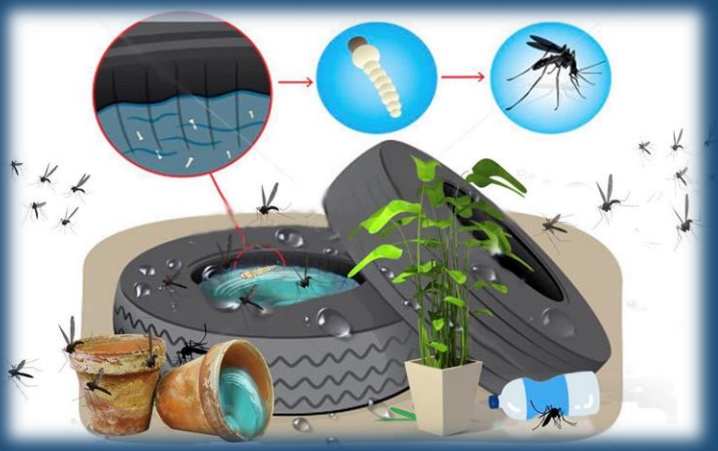
CSIR – National Environmental Engineering Research Institute
Nehru Marg, Nagpur – 440020.

First Training Programme Report
on

Training of Trainers (ToTs) and pilot testing of modules to promote non-POPs alternatives based Integrated Vector Pest Management to participant trainees from Meghalaya, Mizoram & Tripura

Date: 12/07/21 to 26/07/2021
Time: 2.30 to 5.30 PM



gef

UN environment programme

Ministry of Environment, Forest and Climate Change

IN PURSUIT OF CLEAN ENVIRONMENT
cpcb

Table of Content

List of Abbreviations

BCC	Behaviour Change Communication
Bti	*Bacillus thuringiensis var. israelensis*
CCHF	Crimean-Congo Haemorrhagic Fever
CPCB	Central Pollution Control Board
CSIR	Council of Scientific & Industrial Research
DDT	Dichlorodiphenyltrichloroethane
EC	Emulsifiable Concentrate
FFS	Farmer Field School
GEF	Global Environment Facility
GoI	Government of India
HIL	Hindustan Insecticide Limited
ICMR	Indian Council of Medical Research
IEC	Information Education and Communication
IGRs	Insect Growth Regulators
IRS	Indoor Residual Spraying
IVM	Integrated Vector Management
IVPM	Integrated Vector and Pest Management
JE	Japanese Encephalitis
KFD	Kyasanur Forest Disease
LLINs	Long Lasting Insecticidal Nets
MoCF	Ministry of Chemicals and Fertilizers
MoEFCC	Ministry of Environment Forests and Climate Change
MoEFCC	Ministry of Environment, Forest and Climate Change
NEERI	National Environmental Engineering Research Institute
NIP	National Implementation Plan
NVBDCP	National Vector Borne Disease Control Programme
POPs	Persistent Organic Pollutants
RMRIMS	Rajendra Memorial Research Institute of Medical Sciences
RNA	Ribonucleic Acid
RPU	Rational Pesticide Use
SC POPs	Stockholm Convention on Persistent Organic Pollutants
SIT	Sterile Insect Techniques
UNEP	United Nations Environment Programme
VBD	Vector Borne Disease
WDP	Water Dispersible Powder
WHO	World Health Organization
WP	Wettable Powder
ZIKV	Zika Virus

1. Introduction

Stockholm Convention (SC) is an international treaty works for the protection of human health and environment from harmful Persistent Organic Pollutants (POPs). Government of India (GoI) signed the Stockholm Convention on POPs and the Ministry of Environment, Forests and Climate Change (MoEFCC) was assigned as the National Focal Point. India has committed to fulfil its obligations under the Convention, prepared its National Implementation Plan (NIP) and submitted it to the Secretariat of the Stockholm Convention on 21st April 2011. India assured in the NIP, that the development and promotion of non-POPs alternatives to DDT is one of the top priorities that requires immediate action. Accordingly, the project entitled "**Development and promotion of non-POPs alternatives to DDT**" was jointly developed by United Nations Environment Programme (UNEP) and United Nations Industrial Development Organization (UNIDO). The project was approved by Global Environmental Facility (GEF) in April 2015 with two GEF implementing agencies *i.e.,* United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP), which are responsible for supporting delivery of specific project components. Following are the major project components to be implemented under the project:

I. Legislation, policy framework and institutional capacity (UNEP)
II. Alternatives to vector control (UNIDO)
III. Promotion and propagation of new cultivars of Neem (UNIDO)
IV. Development and Promotion of Integrated Vector Pest Management (IVPM)
V. Monitoring and evaluation of results (UNIDO / UNEP)

For the components I and IV, MoEFCC has nominated Central Pollution Control Board (CPCB) as a national Executing Agency to look after a partial execution of the project. As per the project document, the other part will be executed by the UNEP Law Division. The components of UNEP prescribe broadly Legislative framework and development, and pilot application of a set of Guidelines for Integrated Vector and Pest Management. UNIDO is working on the development of non-POPs alternatives to DDT viz. Long-Lasting Insecticidal Nets (LLIN), Neem based insecticides, *Bti* based pesticides under its two components.

The Global Environment Facility (GEF) was established to tackle our planet's most pressing environmental problems. The GEF supports countries to build capacity for the implementation of the Stockholm Convention through introduction and demonstration of viable, cost-effective and sustainable alternatives to eliminate dependency on DDT and other POPs chemicals.

The United Nations Environment Programme (UNEP) is the voice for the environment and the primary driving force for international activities related to the sound management of chemicals in the United Nations system. The UNEP promotes chemical safety by providing policy advice, technical guidance and capacity building to the developing countries. UNEP Chemicals Branch has the leadership of the Global Alliance for the Development and Deployment of Alternatives to DDT. As such, UNEP is a well-placed partner with other organizations to phase out current use and avoid future practices of DDT use in India.

The Directorate of NVBDCP, central agency responsible for guidelines, policy for prevention and control of vector borne diseases in India has been implementing the Integrated Vector Pest

Management (IVPM) strategy for effective management of vectors. It recommends Indoor Residual Spray (IRS) and Insecticide Treated Bed Nets (ITNs)/Long lasting Insecticide Net (LLIN) for vector control in rural areas and anti-larval measures in urban areas.

IVPM is a tool for managing vector population to reduce or interrupt transmission of disease. IVPM is a way forward to improve cost-effectiveness, ecological soundness and sustainability of disease vector control. It emphasizes that the insecticides used in the programme 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. Key stakeholders involved in the project are the three Ministries viz. Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of Chemicals and Fertilizers (MoCF), and Ministry of Health and Family Welfare (MoHF&W) whose mandates and roles are given below:

The Ministry of Environment, Forests and Climate Change (MoEFCC) is the nodal ministry for planning, promoting and coordinating environmental programmes including the management of chemical disasters in India. The Ministry is mandated to protect the land, air and water systems and is responsible for the prevention and control of pollution including hazardous substances. MoEFCC is the GEF and Stockholm Convention focal point in the country, which coordinates activities and cooperation between relevant stakeholders of the NIP.

The Ministry of Chemicals and Fertilizers (MoCF) is mandated to control the production and scaling up of alternatives to chemical pesticides. The Department of Chemicals and Petrochemicals of MoCF is entrusted with the responsibility of policy, planning, development and regulations of chemicals and petrochemicals. The public sector named HIL under the MoCF is involved in the production, scaling up and setting up of the facility for industrial production of the alternatives, viz. production of synthetic pyrethroids, production of Long-Lasting Insecticidal Nets (LLINs), neem-based botanical pesticides and *Bti*-based biopesticides.

The MoHF&W mainly performs advisory role for matters related to public health including vector control programme in the country. The Ministry is responsible for the application, assessment and adoption of alternatives in public health activities; the State Health Departments coordinate and implement the project activities at the respective state level for the evaluation and assessment of newer alternatives to DDT in the field on the target pest; the National Vector Borne Disease Control Programme (NVBDCP), National Institute of Malaria Research (NIMR) and the National Centre for Disease Control (NCDC) undertake activities at the national level and make recommendations on the newer alternatives for adoption at the country level.

The Central Pollution Control Board (CPCB) provides technical services to the Ministry of Environment, Forests and Climate Change of the provisions of the Environment (Protection) Act, 1986. Principal functions of the CPCB are a) to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution and b) to improve the quality of air and to prevent, control or abate air pollution in the country. The

United Nations Environment programme (UNEP) identified CPCB as executing agency for the project.

National Environmental Engineering Research Institute (NEERI), Nagpur is a constituent of Council of Scientific & Industrial Research (CSIR), New Delhi and has a nation-wide presence with its five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai. NEERI is engaged in the research and development of better and scientific solid waste management practices, for more than four decades. It has research and development thrust areas viz. Environmental Health and Environmental Impact & Risk Assessment, etc. As CSIR-NEERI is endorsed as a Stockholm Convention Regional Centre (SCRC) on Persistent Organic Pollutants (POPs), it has been identified for implementing the components IV and V of the project. Accordingly, CPCB, the executing agency (EA) sub-contracted the project to the CSIR-NEERI, Nagpur.

2. Training Objective

At the end of training programme, the participants should be trained to:

- Describe the vectors and their role in Vector Borne Diseases, the basic information about vector borne diseases, how vector borne diseases are transmitted, transmission cycle for respective vector borne diseases and global distribution as well as burden of the diseases in India.
- Define the vector, describe the morphological characteristics of adult and immature stages of mosquitoes and about the biology and ecology of vectors.
- Promotions and development of locally safe, effective, affordable and environmentally sound alternatives to DDT, Environment management methods for vector control: Biological control methods, Genetic control methods, Control of vectors by chemical, non-chemical methods, Natural and conventional vector control management strategies.
- Learn the role of Integrated Vector and Pest Management (IVPM), describe different control measures used to control vectors and pests, learn organization and management of IVM in different sectors including FFS and how IVM improves the awareness in the community through BCC.

3. Training Programme

This 1st online training programme was organised for 10 days, the total number of the training sessions were 10 and each session has 3 or 4 training parts. 36 participants viz. SPOs, DMOs, Zonal Entomologists, VBD Consultants, Entomologist IDSP and DVBDC from the three selected states viz. Meghalaya, Mizoram and Tripura. Dr. L. J. Kanhekar coordinated all the training sessions and Dr. Gujju Gandhi welcomed all the speakers/training faculties. The training contents were from Training module-1: DDT and Vector-borne disease; Training module-2: Vector morphology and bionomics; Training module-3: Alternatives to DDT in vector control management and Training module-4: Integrated vector and pest management, which were developed by CSIR-NEERI under project “Development and promotion of non-POPs alternatives to DDT”.

