"Micro-plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh"

Shireen Akhter
MBBS (Dhaka), MPH (USA),
DTM&H, M.Sc (London)

FACULTY OF POST GRADUATE MEDICAL SCIENCES & RESEARCH
UNIVERSITY OF DHAKA
2001

Dedication

I dedicate the Thesis to

my beloved mother, Mrs. Latifa Haque,

a great and incomparable lady,

whose sacrifice, inspiration and encouragement

has brought

the enjoyment and success of my life.

"Micro-plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh"

Shireen Akhter
MBBS (Dhaka), MPH (USA),
DTM&H, M.Sc (London)

July 2001

This thesis is submitted in partial fulfillment of the requirement for the Degree of Doctor of Philosophy (Medical Science)

FACULTY OF POST GRADUATE MEDICAL SCIENCES & RESEARCH
UNIVERSITY OF DHAKA
2001

I hereby declare that the thesis entitled **"Micro-plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh"** is based on the work carried out by me and no part of it has been presented previously for a higher degree.

The research work was carried out in the Departments of Medical Entomology and Parasitology, National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka-1212, Bangladesh, under the guidance of Professor Md. Shahjada Chowdhury PhD, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka-1212 and Prof. Hamida Khanom PhD, University of Dhaka, Bangladesh.

S Akhter

Dr. Shireen Akhter
M.B.B.S (Dhaka), MPH (USA),
DTM&H, M.Sc (London)

Dated: ....4-7-.... 2001

Dr. Shireen Akhter has worked on the subject **"Micro-plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh"** under our direct supervision. We have gone through the thesis. This is up to our full satisfaction.

Supervisors

M.S. Chowdhury

1. Prof. Md. Shahjada Chowdhury
MBBS; DPH; MSc(London); PhD
Professor & Head, Dept. of Parasitology
NIPSOM, Dhaka-1212, Bangladesh.
Dated: 19/7/01

Hamida Khanum

2. Prof. Hamida Khanum
MSc (DU); PhD
Professor, Dept. of Zoology
University of Dhaka, Bangladesh.
Dated: 30.7.2001

This thesis entitled '**Micro-plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh'** is submitted to the Faculty of Post Graduate Medical Science and Research, Dhaka University, for the degree of "Doctor of Philosophy (Medical Science)" on July 2001.

SAkhter
4.7.01

Candidate

Dr. Shireen Akhter
M.B.B.S,(Dhaka), MPH (USA),
DTM&H (London), M.Sc (London)

M.S. Chowdhury
19/7/01

Supervisor

Prof. Md. Shahjada Chowdhury
MBBS; DPH; MSc(London); PhD
Professor & Head, Dept. of Parasitology
NIPSOM, Dhaka-1212, Bangladesh.

Evaluation of the final examination, the defence of thesis.

We the members of this defence committee unanimously approve the thesis entitled **" Micro Plan for area specific strategy to control malaria, kala-azar and filaria in selected areas of Bangladesh"**

For

Dr. Shireen Akhter

We further agree that she has satisfactory defended her thesis at the examination given on ....

We recommend, therefore, that Dr. Shireen Akhter be awarded the degree of 'Doctor of Philosophy (Medical Science)' from the Faculty of Post Graduate Medical Science and Research, University of Dhaka, Bangladesh.

Dr. Md. Jahurul Karim, PhD **Convenor**
Professor
Department of Parasitology
Bangladesh Agricultural University
Mymensignh 2202, Bangladesh

Professor. C.G. Nicholas Mascie-Taylor, PhD, Sc.D **Member**
Head of Department and Fellow of Churchill College
Department of Biological Anthropology
University of Cambridge
Downing Street
Cambridge, CB2 3DZ

Professor. Md. Shahjada Chowdhury, PhD **Supervisor**
Head, Department of Parasitology,
National Institute of Preventive and Social Medicine (NIPSOM),
Mohakhali, Dhaka- 1212

CONTENTS

Annexure

Map of Study areas

Questionnaire

Acknowledgement

All praises for Almighty God, the Merciful, the Beneficial, for giving me the opportunity, courage and capability to carry out and complete the dissertation work.

First and foremost, I take the rare opportunity to express my appreciation and deepest sense of gratitude to my honourable teacher and guide Professor Md. Shahjada Chowdhury, MSc (London), PhD, Department of Parasitology, National Institute of Preventive and Social Medicine (NIPSOM), cum Dean, Faculty of Medical and Social Sciences, Bangabandhu Seikh Mujib Medical University, Dhaka for suggesting the problems on which I have completed the study. I want to express my indebtedness for his valuable advice, constant supervision, guidance, kind assistance, constructive criticism and critical reading of the manuscript, without which it would have been impossible to complete the study.

I express my profound gratitude to Prof. (Dr.) Hamida Khanam, Department of Zoology, University of Dhaka, Bangladesh, my expert, for sharing with me her expertise, insight and resources, which facilitated the speedy completion of the study. I wish to express my sincere appreciation for her help.

I am sincerely thankful to Professor Syed Modasser Ali, Dean, Faculty of Post Graduate Medicine and Research, Dhaka University, for allowing me to submit the dissertation to the University of Dhaka in the PhD programme (Medical Science) for defense.

I am sincerely thankful to Prof. Sohrab Ali, Prof. and Head, Dept. of Biochemistry, Bangabandhu Seikh Mujib Medical University, Dhaka, cum Ex. Dean, Faculty of Post Graduate Medicine and Research, University of Dhaka, for accepting me in the PhD programme (Medical Science) under the University of Dhaka.

I want to express my gratitude to Dr. Md. Abul Baset and Dr. Motior Rahman, Civil Surgeon, Netrokona, Dr. Md. Abu Ishaque, Civil Surgeon, Thakurgaon, Dr. Moniruzzaman, Civil Surgeon, Tangail and their staff for extending their necessary facilities during my study period.

For successful completion of this study I would like to express my deepest heartfelt thanks to Dr. Golam Rabbani, UHFPO, Kalamkanda Upazilla Health Complex (UHC), Netrokona, Dr. M.A Momin, UHFPO, Baliadangi UHC, Thakurgaon, Dr. Md. Rafiqul Islam, UHFPO, Thakugaon Sadar UHC, Thakurgaon, Dr. Shamsul Haque, UHFPO, Kalihati UHC, Tangail, and their staff for their active support and co-operation for collecting data and follow-up the patients for morbidity and mortality in the Health Complexes, impregnation and reimpregnation of mosquito nets during my field work.

I am grateful to the field staff of Bhaluka, Kalihati, Kalmakanda and Balidandi Upazilla Health Complex for their help and co-operation for collecting data during house-to-house survey and follow-up the patients in households and distribution of bed nets and monitoring the use of bed nets. I am grateful to all the patients and villagers in the study area for their co-operation during collecting history, performing physical examination, collecting blood and aspirated materials from spleen and bone marrow, without which it would have not been possible to carry out the study.

I am grateful to Dr. J.D. Lines, Dr. Colin J. Leake and Prof. C.F. Curtis, Department of Medical Entomology and Parasitology, London School of Hygiene and Tropical Medicine, London, for their constructive suggestion and encouragement. I wish to express my sincere appreciation.

Sincere gratitude to Professor C.G. Nicholas Mascie Taylor, Ph.D.; F1 Biol. Reader, Head of the Department and Fellow of Churchill College, Cambridge, University of Cambridge, for his guidance, suggestion of the statistical tests, useful data analysis, interpretation and constructive criticism of the dissertation work.

I express my heartfelt appreciation to my respected teacher Mr. Touhid Uddin Ahmed, Ex. Principal Scientific Officer, Dept. of Medical Entomology, IEDCR, Dhaka, for his constant support, encouragement, constructive criticism and critical reading of the manuscript of the work. I am thankful to Prof. Ismail Hossain, Dept. of Zoology, Dhaka University, for providing me with valuable papers. I express my thanks to Mr. Rafique Uddin Ahmed and Mr. Jamaluddin Dewan, Ex. Junior Scientific Officers, Dept. of Entomology, IEDCR, Dhaka, for helping me in identifying the mosquito and sandfly both in laboratories and fields. I extent my thanks to Mr. Ruhul Amin, Mr. Mafiz Ahmed, Med.Technologists, Dept.of Entomology, NIPSOM, Dhaka, for their co-operation during collection of sandfly and mosquito from the study areas.

My special thanks go to Mr. M A Hafez, Dept. of Bio-Statistics, NIPSOM, for his support on the statistical analysis. I am thankful to Dr. A.K. Azad, Dept. of Nutrition and Biochemistry, NIPSOM, for providing me papers about writing References in proper way. I express my heartfelt appreciation to all the faculty members of NIPSOM for giving me valuable suggestions.

For successful completion of this study I would like to express my deepest gratitude to Prof. Md. Afzal Hossain, BSMMU, Dhaka, Dr. Md. Anwar Hossain, ICDDRB, Dhaka, Dr. Mirza Mahbubul Haque, Dr. Manjurul Ahmed Chowdhury, for their constant encouragement, which inspired me to carry on the hard work.

I appreciate the Librarians and other staff of National Health Library, Dhaka University Library, ICDDRB Library and NIPSOM Library, for their necessary help in procuring relevant references and reprints.

The author is also grateful to Ministry of Science and Technology, Dhaka, and Bangladesh Medical Research Council (BMRC), Dhaka, for providing me financial support to carry out the fieldwork.

I am grateful to and sincerely want to thank Mr. Zafor Hassan and Minuara Begum who sincerely typed and edited the document with keen interest. I am thankful to Mr. Amir Hossain for his constant support.

Finally, I wish to express my heartfelt appreciation and gratitude to all the members of my family, Dr. Md. Rezaul Karim, Rashed Shahnewaz Karim (Anik) and Rifat Sharmeen (Anika) for their sacrifice to allow me working day and night and also providing me moral support, co-operation and constant inspiration in multifarious ways during the tough period of the study. I will ever remain grateful to them.

To the remainder, unwittingly not mentioned, I acknowledge all, who in one way or other has provided me assistance or inspiration.

Once again, my thanks go to all.

Dr. Shireen Akhter

Curriculum vitae of

Dr. Shireen Akhter

1. Name : **Dr Shireen Akhter**

2. Date of birth and nationality: 02-12-1956, Bangladeshi

3. Address : 'Reza Manzil",
8/2, Kadamtala, Bashabo, Dhaka-1214

4. Academic Qualification :

	Degree	University	Field	Year	Grade
i.	MBBS	Dhaka Medical College Dhaka	Com. Med., Sur., Med	1978	Regular
ii.	MPH	University of Tulane USA	Pub.Hlth., Epid.	1987	A
iii.	DTM&H	The Royal College of Physician, London	Trop. Med., Hyg.	1995	A
iv.	M.Sc.	University of London London	Med. Ento., Parasi.	1995	A
v.	DLSHTM	London School of Hyg. & Trop. Med, London	Medical Entomology	1996	A

5. **Service Record/Experience:**

	Name of the Post & Place of Posting	Period From	To
i.	Assistant Professor, Med. Entomology, NIPSOM, Mohakhali, Dhaka	25-1-2000	Till now
ii.	OSD, DGHS for Ph.D programme	01-07-97	24-1-2000
iii.	Sr. Scientific Officer, Med. Entomology, IEDCR Mohakhali, Dhaka	18-08-88	30-06-97
iv.	Medical Officer, MCH Training Institute, Azimpur, Dhaka.	23-06-85	17-08-88
v.	Medical Officer, Plassy Barak Govt. Dispensary, Dhaka	09-11-83	22-06-85
vi.	Medical Officer, Thana Health Complex, Kaliakair, Gazipur	22-12-79	08-11-83
vii.	Asstt. Surgeon, Dhaka Medical College, Dhaka	29-09-78	21-12-79

6. **Field of Specialization** : **Medical Entomology**

7. **Research Experience**:

i) Participating in various studies, epidemiological investigations and surveys on different communicable diseases including vector borne diseases since 1988.

ii) Conducting research projects as Principal Investigator/Co-Investigator on Vector borne diseases such as malaria, filaria, kala-azar with the support of IEDCR, BMRC & WHO fund.

iii) Conducting laboratory and field evaluation of various insecticides on mosquitoes, flies etc.

8. **Other experiences:**

i) Teaching: Teaching Post-graduate students of MPH courses in NIPSOM on medical entomology since 1997 under local order.

ii) Training: Providing training on Epidemiology & Medical Entomology in different training courses for physicians, Entomologists, paramedics, Health professionals etc.

9. **Scientific Publications:**

1. Ahmed TU, Joshi GP, Ahmed RU, Dewan ZU, Begum NN, Akhter S and Khoda ME. Study on seasonal density of common mosquitoes in Jungle area of Modhupur, Tangail. J. Zool. 1989; 4: 1-14.
2. Ahmed TU, Masum MA, Ahmed RU, Dewan ZU, and Akhter S. Phlebotominae sandflies (Diptera: Psychodidae) of Bangladesh. J. Zool. 1989; 4: 61-64.
3. Ahmed TU, Joshi GP, Ahmed RU, Dewan ZU, Chowdhury MS and Akhter S. Container Habitat mosquitoes of Bangladesh. J. Zool. 1990; 5: 7-16.
4. Ahmed TU, Joshi GP, Ahmed RU, Akhter S, Hakim MA, Bhuiyan MKR and Khoda ME. Observation on the abundance of mosquitoes in a tea-garden area of Bangladesh of Bangladesh. J. Zool. 1991; 6: 30-42.
5. Chowdhury MS, Masum MA, Karim E and Akhter S. Treatment failure due to Sodium Antimony Gluconate administration in Bengali visceral leishmaniasis patients. University of sci. & tech. ann. 1996; 2: 25-29.
6. Ahmed TU, Ahmed RU, Dewan ZU, Molla MAS, Akhter S and Khoda ME. Prevalence of sandflies in a kala-azar endemic area of Bangladesh. J. Zool. 1996; 10 & 11: 19-30.
7. Akhter S, Curtis CF, Lines JD. Impregnation of bed nets with mixtures of pyrethroids and single compound against susceptible and resistant *Anopheles stephensi*. JOPSOM 1998; 17 (2):103-108.
8. Akhter S, Chowdhury MS, Khanom H, Hossain M. Effect of flood on sandfly density and prevalence of visceral leishmaniasis in kala-azar endemic village of Bangladesh. JOPSOM 1999; .18 (2): 32-39.
9. Hossain M, Chowdhury FA, Musa N, Howlader GR, Akhter S, Chowdhury MS, Naher A, Hussain AMZ. Evaluation of field tools for diagnosis of Bancroftian filariasis to be used in national filariasis control program. JOPSOM 1999;18(2): 1-5.
10. Akhter S, Khanam H, Islam MN, Naher A, Chowdhury MS, Biswas S. Assessment of effectiveness of different drug regimen according to the nature of malaria cases in some selected areas of Bangladesh. JOPSOM 2000; 19(1): 86-92.
11. Akhter S, Nehar A, Khanom H, Chowdhury MS. An entomological surveillance for vectors in a malaria endemic area of Bangladesh. JOPSOM 2000, 19(2) : 32-39.
12. Naher A, Chowdhury MS, Mannan MA, Akhter S. Malaria Update including recent advances in laboratory diagnosis, drug resistance, malarial vaccine, prevention and control. JOPSOM 2000, 19 (2): 80-87.
13. Akhter S, Khanom Hamida, Chowdhury MS. Impact of deltamethrin impregnated bed nets on malaria transmission in some rural areas of Bangladesh. JOPSOM 2001; 20 (1): 33-42.

A. Books

1. Visceral leishmaniasis and its control, WHO, June,1993.
2. Zoonotic diseases and related animals in Bangladesh, Bangla Academy (In Bengali), 1994.

Dr. Shireen Akhter

List of Tables

List of Figures

Subjects **Page No.**

List of Plates

Abbreviation or Symbol

Abbreviation =		Stands for
ACD	=	Active Case Detection
AT	=	Aldehyde Test
CFT	=	Compliment Fixation Test
CMI	=	Cell Mediated Immunity
CS	=	Cattle Shed
DAT	=	Direct agglutination Test
DDT	=	Dichloro Diphenyl Trichloroethane
DEC	=	Dielthylcarbamazine Citrate
DGHS	=	Directorate General of Health Services
DH	=	District Hospital
DIMN	=	Deltamethrin Impregnated mosquito
EDPT	=	Early Diagnosis and Treatment
ELISA	=	Enzyme Linked Immuno Sorbent Assay
HA	=	Health Assistant
HBI	=	Human Blood index
HCT	=	Haemato Crit Level
HHNo.	=	Household Number
HT	=	Human Dwelling
IBN	=	Impregnated Bed Net
ICT	=	Immuno-chromatographic Test
IEC	=	Information Education Communication
IIBN	=	Insecticide impregnated bed net
IM	=	Intramuscular
ITBN	=	Insecticide Treated Bednet
KA	=	Kala-azar

LD	=	Leishmania Donovani
M&PDC	=	Malaria & Parasitic Disease Control
MCFR	=	Malaria Case Failure Rate
MCL	=	Malaria Case Load
MEP	=	Malaria Eradication Programme
MLO	=	Mosquito Larvicidal Oil
MP	=	Malaria Parasite
MR	=	Malaria Rate
PHC	=	Primary Health Care
PKDL	=	Post Kala-azar Dermal Leishmaniasis
RIS	=	Residential Indoor Spraying
RMCS	=	Revised Malaria Control Strategy
SM	=	Severe Malaria
SMR	=	Severe Malaria Rate
TBA	=	Traditional Birth Attendants
TFM	=	Treatment Failure Malaria
TFMR	=	Treatment Failure Rate
THC	=	Thana Health Complex
UM	=	Uncomplicated Malaria
UMR	=	Uncomplicated Malaria Rate
VHV	=	village Health Volunteer
VL	=	Visceral Leishmaniasis
WBC	=	White Blood Cell
WER	=	Weekly Epidemiological Report
WHA	=	World Health Assembly
WHO	=	World Health Organization

ABSTRACT

Abstract

Malaria, kala-azar and filaria are three vector borne diseases endemic in some parts of Bangladesh. The present study was conducted on the prevalence of malaria, filaria and kala-azar, abundance of their vectors and impact of deltamethrin treated bed net on the density of vector and the prevalence of diseases in nine selected villages of Kalihati, Kalmakanda and Baliadangi upazilla of Tangail, Netrokona and Thakrgaon district of Bangladesh respectively during the period of June 1996 to May 1999. A total of 258 malaria cases were diagnosed clinically and parasitologically among 11,553 villagers during the period of study. Maximum malaria cases were detected among people of 10-19 years of age (35.65%) followed by age group 20-29 years (32.55%). The cases were classified as Uncomplicated Malaria (UM), Severe Malaria (SM) and Treatment Failure Malaria (TFM) and treated according to the standard drug regimen for UM, SM and TFM. Except 3.87% mortality, rest became cured with that regimen. Early diagnosis and prompt treatment (EDPT) according to the set up criteria would be affective in reducing the morbidity and mortality due to malaria in Bangladesh. During the entomological surveillance in three villages, Kristapur, Burimari and Kadamtali of Kalmakanda upazilla from June 1996 to May 1997, a total of 4832 female *Anopheles* mosquitoes were collected, of which 798 (16.52%) from human dwellings and 4034 (83.48%) from cattle sheds. Out of seven malaria vectors in Bangladesh, six named by *An. vagus, An. annularis, An. philippinensis, An. aconitus, An. minimus* and *An. dirus* were found to be present in the study villages but the density of all was low. The villages were assigned into area A, B and C as intervention areas with deltamathrin impregnated bed nets, non-impregnated bed nets and control where no bed nets were distributed respectively. The

density of female *Anopheles* mosquitoes and the prevalence of malaria cases decreased significantly ($p<0.01$) in area A during the post intervention period whereas no significant changes ($p>0.05$) occurred in non-impregnated or control areas. The finding suggests the effectiveness of deltamethrin impregnated bed net in reducing the transmission of malaria in rural areas of the country.

