak**  
Scientist 'G', AFMC,  
Pune -India  
(Scrub Typhus)



**Dr Alex Eapen**  
Scientist 'F', NIMR-ICMR  
Chennai-India  
(Vector Biology)



**Dr Diwakar S Dinesh**  
Scientist E  
ICMR- RMRIMS Patna  
(Kala Azar Research)



**Dr Amit Katewa,**  
Consultant,  
NVBDCP, Delhi.  
India



**Mrs Usha A,**  
Entomologist  
Dte of Health Services,  
Bengaluru Karnataka, India



**Mrs Sagya Singh**  
State Consultant Entomology  
NVBDCP Jharkhand  
India



**Dr Anju Viswan K**  
Deputy Assistant Director  
NCDC Jagdalpur,  
Chhattisgarh, India



**Dr Surajita Banerjee**  
State Entomologist  
IDSP-NCDC  
West Bengal, India

# Indian Entomologists at WHO



**Dr Raman Velayudhan**  
Unit Head Veterinary Public  
Health, Vector Control &  
Environment  
NTD Division  
WHO, Geneva, Switzerland  
(Arboviral Diseases)



**Dr Rajpal S Yadav**  
Scientist  
Veterinary Public Health, Vector  
Control & Environment  
NTD Division  
WHO, Geneva, Switzerland  
(Malaria, Insecticides, New Tools)



**Dr Roop Kumari**  
National Professional Officer  
WHO India  
(Malaria & JE)



**Dr BN Nagpal**  
Technical Officer  
WHO SEARO  
New Delhi, India  
(Malaria & Taxonomy)

# Indian Entomologists at Academic Institutions working for Vector Control



**Dr. Arti Prasad**  
Prof. & HEAD  
Laboratory of Public Health Entomology  
Department of Zoology  
University College of Science  
Mohanlal Sukhadia University,  
Udaipur



**Dr. E. Pushpalatha**  
Associate Professor  
Department of Zoology  
University of Calicut  
Malappuram, Kerala,  
India



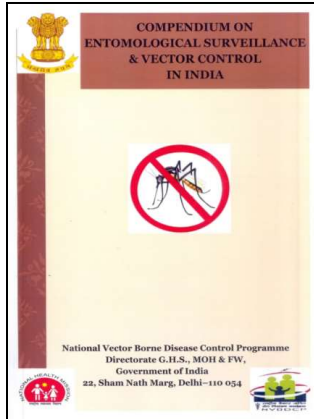
**Dr Jayalakshmi K**  
Asst. Professor  
Dept. of Life Sciences  
Central University Tamil Nadu  
Thiruvavur,  
Tamil Nadu India



**Dr Anupam V. Sharma**  
Sr Assistant Professor  
Department of Zoology  
Hindu College  
University of Delhi  
Delhi-110 007



# Compilation of National and State level vector control experts: an effort towards Resource Mapping



Category	Number
National Level	20
Regional Level	15
State Level	72
Research Institution Level	41
Academic Institution	10
Total in 2016-17 (May change now)	158

<https://nvbdcp.gov.in/WriteReadData/1892s/Compendium-Entomological-Surveillance&Vector-Control-India.pdf>



**Thank You**