Training Module-1
DDT and Vector Borne Diseases

Developed under GEF Funded Project on

Development and Promotion of Non-POPs Alternatives to DDT

(GEF Project ID: 4612)

Training Programme on

Integrated Vector Pest Management (IVPM)

Executed by

Central Pollution Control Board (CPCB)
Ministry of Environment, Forest and Climate Change
(MoEFCC)

Developed by

CSIR- National Environmental Engineering Research Institute, Nehru Marg, Nagpur- 440 020, India

2020

Cover page of Training Module-1

Training Module-2
Vector Morphology and Bionomics

Developed under GEF Funded Project on

Development and Promotion of Non-POPs Alternatives to DDT

(GEF Project ID: 4612)

Training Programme on

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2020

Cover page of Training Module-2

Training Module-3
Alternatives to DDT in Vector Control Management

Developed under GEF Funded Project on

Development and Promotion of Non-POPs Alternatives to DDT

(GEF Project ID: 4612)

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2020

Cover page of Training Module-3

Training Module-4
Integrated Vector and Pest Management

Developed under GEF Funded Project on

Development and Promotion of Non-POPs Alternatives to DDT

(GEF Project ID: 4612)

Training Programme on

Integrated Vector Pest Management (IVPM)

Executed by

Central Pollution Control Board (CPCB)
Ministry of Environment, Forest and Climate Change
(MoEFCC)

Developed by

CSIR- National Environmental Engineering Research Institute, Nehru Marg, Nagpur- 440 020, India

2020

Cover page of Training Module-4

4. Training Schedule

Training of Trainers (TOT) and pilot testing of modules to promote non-POPs alternatives based Integrated Vector Pest Management

Time Table: 10 days online training program to SPO/Entomologists and DMOs

Time	Topic (Lecture discussion)	Faculty
Day 1 (Monday) 12/07/2021		
1430-1520	**Inaugural Function** **Welcome Address** : **Director,** CSIR-NEERI **About the program** : **Dr. A. N. Vaidya**, Coordinator, Stockholm Convention Regional Centre, CSIR-NEERI **Address by** : **Dr. Jitendra Sharma**, UNEP : **Dr. Prashant Gargava,** Member Secretary, CPCB **Vote of Thanks** : **Dr. A. Ramesh Kumar**, Sr. Scientist, CSIR-NEERI	
1520-1540	Introduction to DDT and its use in vector control	Dr. A. Ramesh Kumar
1540-1610	Legal perspectives to the development of IVPM training materials	Adv. Sanjay Upadhyay
1610-1645	Introduction to vector borne diseases: Malaria, Leishmaniasis (Kala-azar)	Dr. R. S. Sharma / All participants
1645-1730	Introduction to vector borne diseases: Japanese Encephalitis, Dengue, Chikungunya and Zika	Dr. L. J. Kanhekar/ All participants
Day 2 (Tuesday) 13/07/2021		
1430-1530	Introduction to vector borne disease: Plague	Dr. N. Balakrishnan/ All participants
1530-1630	Morphology and bionomics of sandflies	Dr. Vijay Kumar / All participants
1630-1730	Introduction to vector borne disease: Scrub Typhus	Dr. N. Balakrishnan All participants
Day 3 (Wednesday) 14/07/2021		
1430-1530	Introduction to Kyasanur Forest Disease (KFD)	Dr. N. Balakrishnan / All participants
1530-1630	Introduction to Crimean Congo Hemorrhagic Fever	Dr. K. Regu / All participants
1630-1730	Morphology and bionomics of vector mosquitoes	Dr. L. J. Kanhekar/ All participants
Day 4 (Thursday) 15/07/2021		
1430-1530	Introduction to vector borne diseases: Filariasis	Dr. P. K. Srivastava / All participants

1530-1630	Morphology and bionomics of flies, fleas	Dr. Amit Katewa / All participants
1630-1730	Entomological surveillance of VBDs	Dr. Himmat Singh/ All participants
Day 5 (Friday) 16/07/2021		
1430-1600	Morphology and bionomics of ticks and mites	Dr. N. Balakrishnan / All participants
1600-1730	Entomological parameters and its importance	Dr. Himmat Singh/ All participants
Day 6 (Monday) 19/07/2021		
1430-1530	Vector control measures/ management: Environmental	Dr. R. S. Sharma / All participants
1530-1630	Vector control measures/ management: Biological and Genetic	Dr. Ratna Joseph / All participants
1630-1730	Vector control measures/ management: Chemical	Dr. R. S. Sharma/ All participants
Day 7 (Tuesday) 20/07/2021		
1430-1530	NVBDCP Recommended Insecticide: Larval source management	Dr. K. Baruah/ All participants
1530-1630	NVBDCP Recommended Insecticide: Adult vector control	Dr. R. S. Sharma/ All participants
1630-1730	Equipment for larviciding and adulticiding	Dr. R. S. Sharma/ All participants
Day 8 (Thursday) 22/07/2021		
1430-1500	Neem derived products for vector control	Dr. Y. P. Ramdev/ All participants
1500-1600	Integrated Vector Pest Management: IVM & IPM	Dr. P. T. Joshi/ All participants
1600-1730	IVPM: Behavior Change Communication & vector management through Farmer Field School approach	Dr. R. S. Sharma/ All participants
Day 9 (Friday) 23/07/2021		
1430-1530	Planning and implementation of IVPM	Dr. R. S. Sharma/ All participants
1530-1630	Monitoring and evaluation of IVPM	Dr. Amit Katewa / All participants
1630-1730	Epidemiological surveillance and parameters	Dr. Ratna Joseph / All participants
Day 10 (Monday) 26/07/2021		
1430-1530	Ecological setup and suitable vector control method	Dr. P. K. Srivastava / All participants
1530-1630	Report preparation: Vector collection and their control	Dr. Amit Katewa/ All participants

1630-1700	Discussion on Non-POPs alternatives to DDT in vector control	Dr. R. S. Sharma/ Dr. L. J. Kanhekar/ All participants
1700-1715	Feedback from participant trainees on modules	Dr. L. J. Kanhekar
1715-1730	**Virtual valedictory session**	**Dr. Ramesh Kumar/ Dr. L. J. Kanhekar**

5. Training programme Inaugural Function

Welcome Address

Inaugural function of the 'Training of Trainers (TOTs) and pilot testing of modules to promote non-POPs alternatives based IVPM' was held on 12th of July 2021, in an online mode via MS Teams, between 14:30 to 15:20 by CHWMD, CSIR-NEERI, Nagpur. Welcome address was delivered by Dr. A. Ramesh Kumar (Project Leader and Senior Scientist, CHWMD). He introduced all the experts and convened the training program. The dignitaries present were Dr. Jitendra Sharma, UNEP and Dr. Prashant Gargava, Member Secretary, CPCB (figure-1).

Dr. Jitendra Sharma explained about the project objectives and congratulated the CSIR-NEERI project team on development of the training modules, booklets and IEC materials. Dr. Prashant Gargava, Member Secretary, CPCB explained the role of CPCB in the project. A brief introduction about the project and the training program was given by Dr. Atul N. Vaidya, Co-ordinator (Stockholm Convention Regional Centre, CSIR-NEERI) and Chief Scientist & Head (CHWMD). He explained the role of CSIR-NEERI in this project as the Regional Centre of Stockholm Convention (Asia). He further explained how CSIR-NEERI is working towards reducing the usage of chemicals in pesticides and insecticides. Dr. A. Ramesh Kumar proposed the vote of thanks at the end of inaugural session (figure-1 and 1a).

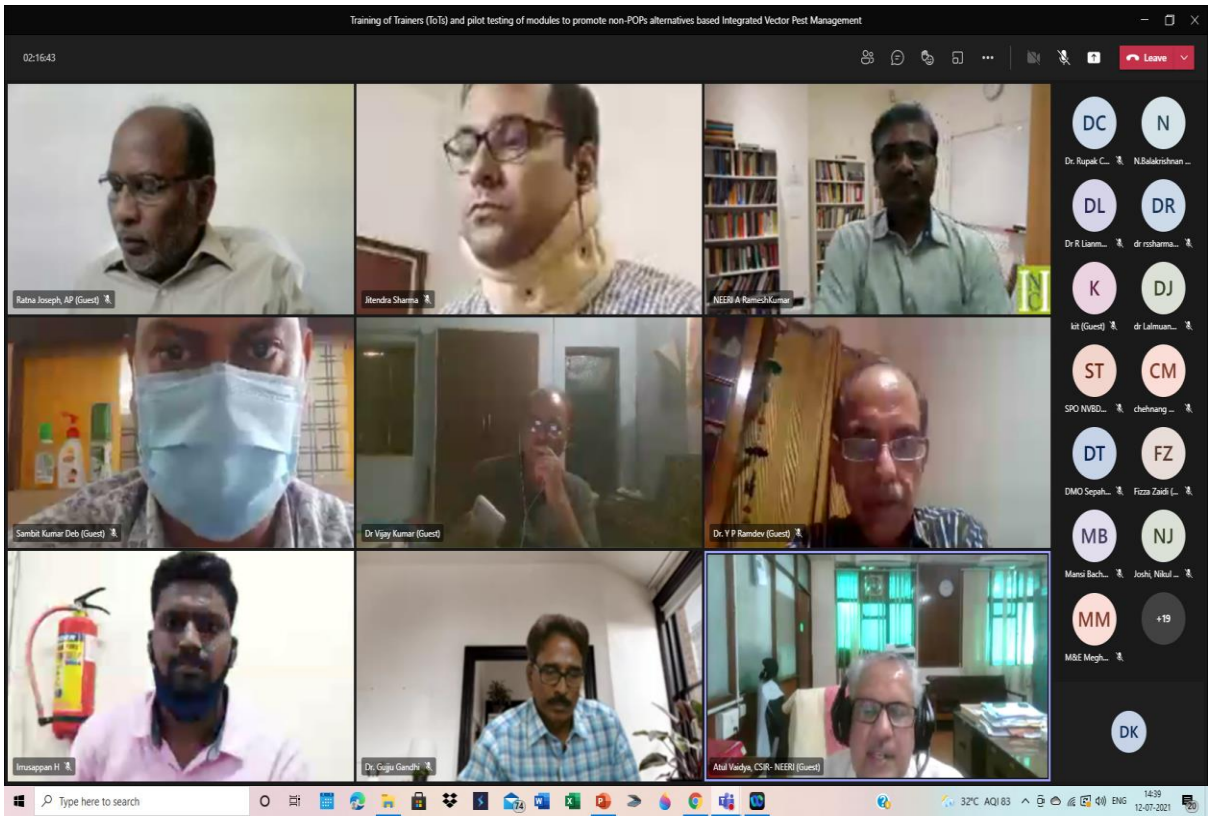

Figure - 1: Inaugural function screen shot, platform MS team group chat software

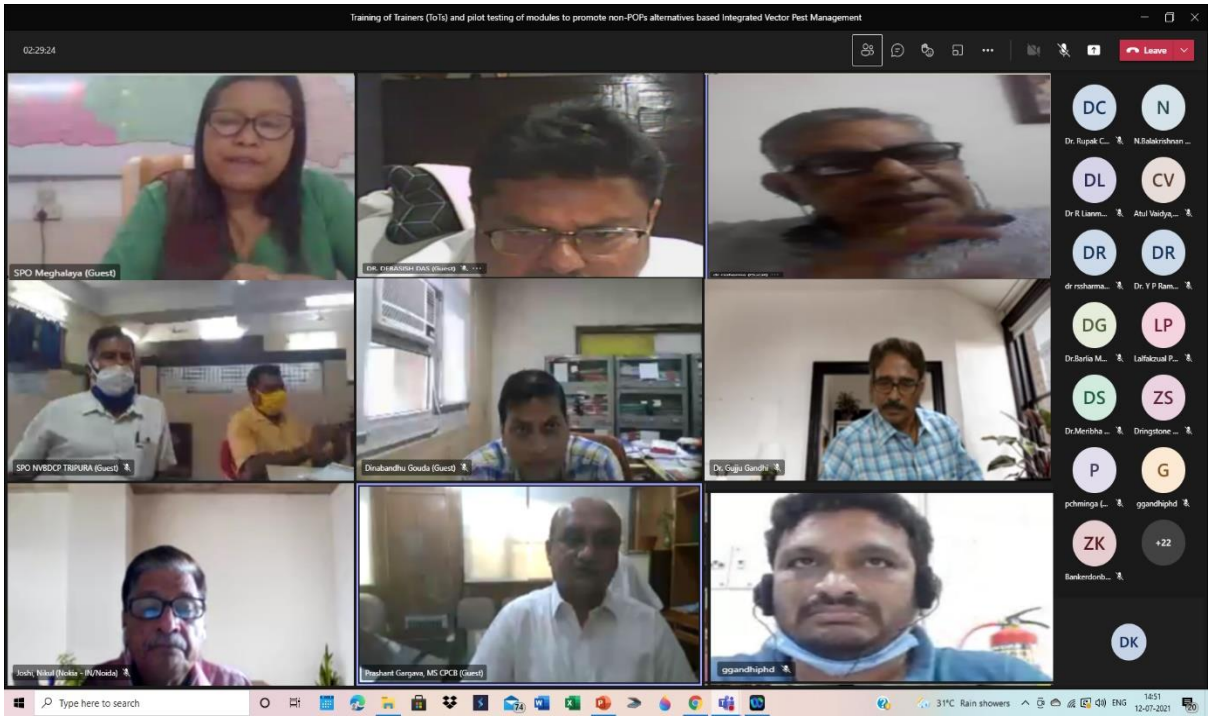

Figure – 1a: Inaugural function screen shot, platform MS team group chat software

6. Training sessions

The total training sessions were 10, each session covered 3 or 4 parts and each part was conducted for approximately 1 hour, the time was managed depending on a questionary discussion in end of the session. Every session was conducted in the afternoon from 2.30 pm to 5.30 pm.