A total of 139 lymphatic filariasis- 60 clinically positive, 67 only micrifilaria positive and 12 both clinically and parasitologically positive cases were detected among 3551 villagers of Bamunia, Maskuria and Bangavita villages of Baliadangi upazilla under Thakurgaon district in Bangladesh during the period of June 1996 to May 1999. Responses to treatment of three regimens, i. Standard therapy ii. Semi-annual single dose therapy and iii. Low dose monthly schedule, were evaluated. With any regimen, the clinical signs did not disappear completely except slight reduction or no further increase. Regarding parasitological cure, strategy III proved most effective (60.1%) followed by strategy I (54.5%) and lastly strategy II (45.5%). During the 1st year period of study, a total of 2608 female mosquitoes were collected by different methods from the three selected villages of Baliadangi upazilla, of which 1836 (70.4%) belonged to genus *Culex* followed by *Anopheles* (26.5%). Among the *Culex* mosquitoes, *Culex quinquefasciatus* was the most predominant species (72.0%). 855 mosquitoes were dissected and only *Cx. quinquefasciatus* was found positive with filarial larvae and the infectivity rate was 8.1%. People's knowledge regarding the cause and transmission of filaria was very poor. The acceptability and practice of using deltamethrin impregnated bed net in area A and non-impregnated bed net in area B was high. The density of *Cx. quinquefasciatus* mosquitoes collected from human dwelling showed a significant decrease ($P< 0.05$) on the 3rd year of study in area A but not in area B and C. The prevalence of filariasis in area A also showed a decreasing trend during the three years of study and not in other two areas. As the acceptance and use of bed net by rural people was high and deltamethrin impregnated bed net reduced the density of filaria vector, it might be effective in controlling filariasis, if maintained for years together.

A total of 228 cases of were diagnosed as kala-azar clinically and serologically by Direct Agglutination Test (DAT) out of the 3776 inhabitants of the villages, Bir Basunda, Pachh Joair and Parki of Kalihati upazilla under Tangail district, during the three years of study. 86% of the patients responded well to 1st line of treatment with Sodium Antimony Gluconate (SAG). 12.6% of the non-responsive and relapsed cases became cured with Pentamidine Isethionate, the 2nd line of treatment. Mortality rate was 1.3%. 12 (twelve) Post Kala-azar Dermal Leishmaniasis (PKDL) cases responded well to 6 (six) courses of SAG. During the base line study, a total of 1140 female adult sandflies were collected by different catches from selected human dwellings and cattle shed of the three villages. Out of total collection, 38.4% was *Phlebotomus argentipes* and rests were *Sergentomyia* spp. 42.4% of the people had the idea that mosquito bite was the cause of kala-azar. A significant association ($P<0.05\%$) was observed between the presence of cattle shed and kala-azar cases in the same house. *P. argentipes* was found highly susceptible to deltamethrin. In the 3rd year of study there occurred a highly significant decrease ($P<0.01$) in the density sandfly in impregnated bed net area, no significant change in non-impregnated bed net area and an increase in the control area. Similar findings were observed regarding prevalence of kala-azar. If ITBN is used properly by all the members of the family and keeping cattle sheds dry and clean and away from dwelling houses, kala-azar can be controlled to a great extend even if not eradicated.

During the period of July to September 1998, the natural disaster of flood occurred in Bangladesh. To study whether flood acts as a natural intervention in reducing the transmission of kala-azar, adult sandfly and larvae were collected from selected houses of the submerged village Dhalia of Bhaluka thana of Mymensing district. Sandfly larva was detected from soil samples collected above flood water level even at 60-90 cm height indicating its survival in flood. The density of adult sandfly was lowest during flood period and increased thereafter. Prevalence of kala-azar remained same before and after flood. Flood reduces the sandfly density temporarily but it does not have any beneficiary impact on the prevalence of kala-azar.

Case Definition

The following case definitions of malaria and the managements have been suggested as the 'Revised Malaria Control Strategy' during the Ministerial Conference in Amsterdam, Netherlands in 1992. Bangladesh has accepted the strategy in 1994.

Malaria has been classified as
1. Uncomplicated Malaria (**UM**)
2. Treatment Failure Malaria (**TFM**)
3. Severe Malaria (**SM**)

Definition of three Malaria clinical types and their respective management protocols are as follows;

1. **UM**= Uncomplicated Malaria

- Fever or history of fever with little or no severity
- No other cause clinically detected to explain the fever
- Not taken any anti malarial drug
- Antimalarial chloroquine or Fansidar taken in improper dose or irregular course or with vomiting

Management
- No slide examination unless the report is of immediate benefit
- Chloroquine in usual dose for first three days and a dose of primaquine of day 4th

2. **TFM**= Treatment Failure Malaria

- Fever or H/O fever with or without severe sickness
- No other cause clinically detected to explain the fever
- Taken antimalarial Chloroquine or Sulphadoxine+ pyramethamine in proper dose and regular course and without vomiting

Management

- Slide should be taken and examined
- Three days quinine in recommended dose with a dose of Sulphadoxine+ Pyrimethrine on the third day
- A dose of prirmaquine on day 4^{th}

3. **SM**= Severe Malaria

- Fever or history of fever with severe sickness
- No other cause clinically detected to explain the fever
- With any of the following
    1. Altered consciousness or coma or convulsion
    2. Oliguria or renal failure
    3. Severe anaemia or circulatory collapse
    4. Prostration i.e. inability to walk or sit

Management

- Always should be treated in hospitals

- Slide should be taken and examined immediately, but initiation of treatment should not wait for the report of smear examination in case of suspicion of severe malaria. Benefit of the doubt should be given of strong suspicion to the patient by starting anti malarial anti parasitic medication as early as possible pending the smear examination report

- Antimalarial anti parasitic medication should be given parentally as early possible with an initial loading dose of quinine DHCL in the recommended dose followed by subsequent doses till patient can have medication orally when oral route of medication would be applied

- A dose of fansidar with primaquine on 4^{th} day or afterwards when the patient takes medication orally

- Concomitant measures should be taken for other complications

During morbidity survey of the present research work, the following case definitions were followed for kala-azar and filaria;

Kala-azar

- Low grade and continuous or double rise temperature within 24 hours
- Fever lasting more than 4 weeks
- No response to antibiotic, antimalarial or anti tubercular drug
- Splenomegaly

Confirmed by Direct Agglutination Test (DAT) +ve or demonstration of LD body in bone marrow or spleen smear

Filaria

- Periodic attacks of fever for few months
- Irritating cough
- Lymphangitis
- Lymphadenitis
- Swelling of lower limb or scrotum

Confirmed by demonstration of microfilaria in the peripheral blood collected at night or Immuno Chromatographic Test (ICT) +ve

CHAPTER 1

INTRODUCTION

Introduction

Topographically, Bangladesh lies on the north part of South Asia between 20°34 and 27°38 north latitude and 88°01 to 92°41 east longitude. The country is bounded by India on the west, north and north-east and by Mayanmur on the south-east. The Bay of Bengal is on the south (Annex-A). Except for the hilly region in the north-east and south-eastern part and high land in the north, the country consists of low and fertile land made up of alluvial soil. The south-west region consists of older and moribund delta with large numbers of dead and cut off rivers, often in the form of oxbow lakes (locally called 'Baors'). Within the north-east part of Bangladesh, lie a number of big and depressed basins (locally called 'Haors') which become completely inundated during the monsoon and also remain full of water during the dry winter months. A large numbers of water collection in the depressed locations (locally called 'Beels') are present in almost every part of Bangladesh. The southern coastal part of the country forms the mangrove forest called the 'Sundarbans', home of famous Royal Bengal Tiger as well as many thousands of other exotic animals and plant species.

Bangladesh is a riverine country. It is a land of three mighty but wanton rivers, the Padma, the Brahmaputra and the Meghna, crisscrossed by myriad of their tributaries numbering about 230. The network of rivers running through the country finally enter the Bay of Bengal. Predominantly the basin formed by these rivers is a vast flood plain floating a few feet above sea level makes up about 8% of the total land area, whereas the forest constituted about 16% (Bangladesh Bureau of Statistics (BBS), 1999).

Bangladesh is the 8th most populous nation in the world. Its area is 1,475,70 sq. kilometers with a population of about 120 million. The population is going to double in about 30 years time. At the moment there are about 755 people per sq. km., perhaps the densest in the world. About 85% of the population is Muslim. Hindus, Christians, Buddhists and tribal form the rest (BBS, 1999).

Bangladesh has a tropical monsoon climate. The annual rainfall ranges from 1432-3903 mm. and the temperature from 09^{0}c and 38^{0}c. The three main seasons are winter (Nov-Feb), summer (March-June) and Monsoon (July –Oct). The climate makes the country rich in flora and fauna, which grow naturally and abundantly. The main food crops are rice and wheat. The main cash crops grown are jute, sugarcane and tea. Jute products manufactured in local industries as well as in raw form are exported in different parts of the world. Tea is other exportable product. Other crops of lesser and sometimes of localized importance are pulses, oilseeds, tobacco etc (BBS, 1999).

Bangladesh is one of the poorest countries of the world with a per capita income of only Taka 15,089.00 (Appx. $314). Agriculture is the mainstay of the country's economy. About 80% of the people of Bangladesh live in villages, 28.3% have no cultivated land and 40.5% have agricultural land up to 1 acre. The literacy rate is very low. Only 38.9% of men and 25.5% women are literate. People's perception is influenced by traditional beliefs, superstitions and other factors due to lack of education. It is unfortunate that the country has a very high infant mortality rate (57 per 1000 live birth) with a maternal mortality of 03 per 1000 live birth. Sixty percent of the country's children are malnourished (BBS, 1999).

It is a disaster-prone country and is a victim of repeated natural disasters such as cyclones, floods, droughts, earthquakes etc. Recurrent floods cover large areas, sometimes up to 30% of the country. These affect and damage crops, seeds, trees, livestock, housing and infrastructure. Floods enhance erosion by the rivers with consequent loss of valuable arable land. The floods which occurred in Bangladesh in 1988 and 1998 have been extremely severe and some of the severity is said to have arisen out of a reduction of forested land in the water shed, increased drainage congestion, on rush of water from across the border of neighbouring countries and destruction of flood plain areas into upstream and in the delta. Accumulation of water due to flood in different parts of the country creates innumerable breeding places for mosquitoes which ultimately transmit diseases like malaria, Japanese encephalitis etc.

Like many other developing countries of the world, Bangladesh is also beset with vital problems of health. Infection, malnutrition and over-population constitute a deadly triangle, one predisposing the other. In addition poverty, illiteracy, superstition, ignorance and disasters are so commonplace that they act as variable catalysts to compound, complicate and aggravate the health problems and create a potent situation for epidemic outburst. Infectious diseases predominate in the country. Diarrhoeal diseases, cardiovascular diseases, respiratory infections and infectious diseases top the causes of deaths in Bangladesh (BBS, 1999). Among infectious diseases, parasitic ones like malaria, filariasis and kala-azar (visceral leishmaniasis) constitute a big proportion, as the topography, climate and population characteristics of the country are favourable to their occurrence. The causative agents of these diseases find ample opportunity to spread among others in the community of this tropical country of the world.

Most of the health problems in Bangladesh are rooted into ignorance, poverty, some orthodox cultural dictation and apathy of the people. The body defence mechanism of general people is low because of inadequate food supply, non-availability of pure drinking water, poor housing, unhygienic disposal of excreta and garbage, uncontrolled breeding of insects and pests. All these encourage creation of an environment where not only parasites grow but also vectors find favourable situation for increasing its density and in disease transmission. In spite of all these discouraging situations, research efforts must be directed towards the solution of the problems.

Background information regarding the study

As the endemicity of malaria in Bangladesh is quite high, lots of work had been done on it during Malaria Eradication Programme and its control phase. Both national and international workers studied the situation of malaria in Bangladesh and submitted many assessment and evaluation reports. But all those reports remained unpublished. Very little properly published information is available on the endemicity, prevalence and control of malaria in Bangladesh. Some researchers carried out few works on malaria, its vectors and impregnated bed nets. The papers on forest malaria in Bangladesh by Rosenberg and Maheswary (1982 a,b) gave some information on the prevalence and transmission of malaria and the breeding habit on *Anopheles dirus* species of mosquito in an isolated, forest dwelling community. 88% of the community people were positive for *Plasmodium falciparum* and 70% for *P. vivax.* High prevalence was observed among youngaged people and with the advancement of age the increased immunity made the people to be asymptomatic with low trophozoite and gametocyte densities. Many cases were resistant to Chloroquine even at that time. More than 3.8% of the captured *An. dirus* were found infective with malaria parasite. Transmission occurred mainly in monsoon and feeding pattern was influenced by presence of DDT and phase of moon. 31% of the biting *An.*

dirus lived long enough to reach infectivity of *P. falciparum*. Breeding of *An. dirus* occurred mainly during monsoon. Puddles of footpaths and turbulent pits at the heads of drainage gullies that held water for at least 5 days without supplemental rainfall were the usual sites of breeding.

Regarding the prevalence of the disease in the country, available information is scanty. Elias *et al.*, (1992a), presented a review article on malaria in Bangladesh. Among the four human malaria parasites namely *P. falciparum, P. vivax, P. malariae* and *P. ovale,* the first two species have been found to be predominant in the country. Ahmed *et al.*,(1985) detected 1% of all the febrile cases in Dhaka city during one year period of study as malaria and all due to *P. vivax*. In Chittagong Hill Tracts falciparum malaria is common with high mortality rate (Waiz *et al.*,1990).

According to the 'New National Malaria Control Strategy' as applied in a hyperendemic area, chloroquine still proved the first line of drug for uncomplicated malaria and quinine for severe malaria (Rahman *et al.*, (1996). Unfortunately the knowledge and attitude of the physicians of upazilla area about standard malaria treatment schedule as detected, was very unsatisfactory (Bhuiyan *et al.*,1993).

Regarding mosquitoes a good number of publications are available. According to the checklist of mosquitoes published by Ahmed (1987), there are 34 species of *Anopheles* are present in Bangladesh. Out of these, four are known as primary vectors of malaria in the country (Elias *et al.* 1982b; Rosenberg and Maheswary, 1982b). These are *An. dirus, An. minimus, An. philippinensis* and *An. sundaicus.* It has been observed that transmission of malaria occurs in the eastern and north-eastern border belt areas of the country by *An. dirus* and *An minimus*, in the western and central plain-land areas by *An. philippinensis* and in the costal region by *An. sundaicus.* The density of first two species is in an increasing trend and other two are disappearing. During mid nineties several malaria outbreaks including deaths have been reported in the epidemic prone bordering areas and during the epidemics *An. aconitus, An. annularis* and *An. vagus* have been incriminated as malaria vectors (Maheswary *et al.,* 1992, 1993 and 1994) and these are called as epidemic vectors. In some other studies on mosquitoes the researches discussed different aspects of malaria vectors (Ameen and Moizuddin, 1973; Ameen *et al.*, 1982, Elias *et al.*, 1982a,b; Ahmed *et al.*, 1989a, 1991). Regarding bionomics, ecology of some particular species and the susceptibility status to different insecticides, information was collected and discussed by more researches (Elias 1995, 1996, 1997; Rahman *et al.,* 1977; Elias and Rahman, 1981; Elias and Ameen,1997; Elias *et al.,* 1985, 1987; 1998). Malaria still continues to be a major public health problem in Bangladesh. The insecticide treated bed nets (ITBN) started more recently in many countries of the world and proved effective. Most vectors of malaria have developed tolerance to DDT in this country. Moreover, DDT has been banned for residual spraying in Bangladesh. The new strategy with ITBN may be thought off. Few studies have been conducted to assess the socio-cultural impact, acceptability of ITBN by villagers and evaluate the effectiveness of it on malaria and its vectors (Elias *et al.,* 1997a,b; Dey and Elias 1997). Further study is needed to evaluate the impact of ITBN on the density of malaria vector and the prevalence of malaria.

