Preface

Japanese Encephalitis (JE), transmitted mostly by *Culex tritaeniorhynchus* belonging to *Culex* vishnui group of mosquitoes, is the leading cause of viral encephalitis in 14 Asian countries. Approximately, 60 % of the world's population live at risk in JE endemic regions of these countries. In humans, JE virus causes inflammation of the membranes around the brain hence the name "encephalitis".

JE started affecting India since 1970s and now it has emerged as a major public health problem due to its epidemic potential, high case fatalities and lifelong disabilities in survivors. Many major JE outbreaks have been reported from different parts of the country and in most of these outbreaks from Northern India, disease transmission could not be explained due to negligible vector density detected during entomological investigations. Every year, so-called "undiagnosed viral illness" invades India and unfailingly claims thousands of lives especially in children below 15 years. Of these several hundred child deaths, >75 % are contributed by Northern India with case fatality rate ranging from 10 to 77.5 %.

Culex. tritaeniorhynchus, primary vector of JE in India is predominantly exophilic i.e. rest outdoors and normally zoophilic, i.e. they prefer to take blood meals from animals. JE virus circulates and multiplies among pigs and birds and infects these zoophilic mosquitoes. These mosquitoes turn into indiscriminate feeder, increasing man–vector contact leading to transmission of JE virus in man during monsoon and post-monsoon months when their density increases tremendously. Therefore, the mosquito sampling techniques used need to be adequately sensitive to detect the sharp increase in vector density for initiating integrated vector control measures to prevent JE outbreak. However, the main reason for failure in detecting sharp increase in JE vector density in earlier JE outbreak investigations from Northern India was the use of inadequate mosquito sampling tools.

In order to overcome the above problem, I have developed "BPD Hop Cage Method" a simple, cost-effective, operationally feasible sampling tool specially designed to capture predominantly outdoor resting mosquitoes from land and aquatic vegetation. This has helped to study nearly every aspect of JE vector bionomics and establish entomological evidences of JE outbreaks occurring in Northern India upon its use since 2003.

This book mainly includes data generated by me on ecological studies of JE vectors undertaken from Northern India over a period of 9 years (1998–2006) at

National Institute of Communicable Diseases (NICD), Delhi, and supported by data collated during outbreak investigations of JE/Acute Encephalitis Syndrome (AES) carried out in different parts of the country by central teams (constituted by the Ministry of Health and family Welfare) in which I was associated as a member. Based on the observation obtained, situation specific integrated vector control strategies were suggested to prevent transmission of the disease in Northern India. Similar JE vector surveillance and vector control measures are suggested for other regions of South East Asia where similar ecological and environmental conditions exist.

Health including control of mosquito borne diseases is a state subject. Entomological man power and set-up available with the state authorities are either very poor or does not exist. In order to improve availability of trained man power in the country, students of Master of Public Health, IP University, Delhi and in-service public health personnel of India and abroad undergoing various training programmes held at NICD were taken for field studies to the JE endemic areas in Karnal district (Haryana) and Saharanpur district (Uttar Pradesh). They were exposed to the operational methodology of various sampling tools used in detecting JE vector abundance during outbreak investigation of JE/AES, along with other procedures for collecting data on environmental and epidemiological parameters of the disease.

Though JE virus cannot be eliminated from the environment, as it is not possible to kill all the infected reservoir birds; however, the disease burden can certainly be reduced appreciably by efficient assessment of JE vector abundance and JE virus infection in local vector mosquitoes. A prime requisite for this is the accurate determination of the species of *Culex* mosquitoes actually involved in transmitting the disease. The only available key can be used by those familiar with taxonomic language and not by common users in the programme. I present here a simple illustrated key, in a language which is tuned to the medical officers and paramedical staff in public health programme, to differentiate 17 commonly encountered species of *Culex* (*Culex*) mosquitoes associated with JE in India.

The objective of the book is to disseminate the knowledge gained by me over a period of nearly last 15 years of research in the field of ecology of mosquito vectors of JE virus from Northern India to anyone who wishes to curtail death of children due to this dreaded disease. I urge you to send me your suggestions for improving the book further.

There are many people behind the successful completion of this book, without whose help I could not have brought this assignment to fruition. I thank Dr. N. Arunachalam, Centre for Research in Medical Entomology (CRME), Madurai, India and Prof. V. K. Gupta, University of Florida, USA for their critical comments on some chapters of the manuscript; Mr. N. L. Katra, former Entomologist, National Institute of Communicable Diseases (NCID) for his valuable suggestions which enriched this book. My sincere gratitude is due to the successive Directors and especially to Dr. V. K. Saxena, Head, Centre for Medical Entomology & Vector Control, National Centre for Disease Control (formerly NICD) for facilities during the course of experiments earlier at NICD. I would like

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