6.1. Training session-1 (Day – 1 (Monday) 12/07/2021)

Training part - 1: Introduction to DDT and its use in vector control

Dr. A. Ramesh Kumar handled this training session and the contents covered were introduction about what are POPs, what is DDT, its structure and its current status and usage in vector control management. He deliberated on Stockholm convention on POPs. State-wise supply of DDT in the year 2019-2020 in India was discussed. Alternatives to chemical pesticides in vector control were proposed. Non-POPs alternatives to DDT were discussed. The legal status of POPs and their use in pesticides and insecticides in India was stated (figure-2).

Training part - 2: Legal perspectives to the development of IVPM training Materials

Adv. Sanjay Upadhyay (Supreme Court) deliberated on legal perspective on the content of the training modules and how the training programme should be conducted (figure-2). He spoke about national legal framework for the alternatives to DDT for vector borne disease control. He gave some information about constitution of India, specific laws for regulating alternatives to DDT including insecticide act 1968 and rules of 1971, pesticide management bill 2020, commercial aspects of alternatives to DDT, etc. He also discussed about gaps in the national legal framework for the alternatives to DDT in vector control.

Training part - 3: Introduction to vector borne diseases: Malaria and kala-azar

Dr. R. S. Sharma deliberated this training session, a brief introduction about the Indian and global disease burden, signs & symptoms and transmission of vector borne diseases like Malaria and Kala Azar. He conducted an interactive session with the participants where he asked the participants various topic related questions, which the participants answered. They are given below:

1. Who received the noble prize for malaria?
   Answer: Ronald Ross.
2. What is the importance of ring stage in malaria?
   Answer: Identification of malaria parasites and species identification.
3. What is the incubation period?
   Answer: Time interval between initial contact with an infectious agent and appearance of the first sign or symptom of disease.
4. Which country eliminated malaria recently?
   Answer: China.
5. Why Kala Azar is not under control in north eastern states?
   Answer: Due to higher ecological stability.

Training part-4: Introduction to vector borne diseases: Japanese Encephalitis, Dengue, Chikungunya and Zika

This training part was covered by Dr. L. J. Kanhekar with learning objectives of training module-2, brief explanation about the introduction, Indian and global disease burden, signs & symptoms and transmission of vector borne diseases viz. Japanese encephalitis, Dengue, Chikungunya and Zika.

At end of training session, discussed on all the training parts which were conducted in the training session with speakers, organizers and all the participants.

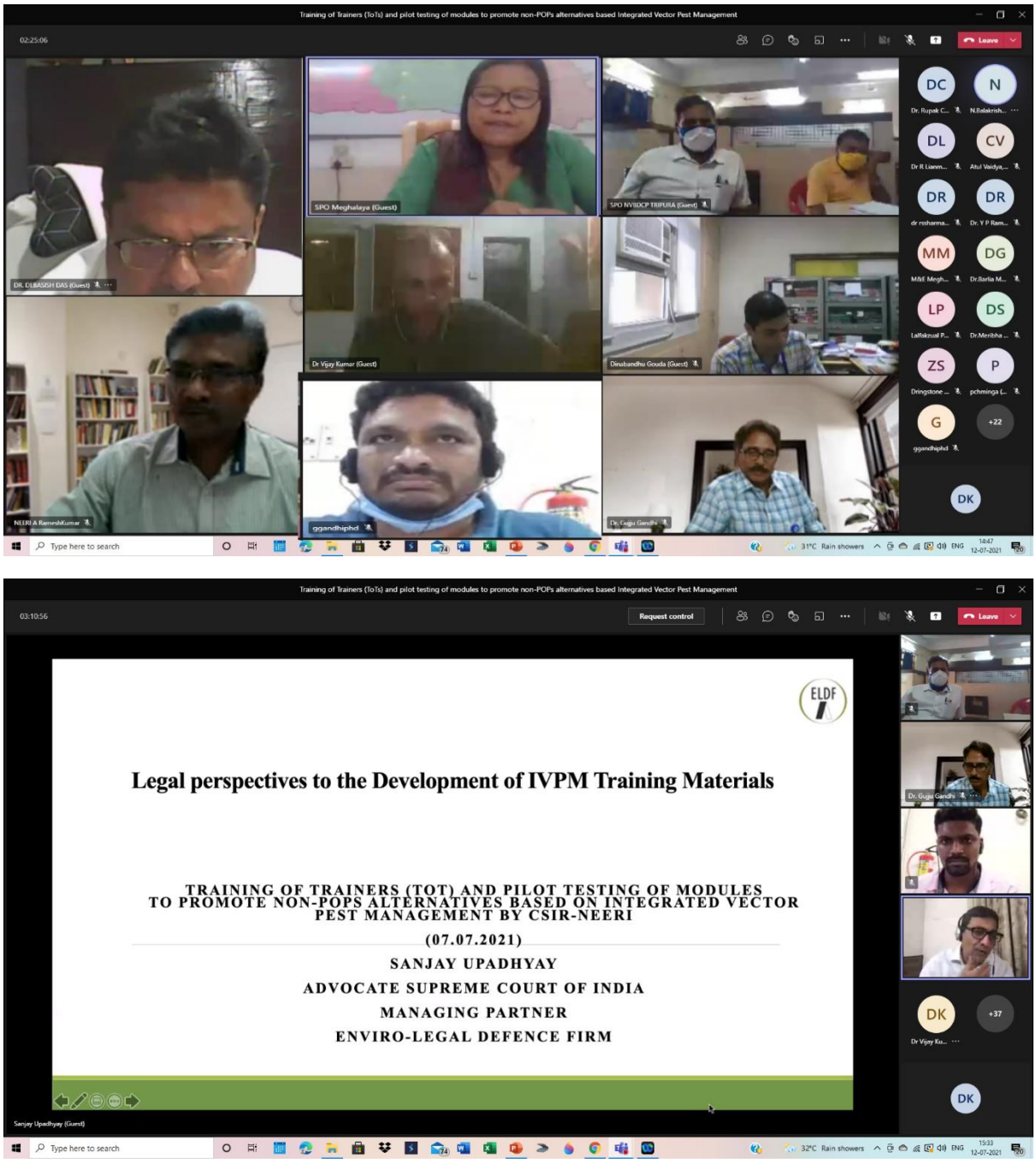

Figure - 2: Screenshot of Training session - 1

6.2. Training session - 2 (Day - 2 (Tuesday) 13/07/2021)

Training part - 1&2: Introduction to vector borne disease: Plague and Scrub typhus

On the second day, Dr. N. Balakrishnan covered Introduction to vector borne diseases: Plague and Scrub typhus. The content covered was introduction about two VBDs viz. plague and scrub typhus. Under plague, he covered various topics like its introduction, historical background, re-emerging plague, its current global status and types of plague. He also deliberated on current status of plague in India, cases and deaths occurred due to it, plague surveillance network, surveillance methodology, surveillance-investigation of seas and airports and endemic plague foci in India (1951). While, under scrub typhus, he covered the topics like introduction, historical background, tick typhus, global prevalence of scrub typhus, outbreaks of scrub typhus epidemiology, transmission, reservoir infection (clinical symptoms/pathogenesis), general aspects of mites, sample techniques (collection of rodent and mites), treatment, vector control, etc.

Training part - 3: Morphology and bionomics of sandflies

Second lecture was deliberated by Dr. Vijay Kumar (consultant ICMR), Former scientist & Head, ICMR-RMRIMS. He spoke about vector morphology and bionomics while specifically covering disease vectors of Kala Azar. He gave brief introduction of Leishmaniasis, its life cycle within the host and parasite, identification of sand fly habitat and seasonality of sand fly. He also made us understand the difference between *Phlebotomus* & *Sergentomyia* species (figure-3).