Filariasis is prevalent in Bangladesh with different degree of endemicity. Published information regarding prevalence is inadequate due to lack of extensive study on epidemiology of filaria in Bangladesh. Only a few isolated surveys have been conducted earlier. Wolfe and Aslam Khan (1971) conducted a survey in some districts on the northwestern area of

Bangladesh. It has been shown that high numbers of cases were found in the greater district of Dinajpur, Pabna, Chittagong, Barisal, Rajshahi and Rangpur with the blood microfilria positivity rate of 11.6%, 5.2%, 4.5%, 3.08%, 3.2% and 2.05% respectively. Lesser number of cases was found in the greater districts of Bogra, Faridpur, Comilla and Sylhet and blood microfilaria positivity rates were also less. No case has been found in Noakhali. Another survey was conducted in two districts of Dinajpur and Rangpur (Wolfe and Aslam Khan, 1972). In Dinajpur district, microfilaria and clinical filarial rates were 14.81% and 9.49% respectively. In Rangpur district the microfilarial rate was 7.72% and clinical filarial rate was 7.86%. In both the districts the clinical signs mainly consisted of hydrocele of scrotum, lymphedema and elephantiasis of the extremity(s) (Wolfe and Aslam Khan, 1972). Except a few cases of *Brugia malayi*, all filarial cases in Bangladesh were due to *Wuchereria bancrofti* (Barry *et al.,* 1971). Recently a study in village of Rangpur showed filarial infection rate 21.9% and all due to *W.bancrofti* (Sarker and Rahman, 1996).

Few hospital-based studies have been conducted on the clinical features, diagnosis and treatment regimens of filariasis in Bangladesh (Rahman, 1992; Ahmed *et al.,*1996; Sarker *et al.,* 1996).

Some works were carried out by different scientists regarding the vector of filaria. The mosquito, *Culex quinquefasciatus* has been incriminated as vector of Bancroftian filariasis. The species have nocturnal periodicity (Ahmed *et al.,*1986). Another study showed average microfilaria infection rate in mosquito was 4.5% in Thakurgaon and 1.6% in Dhaka (Chowdhury *et al.,* 1990a). *C.quinquefasciatus* was found endophagic and enophilic in nature ie. it prefers to feed and rest indoor as observed by Ameen and Moizuddin (1973) and Ameen *et al.,* (1982). Regarding vector, other two studies were conducted by Ahmed *et al.,* (1989a, 1991).

In Bangladesh, no regular filaria control activity exists except very limited treatment of cases in the endemic zones by Upazilla Health Complex or individual effort. No regular vector control activity is also going on.

As filariasis is a choronic disease, diagnosis and treatment are cumbersome. More emphasis is to be given on vector control as the vector of filaria has domestic habit. Larva control would be difficult, as *Cx. quinquefasciatus* breeds in large number of places both in polluted and clean water. Such huge breeding sources are difficult to bring under control activities. Poor sanitation, rapid unhealthy and unplanned urbanization and industrialization of the towns of the country, have made conditions ideal for transmission of *W.bancrofti* by mosquito (Ameen and Maizuddin, 1973).

Considering the factors, the present study has been planned to find out the clinical and epidemiological factors of Bangcraftian filaria, diagnosis by serological and parasitological method and efficacy of different treatment regimen. In addition, an entomological survey is needed to be conducted in the filaria endemic area.

Permethrin impregnated bed nets reduced the human blood Index for filaria and the vector density significantly as observed in other country (Bogh *et al.*,1998). It was recommended to use permethrin impregnated bed net for effective personal protection, reducing vector and controlling the disease. As filaria is a disease of low privileged group, use of bednet impregnated with deltamethrin, might be helpful in reducing the vector density and interrupting the transmission, lowering the prevalence of filaria and controlling the disease. Thereby, a trial with ITBN has been planned to evaluate the effectiveness of ITBN on filaria vector and the disease.

During pre-malaria eradication period the first survey was conducted on kala-azar by WHO malaria control demonstration team in 1950-51 and the findings were published by Nasiruddin (1952) and Gramiccia & Sacca (1953). A long kala-azar free period existed from early sixties to late seventies during the Malaria Eradication Programme. That was due to high susceptibility of kala-azar vector to DDT (Rahman and Islam 1979).

Though due to indoor residual DDT spraying and treatment of patients with urea stibamin, the disease reduced below the level of public health importance but it was never totally eliminated. From 1973 to 1976, several cases were diagnosed as post-kala-azar dermal leishmaniasis (PKDL), which were actually sequel of visceral leishmaniasis (VL), (Khan 1977).

In the mid-seventy, reappearance of kala-azar case was diagnosed by demonstrating *Leishmaniasis donovani* (LD) bodies in the spleen material of a TB patient. Presentation of the case in a clinical conference brought attention of other scientists about reappearance of kala-azar in the country (Islam 1982). Gradually more information regarding kala-azar was published (Ahmed and Ahmed, 1983; Rahman and Islam 1983; Hossain and Rashid, 1987; Chowdhury *et al.,* 1988; Elias *et al.,* 1989). Since then more and more information regarding reappearance of kala-azar in the country was available. Two outbreaks were recorded in 1987; one in Tangail and other in Thakurgaon district and information was published (Masum *et al.,* 1990a,b). A cross sectional study regarding the prevalence of kala-azar in 1987 was published (Chowdhury *et al.,* 1990) and another survey report in Shishu Hospital about the prevalence of kala-azar among children was recorded (Chowdhury *et al.,* 1991c).

Regarding the abundance and bionomics of vector of kala-azar and their susceptibility status some published information is available (Ahmed *et al.,* 1989, 1996; Masum *et al.,* 1990a,b; Hossain *et al.,* 1993).

Some scientists published information about the clinical features and diagnosis of kala-azar (Ahmed and Ahmed,1983; Hossain and Rashid,1983; Harith *et al.,* 1986; Chowdhury *et al.,* 1990, 1991; Islam 1991).

According to the recommended drug regimen of WHO expert committee, study was conducted on the regular and alternate regimen (Chowdhury *et al.,*1990b,1991b). Though kala-azar is coming a big way involving new and new areas, unfortunately there is no established control program as yet in the country. The main and only reservoir of kala-azar in Bangladesh is man. Presently, major thrusts of the control efforts in the country are given on case detection and treatment. Almost no emphasis is given on vector control measures.

Malaria, filaria and kala-azar are more prevalent in the rural areas of the country. In a developing country like Bangladesh, it is not possible to control the vector borne diseases specially chronic disease like kala-azar by curative treatment only. The early case detection and treatment needs a huge expense, which is really difficult to carry out by the people even the Government of the poor country. So the next step to control the diseases may be considered and that is by vector control. The operational and social constrains such as increase refused rate of house owners, change of vector bionomics, environmental pollution, high cost and modern operational technique for new insecticides have brought to a revision of vector control strategy by residual spraying of insecticides.

There is an urgent need for an alternative method of vector control to limit transmission of malaria, filaria and kala-azar. Therefore, a longtudinal study is necessary, which will gather baseline epidemiological information and clinical data by appropriate diagnostic methods regarding the above-mentioned diseases, the treatment strategy and also the entomological data regarding vector.

Use of mosquito net is a common practice to prevent mosquito nuisance in the country. But it only prevents man- mosquito contact. It neither kills nor knocks down mosquito or sandfly. Moreover, because of small size of sandfly, ordinary mosquito net cannot provide any protection against it.

The idea to impregnate the mosquito net with an insecticide goes back to many years early. But at that early age, insecticides were not very safe for human being. Since late 1970, pyrethroids, which are safe for human use, became available and made it possible to envisage the use of pyrethroid treated nets for domestic purpose (Zebra, 1988). In addition pyrethroids have high insecticidal activity and rapid environmental degradatation. The only drawback of using treated bed nets is that if they are washed, much of the insecticide is lost. In Bangladesh, the use of insecticide impregnated mosquito net is not a common practice. Therefore, published information on the use of insecticide impregnated bed net in the country is scanty (Elias *et al.*, 1997a,b; Dey and Elias, 1997). In other countries, the impact of pyrethroid impregnated bed net on the density of *Anopheles* mosquito and the prevalence of malaria were evaluated by several studies ((Curtis *et al.*, 1991; Jeffry *et al.*, 1993; Alonso *et al.*, 1993) and proved effective. Some small-scale trials with pyrethroid impregnated bed net also proved effective against sandfly (Majori *et al.*, 1989, Malori *et al.*, 1991, Alexander *et al.*, 1995). The increasing move towards primary health care and allowing people to determine their own objectives in the control of diseases and household nuisances is very favourable to the concept of impregnated nets.

Other reasons for the growing interest of using Insecticide treated bed net are the simplicity of treatment and relative cheapness compared to residual house-spraying and the beneficial side effects such as mortality of head lice and bed bugs.

Considering these situations an intervention study with Insecticide treated bed net has been planned to conduct to evaluate its effectiveness on the density of vector mosquitoes and sandfly and the prevalence of malaria, filaria and kala-azar in some selected areas of Bangladesh. As a prerequisite of the study, the base line information regarding the vector density and the prevalence of the diseases in those selected areas is necessary.

During the present research work, a series of study has been conducted in three purposively selected malaria, filaria and kala-azar endemic areas. The prevalence of the diseases and the vector densities in the selected areas have been detected during the baseline study. The effectiveness of deltamethrin impregnated bed net on the density of vector mosquito and sandfly and the prevalence of malaria, filaria and kala-azar in those areas have been evaluated and compared with nonimpregnated bed net and control areas.

The introductions of the respective studies of the series are described chronologically as follows from 1.1 to 1.10.

1.1. Clinical features of malaria and the effectiveness of different drug regimens in some selected areas of Bangladesh

Malaria has been a major public health problem in many tropical and subtropical countries including Bangladesh. The situation is worsening in the recent years. Of the two prevalent infectious agents, *Plasmodium falciparum* and *P.vivax*, the former is the most predominant in some parts of Bangladesh and is responsible for maximum morbidity and mortality due to malaria in the country.

At present about 10% of the population (Approx. 12.8 million) is considered to be at high risk of acquiring *P. falciparum, P.vivax* and mixed (*Pf* + *Pv*) infections. This population mainly lives in the forested hills and forest fringe areas and also in plain land. In 1995, total confirmed malaria cases reported were 152,729 as against 75,860 (50%) *P. falciparum* cases. The corresponding number of total cases in 1996, 1997 and 1998 were 100,864; 68,584 and 60,023 respectively. There were a total of 63,738 laboratory confirmed cases in 1999 (DGHS report 1999).

Bangladesh endorsed the World Declaration on the Control of Malaria and the Revised Malaria Control Strategy (RMCS) derived from the Amsterdam meeting in 1992 (Ministerial Conference, 1992). Since then, the country adopted the three case definitions of clinical malaria as Uncomplicated Malaria (UM), Severe Malaria (SM) and Treatment Failure Malaria (TFM). In addition to the main clinical findings, the managements of the three types were also elaborated in the RMCS. Early Diagnosis and Prompt Treatment (EDPT) is the first step of malaria control strategy.

However, treatment of uncomplicated malaria (UM) cases caused by *P. falciparum* and *P.vivax* are done by chloroquine (Total dose = 25 mg/kg body weight) in 3 days regimen followed by primaquine (45 mg of primaquine for adult) in a single dose (1st line treatment). For severe malaria (SM) cases, treatment with injection quinine (Quinine di-hydrochloride 10 mg/kg body weight) has been prescribed (3rd line treatment).

Emergence of drug resistance *P. falciparum* cases in some places of the country is posing serious problem. Resistance increased from 10% in 1979 to 45% in 1989 and 48% in 1999 in Bangladesh (DGHS report 1999). A few reasons e.g. indiscriminate use of Antimalarial drug by quacks, free sale of drugs from commercial outlet and large proportion of non-compliance etc. contributed significantly to the process of development of drug resistance. For this reason the cases which are not cured by 1st line treatment, they are given 2nd line treatment with tab quinine (10 mg /kg) for 3 days along with tab fansider (single dose) on the 3rd and tab primaquine (15 mg) on the 4th day. The degree of resistance of *P. falciparum* to chloroquine has also increased remarkably in many parts of the world (Bjorkmen *et al.*, 1985).

It is known that no proper study has been done in Bangladesh to see the effectiveness of treatment as "Malaria Treatment Chart" prepared by the Malaria & Parasitic Diseases Control (M & PDC) unit of Directorate General Health Services (DGHS) of Bangladesh. It is also known that physicians serving in different corners of the country do not properly follow the drug regimen set for treating uncomplicated, severe and treatment failure malaria cases as "Malaria treatment Chart" prepared by M & PDC is not available with all of them. It may be possible that all the proper drugs are not available with them or in the market as such malaria causing mortality in the country in the recent years.

The present study was carried out to find out the significant clinical sign symptoms of malaria cases, which were treated as per Malaria Treatment Chart in a malaria endemic area and evaluate the outcome of treatment, which might be base line information. The baseline information will lead to take a properly designed case control study in future.

1.2. Entomological surveillance for malaria vectors in an endemic area of Bangladesh

Mosquito borne diseases such as malaria, visceral leishmaniasis (kala-azar), filaria, dengue and Japanese encephalitis are major public health problems in Bangladesh (Rosenberg *et al.*, 1982; Elias *et al.*, 1989; Ahmed *et al.,* 1986; Khan and Ahmed, 1986; Khan *et al.,* 1981). Though during malaria eradication programme in Bangladesh (1960-74), the mosquito density and malaria transmission reduced, but for the last few years the malaria incidence has been observed to be on the increase in the country (DGHS Report, 2000). The malaria risk areas are distributed in the border belt territories of the country. According to area, five major epidemiological types of malaria have been defined which are i) Malaria of forested hills, ii) Malaria of forest fringe, iii) Malaria of plain border belt areas, iv) Malaria of plain rural areas and v) Malaria of urban areas.

According to Government report, 90 –99 % of malaria cases reported during 1994 –1999 were from 13 of 64 districts, in which a total population of 24 million, who are at high risk. Majority of the country's population live in plain rural areas where only *Plasmodium vivax* malaria is reported, although both *P. facliparum* and *P. vivax* are noticed in the risk areas.

Trend in the development of parasite resistance to antimalaria drugs, both chloroquine and sulphadoxin-pyremethamine is problem in malaria control. The development of physical resistance to DDT by many species of Anopheles mosquito, behaviour change of vector mosquitoes, ban on DDT (which in the past was produced locally and was affordable), the high cost and non affordability of alternative insecticide for residential spraying, another selective and sustainable vector control measures by using insecticide treated bed net (ITBN) has been planned.

In the present study, as a pre-requisite of the trial of ITBN, an entomological surveillance was conducted in a malaria endemic area for one-year period to gain information on the extent of the exiting problem of malaria mosquitoes. Present paper records information of the species of *Anopheles* mosquito collected from selected houses and cattle sheds in the morning and nighttime.

1.3. Impact of deltamethrin impregnated bed nets on malaria transmission in some rural areas of Bangladesh

During fifties, the malaria control activities were limited to the use of anti-malarial drugs for patients and anti vector measures by larvicides in a very limited scale (Elias *et al.*, 1992a). From 1961, the National Malaria Eradication Program (MEP) activities continued up to 1974 with house-to-house surveillance, indoor residual DDT spraying and treatment of cases. The incidence of malaria came down significantly during the program (Elias *et al.*, 1992b). However, because of some problems like increasing costs of materials, ban on DDT, defective administration, technical problems associated with vectors and parasites like change of behaviour of vectors and development of resistance of parasites against anti-malarial drugs and social factors as refusal of rural households to indoor spraying, the option of MEP activities was disrupted. An appropriate technology is necessary to overcome the problems. The malaria situation is worsening in the recent years and at present about 10% of the population (appx. 12.8 million) is considered to be at risk of acquiring *Plasmodium falciparum* and *P. vivax* malaria infection (DGHS Report, 2000).

Even in early days, mosquito nets were used widely for preventing man vector contact. In a study in the Gambia, it was reported that spleen and parasite rates were less in children sleeping under bed nets than those not using them (Bradley *et al.*, 1986), even though the finding of another study in the same country did not show similar results (Snow *et al.*, 1988).

In late sixties and early seventies, impregnation of bed nets with repellent was started and several studies were conducted on the impact of different repellent impregnated bed nets on malaria vectors (Gouck *et al.*, 1967; 1969; Grothaus *et al.*, 1974). The insecticide treated mosquito nets with pyrethroid were started in late eighties and its effectiveness on malaria vectors was evaluated by different trials in some countries of the world (Lindsay *et al.*, 1988; Curtis *et al.*, 1991; Rozendaal *et al.*, 1989; Choi *et al.*, 1995). In a study it was concluded that bed nets were considered unlikely to be an effective malaria control measure so long as they were untreated with insecticide (Lindsay *et al.*, 1989a). The malaria control strategies in Bangladesh were replanned in 1977, 1982 and finally in 1994 following Amsterdam Conference in 1992 (Ministerial Conference, 1992). WHO/TDR have included the use of insecticide treated bed nets (ITBN) as one of the strategies for malaria control policies. This strategy (IBN usage) has also been taken up by Bangladesh malaria control programme. But information on socio-economic and cultural background of mosquito net users and the effectiveness of the use of insecticide treated bed nets (ITBN) in Bangladesh is scanty (Elias *et al.,* 1997a,b; Dey and Elias, 1997).

The present study was conducted to assess the socio-cultural behaviour pattern of the bed net users and acceptability of impregnated bed nets to the rural people. The other objective was to evaluate the effectiveness of village scale use of deltamathrin impregnated bed nets with that of use of non-impregnated bed nets and control in rural environment.

1.4. Bancroftian filariasis in Bangladesh: clinical aspects, diagnosis and chemotherapy for treatment: comparative efficacy of three strategies

Lymphatic filariasis infects 120 million people in 73 countries worldwide and continues to be a worsening problem, especially in Indian subcontinent and Africa. Elephantiasis, lymphoedema, and genital pathology afflict 44 million men, women and children, another 76 million have parasites in their blood and hidden internal damage to their lymphatic and renal systems. 900 million people are at risk (Ottesen *et al.*, 1997). This disease is prevalent with diversified degree of endemicity in different areas of Bangladesh since long. Few surveys were conducted in late sixties and early seventies on filariasis, where high prevalence rates were found in northern districts of the country (Wolfe and Aslam Khan, 1971, Barry *et al.*, 1971). In a survey by Wolfe and Aslam Khan, (1972), 43 persons (11.6%) were found positive with microfilaria out of 371 persons checked in greater Dinajpur district in late 60's.

Since last thirty years almost no data about the prevalence, clinical findings, diagnosis and treatment of filariasis are available in Bangladesh. From the last 5 years' records of upazilla health complexes (UHP) of northern districts of Thakurgaon, Panchagar, Dinajpur, Rangpur, Lalmonirhat and Nilphamari, it is evident that filariasis is still prevalent in those districts and this chronic disease is creating great social problem. During acute episodes of the disease, patients become totally disabled. It affects the domestic activities severely. In chronic cases labour loss is a serious impact. Filariasis is a disease of the poor and underprivileged. Women suffer from lymphatic filariasis to a great extent but embarrassment, shame, cultural constraints and social taboos are some of the reasons that refrain them from reporting problems and seeking help. Women are thus silently bearing the burnt of this disease (Bandyopadhyay, 1996).

In the past, tools and strategies for the control of the condition were inadequate, but over the last 10 years dramatic research advances have led to new understanding about the severity and impact of the disease, new diagnostic and monitoring tools and most importantly, new treatment tools and control strategies. In several countries effective control campaigns have greatly reduced the prevalence of lymphatic filariasis caused by *W. bancrofti* and *B. malayi*, particularly, in China, India and Sri Lanka. Considerable success has been achieved in eliminating the parasites in the southern Brazil, Japan, Turkey and Republic of Korea, where filariasis transmission is seasonal (WHO, 1984).

In some of these areas there has also been a spontaneous decline in prevalence of filariasis, which were associated with improvement in economic status of the community and in sanitation and with effective mosquito control. The increasing use of diethylcarbamazine citrate (DEC) has reduced the proportion of people developing the chronic lesions of hydrocele in many endemic areas. This drug is prescribed by the practitioners and taken by patients as self-treatment because of free availability of drug (WHO, 1984).

Institute of Epidemiology, Disease Control and Research (IEDCR) conducted an epidemiological survey in Thakurgaon district in 1976-77 and found 14.81% microfilaria rate in that district (IEDCR report-1977). Since then for the last two decades, except the passive case detection in upazilla health complexes of the northern districts of Bangladesh, no survey has been conducted. So, no up-to-date data on the clinical features and prevalence of filarial are available. Of course, diagnostic facilities are not adequate. People are not much conscious about filaria because of its low mortality. No preventive measures are being taken in the filaria endemic areas of the country. Only a limited facility of treatment by diethyl carbamazine (DEC) is available in the UHCs and sometimes the course cannot be completed due to shortage of medicine. Moreover there is almost no facility for surgical treatment in the UHCs.

Concerning these facts, the present study was designed to determine the prevalence of filariaris by clinical examination and performing two diagnostic tests in selected endemic areas of the country. In addition, the study was also conducted to compare and evaluate the responses of three strategies of treatment schedules.

1.5. Filaria vector surveillance in a filaria endemic area of Bangladesh

Among the vector borne diseases, endemicity of filariasis was very common in northern districts of Bangladesh. Two surveys were conducted in 1969 and 1970 in Thakurgaon, where high microfilaria rate were detected (Barry *et al.* 1971; Wolfe and Aslam Khan, 1972). Wolfe and Aslam Khan, (1972) also made in-depth study on vectors of filaria and found that Bancroftian filariasis was transmitted by only one species of *Culex* mosquito, *Culex quinquefasciatus*. This mosquito when bites infected humans, picks up the microfilariae that develop, inside the mosquito, into the infective stage. The process usually takes 7-21 days. The larvae then migrate to the mosquitoes' biting mouthparts, ready to enter the punctured skin following the mosquito bite, thus completing the cycle.

As the disease is not a fatal one, very little attention was given on its control. No anti-mosquito measures were taken to control filarial vectors since long. Reports on filaria problem and its social and economic burden are often reported in the newspapers. WHO also identified lymphatic filariasis as the second leading cause of permanent and long-term disability worldwide (WHO Bull 1993).

No entomological study was carried out in filaria endemic areas of Bangladesh since last two decades. The present status of filaria vector is also unknown. As there is no filaria control activities going on in the filarial endemic area of Thakurgaon district, a trial by using insecticide treated bed net (ITBN) has been planned. As a pre-requisite of the trial of ITBN, an entomological investigation was conducted in a filaria endemic area for one-year period to gain information on the extent problem of filaria vector mosquitoes.

1.6. Mosquito nets impregnated with deltamethrin against lymphatic filariasis and its vector in a filarial endemic area of Bangladesh

Lymphatic filariasis is a mosquito borne parasitic disease caused mainly by *Wuchereria bancrofti* in Bangladesh. It is present all over the country with high prevalence in the north-western part of the country. The mosquito *Culex quinquefasciatus* was found to be the only vector of Bancroftian filariasis of nocturnal periodicity in Bangladesh (Wolfe and Aslam Khan, 1972; Ahmed *et al.,*1986). The disease is not associated with high mortality rate but chronic filarial infection causes enormous sufferings to the patients. It is a disease of unprivileged people who do not have awareness about the disease and knowledge or ability to control it. As filariasis is a mosquito borne disease, interruption of man vector contact may be an effective method to control the disease. Mosquito nets were used for centuries to prevent mosquito nuisance. There had been some work to find out whether simple bed nets actually protect individuals from malaria or other mosquito borne diseases, but the trials showed contradicting results (Charlwood, 1986; Bradley *et al.,* 1986; Snow *et al.,* 1988; Burkot *et al.,* 1990). However, impregnated bed net (IBN) with safe insecticide reduces the transmission of diseases by decreasing the vectorial capacity of vector and increasing the vector mortality (Rozendaal *et al.,* 1989). IBN also provides protection to individuals sleeping under nets and occupants of houses by repellency or irritancy or through inhibition of biting (Graves *et al.* 1987). There is no prevention or control programme going on in the filaria endemic areas of the country. As filaria is also a mosquito borne disease like malaria, an intervention study has been planned in a filaria endemic area of

Bangladesh to evaluate the effectiveness of village scale use of deltamathrin impregnated bed nets on filariasis in comparison to that of use of non-impregnated bed nets and control in separate villages. In addition, in the study, an attempt has been made to assess the knowledge of villagers on filariasis and find out the practices to prevent the disease.

1.7. Epidemiological, clinical and therapeutic features of visceral leishmaniasis (kala-azar) in a kala-azar endemic area of Bangladesh

After a long interval of absence of kala-azar during and after Malaria eradication period (MEP) in Bangladesh, the reemergence of the first reported case was from Shahjadpur Upazilla of Pabna district in 1981 (Ahmed and Ahmed, 1983). Since then it had been reported from other districts like Sirajganj, Mymensingh, Pabna, Rajshahi, Dinajpur, Thakurgaon and Tangail which have later been identified as kala-azar endemic areas of Bangladesh (Rahman and Islam, 1983, Hossain and Rashid, 1987). With the exception of few districts in the north-east and south-east, increasing number of visceral leishmaniasis and post kala-azar dermal leishmaniasis (PKDL) have been reported from all over the country (Elias *et al.*, 1989). PKDL is a squeal of visceral leishmaniasis (VL) with chronic dermal granulomatous changes. The disease is gradually spreading in Bangladesh and outbreaks of kala-azar are being reported in various parts of the country. At present kala-azar cases have been reported from 38 out of 64 districts of Bangladesh (DGHS report, 2000).

The main and only reservoir of visceral leishmaniasis in Bangladesh is man. Patient usually remains ambulant, possesses good appetite, does not have any malaise or apathy and may be quite unaware of fever.

Besides PKDL, these active patients also act as source of infection. Patients are generally diagnosed by passive case detection in the upazilla health complexes by Aldehyde test (AT). Treatment of both kala-azar and PKDL cases are given mainly from the Government facilities to control of the disease, which is not sufficient for this purpose. House-to-house visits and mass survey are necessary in endemic areas for early detection of cases and prompt treatment (EDPT).

Research concerning public health aspects of kala-azar is considered less important by the professionals because of the chronic nature of the disease. Though presence of kala-azar cases has been reported from many districts of the country detailed basic epidemiological information is inadequate. Considering these, the present study was conducted to collect information regarding clinical and epidemiological features of kala-azar in a kala-azar endemic area of Bangladesh.

1.8. Entomological investigation of a kala-azar focus in Bangladesh

Kala-azar or Indian visceral leishmaniasis is a chronic febrile disease caused by a protozoan parasite, *Leishmania donovani* and transmitted by certain species of sandfly, *Phlebotomus*. It was endemic in Bangladesh during fifties (Nasiruddin 1952, Grammiccia and Sacca 1953, Plan of operation 1960). The malaria eradication programme, involving wide spread indoor residual spraying of DDT during sixties and early seventies reduced the incidence of kala-azar to a medical rarity because of the collateral effect of DDT on sandfly, the vector of kala-azar (WHO 1978). The reason for this has been attributed to the high susceptibility of kala-azar vector for DDT during the program (Ahmed and Ahmed, 1983). Except a few cases of post kala-azar dermal leishmaniasis (PKDL), kala-azar almost disappeared from the country (Elias *et al.*, 1989). A resurgence of kala-azar including PKDL were reported occasionally from different parts of the country in seventies (Khan 1977, Islam 1982, Rahman and Islam 1983). Even in India, sporadic cases of kala-azar continued to visit hospitals and PKDL cases were reported during that period (Gon *et al.*, 1975, Aikat *et al.*, 1979). The sporadic reappearance of kala-azar did not draw keen attention either of the department of health or the general physicians. More over many cases were misdiagnosed. The rise of vector density following cessation of DDT spraying together with available reservoir of infection of PKDL and kala-azar cases and other factors like lack of surveillance, irregular and inadequate treatment, there occurred a steady rising trend of cases since eighties (Thakur 1984, WHO 1984). Due to lack of attention and timely intervention measures, number of cases greatly increased and several outbreaks of kala-azar in epidemic form have been reported in Bangladesh (Chowdhury *et al.*, 1988, Elias *et al.*, 1989, Masum *et al.*, 1990a,b). In all the reports it was observed that kala-azar mainly affected the people having low socio-economic background in rural environment of the country.

As the treatment of kala-azar is really troublesome and costly for the poor people of the epidemic or endemic areas of Bangladesh, the strategy of 'prevention' is better to be adopted to control the disease. Moreover, as observed during MEP, the decrease of vector population was directly proportional to the disappearance to kala-azar, emphasis to be given to control vector for controlling the disease rather than to treat the cases alone.

Phlebotomus argentipes is the reorganized vector of kala-azar in Indian sub-continent (Swaminath *et al.*, 1942). Das Gupta *et al.*,(1955) were successful to develop leptomonads of *Leishmania donovani* in sand fly of species *P. argentipes* and proved that this species transmits kala-azar in West Bengal and Bihar.

Information on kala-azar vector in our country is scanty and scattered. The earliest records on sandfly in Bangladesh region were made by Sinton (1932). Nasiruddin (1952), Grammiccia and Sacca (1953), Ahmed and Ahmed (1983), Masum *et al.*, (1990a,b) conducted some entomological investigations on sandfly fauna, but all those information was only during epidemic outbreaks in the country. Very few detail entomological surveillance were conducted to collect information on distribution of species, seasonal density, resting and biting habit of sandfly in any endemic area, which would provide base line information about prevalence of sandfly in Bangladesh (Hossain *et al.,* 1993; Ahmed *et al.,* 1995). The present paper records the findings of a detail entomological study conducted in a kala-azar endemic area.

1.9. Impact of deltamethrin impregnated bednet on prevalence of kala-azar in selected villages of a kala-azar endemic area of Bangladesh

In Bangladesh, kala-azar was one of the public health problems during the pre-malaria eradication period in the fifties (Nasiruddin 1952, Grammiccia and Sacca 1953). It almost disappeared during malaria eradication program in sixties and early seventies as a result of wide scale indoor residual spraying of DDT, because of the collateral effect of residual DDT spraying on sandfly, the vector of kala-azar (WHO 1978). Kala-azar vector in Bangladesh, *P.argentipes* was highly susceptible to DDT. The vector habitat is restricted to domiciliary and peri- domiciliary areas. When mass scale spraying of DDT was ceased, a resurgence of kala-azar including PKDL were reported occasionally from different parts of the country in seventies (Khan 1977, Islam 1982, Rahman and Islam 1983). Gradually the number of cases greatly increased and several outbreaks of kala-azar in epidemic form have been reported (Chowdhury *et al.*, 1988, Elias *et al.*, 1989, Masum *et al.*, 1990a,b).

The main and only reservoir of anthroponotic visceral leishmaniasis is man. Consequently early diagnosis and prompt treatment (EDPT) is of high priority and pre-requisites for reducing the source and vector control for interrupting the transmission and thus controlling the disease. Presently, major thrusts of the control efforts in the country are given on case detection and treatment. Currently it is considered that there are appx. 40,000 accumulated cases of kala-azar in Bangladesh, which represent a severe overload for curative service. In most cases of kala-azar if not treated the result is fatal. In a developing country like Bangladesh, it is not possible to control a chronic disease like kala-azar by curative treatment. So emphasis may be given on preventive aspect. Attack on parasite in reservoir by early detection may be one step. This early case detection and treatment needs a huge expense that is really difficult to carry out by the Government of our poor country. So the next step to control the disease may be considered and that is by vector control. DDT residual indoor spraying (RIS) during National Malaria Eradication Program (MEP) has been in the past effective in reducing kala-azar transmission in the Indian subcontinent (WHO, 1990). However the same operational and social constrains that have brought to a revision the malaria control strategy based on widespread use of residual indoor spraying of DDT also apply to the kala-azar vector control component. The major constrains are as follows,

Increased operational costs versus decrease in funding for vector control, loss of motivation and supervisory skills among health workers due to the prolonged and non-sustainable nature of the intervention and presence of inefficient manpower.

Increased refusal rates among house owners to allow DDT residual indoor spraying to be carried out into their premises due to the perceived adverse side effects following repeated use of this technology e.g. death of pets, bad smell, no visible effects on house vermin. Other factors like, development of resistance against vector, change of resting habit of vector due to irritability, environmental pollution. Govt. of Bangladesh has recently banned DDT for residual indoor spraying mainly for its prolonged persistence in nature, which is hazardous for ecological balance, costs of other new insecticides are high and operational technique for those are more hazardous than DDT and integration of the vector control programme in the primary health care system and subsequent major loss of effective operational field capability.

There is, therefore, an urgent need for an alternative method of vector control for limiting transmission of kala-azar. In our country use of mosquito net to prevent mosquito or other insect nuisance is a common practice. Because of the small size of sandfly, ordinary mosquito nets cannot provide any protection against them. In many tropical and subtropical countries there has recently been much success in using bednet impregnated with pyrethroid insecticide against malaria vector. Some small-scale trials with have also been conducted with permethrin and deltamethrin impregnated bednet against sandfly (Majori *et al.*, 1989; Maroli *et al.*,1991; Alexander *et al.*,1995) and found effective. The efficacy of ITBN to control kala-azar in Bangladesh may be observed. Use of insecticide treated bed nets (ITBN) may come up if found feasible and effective. The present study has been conducted to evaluate feasibility and acceptability of the use of insecticide treated mosquito nets (ITBN) among the rural people of a kala-azar endemic area and to measure the efficacy of ITBN through community participation to control kala-azar in rural Bangladesh.

1.10. Effect of flood on sandfly density and prevalence of kala-azar in a kala-azar endemic village of Bangladesh

Resurgence of kala-azar occurred in several parts of India and Bangladesh during the late seventies when large-scale use of DDT spraying under Malaria Eradication Programme was discontinued (Ahmed and Ahmed, 1983; Elias *et al.* 1989). Kala-azar is now widespread in the eastern part of Indian subcontinent including the north and north-western parts of Bangladesh (Rahman and Islam, 1983; Masum *et al.*1990a,b; Birley 1993). Ecological factors such as soil condition, climate, topography, housing types and socio-economic condition of the people in rural set up of Bangladesh are so, that help the spreading of the disease, kala-azar. All these factors are again influenced by natural disasters like flood, cyclone, tornado etc.

Bangladesh is a flood prone country. Flood occurs almost every year in plain and low laying areas of the country. Flood may have direct or indirect effect on insect borne diseases like kala-azar, malaria, Japanese encephalitis etc. Although some information on bionomics of sandfly exist in the country (Ahmed and Ahmed 1983, Ahmed *et al.* 1989, Hossain *et al.* 1993), no study was carried out on the effect of flood on sandfly breeding and its density. In 1998, flood havoc persisted from July to September throughout the whole country. In order to study whether flood acts as a natural intervention in reducing sandfly density and prevalence of kala-azar, a study was carried out in a flood affected kala-azar endemic village during the whole flood period from July to September, 1998 which was followed by a follow up study from October, 1998 to June, 1999.