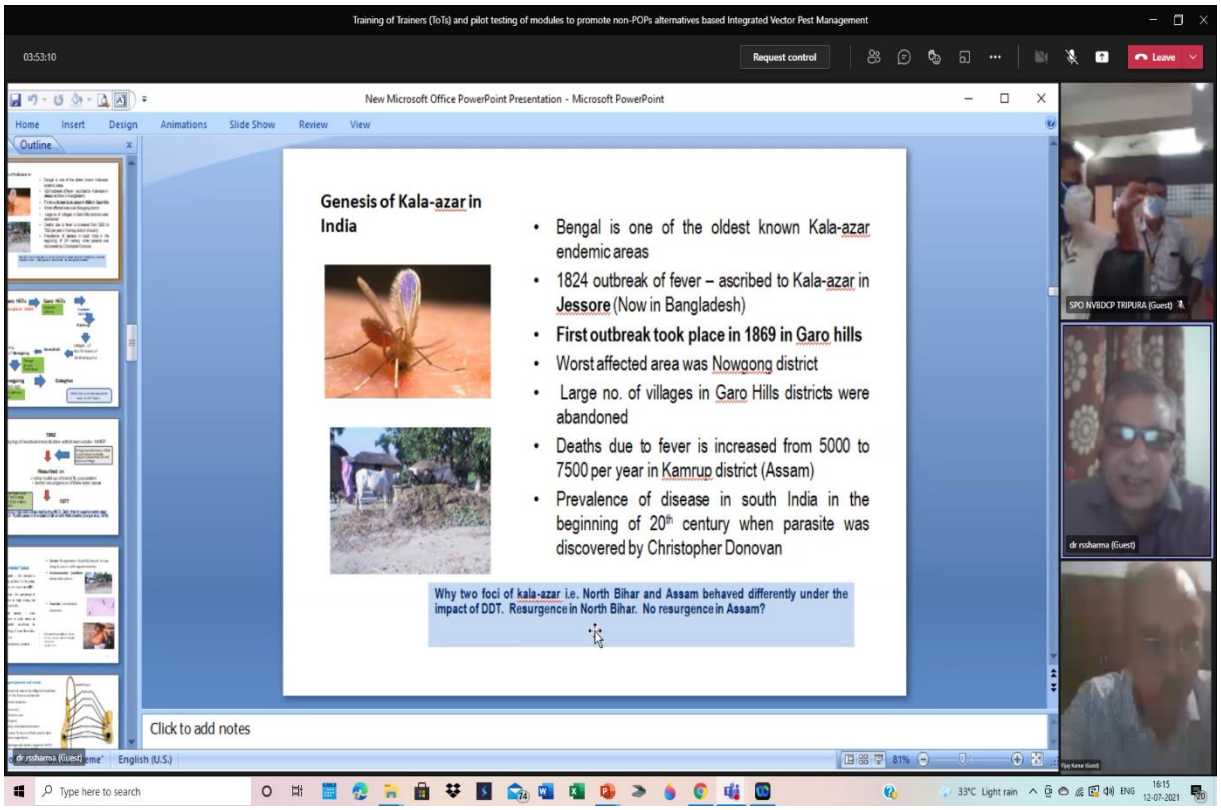

Figure - 3: Screenshot of Training session - 2

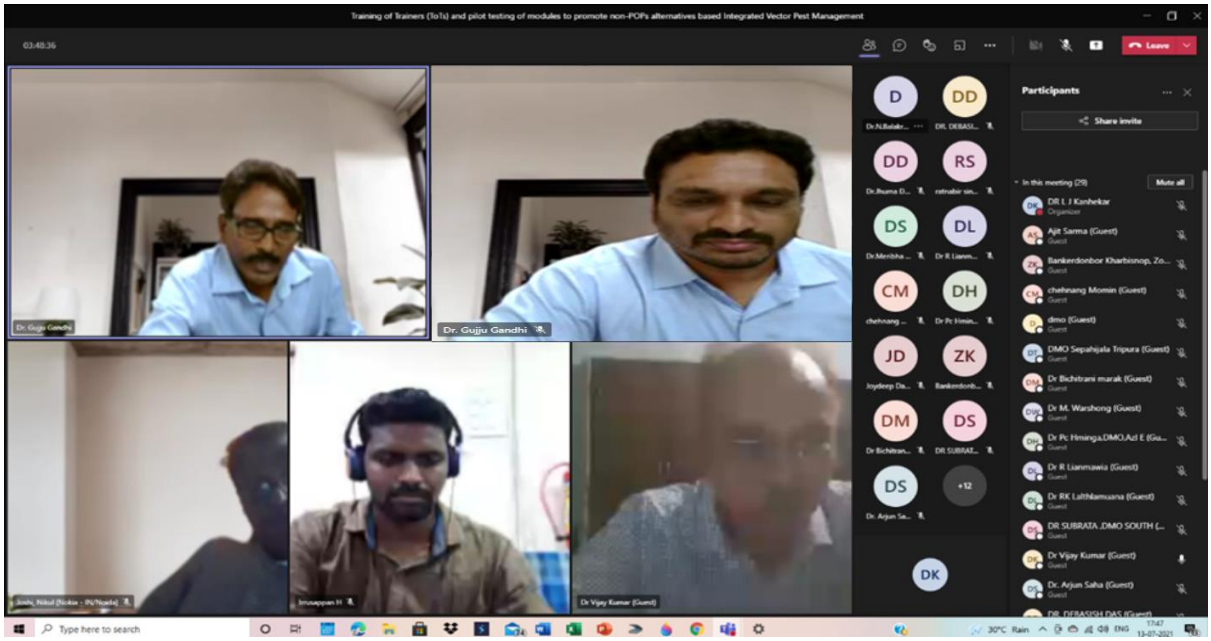

Figure -4: Discussion Screenshot of Training session - 2

6.3. Training session-3 Day 3 (Wednesday) 14/07/2021

Training part - 1: Introduction to Kyasanur Forest Disease

Dr. N. Balakrishnan gave a lecture on Kyasanur Forest Disease (KFD). He deliberated about history of KFD and its first outbreak. He discussed about agent of the disease, its natural host and reservoirs, amplifying host, introduction of KFD virus and its global and national burden.

Training part - 2: Introduction to Crimean Congo Haemorrhagic Fever

The training part of introduction to Crimean Congo Haemorrhagic Fever (CCHF), was covered by Dr. K. Regu, the contents covered were introduction about CCHF, history of CCHF, causative agent (virus and vector), transmission (vertical and horizontal transmission), epidemiology, burden in India and global burden.

Training part - 3: Morphology and bionomics of vector mosquitoes

Dr. L. J. Kanhekar deliberated in this training part (figure-4 and 5), before starting the lecture he discussed the learning objectives of training module-2, classification of mosquitos and morphological characters of mosquitos (head, mouthparts, thorax and abdomen). He then deliberated the lecture about vectors of malaria, filaria JE, Dengue, Chikungunya, and Zika. The topics especially covered were introduction of all disease vectors, morphological characters and bionomics of malaria vectors: *Anopheles* mosquito, morphological character, classification (egg, larva, pupa and adult), vector biology and ecology (life cycle of *Anopheles*), vector bionomics of *Anopheles culicifacies*, *An. stephensi*, *An. fluviatilis*, *An. minimus*, *An. dirus* (*An. baimai*) and *An. epiroticus* (*An. sundaicus*). Vector of lymphatic filariasis, JE, Dengue, Chikungunya and Zika: introduction, classification, morphological character (egg, larva, pupa and adult), vector bionomics of *Culex quinquefasciatus*, *Cx. tritaeniorhynchus*, *Aedes aegypti* and *Ae. Albopictus*.

Figure-5: Screenshot of training session - 3

6.4. Training session - 4 (Day – 4 (Thursday) 15/07/2021

Training part-1: Introduction to vector borne diseases: Filariasis

Dr. P. K. Srivastava covered this training part (Figure-6). Contents covered were introduction of VBDs while mainly focusing on Lymphatic Filariasis. Contents covered by him were introduction to Lymphatic Filariasis, its causative agent, microfilarial periodicity, human filarial parasites, transmission cycle (in human and mosquito body), external morphology of the vector (egg, larva, pupa and adult), vector biology and ecology, resting and feeding habitats of the vector, its flight range and breeding places. He also discussed national and global burden of Filariasis, its history in India, salient features of the vector life cycle, elimination of Lymphatic Filariasis, Species of filarial infections prevalent in India, current status of Lymphatic Filariasis in India, difference in *W. bancrofti* and *B. malayi* species, Filariasis disease manifestation (acute & chronic), paradigm shift in LF control, elimination strategy: 1997 and guidelines about elimination of Lymphatic Filariasis in India.

Training part-2: Morphology and bionomics of Flies, Fleas

In the second training part of the day, Dr. Amit Katewa deliberated lecture about the morphology and bionomics of vectors of the enteric diseases. He explained about fleas and flies, their classification and external morphology, biology & ecology and their life cycle. He made us understand the difference between male & female vector, its identification and life cycle. He also deliberated on morphology of the house fly and its life cycle.

Training part-3: Entomological parameters and its importance

Dr. Himmat Singh covered this training part (figure – 7 B), the contents covered were entomological surveillance of the vector borne diseases. During his lecture, he covered topics

like entomological surveillance, collection of adult mosquitoes, different types of collections (qualitative and quantitative), adult collection, hand collection by aspirator and other mechanical devices, selection of houses, spray sheet collection, landing collection, trap collection (fixed & exit trap, height trap, mangoon trap, veranda trap, tent trap, sticky trap) and objective of larval collection.

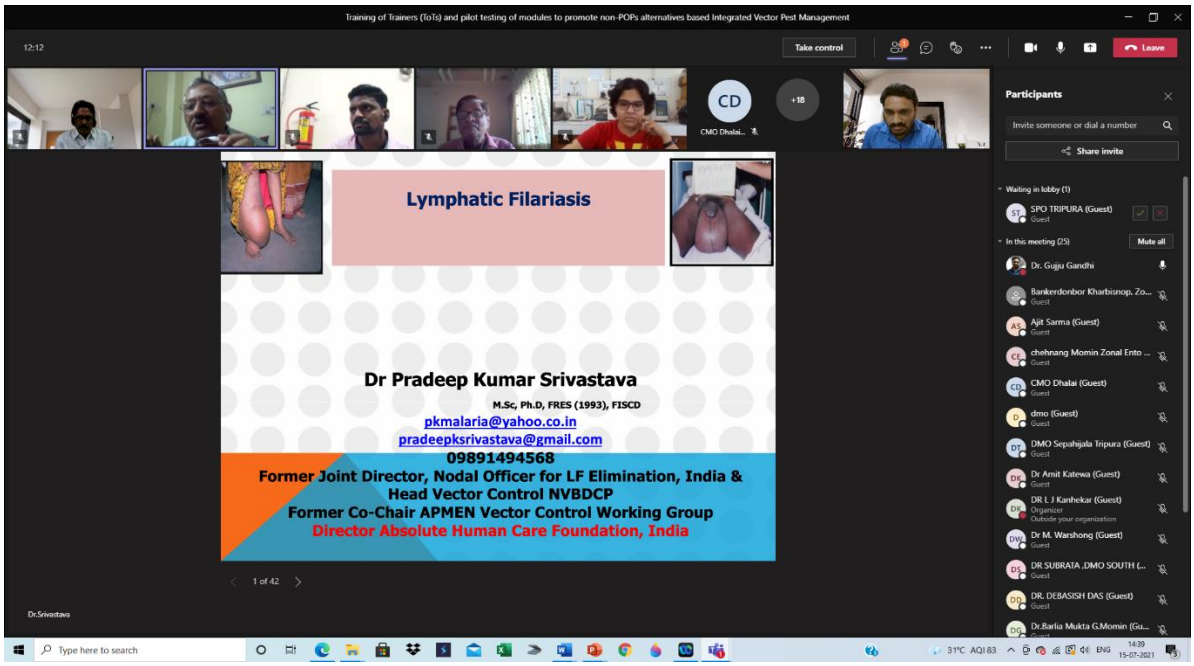

Figure-6: Screenshot of training session - 4

6.5. Training session – 5 (Day – 5 (Friday) 16/07/2021)

Training part – 1: Morphology and bionomics of Ticks and Mites

Dr. N. Balakrishnan deliberated in this part (figure – 7 A), the content covered was morphology and bionomics of ticks and mites. In his lecture, he included topics like taxonomy of hard (Ixodidae) and soft ticks (Argasidae), their external morphology, key morphological characters for the identification of ticks, their life cycle, tick collection methods, sampling technique of ticks, tick index, tick infestation rate and tick-borne diseases in India. He also spoke about general aspects of mites, their life cycle, vector biology, *Leptotrombidium* chiggers and habitat of mites (Mite Island). He explained the sampling techniques and mite index.

Training part – 2: Entomological parameters and its importance

In the second training part covered by Dr. Himmat Singh the main content was monitoring and evaluation. He stated the entomological parameters and their importance. He gave importance of surveillance parameters and adult vector parameters (density, sporozoite rates, parity, infectivity, minimum infection rates & flea index). Topics discussed were Indoor resting density, human biting rate (ethical clearance required), human blood index, insecticide susceptibility, entomological indices (malaria vector density, abdominal conditions, vector incrimination, landing collection, space spray collection entry/exit trap collection) and mosquito life expectancy (longevity). Entomological parameters of filaria (ten-man hour vector

density, mf rate, infectivity rate, infection rate, mean number of L3/infective mosquito), parameters of flea (total flea index, percentage of hosts infested, burrow index), larval survey (larval density, pupal density) and Dengue larval survey (house index, container index, breteau index, pupa index) were also discussed (figure – 7 B).