Rational and justification of the study

The incidence of a communicable disease is the resultant reaction of the causative agent and a susceptible host in a favourable environment. Vector plays the role of transmission of the agent from infective to susceptible host. The disease process cannot proceed if any link of the triad (agent, host and environment) is broken, but it is true that the task is not so easy. Successful vector borne disease control programme aims at vulnerable points of interactions - the vector, the reservoir, the pathogen, human host and the environment (Russell, 1963). To control any disease early diagnosis and prompt treatment (EDPT) of the disease are considered to be the first step. However, in case of vector borne disease, in addition to treatment of patients, vector control remains an essential component to control the disease. To prevent transmission or control of vector borne diseases, reduction of abundance and host contact of the vector is essential. To achieve this, knowledge on local condition of the diseases and bionomics of the specific vectors are prerequisite.

Problems related to malaria, kala-azar and filariasis are enormous in the context of Bangladesh, which cause both morbidity and mortality. However, recent information regarding the prevalence and distribution of those diseases in Bangladesh, specially in rural areas, is almost not existant.

As mentioned earlier the pressing health problems of Bangladesh are mostly the communicable diseases. Many such parasitic and vector borne diseases are endemic in different parts of both rural and urban areas of the country. The endemic vector borne diseases that plague the country include malaria, filaria and kala-azar and the non-endemic ones include dengue fever and Japanese encephalitis. These vector borne diseases continue to be of public health importance in many other tropical countries besides Bangladesh. The prevention and control of these diseases are linked closely to various ecological factors, which depend mainly on anti-vector measures.

Vector control service, research and operation, have been escalated especially since the end of World War II, where various control methods were developed and some were effectively used for years in the national control programmes of vector borne diseases. In recent years, many operations which were dependent mainly on chemical methods e.g. spraying indoor insecticides have been facing several problems, vector resistance to older insecticides, changes in the bionomics, higher cost of newer insecticides, environmental pollution, reduced acceptance by householders, inefficient manpower to run a vertical programme. Therefore, alternative strategies of vector control programmes against malaria, filaria and kala-azar are to be planned out where these problems could be avoided.

Many countries in the south-east Asian region have converted their time bound vertical vector borne disease control programmes to Primary Health Care (PHC) approach through community participation and this strategy has brought about moderate changes in reducing the communicable vector borne diseases. Among the vectors causing diseases in this region, mosquito and sandfly are the most important ones. For controlling the vector borne diseases, emphasis are to be given on control of the vectors.

As there is no vertical program for control of vector borne diseases in Bangladesh, information available is based on poor recording and reporting of cases and mainly paper works made at the grass root level.

Reporting as well as diagnostic and curative capabilities of rural health services are still very limited. The data presently available by passive surveillance in Upazilla Health Complexes are therefore a gross underestimation of the epidemiological situation. Existing basic epidemiological information is inadequate.

The research on vector borne diseases in Bangladesh is limited. Research concerning public health aspects of the diseases is considered less important by the professionals. Considering the threat of infections and the possibilities of minimizing the risk of acquiring the infection through appropriate intervention, an epidemiological study is needed.

The main and only reservoir of malaria, filaria and kala-azar in Bangladesh is man, consequently early diagnosis and prompt treatment (EDPT) is of high priority and prerequisites for reducing the source and vector control for interrupting the transmission and thus controlling the disease. Presently, major thrusts of the control efforts in the country are given on case detection and treatment. Suspected cases are initially found out by the community health workers and are referred to Upazilla Health Complexes (UHC) for screening. Medical Officers diagnose cases based on history, clinical examination, investigation in the Complex laboratories and start treatment. Doctors, nurses and paramedics have been trained on the treatment protocol. Patients also need strong motivation to avoid dropouts and non-compliance.

In a developing country like Bangladesh, it is not possible to control any disease especially a chronic disease by curative treatment. It is known that prevention is better than cure. So, emphasis is to be given on preventive aspect. Attack on parasite in reservoir is one step. Active and passive case detection and treatment of cases are the most important strategies to control of the disease. This early case detection and treatment needs a huge expense that is really difficult to carry out by the Government of our poor country. So the next step to control the disease may be considered by vector control. Recently Primary Health Care (PHC) approach is becoming more and more acceptable for any disease control programme in health care delivery system. Community participation is the vital element in PHC approach. This approach may protect the host from the disease. Health education is necessary for community participation. To control a vector borne disease use of mosquito net or screening of the house is a necessity. Use of ground floor for sleeping purpose should be avoided. Use of insect repellents in the form of lotion or cream may be applied over the exposed parts of the body for temporary protection. Dwelling environment should be kept clean. Plastering of the mud houses and cattle sheds at regular interval is effective to decline sandfly population. Periodic fumigation of sleeping room is helpful. In our country use of mosquito net to prevent mosquito or other insect nuisance is a common practice.

In the past DDT residual indoor spraying (RIS) for malaria control has been effective in reducing kala-azar transmission in the Indian subcontinent (WHO, 1990). However the operational and social constrains that have brought to a revision the malaria control strategy based on widespread use of residual indoor spraying of DDT, also applicable at present,

- Increased operational costs versus decrease in funding for vector control, loss of motivation and supervisory skills among health workers due to the prolonged and non-sustainable nature of the intervention and presence of inefficient manpower.
- Increased refusal rates among house owners to allow DDT residual indoor spraying to be carried out into their premises due to the

perceived adverse side effects following repeated use of this technology (e.g.death of pets, bad smell, no visible effects on house vermin).

- Development of resistance against vector
- Change of resting habit of vector due to irritability.
- Environmental pollution. Govt. of Bangladesh has recently banned DDT for residual indoor spraying mainly for its prolonged persistence in nature which is hazardous for ecological balance.
- Costs of other new insecticides are high and operational technique for those are more hazardous than DDT.
- Integration of the vector control programme in the primary health care system and subsequent major loss of effective operational field capability.

To reduce the density of vectors and minimize the man-vector contact, different options are to be thought off. Present day, the vector control specialists are giving emphasis on reducing man-vector contact by different means. Mosquito nets or bed nets have long been used worldwide as a simple means of protecting people against or other insect bites. By preventing vector bites, bed nets probably reduce vector borne disease transmission. When the bed net is impregnated with insecticide, it gives more protection by its repellent and toxic effect on the mosquitoes. Since the mosquitoes that come in contact of impregnated net would be killed, the attack rate of mosquitoes is also reduced. Besides, the parasites if any, would not get enough time to become infected, transmission of diseases not possible. Finally, the treated net would also become a toxic resting site during the day when the net is not in use (Schreck and Self, 1985). In many tropical and subtropical countries there has recently been much success in using bednet impregnated with pyrethroid insecticide against malaria vector. Because of the small size of sandfly, ordinary mosquito nets cannot provide any protection against them. Some small-scale trials have also been conducted with pyrethroid-impregnated bednet against sandfly in other countries, which proved effective (Majori *et al.,* 1989; Maroli and Majori, 1991; Alexander *et al.,* 1995). The efficacy of ITBN to control kala-azar in Bangladesh may be observed.

As such, use of insecticide treated bed nets (ITBN) has created a new hope in controlling a new hope in controlling the vector borne diseases. No such real trial on the effectiveness of impregnated bed nets has been conducted in Bangladesh against the vectors of malaria, filaria and kala-azar, the main vector borne endemic diseases of the country.

But the choice of proper insecticides is the real thing in ITBN. Considering the high insecticidal activity, low mammalian toxicity and rapid environmental degradation of pyrethroids, these may be considered as the insecticide of choice for the impregnation of bed nets (Elliot *et al,* 1978). WHO has also recommended pyrethroid for the impregnation of bed net because of its safety for human, rapid insecticidal effect, low volatility, long lasting persistence on netting and lack of odour (WHO, 1985). As an appropriate technology of vector control, permethrin and deltamethrin, two pyrethroid compounds, have been most widely used (Curtis *et al,* 1991).

Till today, most of the works by impregnated mosquito nets are at the hand of assigned researchers and carried out against malaria vectors (Rosendaal and Curtis, 1989). Recently reports are available on the effectiveness of pyrethroid impregnated bed nets in controlling malaria in several countries like the Gumbia, Burkina faso, Tanzania, Malaysia, China etc. (Curtis *et al,* 1991). It encouraged an evaluation of the same method to control other vector borne diseases like kala-azar and filaria. Study is also needed to confirm the efficacy of pyrethroid impregnated bed net against these diseases, so that at the cost of one intervention more than one disease can be controlled if the diseases are present in the same area.

Considering all the above-mentioned facts, a detail study was conducted in some parts of the country where malaria, filaria and kala-azar are endemic. The present study tried to evaluate whether in addition to early diagnosis and prompt treatment of malaria, filaria and kala-azar, community based integrated vector control approach by using impregnated mosquito nets would be an effective measure in reducing the indoor vector population responsible for transmission of these diseases and the risk of acquiring infection in rural Bangladesh. The study aims to evaluate the feasibility, acceptability and sustainability of ITBN and the impact of deltamethrin-impregnated mosquito nets on the vector density and the prevalence of malaria, filaria and kala-azar in some selected endemic areas of Bangladesh. If it is found effective and feasible, a micro plan for area specific strategy can be chalked out to control the vector borne diseases in the country.

Hypothesis

Vector control methods are necessary components of any vector borne disease control programme for effectively controlling and preventing the transmission of the disease.

Community use of insecticide (deltamethrin) treated mosquito nets is effective in reducing the density of vectors of malaria, filaria and kala-azar in rural areas of Bangladesh.

Use of insecticide (deltamethrin) treated mosquito nets by the community under the prevalent socio-economic conditions of the country is an appropriate, acceptable and sustainable method to reduce the prevalence of malaria, filaria and kala-azar in endemic areas of Bangladesh.

Objectives of the study

General

To develop micro-plan for area specific strategy to control malaria, filarial and kala-azar in selected areas of Bangladesh.

Specific

- To find out the endemicity of malaria, filaria and kala-azar in selected areas of Bangladesh;
- To find out the distribution and density of vectors of malaria, filaria and kala-azar in the study areas;
- To define the socio-demographic characteristics of malaria, filaria and kala-azar patients in the study areas;
- To provide early diagnosis and prompt treatment for malaria, filaria and kala-azar in the study areas;
- To evaluate the different drug regimens against malaria, filaria and kala-azar in the study areas;
- To implement vector control measures by deltamethrin impregnated bed nets through community participation in the study areas;
- To determine the acceptance of impregnated bed nets and related behaviour of the users in the study areas;
- To evaluate the impact of impregnated bed nets on the transmission of malaria, filaria and kala-azar;
- To find out the effect of flood as a natural intervention on the vector of kala-azar and the disease.

2.1 Malaria

Malaria is a protozoal disease caused by infection with parasite of the genus *Plasmodium* and transmitted to man by certain species of infected female Anopheline mosquito.

2.1.1 Historical background of malaria

Malaria is a disease of antiquity. The word malaria is derived from two Italian words 'mal' and 'aria' meaning bad air. The name originated from the old concept of the Roman people that the disease was caused due to inhalation of poisonous emanation from the ground, especially in the marshy places i.e. marshy vapour or bad air (Russel, 1963).

It was reported that the disease used to be recognized by the Greek physicians as early as in 5th century B.C. Hippocrates (460-370 B.C.) described quotidian, tertian and quartan fevers according to the periodicity. Greeks and Romans also mentioned some relationship between intermittent fever and swampy terrain (Khan, 1989).

During 17th century treatment of malaria was given with the bark of a tree, which later on was given the name 'Cinchona' in the honour of a Spanish countess 'Cinchona', who was treated by the bark of that local tree. In 1820, quinine was isolated from 'Cinchona' bark (Russel 1963).

In 1880, Louis Charles Alphons Laveran, a French army surgeon in Algiers, North Africa, first described the malaria parasite in the blood. In 1891, Romenowski, in Russia, developed a new method of staining blood films to diagnose malaria parasite. In 1894, Manson hypothesized that mosquitoes transmit malaria. The hypothesis was confirmed by Ronald Ross, who, while working in Secunderabad, India, found malaria parasite growing as oocyst in the stomach wall of an Anopheline mosquito which had previously fed on a malaria patient. Later on Ross completed his work on the life cycle of malaria parasite with bird malaria in 1898. In the same year (1898) the Italian scientists Bignami, Bastranalli and Grassi demonstrated human malaria parasite (sporozoite) in the salivary glands of *Anopheles* mosquito (Khan, 1989).

2.1.2 Global malaria situation and anti-malaria activities

Malaria is the world's most important vector borne parasitic tropical disease. It kills people more than any other communicable diseases except tuberculosis. It is a major public health problem in about 100 countries inhabited by a population of 2400 million, which is about 40% of the world population. Sub-Saharan Africa constitutes more than 50% of all malaria cases in the world. Two-third of the remaining cases are concentrated in 6 countries namely India, Brazil, Srilanka, Afganistan, Vietnam and Combodia, in accordance of prevalence. It is reported that worldwide incidence of clinical malaria is 300-400 million and mortality due to malaria was 1.5-2.7 million each year. Majority of deaths result from cerebral malaria and anaemia and occurred in young children of rural Africa. Malaria also contributes indirectly to illness and deaths from respiratory infection, diarrhoeal disease and malnutrition (WHO, 2000a).

Urban and periurban malaria are on the increase in South Asia. Military conflict, civil unrest, unfavourable ecological changes have reatly contributed to malaria epidemics, as large number of unprotected, non-immune and physically weakened refugees move into malarious areas. Such population movement contributes to new malaria outbreaks and make epidemic prone situation more explosive (WHO, 2000a).

Malaria continues to pose a major global threat to health and social and economic development. The WHO estimates the mortality due to malaria in the regions of Africa, Esat Mediterranean, SEAR (excluding India), India and Western Pacific are 961, 53, 53, 20 and 20 thousands respectively (WHO, 2000b).

All member countries of SEAR (except Maldives) have malaria endemic areas. The reported malaria incidence and mortality in the year 1996 in India, Bangladesh, Myanmar, SriLanka and Indonesia were 2870, 101, 96, 184 and 180 thousands respectively (WHO, 1999).

The fight against malaria has a long tradition of International co-operation, going back to the early efforts of the Pan American Sanitary Bureau, the Rockerfeller Foundation and the Malaria Commission of the League of Nations (Khan 1989).

In 1939, Paul Muller discovered the insecticidal properties of DDT (Dichloro-Diphenyl Trichloroethane) and that opened a glorious chapter in the history of anti-malarial campaign (Russel 1963). Thus the main component of the eradication programme became the indoor residual spraying of DDT. The programme achieved an initial success, but the success could not last long and set back occurred in many countries. Following the reports of development of resistance to DDT by some malaria vectors in various parts of the world and recognizing the failure of MEP implementation due to various technical and administrative reasons and resurgence of malaria in many countries of the world, WHO in its 22nd World Health Assembly (WHA) in July, 1969 re-examined the global strategy of MEP and considered that control of malaria would be more appropriate than eradication of malaria. In1978, the international conference on Primary Health Care (PHC) was held in Alma-ata.

According to the historic declaration of the said Alma-ata conference, primary health care (PHC) approach was accepted in various sectors. It was recommended that the malaria control programme would be implemented by the general health services through the primary health care program. The technical approaches would vary from place to place and to be worked out for each area according to the local epidemiological situation prevailing in the area (Khan 1989).

In 1992, Ministerial Conference on Malaria Control was held in Amsterdam, the Netherlands, which endorsed Malaria Control strategy for the world population adopting four basic elements – 1) provision of early diagnosis and prompt element, 2) planning and implementing selective and sustainable preventive measures including vector control, 3) early detection for the prevention or containment of epidemics and 4) strengthening of local research capacities to promote regular reassessment of countries' malaria situation in particular the ecological, social and economic determinants of the disease (WHO 1989).

By mid 1995 all malaria endemic countries had adopted the revised malaria control strategy. Malaria control added ompetus through Roll Back Malaria and the main strategies are,

a) Strengthen health system to ensure better delivery of health care at district and community level.
b) Ensure the proper and expanded use of insecticide treated bed nets.
c) Ensure adequate access to basic health care and training of the health care workers.
d) Early and appropriate treatment of malaria, specially in children.
e) Development of more effective and new anti-malarial drugs (WHO, 2000c).

2.1.3 Malaria situation in Bangladesh and its control activities

Malaria has always been a major public health problem in Bangladesh. During fifties, malaria was widely spread in Bangladesh and had taken a toll of human lives. Due to the great loss of manpower and prolonged ill health, the country's economy suffered a lot. It affected the agricultural, industrial and other developmental works of the country (Plan of Operation, 1060). The WHO malaria survey of 1960 indicated a low malaria parasite rate in some plain land of Bangladesh. But high endemicity was mostly along the northwestern, northern and northeastern border districts and mostly in the greater Chittagong Hill Tracts and Chittagong. During malaria eradication programme (MEP) (1961-1974) the incidence of malaria was substantially reduced. After discontinuation of the programme, the situation of malaria in Bangladesh gradually worsened till the recent years. At present about 10% of the population (approx 12.8 million) is considered to be at high risk of acquiring *Plasmodiam falciperam* and *P. vivax* malaria infection. This population mainly lived in the forested hills and forest fringe areas and also in plain border belt areas of 13 districts: Bandarban, Coxe's Bazar, Rangamati, Khagrachari, Chittagong, Habigonj, Moulavibazar, Sunamgonj, Sylhet, Netrokona, Mymensing, Sherpur and Kurigram (DGHS Report, 2000).

A total of 886,948 clinical malaria cases, 68,594 laboratory confirmed malaria cases and 478 deaths due to malaria here reported in 1997. In 1998, a total of 377,095 clinical cases, 60,023 laboratory confirmed cases and 528 deaths were reported. In 1999, there had been 147,895 clinical cases, 63,738 laboratory confirmed cases and 277 deaths (DGHS Report, 2000). The malaria cases reported are a gross under estimate of the disease burden in the country because of shortcomings in surveillance and information management.

A majority of malaria cases are reported from 13, out of 64 districts in the country. The 13 districts have a total population of 24 million, of which 10 million is considered at the highest malaria risk. The reported number of cases, *P. falciparum* infection among them, treatment failures, incidence of severe and complicated malaria and deaths due to malaria have remained high in the recent years (DGHS Report, 2000).

The 13 districts represent the forested, hilly and adjacent areas and account for 97% of all laboratory confirmed malaria cases and 99% of all *P. falciparum* cases in the country. About 4 million people living in 34 upozills of 8 of 13 districts live in epidemic prone border belt areas. Capacity to predict, detect, alert and respond early to malaria outbreaks is inadequate. So, focal outbreaks occur every year.

Majority of country's population live in plain rural areas where mainly vivax malaria is reported in foci of low endemicity. However, these lead to epidemic outbreaks several times (Maheswary *et al.*, 1992, 1993, 1994). Moreover, with intense population movement and the prevalence of vector population, the potential of introduction of *P. falciparum* and transmission throughout the whole country especially in plain areas cannot be overlooked.

Prior to 1920, there was no anti-malarial activity in Bangladesh. In 1920, Department of Public Health started functioning. But very little activities were carried out except some anti larval measures in a piecemeal manner. In 1961, a semiautonomous, time limited, phrased vertical malaria eradication programme (MEP) was launched with the objective of eradicating the disease from the country in a limited period of time

(1960-1974), which progressed steadily up to 1970. During the eradication programme, the morbidity and mortality due to malaria brought down to a great extent except some border districts in the northern and eastern parts in the country. The programme was eroded in early seventies and like many other countries, the malaria eradication programme was replaced by the malaria control programme. A plan of operation was signed by the government and World Health Organization laying down the strategies of malaria control and dividing the country into low and high-risk areas. During that time the strategy of malaria control was treatment of clinical and laboratory confirmed malaria cases and vector control by indoor residual spraying of DDT. In 1977, it was integrated with the Integrated Thana Health Complex (ITHC) Scheme of the General Health Service of the country under the framework of primary health cares. In 1982, malaria control programme was reviewed by an International Review team. According to their recommendation the country was divided into three strata based on the epidemiological situation and vector distribution (Assessment Report, 1982). Stratum I: first priority area- all forested and foothill areas with *Anopheles dirus* and *An. minimus* as vectors and *P. falciparum* is the predominant species. Stratum II: second priority area- plain areas with *An. philippinensis* and *An. sundaicus* as vectors with either imported or indigenous *P. falciparum* cases. Stratum III: plain areas with *An. philippinensis* vector and *P. vivax,* the agent. During 1989, the malaria control activities were again assessed by an International Assessment team. In that assessment, the criteria for the three strata had been retained but redistribution of the previously stratified areas were recommended, because of epidemiological and ecological changes. (Assessment Report, 1989). Due to development of drug resistance, change of habit of vectors and development of resistance of DDT against vector, the previous strategy has been changed. In 1994, in response to the Amsterdam declaration of 1992 on malaria control and in accordance to global revised malaria control strategy, Bangladesh has been divided into areas of five major epidemiological types of malaria with required specific actions for each type. The five major epidemiological types are i) malaria of forested hill areas, ii) malaria of forest fringe areas, iii) malaria of plain border belt areas, iv) malaria of plain rural areas, v) malaria of plain urban areas. The main components of the present control activities are i) early diagnosis and prompt treatment (EDPT) according to the clinical case definition of uncomplicated malaria (UM), treatment failure failure malaria (TFM) and severe malaria (SM), ii) insecticide (deltamethrin or permethrin) impregnation of the available bed nets, iii) selected indoor residual spraying of malathion and iv) health education with community participation.

2.1.4 Epidemiological factors of malaria

In the epidemiology of human malaria the following factors are responsible, i) malaria parasite, ii) mosquito vector, iii) human host and iv)environmental factors. The main three links of epidemiological chain of malaria are the first three. However, besides these three links factors, the epidemiological picture of malaria is determined by the influence of the surrounding multiple environmental factors that play a major role in malaria transmission (Park, 2000).

i. Malaria parasite

Four distinct species of protozoa *Plasmodium* namely, *P. vivax, P. falciparum, P. malarae* and *P. ovalae* are pathogenic to men. These are known as malarial parasites and cause benign tertian, malignant tertian, quartan and tertian malaria respectively. *Plasmodium vivax* has the widest distribution throughout the world and next comes *P. falciparum.*

P. ovale is found in Western Africa only and *P. malariae* is rare in the recent years in the world. Infections due to two or more species of malaria parasites are not uncommon, but they are often overlooked. In endemic malarious areas mixed infections are particularly frequent. However there is tendency for one species of malaria to predominate over the other. The most common type of mixed infections are *Plasmodium vivax* and *P. falciparum* in tropical and subtropical areas (Watt *et al.*, 1990). Among the four species *Plasmodium vivax* and *P. falciparum* are pre-dominant in our country. *P. malariae* has been found occasionally during early sixties. *P. ovale* could not be detected as yet in this country.

ii) Malaria vector

Malaria is transmitted from one person to another by certain species of female *Anopheles* mosquitoes, the number and type of which determine the extent of transmission in a given area. The main factors that determine the vectorial importance of mosquito are, distribution and seasonal prevalence, breeding habits, susceptibility of development of sexual cycle of malaria parasite inside the mosquito, host preference, density and longevity, biting and resting habits and resistance of insecticides. Transmission of malaria is affected by climate and geography, and often coincides with the rainy season. The presence of an *Anopheles* malaria vector does not necessarily create malaria endemicity. The eminent malariologist Prof. G. Macdonald (1952) discussed the 'critical density' meaning the average number of *Anopheles* bites per person per night below which there would be progressive reduction of malaria until it becomes extinct (Mashaal, 1986).

The number of efficient vectors of malaria among approximate 400 known *Anopheles* mosquitoes is surprisingly very low. Among those recorded species in the world, about 70 are proven vectors of human malaria and they feed on man with sufficient regularity to maintain the infection. The local conditions play a major role on the particular *Anopheles* species that transmit malaria. Therefore, epidemiological surveys in an area are necessary to determine the vectors, the prevalence, besides several other factors involved. Different *Anopheles* species vary greatly in their breeding habits behaviour, life span etc, and therefore control measures will vary from an area to another, depending on the species involved. However, in each geographical area there are usually not more than 3 or 4 species that are considered most important vectors in that area (Rashid *et al.*, 1999).

In Bangladesh, among the 34 species of *Anopheles* mosquitoes recorded (Ahmed, 1987), four were considered to be relatively important vectors namely, *An. dirus, An. minimus, An. philippinensis* and *An. sundaicus* (Elias *et al* 1982, 89, 92). Recent investigations reveal that *Anopheles minimus* and *Anopheles sundaicus* are rarely found. The density of *Anopheles philippinensis* is also found to be gradually declining. *An. aconitus, An. annularis* and *An. vagus* have recently been incriminated to be the vectors of malaria in some plain lands of the country during epidemics (Maheswary *et al.* 1992, 93, 94). *An. aconitus* is probably now playing a major role in maintaining malaria transmission in the plain areas. *An.dirus* is mainly responsible for malaria transmission in the forest hilly areas (Country report 1992).

iii) Human host

The reservoir and source of infection human malaria is man. Factors to be mentioned regarding human host are, age, sex, occupation, race, pregnancy, socioeconomic status, housing, population mobility, habits and immunity. Man in the tropical and sub-tropical countries resides in openly constructed houses and prefers to wear light, poor protective clothes. Therefore they are exposed more frequently to vector bites. The sleeping habits (indoors and outdoors) expose man to variable degree of man vector contact (Mashaal, 1986).

iv) Environmental factors

Role of environmental factors in malaria epidemiology is of great importance. The main factors related to physical, biological and social environment in malaria epidemiology are, a) climatic factors: season, temperature, humidity, rainfall, wind, artificial breeding places etc b) social factors: social structure, cultural pattern, housing, per capita income, community awareness, c) behavioral aspects of human ecology: constantly altering ecosystem by human activities such as deforestation, new settlement, construction of canals, dams, roads etc may create malaria problems and also epidemics. Again human habits, out door sleeping, not using bed nets, customs, beliefs, knowledge, attitudes, movement of people affect the occurrence of disease. The most important environmental factors related to malaria transmission are temperature, humidity and rainfall. In addition, the topography of the area and altitude are important because these determine the number of water surfaces favourable to the breeding of vectors. Temperature and humidity influence the life cycle, behaviour and survival of vector (Park, 2000).

Generally there occur two peaks of malaria incidence in most tropical countries where rainfall is seasonal. One in June ¬July and the other in November-December, which correspond respectively to the usual pre-monsoon and post –monsoon transmission seasons of malaria. The peak in June ¬July may be due to the optimum temperature and humidity suitable for vector longevity and the availability of increased breeding places in the rainy seasons. The November-December peak is due to stagnant water collection after monsoon providing breeding places of vectors (Mashaal, 1986).

2.1.5 Malaria vector control measures

Millions of people all over the tropical world are debilitated by the destructive disease, malaria and the socio-economic development of many countries is impeded by it. It is an endemic disease. Control of endemic disease is one of the components of primary health care. Disease management through early diagnosis and prompt treatment is fundamental to malaria control. It is a basic right of affected populations and needs to be available wherever malaria occurs. Children and pregnant women, on whom malaria has its greatest impact in most parts of the world, are especially important. In many countries, most cases of malaria are diagnosed and treated in the home or by private sector practitioners, often incompletely and with irrational regimens. This speeds up the spread of parasite resistance to antimalarial drugs, which poses another problem-a dramatic rise in the cost of treating uncomplicated malaria. Drug treatment alone is not sufficient for malaria control programme. As malaria is a vector borne disease, control of vector would be the first step. Different vector control methods are employed to interrupt the transmission of malaria and to control the disease. Amongst them, methods preventing man vector contact and methods causing the destruction of the vector are widely practiced throughout the world. Mosquito nets, used as a mechanical barrier is one of the widely practiced old method of preventing man vector contact and their efficacy is enhanced when they are impregnated with a safe insecticide (Rashid *et al*, 1999).

Parasite resistance to drugs and vector resistance to insecticides, diversity in the biology of different major malaria vectors are important factors which block the way of development of simple universally applicable strategy for malaria control. Increased cost of the available tools for malaria control exceeded the public health resources in most malaria countries. Hence, malaria vaccines and mosquito targeted genetic control method might be regarded as long term tools; and insecticide impregnated mosquito nets might be considered as a new tool for short team approach towards the problem (WHO, 1998).

2.1.6 Mosquito nets

Bed net use is the most common practice to protect one from mosquito biting. The earliest record of the use of bednet was in the 6th century BC in the Middle East. Since then the history of mosquito net use was abundant the European countries, America, India, Africa, Far east. Marcopolo, during his travel in India in the 13th century, found the people of upper class had the privilege of using bednet, whereas those of lower class had to lie in open space. The British people in India regularly used the bednets as early as the 18th century. The reason was actually to minimise mosquito nuisance and bite than to prevent disease (Lindsay and Gibson, 1988).

The extent to which bednets are used worldwide is difficult to estimate. The mosquito nets were used in many countries of the world to a varying extent that depends on the prevalence of mosquito nuisance, tradition, availability and affordability. In some countries the use is very high, for example, MacCormack and Snow (1986) reported that in the Gambia as many as 99% of rural Mankinda people sleep under bed nets, but only 64% of Wolof and 55% of Fulas do so. Another survey conducted in Tanzania by White (1969) revealed that only 7% of dwellings inspected had sufficient bednets for all sleepers, as nets were very expensive compared to their income and most people felt inconvenience sleeping under net. A study carried out in northern Thailand found that although 81.1% of households in the villages owned mosquito nets and 69.7% of villagers working outside the villages carried the nets to the forest but their use was irregular. It was evident that where the mosquito density was low, bed net use was also low. Cost and inconvenience or uneasy feeling to sleep under nets were other factors of not using nets (Chitprarop *et al.*1986)

Some studies and trials were conducted to assess whether use of mosquito net had any impact on malaria morbidity or mortality. These trials had contradicting results.

In Papua New Guinea, a comparative study was conducted to observe the response of *Anopheles* and *Culex* mosquitoes towards mosquito nets. In one room persons were sleeping under mosquito nets and in other room without nets. The study found that the number of mosquitoes entering both the rooms with or without mosquito nets is same; but in the room with mosquito net, the *Anopheles* mosquitoes departed to another room or host much earlier for search of blood meal. The study revealed the fact that the very presence of mosquito net in a room reduced the density of *Anopheles* population. Similarly the number of blood fed *Culex* mosquito was also less in the room with mosquito net. The study concluded that the mosquito nets were an effective means to reduce the mosquito attacks (Charlwood, 1986).

Snow *et al.,* (1988) conducted an intervention study in the rural area of the Gambia, West Africa, to assess the impact of the use of bednets on malaria morbidity. The incidence of febrile episodes with associated malaria parasitaemia throughout the rainy season and the prevalence of splenomegaly and parasitaemia at the end of the rainy season were determined in 233 children aged 1-9 years who slept under bednets and in 163 children who did not. The trial found that there was no significant difference in the incidence of clinical attacks of malaria or in any other malariometric measurement between the two groups of children, one sleeping under bed nets and the other, not sleeping under nets. Widespread use of hammock nets in Surinam also did not result in an appreciable reduction of malaria.

For many years, mosquito nets have been used to protect against mosquitoes and other biting insects. The mosquito nets were used in most of protection against malaria. Little published evidence existed about the efficacy of the available nets in reducing malaria. It is safe to state that mosquito nets, if properly used, protect people substantially from mosquito bites, if suitable alternate source of blood, animal or human, was available. Whether the reduction of bites would cause a measurable reduction of malaria morbidity depended on the number of infected mosquito available, vector dynamics, local epedemiology and the immune response (Rozendaal *et al.*,1989).

Burkot *et al.*, (1990) conducted a study in a hyper endemic village of Papua New Guinea to find out the impact of untreated bednet on the transmission of human malaria in that endemic village. In *Anopheline* mosquitoes, the *P. falciparum* sporozoite antigen rate dropped significantly after bednets were introduced. This reduction in human vector contact did not affect the mosquito density, as no significant difference in either the landing rates or the indoor resting catches was found. However, the reduction in the *P. falciparum* sporozoite antigen rate in mosquitoes was not accompanied by a reduction in either malarial parasite or antibody prevalence or titre against *P. falciparum* circumsporozoite protein. The study concluded that bednets may have a measurable impact on malaria indicators and host morbidity and recommended the use of bed net as a part of integrated malaria control scheme.

2.1.7 Pyrethroids and impregnated mosquito nets

Pyrethorids are carboxylic acid esters. Several isomers are possible having different degree of biological activity. The synthetic pyrethroid has high toxicity against insect and greatly increased stability but very negligible mammalian toxicity (Elliot *et al.*,1973).

Pyrethroids are classified into two, type 1 and type 2. Type 1 compounds e.g. permethrin, have no alpha cyano group, act on peripheral nervous system, have good early knock down but comparatively poor killing effect. Type 2 compounds e.g. deltamethrin, lambda-cyhalothrin, have an alpha cyano group, act on central nervous system, have good killing but poor knock down effect (Narahashi,1977).

Pyrethroids are neurotoxic to insects. They act at the nerve membranes to modify the Sodium channel, probably by impending protein change at the lipid protein interface. The high insecticidal activity, very low mammalian toxicity and rapid environmental degradation of pyrethroid made them the insecticides of choice for the impregnation of bed net. Deltamethrin is hundreds of times as active, weight for weight, against mosquito as DDT (Zebra, 1988).

Permethrin and deltamethrin are classified by WHO as moderately hazardous (WHO, 1986). Both have been used in bednet without any complaints by bednet users of adverse side effects. A tingling may be experienced on handling the emulsifiable concentrate (EC) or diluted emulsion of deltamethrin when dipping nets (if rubber gloves are not worm) but this soon wears off (Curtis *et al.*, 1989).

It was reported that Herodotus, in the 5th century BC, observed the behaviour of fisherman living in marshy areas of Egypt as follows: "Every man has a net by which he catches fish in the day and creeps under it and sleeps at night. If he sleeps in a garnet or cloth, the gnats (mosquitoes) bite through it; but through the net they do not try to bite even." Perhaps fish oil or some other substance applied to the net repelled the gnats (mosquitoes) from biting through it (WHO/VBC 1989).

Impregnated bednet give better individual protection than un-impregnated or simple nets for few reasons. Firstly simple nets become easily torn and are not always mended, which allows mosquitoes to enter the net for feeding. This is greatly reduced if the nets are treated. Snow *et al.*, (1987) observed only 10 mosquitoes in treated net whereas 265 in an untreated net having similar number of torn. Lindsay *et al.*, (1989) reported no mosquito found in torn treated net whereas 81 in untreated net of same condition.

Secondly, if a number of people share one bed net, it is quite likely that limbs of the people who sleep on the sides of the bed, come into contact with the netting and consequently to mosquito bite. Hossain and Curtis (1989) showed that mosquitoes did not feed on an arm pressed against a treated bed net although they feed through an untreated one.

Lastly, bed net may not be tucked in properly, windows may be kept open, mosquitoes enter the room and bednet. The excito-repellent and deterrent effect of pyrethroid treated net reduce the chance of this occurring.

The use of pyrethroid impregnated bed nets is increasing gradually for control of malaria throughout the world for last decade. Impregnation of net could theoretically reduce transmission of vector born diseases specially malaria, filaria and kala-azar by following mechanisms:

a) decreasing vectorial capacity by increasing mortality rate and reducing the life span of the vector.
b) providing protection to individual sleeping under treated net or to some extent, in houses when other occupants have treated nets by repellency or irritancy or through inhibition of vector biting (Graves *et al.*,1987).