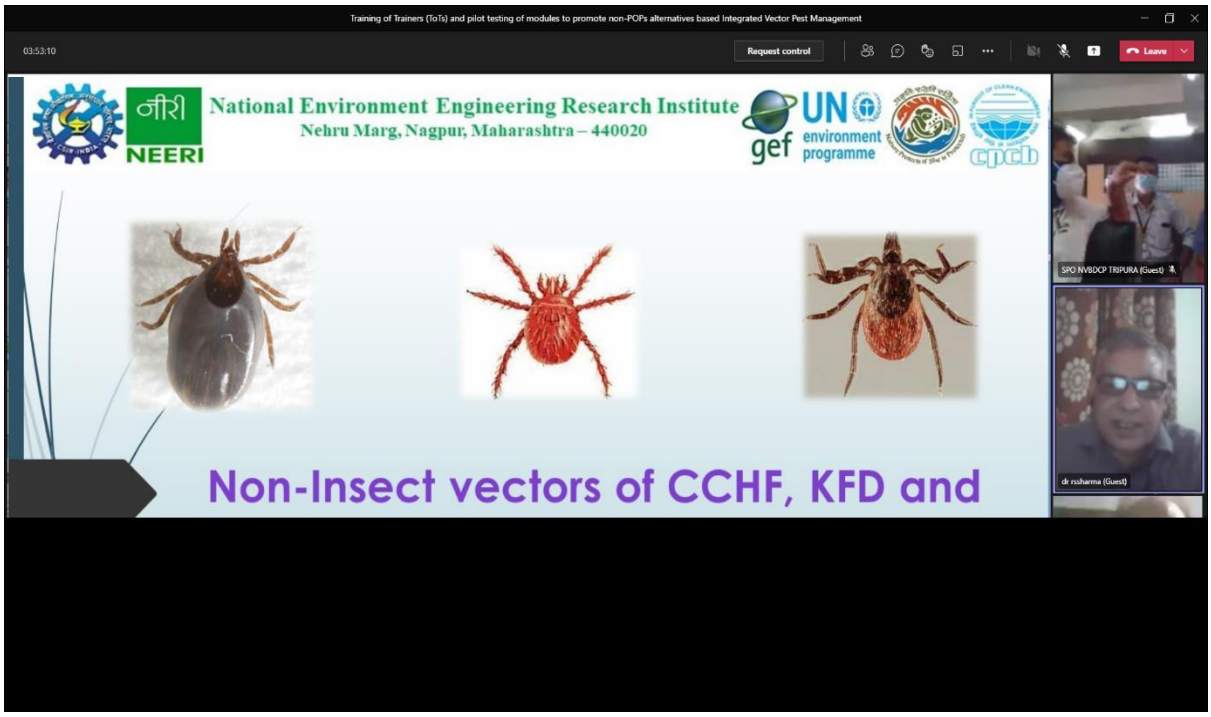

Figure – 7 (A): Photograph of training session - 5

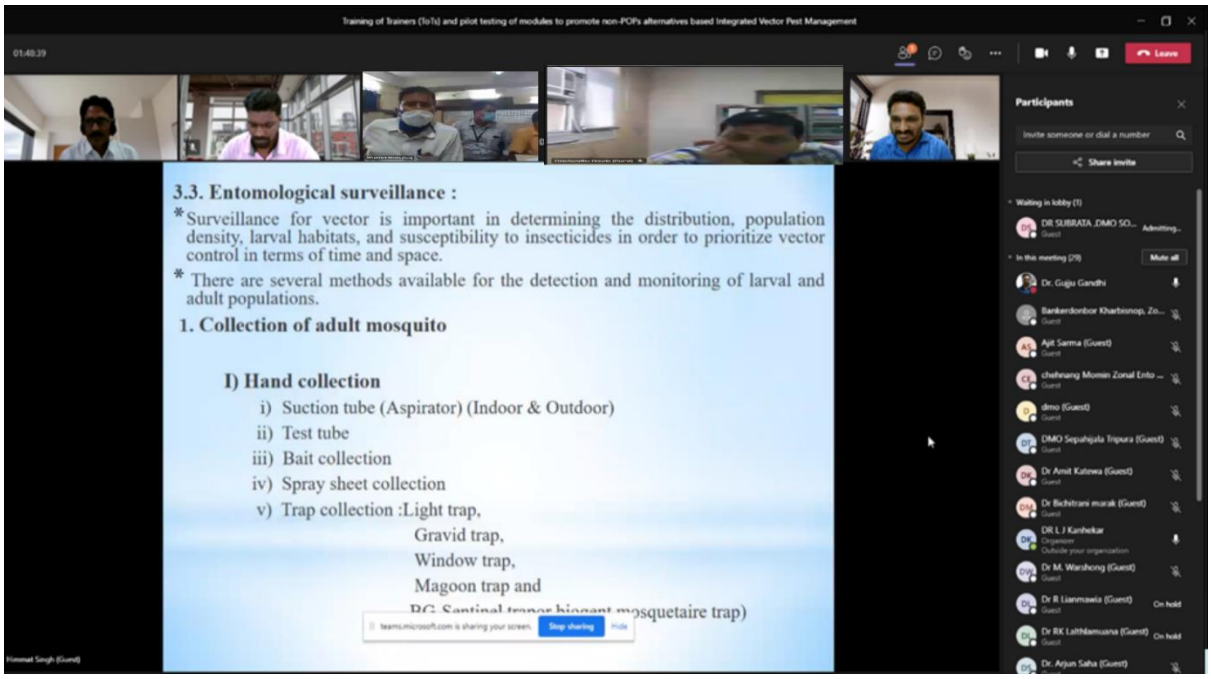

Figure – 7 (B): Screenshot of training session – 5

6.6. Training session – 6 (Day – 6 (Monday) 19/07/2021)

Training part – 1: Vector control measures or management: Environmental management

Dr. R. S. Sharma covered this training part (figure – 8 A), the contents covered were learning objectives of environmental management, history of DDT used in vector control, environmental and engineering methods (EEM), the introduction of other vector control methods (conventional, biological, chemical, genetic, and natural control method). EEM technology in irrigation malaria, EEM technology in 2nd world war, environmental manipulation and modification or manipulation of human habitation behaviour, types of environmental manipulation and modification, EEM – source reduction, EEM for *Anopheles* clear groundwater, EEM for *Aedes* containers, EEM for *Culex*: polluted groundwater and rice fields, environmental approach to vector control pre-DDT, vector control in tea garden-Assam, vector control in Delhi, urban malaria control with environmental and engineering methods technology and legislative control in 1928, EEM replaced by DDT, EEM Mumbai, malaria outbreak in 2010 impact of larval source management/control, Sabarmati rivers changing scenario and conclusion of environmental management.

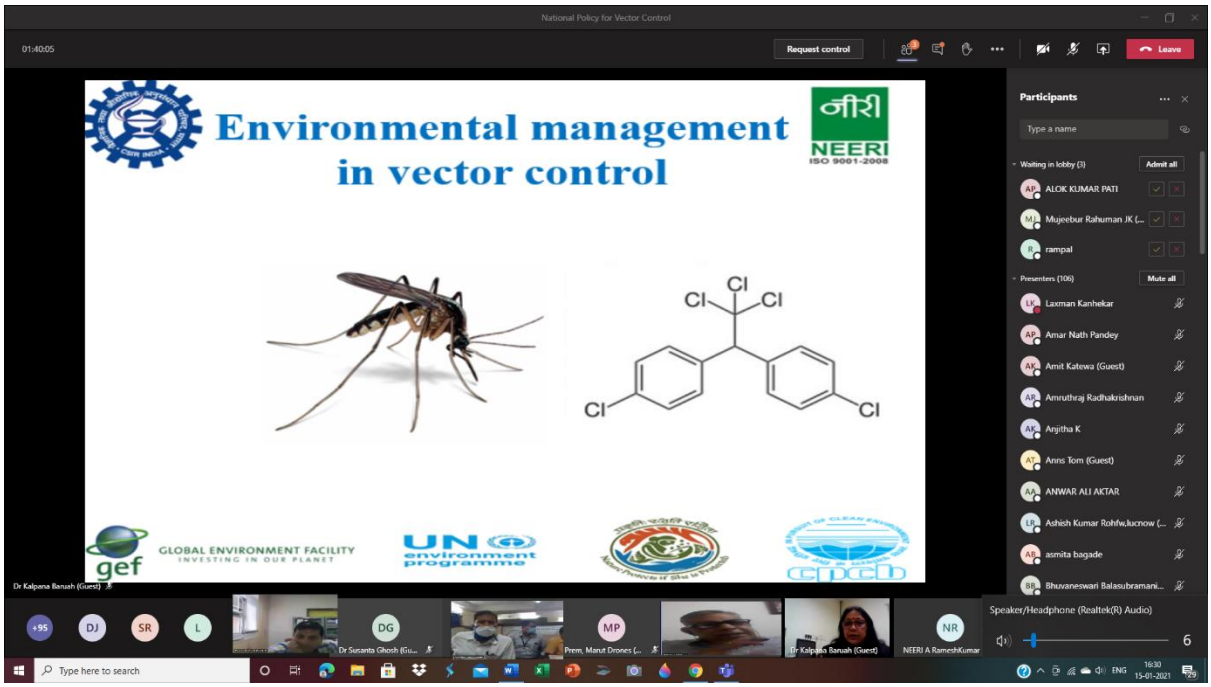

Figure – 8 (A): Screenshot of training session - 6

Training part - 2: Vector control methods: Biological and genetic

This training part was covered by Dr. T. Ratna Joseph (figure – 8 B), the contents covered in this part were biological control management, advantages of biological control, desirable attributes of biocontrol agent (predators, parasites, parasitoids, pathogens), different biological agents used in vector control (copepods, nematodes, flatworms, fungi, invertebrate predators, anuran predators, bacteria, protozoans, larvivorous fishes (*Gambusia affinis* (*Gambusia*), *Poecilia reticulate* (Guppy), *Oreochromis mossambicus* (Tilapia), Danio rerio (Carp)). In

genetic control management, the content covered was genetic engineering technique, salient features of genetic control, sterile insect technique (conventional SIT, translocation heterozygotes, genetic sexing, cytoplasmic incompatibility and hybrid sterility), refractoriness to disease, population replacement using Wolbachia, the release of insect carrying the dominant lethal gene- and gene-splicing using RNA interference. Different types of genetic control, sterilization, irradiation, gene modification (mutagenesis, cis-genesis, trans-genesis, para-transgenesis).