Bed nets are easy to impregnate. They are dipped in an emulsion of insecticide and water, wrung out and left to dry. It takes a few minutes. No furniture needs to be removed, there is no risk of food becoming contaminated, no mal-odourous residue is left in the house and no spray equipment or specially trained personnel are needed as in indoor residual insecticide spraying. The increasing move towards primary health care (PHC) and allowing people to determine their own objectives in the control of diseases and household nuisances is very favourable to the concept of impregnated nets. Impregnation also has beneficial side effects e.g. the reduction of head lice and bed bugs. Again impregnation of bed net is probably cheaper than wall spraying. In an area of China where people generally used nets, it was found that the cost of a residual house spraying using DDT and the impregnation of bednets using deltamethrin were $0.12 and $0.065 per person per year respectively (Curtis *et al.*, 1989).

The use of insecticide treated bed nets is a focused intervention that requires far less insecticide than spraying the wall and ceiling of the house containing them (Mac Cormack *et al.,* 1989). MacCormack and

Snow (1986) calculated the cost of cotton bed net during a trial in The Gambia. The cost of net became $ 1.50 per year and two permethrin dips per year added a further $0.60.

A significant reduction in the number of *Anopheles* resting in houses with treated net than with untreated net, was observed by Snow *et al.*, (1987a). During assessing the efficacy of permethrin impregnated bednet Lines *et al.*,(1987) found that treated bednet killed significantly more mosquitoes than untreated nets and the survivors came out of the room more. Unlike the above workers, Ree (1988) did not find any reduction in number entering a hut with treated net as compared with control, though mortality was significantly higher. In a trial in Orissa, India, Jambulingam *et al.*, (1989) reported significant reduction in per man-hour density in village where impregnated bednet were used than control village.

In a trial in the Gambia 91% mother liked treated bednet as it reduced headache and sweating i.e. sub-clinical malaria (Snow *et al.*, 1988). In Papua New Guinea, Charlwood and Dagaro (1989) stated that control of head lice and bed bug was the main reason of bed net treatment. The effects on domiciliary arthropods encouraged the acceptance of treated net by a community.
During evaluating the existing practice for vector control and the attitude to use impregnated bed net, the people of Gambia of West Africa, it was found that more the 90% of people interviewed would accept buying and using an insecticide impregnated bed net if supplied at a lower rate (Snow *et al.*, 1988). If the distribution would be at an impregnated centre where impregnation of the existing bed nets would be carried out and also public was informed about treated bed net, the use of ITBN would be popular.

The results of the interventions with insecticide impregnated mosquito nets on reducing the malaria mortality were encouraging which allowed planned large scale introduction of treated bed nets in China, The Solomon Islands, Papua New Gaunae and in Vietnam (Rozendal *et al.*, 1989).

Darriet *et al.*, (1989) carried out trial with permethrin impregnated bednet and reported a reduction of 70% mosquito entering the hut, 20% reduction in biting rate and 20% more mortality than control.

Sexton *et al.,* (1990) evaluated the effectiveness of permethrin impregnated bed nets and curtains used for malaria control purpose in Urini, Kenya in 1998. 105 families were randomly assigned to one of the three-study groups control, bed nets or curtains. The result showed that *Plasmodium falciperum* infection per person week at risk was significantly higher in the control group than in the either the curtain group or the bed net group. The curtain group had fewer infections per week than the bed net group. Impregnated bed net and curtain group had fewer episodes of fever and chill than the control group. Indoor resting vector *An. Gambia* and *An. funestus* were reduced in impregnated net and curtain groups.

Carnevale *et al.,* (1991) studied the impact of insecticide-impregnated mosquito nets in the Gambia, Burkina Faso and Tanzania where *An. Gambia* and *An. funestus* in Barkina Faso were the main vectors. The insecticides used were permethrin, deltamethrin and lambda-cyhalothrin. It was found in the studies conducted in those sub-Saharan countries that mosquito nets were efficient when used on a large scale and not on an individual level. Large-scale use acted on the longevity and infectivity of the vectors and decreased malaria transmission by more than 90%. The overall parasite rate was not decreased, but it was found that there was decrease in the number of children with parasitaemia higher than the critical level, which was a sensitive parameter of malaria morbidity. The studies showed a decrease of malaria morbidity by 60%. The studies concluded that impregnated mosquito nets were found useful to reduce malaria transmission and morbidity. The acceptance of the impregnated bed nets by the population was also found very high.

Alonso *et al.,* (1991) conducted a study on the impact of insecticide impregnated bed nets in the Gambia. At the beginning of the malaria transmission season, bed nets were impregnated with insecticide in the villages participated in a primary health care scheme. Additionally, children aged between 6 months to 5 years were randomized to receive either chemoprophylaxis or placebo, which was continued through out the transmission season. The mortality of children in PHC villages before and after the interventions was measured and the results were compared with the mortality in villages where no intervention was done. The results showed that after intervention, mortality attributable to malaria in children aged 1-4 years in the intervention villages was 30% of that in the non-intervention villages. In children using bed nets, there was no evidence of any additional benefit from chemoprophylaxis. Insecticide treated bed nets were found simple to introduce and could reduce mortality from malaria.

Le Goff *et al.,* (1992) evaluated the efficacy of insecticide impregnated bed nets to control malaria in a rural forested area in Cameroon, Central Africa where transmission of malaria is permanent. The trial was performed in the southern part of the country and the insecticide used was deltamethrin, 25 mg/m^2. The result showed that there was reduction of transmission by 78% and parasitaemia of *P.falciperam* by

75%. This study indicated that intervention with impregnated bed nets reduced malaria morbidity.

Choi *et al.*, (1995) reported that the incidence of malaria might be reduced by the use of insecticide impregnated mosquito nets. Several field trials evaluated their effectiveness as a malaria prevention method. Analysis was performed on 10 field trials to calculate the incidence rate ratios of infections among the study groups. These data suggest that insecticide impregnated bed nets were effective in preventing malaria, decreasing the incidence rate ratio by approximately 50% in the field trial performed.

Between 1991 and 1994 Kroegar *et al.*, (1995) conducted an intervention study with insecticide impregnated bed nets. Evaluation was done over a period of 9 months in each of five endemic malarias area of Ecuador, Colombia and Peru. The program was evaluated through household surveys, blood sampling, in depth longitudinal studies and entomological analysis. It was a randomized control trial involving 84 communities of approximately 35,000 individuals. The result showed that the people's acceptance of the method was related to their perception of an immediate protective effect against insects. The effectiveness of the bed nets, measured as a reduction of malaria incidence was 40.80% when a four months incidence of clinical malaria attacks were considered. Other observations were high insect susceptibility to the pyrethroid insecticides, higher coverage with nets, high malaria incidence, good community participation, high mosquito density and high proportion of *P. falciparum* infection. In one area, where DDT spraying was executed in the control community, it was found that the effectiveness of bed net impregnation was slightly better than that of spraying.

A "cross over" trial among under 5 children in two villages in rural Zanzibar was carried out from 1989 to 1994 by Stick *et al.,* (1994). Intervention with insecticide treated nets was done to the study village and control village remained unprotected. After 3 years the control village was given newly impregnated bed nets. The result showed that introduction of insecticide-impregnated bed nets led to a 74%-78% reduction in the weekly rate of re-infection. The nets also affected perceived clinical symptoms, hemoglobin levels and the mosquito sporozoite rate.

2.2 Filaria

Filaria covers infection with any of the closely related nametod parasites, *Wuchereria bancrofti* (*W. bancrofti*), *Brugia malayi* (*B.malayi*) and *Brugia timori* (*B. timori*). The diseases are transmitted through infective bite of a vector mosquito of genus *Culex, Aedes* or *Anopheles* (Taylor *et al.,* 1992).

2.2.1 Historical background

The word "filaria" is derived from "filar" that means thread like. The disease has been existence in India since the 6th century B.C. In 1709, Clark in Chochin gave the name "Malaber legs". The larval form of the parasite was first found by Demarquay, in 1863, in the hydrocele fluid of man. In 1866, Wucherer in Brazil found microfilaria in chylous urine. In 1872, Lews working in Calcutta found microfilaria in peripheral blood of infected individuals. In 1876, Bancroft discovered the adult female in Brisbane, Australia. In 1878, while working in China, Manson discovered the development of *W. bancrofti* in mosquito. Subsequently, Borne discovered the adult male parasite in 1888. In 1927, Bruge discovered the microfilaria of *B. malayi* in Indonesia. In 1940, Rao and Maplestone discovered the adults of *B. malayi* in India (Park, 2000).

2.2.2 Global situation of filariasis and control activities

Filariasis is a global problem. It is a major social and ecinomic scourage in the tropics and subtropics of Africa, Asia, Western Pacific and parts of the Americas, affecting about 120 million people in 73 countries. More than 1.1 billion people live in areas where they are "at risk" of aquiring the parasite (WHO, 1998).

It is estimated that about 600 million people are living in areas endemic for lymphatic filariasis in South East Asian Region (SEAR). Allthree types of parasites are present in the region. There are about 60 million people infected with microfilaria (mf) and about 31 million people have clinical manifstation of the disease ((WHO, 1999).

In Asia, filariasis occurs mostly in south-eastern part of the continent. The endemic region extends from as far as westerns India to Korea in north-east. Outside these limits only scattered unimportant foci are found. Periodic and sub-periodic from of *W. bancrofti* are the most common in the filarial areas of Asia. In addition, *B. malayi* (periodic form) occurs throughout most of the filarial areas of Asia, though less extensively than *W. bancrofti. B. malayi* is found in Indonesia, Korea, costal area of China and India. Sub-periodic form of *B. malayi* occurs in Indonesia, Peninsular Malaysia, Thailand, South Vietnam, Sabah, Sarawak and Philippines (WHO, 1999). Timor microfilaria (*B. timori)* has been found only in Timor and neighboring Islands (Hawking, 1976).

In the Pacific region, high incidences of filarial infection (mf rate > 15%) have been recorded. The infection occurs mostly in the flat low-lying areas. Only one species of human filarial parasite is present in the pacific area, namely *W. bancrofti.* It occurs in two forms "Periodic" and "sub-periodic" (WHO, 1998).

In the African region, *W. bancrofti* occurs in nocturnal periodic form in most of the hot humid sub- Saharan areas of the continent. There are also relatively few focus in Egypt. *Brugia* does not occur in Africa (WHO, 1998).

In America, three specie of filarial namely *W. bancrofti* with nocturnal periodicity, *Dipetaloinema perstan* and *Mansonella ozzarde* were prevalent. In general *W. bancrofti* had been found occur in the costal plains of central and South America (Hawking, 1979). In Europe there is no known focus of human filariasis, although cases occur among immigrants (WHO, 1998).

In several countries effective control campaigns have greatly reduced the prevalence of lymphatic filariasis. Particularly, in China, India and Sri Lanka, the incidence of filariasis caused by *W. bancrofti* and *B. malayi* are decreasing due to effective control programme. Considerable success has been achieved in eliminating the parasites in the southern Brazil, Japan, Republic of Korea and Turkey, where the filariasis transmission is seasonal. In some of these areas, there has also been a spontaneous decline in prevalence of filariasis, which was associated with improvement in economic status of the community and in sanitation and with effective mosquito control. The increasing use of diethyl carbamazine citrate (DEC) has reduced the proportion of people developing the chronic lesions of hydrocele in many endemic areas. There has been a decrease in filariasis consequent to malaria control campaigns in areas like Malaysia, Solomon Islands, where *Anopheles* mosquitoes are the main vectors of filariasis (WHO, 1998).

The current strategies of filariasis control are based on:

i) Detection and treatment of human carrier.

ii) Recurrent anti-mosquito measures.

i. Detection and treatment of carriers

An ideal parasitological diagnostic technique is necessary in epidemiologiocal assessment of infection. The diagnosis of lymphatic filariasis is based on direct demonstration of parasite and /or immunological evidences. Direct evidence includes presence of microfilaria in the peripheral blood, chylus urine, hydrocele fluid etc. Indirect evidences by immunological methods and those are detection of filarial antigen and antibody.

Classical diagnosis of lymphatic filariasis is the detection microfilaria. For *W. bancrofti* the time of collection is between 10 pm to 4 am. So, blood to be collected at nighttime. Udonsi (1988) used 'provocative' day sampling test. But unfortunately these tests yielded fewer microfilaria than smear taken at night.

Immunodiagnostic tests detect either antigen or antibody in the sera of filarial patients. The ICT Filariasis, an immunodiagnostic test for the detection of *Wuchereria bancrofti* antigen in serum or plasma was done with the serum. It is sensitive to detect low-density microfilaria, easy to handle, economic and capable of species identification of microfilaria.

The drug of choice for treatment is diethylcarbamazine citrate (DEC). It is usually effective in killing microfilaria and to some extent adult worms and reduces the parasite load in the human reservoir (Cartel *et al*, 1990). But the problem is that the microfilaria clearance with DEC may be incomplete at times even after adequate treatment and people living in endemic areas are re-infected (Park, 2000).

In addition to specific treatment of filarial cases, mass chemotherapy has been tried in different countries. In India the mass chemotherapy approach was tried during 1958-1960 but had little success because of operational difficulties and was abandoned. In Indonesia, mass treatment with DEC was tried for control of filariasis (*B. malayi*), the microfilaria rate decreased dramatically and remains low for 2-3 years. Similar result also has been observed in case of Bancroftian filariasis. However, useful results were reported by the use of DEC medicated common salt in chemotherapy. In China, a Bancroftian filarial control conducted at Kinmen Island with DEC medicated salt from 1970-1982. The microfilaria rate and density reduced from 6.9% and 14.4/20 cmm of blood to 0.3% and 1.9/20 cmm of blood respectively (WHO, 1984).

Recently it has been reported that Ivermectin, a new microfilaraecidal drug administered orally as a single dose (150-200 μg/kg) once a year for treatment of Onchocerciasis proved effective against filaria (Goa, 1991). However, low dose ivermectin treatment followed by standard dose of DEC has more effective macrofilaraecidal in *W. bancrofti* infection (Weil *et al.*, 1991).

In an endemic area of Polynesia, Bancroftian filariasis was controlled by twice-yearly doses of ivermectin (400 μg/kg) for 3 treatments. This dose was well tolerated and compliance was excellent (Nguyen *et al.*, 1996)

Another trial on asymptomatic microfilariaemic subjects with *W. bancrofti* infection, with any combination of a single dose of albendazole (600 mg), ivermectin (400 microg/kg) and diethyl carbamazine citrate (6mg/kg) were compared 15 months after treatment. All combinations significantly reduced the mf counts but albendazole/ivermectin was the most effective regimen and was suggested for control programme (Ismail *et al.*, 1998).

In a trial, mass treatment had been given, using 400 microg/kg invermectin plus 6 mg/kg diethylcarbamazine citrate (DEC) in a village where pre- and pos-treatment collections of freshly blood-engorged mosquitoes from the same bedrooms were performed. All blood-fed mosquitoes collected less than 4 days after mass treatment died within 9 days, whereas 67% of those collected before treatment survived for >9 days. Comparison (using the log-rank test) of the survival curves for mosquitoes collected (i) before treatment, (ii) <4 days after treatment, and (iii) 28 days after treatment, showed the survival rate of group (iii) to be significantly lower than the other two (chi2=176, df=2, P<0.0001) (Bockarie *et al.*, (1999).

The efficacy and nutritional benefit of combining chemotherapeutic treatment for intestinal helminths (albendazole) and lymphatic filariasis (ivermectin) was investigated in some Haitian school children. 54.7% of the children had one or more helminths and *W. bancrofti* microfilaria was found in 13.3% of the children. Combination therapy significantly reduced the prevalence and density of microfilaria and other helminthic worms compared to placebo or either drug alone. Combination therapy also resulted in significantly greater gains in height and weight compared to other groups (Beach *et al.*, 1999).

Annual single dose either co-administration of two drugs (ivermectin + diethylcarbamazine (DEC) or albendazole) reduces blood microfilariae by 99% for a full year; even a single dose of one drug (ivermectin or DEC) administered annually can result in 90% reductions; field studies confirm that such reduction of microfilarial loads and prevalence can interrupt transmission (Ottesen *et al.,* 1999).

ii. Anti-mosquito measures

For vector-borne disease, it is important to reduce the rate of transmission by means of vector control. The feasibility and value of vector control depend upon the identity, ecology and behavior of local vectors and others epidemiological conditions.

Present approach to vector control is based on recurrent antilarval measures by mosquito larvicidal oil (MLO), organophosphorus larvicide (Abex-Batex), larvovorous fish, *Poecilia reticulata,* larvicidal bacterium, *Bacillus sphaericus* or spore forming bacterium, *Bacillus thuringiensis* etc. (WHO, 1984).

Efficient drainage of sewerage system that removes wastewater and solid waste helps to eliminate mosquito breeding. When properly maintained, they are the most efficient approach to control mosquito breeding specially *Culex quinquefasciatus,* the vector of Bancroftian filariasis. House screening and use of mosquito nets are very efficient if they are correctly used (Park, 2000).

A single campaign of mass treatment for Bancroftian filariasis with diethyl carbamazine (DEC) in a town of Tanzania, combined with elimination of mosquito breeding in pit latrines with polystyrene beads was followed by a progressive decline over a 5 year period in the microfilarial rate from 49% to 3%. In Zanzibar town, treatment of 3844 wet pit latrines and cesspits with polystyrene beads reduced the adult mosquito population in houses by about 65%. Supplementary treatment of open drains and marshes with *Bacillus sphaericus* produced little or no additional reduction compared to a sector of the town where only pit treatment with polystyrene was carried out. Maxwell *et al.,*(1999) recommended that the cost and effort of achieving the 65% reduction in mosquito population could hardly be justified for its impact on filariasis alone, but its noticeable impact on biting nuisance might help to gain community support for an integrated program.