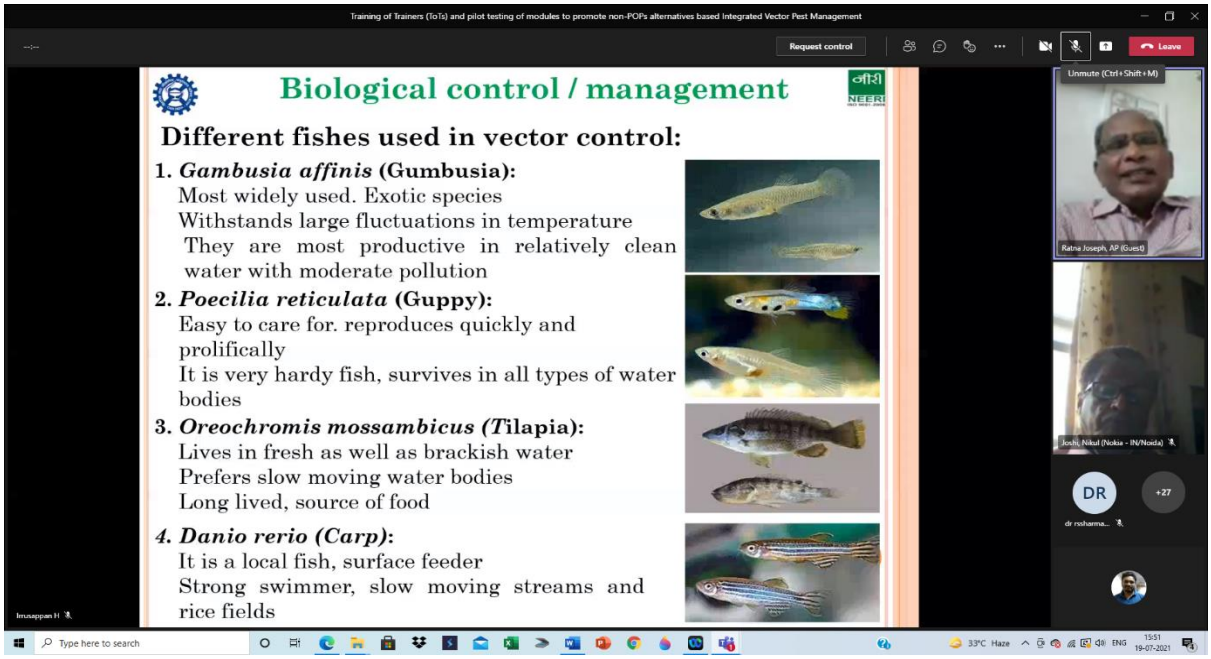

Figure – 8 (B): screenshot of training session – 6

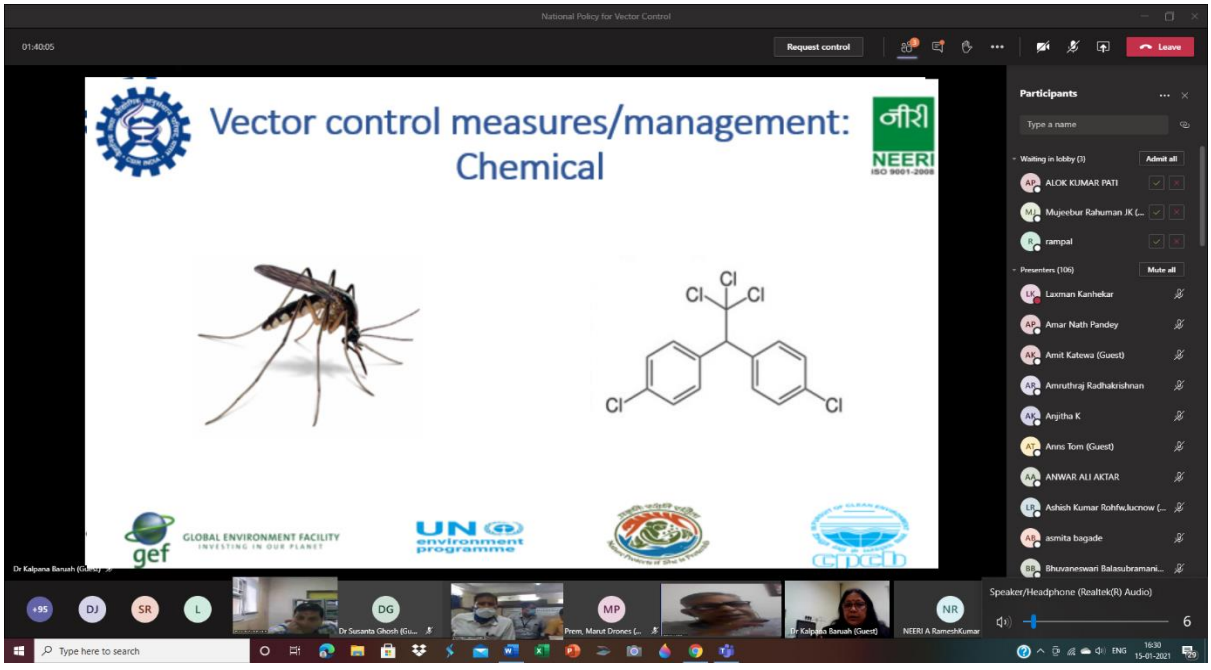

Figure – 8 (C): Photograph of training session – 6

Training part - 3: Vector control methods: Chemical control

Dr. R. S. Sharma covered this training part, the contents covered were an introduction of chemical control, WHO-Global technical strategy for malaria in chemical control, chemical vector control options, chemical control methods: Plant products including pyrethrum, neem derived products, synthetic chemicals classification (organophosphorus, organochlorine, synthetic pyrethroids and carbamates, mode of action of insecticide, Indoor Residual Spray (IRS), organophosphate, (adulticide and larvicide), insect growth regulators (IGR), Bio larvicide, the challenge of chemical vector control in IRS, space spray, thermal fog, Interpretation of IRS (figure – 8 C).

6.7. Training session – 7 (Day – 7 (Tuesday) 20/07/2021)

Training part - 1: NVBDCP Recommended insecticide: Larval source management

This training part was covered by Dr. Kalpana Baruah, Addl. Director, NVBDCP contents covered were introduction of larval source management and NVBDCP recommended insecticide, importance of larval source management, methods of larval source management, mosquito larvicidal oil, Temephos 50% EC, Temephos 1% GR, insect growth regulators (IGR) including pyriproxyfen 0.5% and Diflubenzuron 25% WP (figure – 9 A).

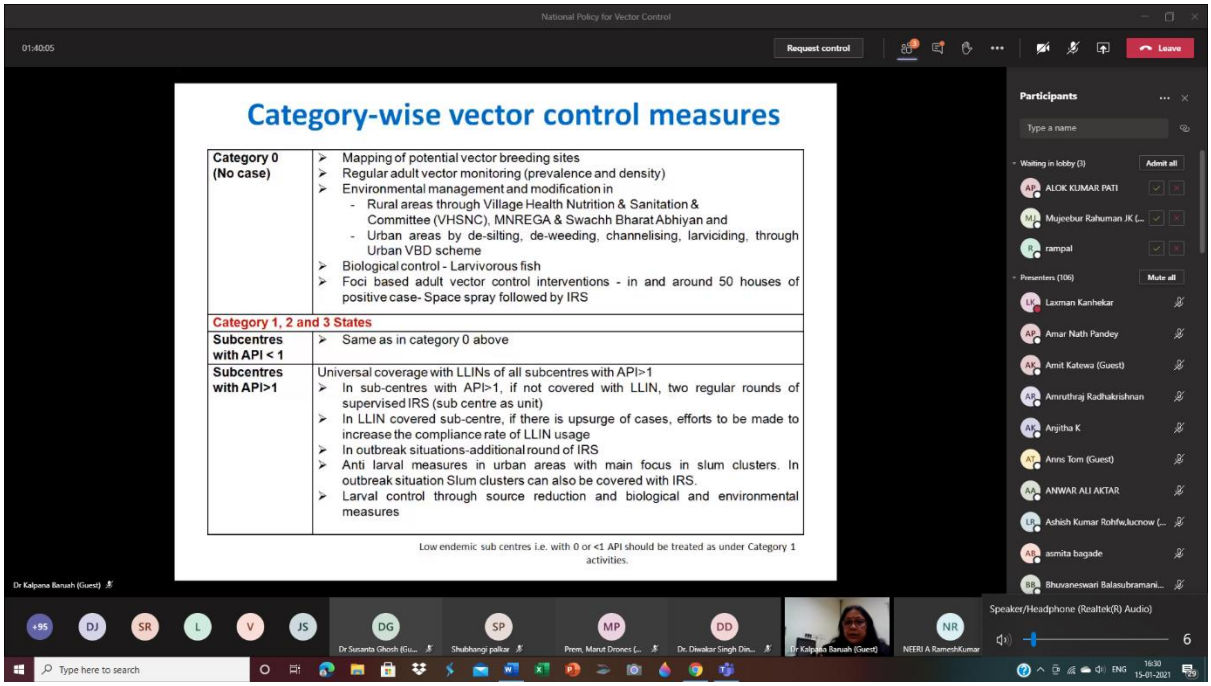

Figure – 9 (A): Screenshot of training session – 7

Training part - 2: NVBDCP Recommended insecticide: Adult vector control

This training part was covered by Dr. R.S. Sharma, before starting the training he gave some introduction to DDT, the talked about the book "silent spring" by Rachel Pearson, and content covered in this training parts was insecticide for indoor residual spray under NVBDCP:

Malathion 25% WP, synthetic pyrethroids, deltamethrin 2.5% WP, cyfluthrin 10% WP, lambda-cyhalothrin 10% WP, Alphacypermethrin 5%, insecticide formulation and their dosage for indoor residual spray under NVBDCP, space spray-dosage, manpower requirement for IRS, Approved larvicide formulation & dosage, calculating the IRS dosage of DDT with a stirrup pump, calculating the IRS dosage with hand compression pump with control flow value and WHO recommended insecticide for IRS with their respective doses (figure – 9 B).

Training part - 3: Equipments for larviciding and adulticiding

This training part was also covered by Dr. R. S. Sharma, contents covered were different types of sprayers such as knapsack sprayer, stirrup pump, hand compression pump, fogging machine, portable thermal fogging machine, ultra-low volume, vehicle-mounted fogging machines, vehicle-mounted thermal fogging machine, vehicle-mounted cold fogging machine, calculating speed of vehicle movement and discharge rate of a sprayer.

Figure – 9 (B): Photograph of training session – 7

6.8. Training session – 8 (Day – 8 (Thursday) 22/07/2021

Training part - 1: Neem derived products for vector control

Dr. Y. Ramdev covered this training part, he gave some introduction about UNIDO, and alternative to DDT in vector control. In this training part, contents covered were introduction of neem, DDT, Stockholm convention on POPs, the status of ratification, DDT application, rational pesticide use (RPU), effective pesticide application (coverage, dosage and timing), droplet size, droplet density, spray retention, the contact angle of a droplet, concentration organism susceptibility, dosage temperature, humidity, air velocity. The wide range of droplets through the hydraulic system, application inefficiency existing strategy: adulticide-IRS,

national implementation of suitable alternative products, methods and strategies was discussed. (Figure – 10 B).

Training part - 2: Integrated vector pest management: IVM & IPM

This training part was covered by Dr. P.T. Joshi, lecture started with the basic introduction of VBDs in India, integrated vector and pest management. The main contents covered were IVPM basics, fine key elements of IVM, methods of IVM, vector bionomics of IVM. Integrated vector control methods: environmental management (modification, manipulation and changes to human habitation (or) behaviour, personal protection (protective clothing, repellents, installation of vaporization), larval source management (chemical control- larvicides (dosage & formulation), insect growth regulators, biological control (larvivores fish-Gambusia, Guppy), IRS, LLINs, Spray formulation & dosage for impregnation of bed-nets (figure – 10 A).

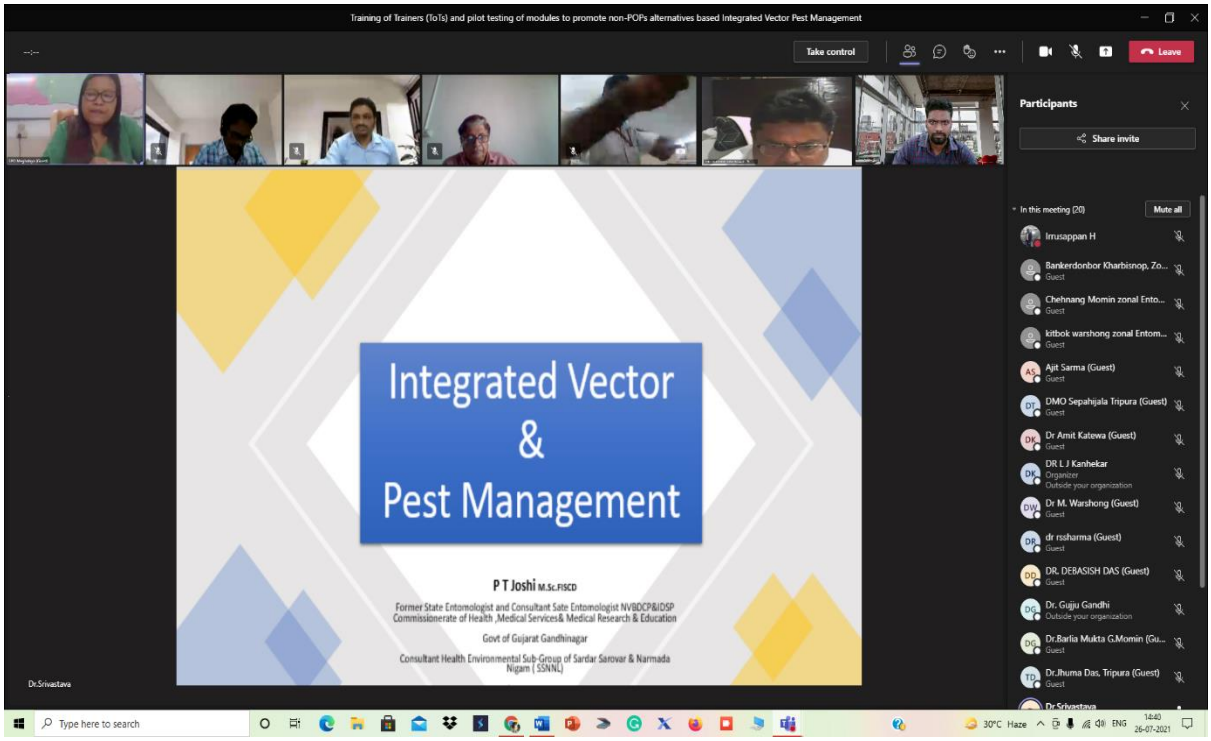

Figure – 10 (A): Screenshot of training session – 8

The impact is based on IVM strategy, manpower requirement trained, equipments: spray operation, preparation of insecticide spray suspension, spraying technique for IRS, guidelines for spraying activity for IRS, space spray, indoor space spray, outdoor fogging, portable equipment for outdoor fogging and formulation. IVM in different situations (endemic and epidermic), epidemic preparedness and response for malaria, rapid response team, epidemic preparedness of dengue and chikungunya, organization and management, techniques used in the implementation of IVM, collaboration of health sectors (at central and state level), core function required for IVM at central and local levels, intersectoral collaboration, conceptual framework of intersectoral collaboration.

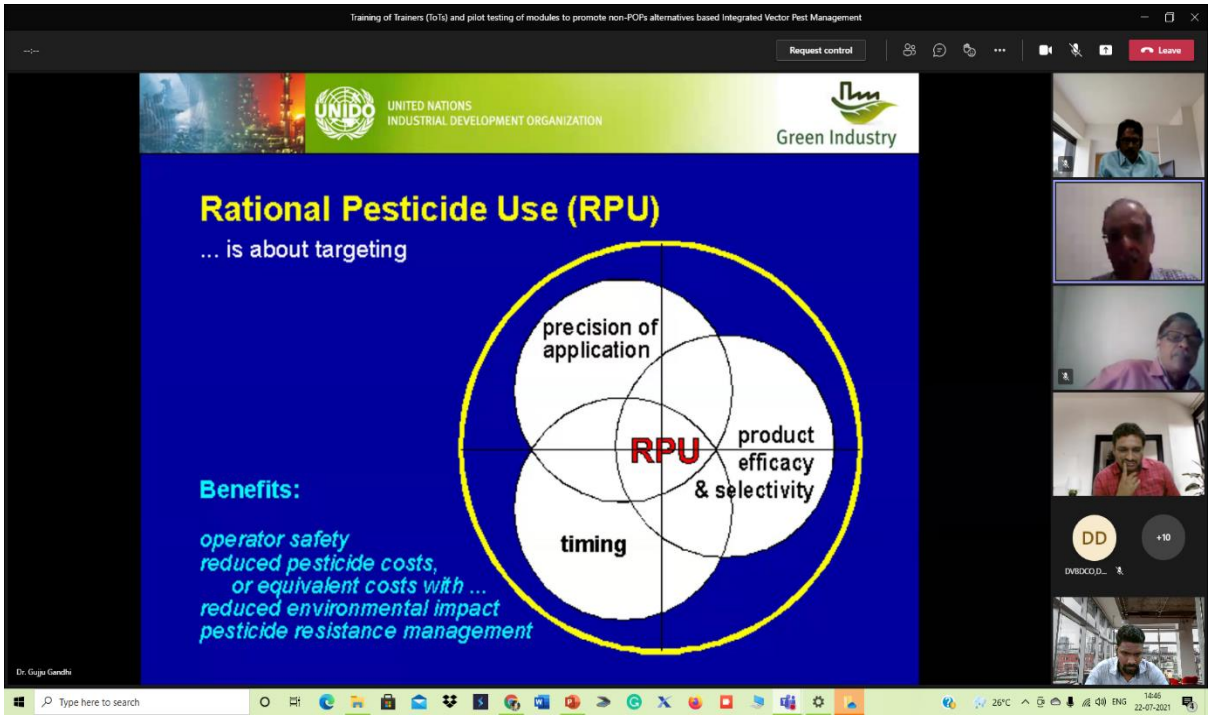

Figure – 10 (B): Screenshot of training session – 8

Integrated pest control was the unique training part of this programme, contents covered were biological control, habitat manipulation, modification of cultural practices, use of resistant varieties. Integrated pest control, mechanical and physical control and chemical control. The following are the factors to consider-suppression of harmful organisms, monitoring, adequate decision-making, specific pesticides evaluation, IPM implementation, monitoring and evaluation (adequate decision making, specific pesticide, farmers field school for IPM).

Training part - 3: IVPM: Behaviour change communication & vector management through farmer field school approach

This training part under the integrated vector and pest management (IVPM), was covered by Dr. R.S. Sharma, contents covered were background, rational and concept of BCC and FFS in IVPM. He gave training to trainees about how to implement and monitor BCC and FFS in the public health and agricultural community. Farmer Field School (FFS): Evolution of the farmer field school approach, integrated production and management though FFS, vector and VBDs management though FFS, farmers health risks associated with agriculture in India. Role of FFS at the field level for increasing continued monitoring and evaluation to reduce the vector and pest population. Management of mosquito breeding in rice field through BCC and FFS. This is a very important part in Integrated vector and pest management in the community.

Training session – 9 (Day – 9 (Friday) 23/07/2021)

Training part – 1: Planning and implementation of IVPM

Dr. R. S. Sharma covered this training part. The planning and implementation of IVPM depends on types of intervention, management of resources and stakeholder's participation.

The programme should be based on valid and accurate observations, data and proper analysis at the local level. This training part content covered operational steps to be conducted at district or village level compressing of analysis and mapping of local disease determinates, selection of vector control methods, assessment of available resources, epidemiological and entomological assessment, estimation of disease occurrence, determinates of local diseases for the implementation of a local IVM strategy (figure 11 A).

Figure – 11 (A): Screenshot of training session – 9

Training part - 2: Monitoring and evaluation of IVPM

The monitoring and evaluation of the IVPM training part was covered by Dr. Amit Katewa, Consultant, NVBDCP. In this session, participants learnt about methods of monitoring including design, data collection and results; described different outcome indicators and entomological as well as epidemiological surveillance. Guidance for monitoring and evaluating the implementation of the national IVPM strategy is vital in achieving objectives to make any required improvements. It helps to propose standard monitoring and evaluation methods at a regional and national level. Methods of monitoring and evaluation are important implications that are designed to improve the existing system of vector control and prevention of VBDs. Organization and management must be monitored and evaluated to state and central levels to train for all participants.

Training part - 3: Epidemiological surveillance and parameters

Dr. Ratna Joseph was covered this training part. Epidemiological surveillance is a process to determine the actual burden of disease to assist in decision-making on resource allocation and allow evaluation of the impact of the intervention strategy. The main contents in this session

were epidemiological triad of VBDs, Epidemiological surveillance, Epidemiological parameters of malaria (Annual blood examination rate, Annual parasite Incidence, Annual falciparum Incidence, Slide positivity Rate and Slide falciparum rate), Incidence, Prevalence (point prevalence & period prevalence). Epidemiological parameters of filariasis (Filarial endemicity, Microfilaria rate and Microfilaria density were also discussed (figure – 11(B).

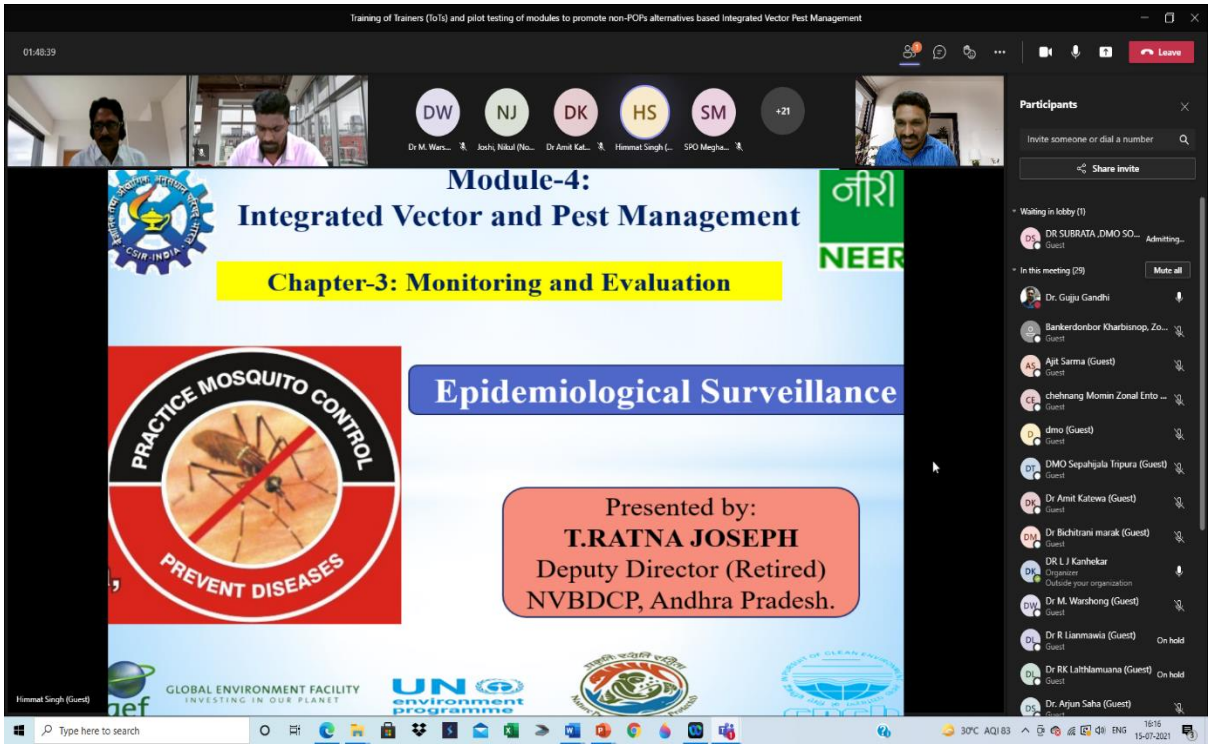

Figure – 11 (B): Screenshot of training session – 9

Training session – 10 (Day – 10 (Monday) 26/07/2021)

Training part - 1: Ecological setup and suitable vector control method

Ecological setup and suitable vector control method is depending on the situation of disease transmission. The participants should learn techniques for which vector control method used in different situations of disease transmission. This training part was covered by Dr. Pradeep Kumar Srivastava, the contents covered were vector control methods for different diseases, selection criteria of vector control methods, classification of malaria types related to human activities in India (urban malaria, Trible malaria), the burden of malaria in India, IVM: Crucial information on vector, entomological priorities in different situation in India, Basic concept of IVM and training to perform monitoring (figure – 12 A).

Training part - 2: Report preparation: Vector collection and their control

The reports communicate information that has been compiled as a result of research and analysis of data or work. Reports can cover a wide range of topics but usually focus as on transmitting information with a clear purpose, to a specific audience. Good reports are documents that are accurate, objective and complete. The objective of this session was that

participants should be able to prepare the reports for vector collection and their control activities. This session was handled by Dr. Amit Katewa, contents covered were collection of information/data, analysis of the data, draft of report using proper formation/proforma, using annexures, review before submission and submission of the report (soft copy of filled proforma, avoid submission of many reports at a time and check the right place/division for submission (figure – 12 B).

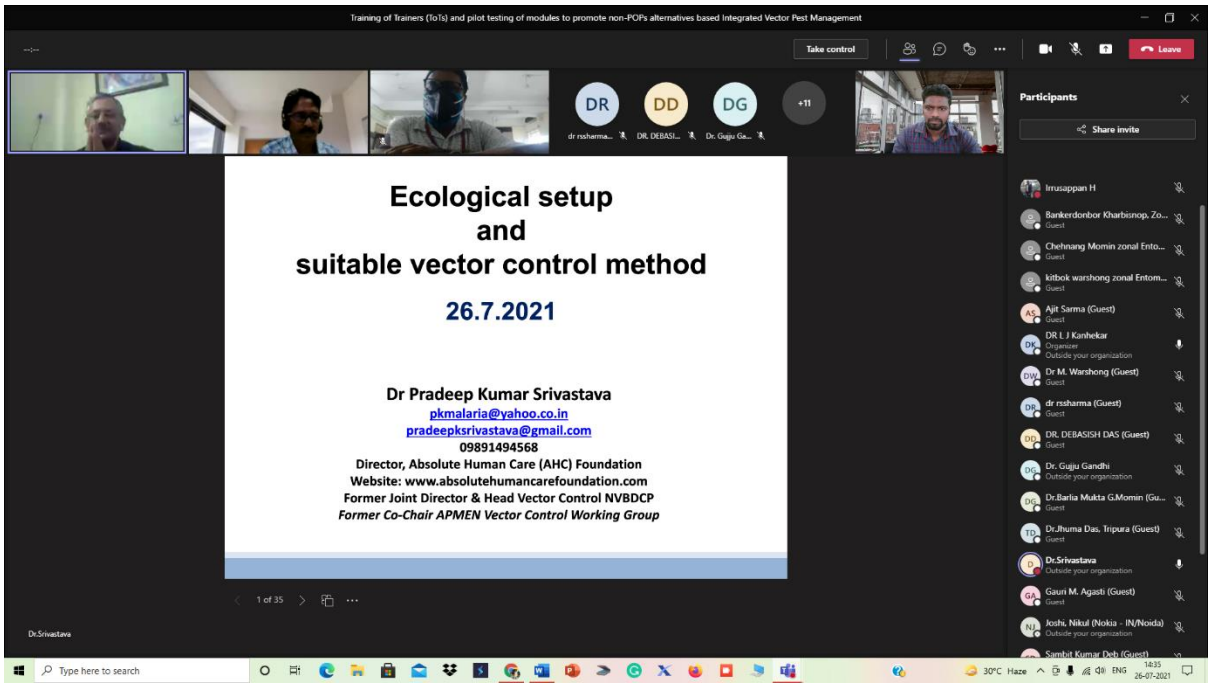

Figure – 12 (A): screenshot of training session – 10

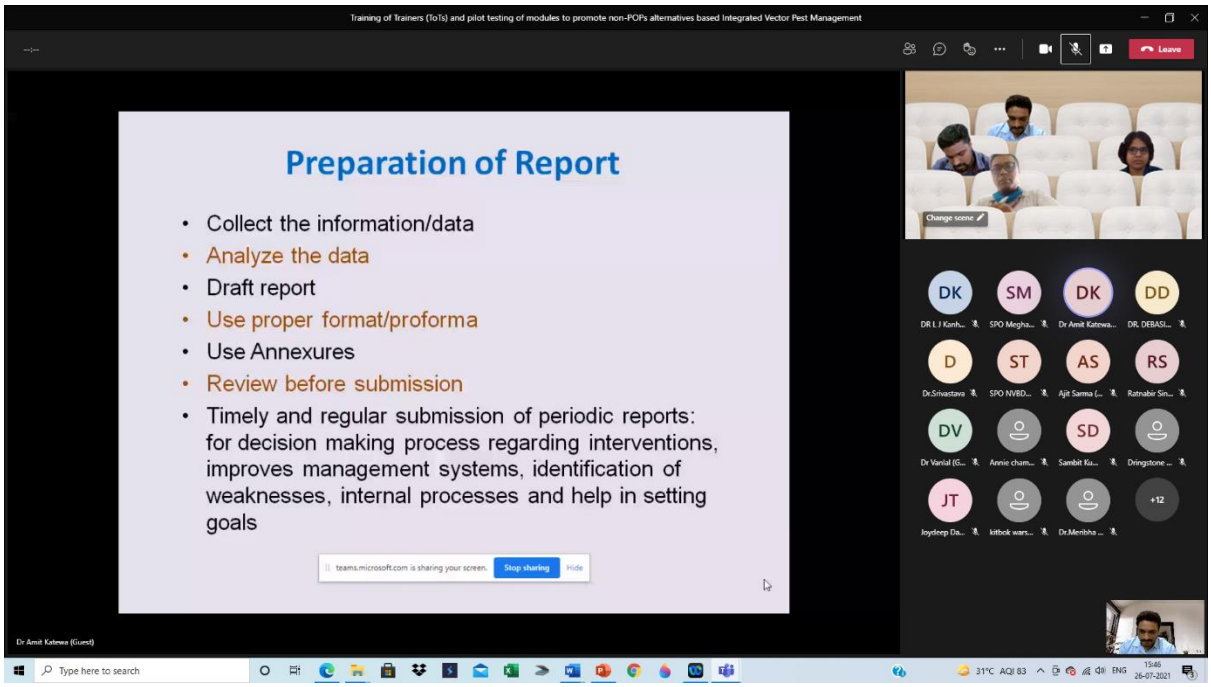

Figure – 12 (B): Screenshot of training session – 10

7.0. Discussion on Non-POPs alternatives to DDT in vector control

This session was the conclusion part of our training programme, the non-POPs alternatives to DDT in vector control methods to induce phase out of DDT from vector control usage in public health. Dr. R. S. Sharma coordinated this session, he discussed all alternatives to DDT in vector control methods (physical, chemical, biological, personal production and environmental control) and concluded the discussion part for non-POPs alternatives to DDT in vector control.

8.0. Feedback from participants/trainees on modules

The training programme came to an end on 26th of July with the feedback of the participants. Dr. L. J. Kanhekar asked the participants to give their valuable responses and inputs on the training modules, booklets, PPTs and the IEC material provided to them by filling the Feedback forms sent to them via e-mail. After conducting all the pilot testing, amendments would be made to the training modules as per suggestions of the participants and comments of the experts.

9.0. Virtual valedictory session

Dr. A. Ramesh Kumar conducted a virtual valedictory session and proposed the vote of thanks to all the participants and experts, thus summing-up the training programme. He also asked the participants for their opinions on the training programme by filling the feedback form provided to them (figure – 13).

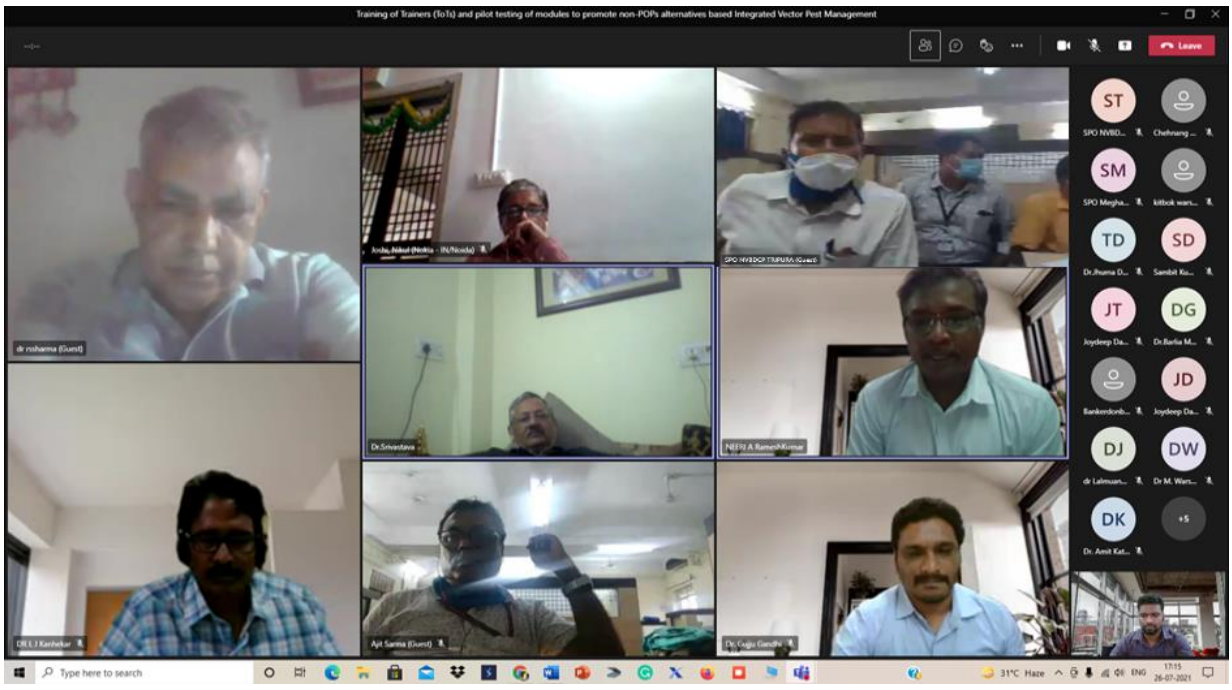

Figure - 13: Screenshot of end session of Training Programme

10.0. Annexures

10.1. List of organizing members

1. **Dr. A. N. Vaidya,**
   Coordinator, Stockholm Convention Regional Centre,
   HOD, Chemical and Hazardous Waste Management Division,
   CSIR – National Environmental Engineering Research Institute.

2. **Dr. A. Ramesh Kumar,**
   Sr. Scientist, (Project Leader)
   CSIR – National Environmental Engineering Research Institute.

3. **Dr. L. J. Kanhekar,**
   Project Consultant,
   CSIR – National Environmental Engineering Research Institute.

4. **Dr. Gujju Gandhi,**
   Project Research Associate,
   CSIR – National Environmental Engineering Research Institute.

5. **Mr. Irrusapann. H,**
   Project Associate-II (Entomology)
   CSIR – National Environmental Engineering Research Institute.

6. **Ms. Gauri Agasti,**
   Project Associate-I
   CSIR – National Environmental Engineering Research Institute.

10.2. List of faculties

1. **Dr. R. S. Sharma,**
   Ex. Additional Director,
   National Centre for Disease Control

2. **Dr. P. K. Srivastava**
   Ex-Joint Director,
   Directorate of National Vector Borne Disease Control Programme

3. **Dr. Kalpana Baruah**
   Addl. Director,
   Directorate of National Vector Borne Disease Control Programme

4. **Dr. Amit Katewa,**
   Consultant,
   Directorate of National Vector Borne Disease Control Programme.

5. **Dr. Himmat Singh,**
   Scientist – D,
   ICMR - National Institute of Malaria Research.

6. **Dr. Vijay Kumar,**
   ICMR- Consultant, (Ex- Scientist E),
   ICMR-Rajendra Memorial Research Institute of Medical Sciences.

7. **Dr. N. Balakrishnan,**
   Ex-Joint Director,
   National Centre for Disease Control.

8. **Dr. P. T. Joshi,**
   Ex- State Entomologist, Gujarat state.

9. **Dr. T. Ratna Joseph,**
   Ex-Deputy Director,
   Government of Andhra Pradesh.

10. **Dr. Y.P. Ramdev,**
    National Technical Adviser,
    United National Industrial Development Organization.

10.3. List of Participants – Meghalaya, Mizoram and Tripura

Training of Trainers (TOT) and pilot testing of modules to promote non-POP alternatives based Integrated Vector Pest Management

Training dates :12-07-2021 to 26-07-2021 (2.30PM to 5.30PM)

	Meghalaya	
Sl. No	**Participant Trainee Names**	**Designation**
1	Dr. (Mrs.) Bibha R. Marak	State Programme Officer
2	Dr. M. Warshong	DMO Incharge
3	Shri. Kitbok Warshong	Zonal Entomologist
4	Dr. E. Challam	DMO Incharge
5	Dr. Barlia Mukta Momin	DMO Incharge
6	Shri. Chenang Momin	Zonal Entomologist
7	Dr. (Mrs). Bichitrani Ch Marak	DMO Incharge
8	Shri. Dringston M. Sangma	Zonal Entomologist
9	Dr. Bonie D. Shira	DMO Incharge
10	Dr. R. Laloo	DMO Incharge
11	Shri. Bankerdonbor Kharbisnop	Zonal Entomologist
	Mizoram	
12	Dr. Lalremmawii	SPO(VBD)
13	Dr. K. Vanlalhruaia	M&E Consultant
14	Mr. Lalfakzuala Pautu	Entomologist
15	Dr. PC. Lalhmingliana	District Malaria Officer (DMO)
16	Dr. Lalbiaksiami	District Malaria Officer (DMO)
17	Dr. Lalhlunpuii	District Malaria Officer (DMO)
18	Dr. R. Lianmawia	District Malaria Officer (DMO)
19	Dr. Lalrinthangi	District Malaria Officer (DMO)
20	Dr. S. Thaizi	District Malaria Officer (DMO)
21	Dr. Lalnunziri	District Malaria Officer (DMO)
22	Dr. RK. Lalthlamuana	District Malaria Officer (DMO)
23	Dr. Lalmuanawma Jongte	District Malaria Officer (DMO)
	Tripura	
24	Dr. Kajal Dev Gupta	SPO NVBDCP
25	Shri. Sambit Kumar Deb	Consultant PSCM
26	Shri. Joydeep Datta	Consultant IEC/BCC
27	Dr. Jhuma Das	Entomologist, IDSP
28	Shri. Ajit Sarma	DVBDC
29	Dr. Apollo Kaloi	District Malaria Officer (DMO)
30	Dr. Arjun Saha	District Malaria Officer (DMO)
31	Dr. Padma Ram Jamatia	District Malaria Officer (DMO)
32	Dr. Rupak Chakma	District Malaria Officer (DMO)
33	Dr. Manabandra Reang	District Malaria Officer (DMO)
34	Dr. Subrata Das	District Malaria Officer (DMO)
35	Dr. Saradindu Reang	District Malaria Officer (DMO)
36	Dr. Debashish Das	District Malaria Officer (DMO)