Integrated control measures against *Culex quinquefasciastus* have been implemented by Regis *et al.*,(1995) in a pilot urban area in Recife, Brazil with *Bacillus sphaericus,* which showed very significant reductions *Cx. quinquefasciatus.*

The impact of permethrin impregnated bednets on resting and feeding behaviour of mosquito vectors of *Wuchereria bancrofti,* causing human lymphatic filariasis was studied in six pairs of villages (treated and untreated) in Kenya before and after intervention by Bogh *et al.,* (1998). Bancroftian filariasis was highly endemic in the study villages. Introduction of impregnated bednets in 1995 significantly reduced the number of indoor-resting *An. gambiae* by 94.6% and *An. funestus* by 96.7%, but there was no change in the number of *Cx. quinquefasciatus* collected indoors. ELISA analysis of mosquito blood meals showed a shift from human to animal feeding after the introduction of treated nets. The human blood index (HBI) and mosquito density were estimated to be reduced significantly. These results suggest that permethrin impregnated bednets give effective personal protection against transmission of *W. bancrofti* by *An. gambiae, An. funestus* and *Cx. quinquefasciatus* in East Africa.

2.2.3 Filaria situation in Bangladesh and control activities

Bangladesh is surrounded by West Bengal, Bihar and Assam states of India and Mayanmur, where filariasis is known to be endemic. Filariasis is prevalent in Bangladesh with different degree of endemicity. The information regarding prevalence and epidemiology of filariasis in Bangladesh is inadequate due to lack of study, but few isolated survey have shown filariasis is prevalent in different parts of Bangladesh. It has been showed that high number of cases were found in the greater district of Dinajpur, Pabna, Chittagong, Barisal, Rajshahi and Rangpur with the blood microfilaria positivity rate of 11.6%, 5.2%, 4.5%, 3.08%, 3.2% and 3.05% respectively. Lesser number of cases was found in the greater districts of Bogra, Faridpur, Comilla and Sylhet with blood microfilaria positivity rate were between the two groups. No cases have been found in Noakhali (Wolfe and Aslam Khan, 1971).

Another survey showed that filariasis was most prevalent in north-western districts particularly Thakurgaun, Dinajpur and Rangpur. In Dinajpur district, microfilaria and clinical filarial rates were 14.81% and 9.49% respectively. In Rangpur district the microfilarial rate was 7.72% and clinical filarial rate was 7.86%. In both the districts the clinical signs mainly consisted of hydrocele of scrotum, lymphedema and elephantiasis of the extremity(s) (Wolfe and Aslam Khan, 1972). Expect few cases of *B. malayi*, all filarial cases in Bangladesh were due to *W. bancrofti* (Barry *et al.*, 1971).

Although lymphatic filariasis is not associated with high mortality rate, chronic filarial infection causes enormous suffering. The socio-economic impact due to long term disability and deformity are extraordinally great. The determination of prevalence of the filarial infection in the community is important and necessary for public health program. The effective control of communicable disease like filariasis depends on early detection of cases, monitoring and surveillance of the disease. Detection of microfilaria by thick film examination is currently practiced in Bangladesh, which is time consuming and tedious and difficult for handling large samples. Moreover, there is possibility of false negative result. It appears that development of serodiagnosis is highly relevant. Serological tests that identify the micorfilaraemic individuals within populations in endemic areas without the need for night blood collection, identify actively infected individuals without microfilaria and quantify adult worm burdens following treatment would facilitate and constitute valuable tool for monitoring filariasis.

As baseline information is not available, surveillance system has not been developed in the endemic region of Bangladesh, it is a real need to find out the real picture of filariasis in the country. Immunological methods like Immunochrotographic test (ICT) filariasis, a rapid, simple and sensitive test may be more advantageous over the conventional parasitological examination.

As filariasis is a chronic disease, it is really difficult to control the disease by chemotherapy alone. As the disease is a vector borne one, some efforts to prevent man-vector contact would be more helpful to control the disease. *Culex quinquefasciatus*, the vector of Bancroftian filariasis in Bangladesh, is a domestic mosquito. Different works carried out by different scientists in Bangladesh also showed that this species is endophilic in nature i.e. it prefers to rest indoor (Ameen and Moizuddin, 1973; Ameen *et al.,* 1982, 1984; Ahmed *et al.,* 1986, 1989, 1991).

In Bangladesh, filariasis control activities do not exist except very limited treatment of cases in the endemic zone with individual effort. In such places personal protection with impregnated bed net may help to control the disease. In the areas where malaria and filaria both are endemic, use of insecticide-impregnated bed net may be a more fruitful method to control the diseases.

2.2.4 Epidemiological factors of filariasis

The three components of filarial epidemiology consist of parasite, vector and host.

i. Parasite or causative organism

The filarial parasite that are generally recognized as being distinct entities are,a) *Wuchereria bancrofti* (nocturnal periodic, sub periodic), b) *Brugia malayi* (nocturnal periodic, sub periodic) and c) *Brugia* timori (only nocturnal periodic). The adult worms live in the lymphatic glands and vessels. The female produces microfilaria, which circulate periodically in the peripheral blood either nocturnally or diurnally (WHO, 1984). Diagnosis of lymphatic filariasis was based on the identification of mf in the peripheral blood. Night blood collection is the traditional method for detection of microfilaria (mf) in peripheral blood (Harinath, 1985). To avoid the inconvenience of night blood collection, Udonsi used "provocative test" for collection of blood sample in daytime. Unfortunately this yielded fewer microfilaria than smear taken at night (Taylor *et al.*, 1992). In 1967, Bell introduced membrane filter concentration technique for detection of mf. Later on, in 1971 Denis used nucleipore polycarbonate membrane. In 1931, Fairly first employed immuniodiagnosis to detect antibody by CFT using *Dirofilaria immitis (D. immitis*). Subsequently IFAT, ELISA, ICT etc. are used (Rao *et al.*, 1981).

ii. Filaria vector

Mosquitoes are the only known vectors of lymphatic filariasis. *Culex quinquefasciatas* has been recognized as the vector of nocturnally periodic *W. bancrofti.* In African region, two fresh water breeding mosquitoes of *Anopheles gambia* complex namely *An. arbinenses* and *An. gambia* are now known as the filarial vectors. But in Libaria, *An. nile* and

An. hancock have been incriminated as vector of filariasis. *An. danotities* and *An.dirus* have been found to be responsible for filariasis in western pacific and in Southeast Asia respectively. In Thailand, *Aedes niveus* and in Philippines *Ae. poicilus* have been incriminated as the vectors of *B.malayi*. *An. barbirostris* has been reported as the vector of *B. timori* infection in Timor, Indonesia. Mansonia mosquitoes, *Mansonia annulifera* and *M. uniformis* are vector of Brugian filariasis in India (WHO, 1998). *Culex quinquefasciatus* was found to be the only vector for bancroftian filariasis of nocturnal periodicity in Bangladesh (Aslam Khan and Wolfe, 1972; Ahmed *et al.,* 1986).

Filariasis is transmitted by the of infected mosquitoes. The severity of the disease is proportional to the intensity of biting by infected mosquito. In Africa, microfilaraemia rate was 45% in adult and the rate of exposure infective bites were 400 per person per year. In Tanzania, the annual infective biting rate was 149 in the most highly endemic village (microfilaraemia rate 28.5%). In India, 32 infective bites per person per year maintained a microfilaraemia rate of 16.7% (WHO, 1998).

iii. Host (reservoir of infection)

Man acts as the host of filarial infection. All ages are susceptible and males are more affected. The disesase is associated with urbanization, industrialization, and migration of people, illiteracy, poverty and poor sanitation. Variety of non-human primates such as gibbons, macaques, leaf monkey and orangutans are the important reservoir of zoonotic filariasis. They play an important role in epidemiology of human filariasis in endemic areas (Park, 2000).

Filariasis is a disease of the poor and underprivileged. Women suffer from lymphatic filariasis to a great extent but embarrassment, shame, cultural constraints and social taboos are some of the reasons that refrain them from reporting problems and seeking help. Women are thus silently bearing the burnt of this disease (Bandyopadhyay *et al.*, 1996).

Ina study it was observed that people were well aware of filariasis in their communities and recognized its different clinical manifestations. Only 9% of those with and 20% of those without the disease knew that filariasis was caused through mosquito bites; the rest attributed it to many other causes. People's knowledge about transmission and prevention of filariasis was also very poor (Ramaiah, 1996).

In another study, 104 residents of an endemic area in Haiti were interviewed by Eberhard *et al.*,(1996). Fewer than 50% of residents had heard of filariasis and only 6% of the surveyee knew that mosquitoes transmitted it. In contrast, all persons knew of the clinical conditions of hydrocele and elephantiasis. Hydrocele was thought to be caused by trauma or trapped gas, elephantiasis by walking bare foot on soil or water or by use of ceremonial powder that had been sprinkled on the ground. 76 respondents thought that hydrocele could be treated through surgery or a drug, respectively, whereas 86 respondents believed that either surgery or a drug could be used to treat elephantiasis.

Regarding cost of filariasis in India, a mean annual expenditure became Rs. 72 (US $2.1). Most patients did not leave work, as chronic disease manifestations are mostly irreversible. An estimate 8% of potential male labour input is lost due to the disease. Regression analyses revealed that lymphatic filariasis has a significant effect on work time allotted to economic activity ($P<0.05$) but not on absenteeism from work ($P>0.05$). Female patients spent less on domestic activity compared to their matches' controls ($P<0.05$). The results clearly show that the chronic

iii. Eastern Mediterranean region-Afganistan, Iran, Iraq, Tunisia, Egypt, Sudan, Libyan, Arab, Jambia, Jordan, Lebanon, Syria and Israel are included into this region.

iv. European region-Turkey, Italy, Spain, Greece, France, Portugal, Albenia, north-eastern Russia.

v. American region- Brazil, Argentina, Venezuela, Paraguay, Bolivia, EL Salvador, Honduras, Colombia, Panama, Guatemala and South Mexico.

vi. Western Pacific region-China, Democratic People's Republic of Korea and Democratic Kampuchia.

Kala-azar in India

From the history it appears that kala-azar or visceral leishmaniasis (VL) existed as a major public health problem in the Indian sub-continent since 1850. The name of 'kala-azar' was present as early as 1869. The Ganges and the Brahmaputra river valleys of India and Bangladesh were the home of visceral leishmaniasis (Bryceson, 1987). Kala-azar was first noted in an epidemic form in the country (present Bangladesh) in the Garo-Hill area adjacent to the Brahmaputra valley of Assam in 1880. In 1882, Clark of Sanitary commission drew public attention by reporting 100 cases from Garo hills (Sanyal, 1985). Irregular epidemic waves have swept through Assam, Bengal (Bangladesh) and Bihar, with a frequency of 15-75 years depending on locality. Reports of large outbreaks in Bengal are obtained in 1824, 1873, 1902 and 1943 (Ashford and Bettini, 1987). These periodic outbreaks had been attributed to some variation in the proportion of immune individuals in the population and the density of vector sandfly (Rahman and Islam, 1979).

In 1924 kala-azar fever was widespread over much of the country and particularly the areas of the districts of Rajshahi, Nadia, Jessore, Mymensingh and Noakhali. In 1936 kala-azar prevalence was highest in Rangpur, Jessore, and Noakhali (Birley, 1993). In 1947 kala-azar survey was carried out in the then province of Assam, West Bengal, Bihar and East-Bengal (Bangladesh) which revealed few foci endemic for kala-azar (WHO, 1987).

As a result of wide-scale indoor DDT spraying for the control of malaria under the National Malaria Eradication Programme in 1950s and 1960s, kala-azar came to a medical rarity due to reduction kala-azar vector density in Indian subcontinent (WHO, 1984; Thakur and Kumar, 1991). Mass chemotherapy with pentavalent antimony and an increase in herd immunity were perhaps the contributory factors (Sehgal and Bhatia, 1988).

The period from 1960 to '70 could be regarded as VL free period. It was in withdrawal areas of DDT, that first outbreak of kala-azar started reappearing during 1970 in Bihar and by 1977 progressive rise in incidence reached an estimated figure of 100,000 cases with 4500 deaths by 1970-80. The epidemic in Bihar, India in 1977 started from a small block and gradually spread to almost all of North Bihar. According to survey of the National Institute of Communicable Disease, India, about 70,000 cases were recorded with 4000 deaths during the epidemic. It took 5 years to control the epidemic. Male female ratio was 5.5:1. Maximum (63.4%) cases were among 10-29 years of age. Clinical features were classical. Treatment with sodium stibogluconate was effective in 92.6% cases. Kala-azar patient who had tuberculosis, were treated with antimonial and antitubercular drugs concurrently and all cases recovered. Unresponsive cases were treated with pentamidine but side effects were serious. The infection spread to Malda district of West Bengal. The infection has also crossed over to Bangladesh in the East and Nepal in the North, where this disease now affects large areas (Thakur, 1984).

A five-years long epidemiological study, from 1985 to 1988, was carried out in a kala-azar endemic village Jethuli in rural Bihar, India. The first VL case was found in a migrant who came from a village where epidemic had occurred recently. The study showed that the infection was built up slowly, first in the same house and then in the immediate neighbourhood. The researchers discussed that rare availability of infected macrophage in peripheral blood of a patient for vector sandflies to suck in, short flight range of sandflies, non-availability of an animal reservoir indicate slow and limited transmission potential and even so epidemic occurs every 15 to 30 years (Dhiman and Sen 1991).

Most of the present global population at risk from kala-azar is in India and Bangladesh and about half the case reports of the world are from these countries (Ashford *et al.*,1992).

2.3.3 Kala-azar in Bangladesh and control activities

Kala-azar was endemic in this country during the pre-malaria eradication period in the 1950s. During 1950-51, the WHO malaria control demonstration team (WHO/UNICEF/ Government) with the participation of the national staff, carried out a kala-azar survey among children up to 15 years of age in a thana of Mymensingh district. Diagnosis of kala-azar depended on spleen enlargement and the modified aldehyde test (AT). During the first survey in the unsprayed area from January to July1950, 8.35% of the children were positive by means of formaldehyde test in capillary tube and 44.5% of the children had enlarged spleen by Hackett classification. The youngest case was a child of one year old. About 41% of the families had more than one person infected with kala-azar. During the second survey form October 1950 to January 1951, after DDT spraying in May-June 1950, only 1.85% of the children gave a positive kala-azar test and no children was found with enlarged spleen. Thus it was concluded that residual house spraying for control of malaria could interrupt kala-azar transmission. Out of 123 persons examined for both kala-azar and malaria, ten were positive for AT test and also harboured malaria parasite in their blood, suggesting that there was no incompatibility between VL and malaria infection in the same individual .For treatment of kala-azar biweekly injections of urea stibamine was given to 95 patients found positive by AT and follow up given for 6 months, except 4.2% who suffered a relapse, all became cured (Nasiruddin 1952; Gramiccia and Sacca, 1953).

Malaria eradication program involving widespread use of DDT residual spraying continued from 1958 to 1964 in the malaria endemic areas of both Bangladesh and India. It reduced the incidence of kala-azar to a medical rarity during the 1960s and early seventies due to the collateral effect of residual spraying on sand fly, the vector of kala-azar. The reason for this has been attributed to the high susceptibility of kala-azar vector to DDT (Rahman and Islam, 1979; Ahmed and Ahmed, 1983). Mass chemotherapy with pentavalent antimony and an increase in herd immunity were perhaps also contributory factors for regional decline in the incidence of VL (Sehgal and Bhatia, 1988). Except a few cases of post kala-azar dermal leishmaniasis (PKDL), kala-azar almost disappeared from the country (Elias *et al.*, 1989).

In Bangladesh, the first kala-azar case diagnosed was in the middle of 1970 by demonstrating Leishman-donovan bodies in the spleen material of a patient who also had been suffering from pulmonary tuberculosis. Presentation of the case in the clinical conference brought attention of other scientists about the re-appearance of kala-azar in the country (Islam, 1982).

Although due to indoor residual DDT spraying and treatment of kala-azar patients with urea stibamin, the disease reduced below the level of pubic health importance, the disease was never totally eliminated. Post kala-azar dermal leishmaniasis (PKDL) is a squeal of visceral leishmaniasis (VL) with chronic dermal granulomatous changes. Ten cases were diagnosed as PKDL among the referred cases to skin and VD department of Institute of Post Graduate Medicine and Research (recent Bangabandhu Sk. Mujib Medical University), Dhaka from 1973 to 1976 (Khan, 1977). It drew attention of physicians about the presence of the disease in the country.

In a working paper submitted to the seminar on 'Epidemiological methods for leishmaniasis' in USSR by a teacher of the Post Graduate Institute of Dhaka, Bangladesh, described that Complement fixation test (CFT) and Aldehyde test (AT) were performed for 218 clinically confirmed cases of kala-azar. Microscopic examination of spleen puncture material was made in all cases except four whose bone marrow aspirate was examined. In all the cases (99.5%) except one, CFT and AT were positive. LD bodies were demonstrated in 27% of the cases. On age and sex distribution, the author noted that all cases were adults and 70% were male (probably they sick treatment more frequently than female). Another group of 41 suspected cases with dermal lesions were examined and PKDL was confirmed in 6 (14.6%) cases by skin scrapping. On control, the author believed that DDT house spraying for malaria eradication greatly reduced the sandfly vector population and consequently the incidence of kala-azar was markedly reduced. With the discontinuation of the spraying campaign of Malaria Eradication Programme, there had been a recrudescence of cases in Bangladesh. On drug treatment, the author cited the use of sodium antimony gluconate (SAG) was the choice of drug. In unresponsive cases hydroxystilbamidine is resorted to (Rahman, 1980).

In 1980, an outbreak of kala-azar was reported at Shahjadpur thana of Sirajganj district in which out of 218 suspected serum samples 134 cases were detected by Aldehyde test. Subsequently, a thorough parasitological investigation was conducted by Khan during 1980-81. He confirmed the outbreak by demonstrating the parasite in the patients (Ahmed and Ahmed, 1983).

59 cases as kala-azar out of 218 suspected cases werte confirmed at the Post-graduate hospital (recent BSMMU), Dhaka and out of 41 cases with skin lesion, 6 were confirmed as PKDL. These patients came to Dhaka from different districts of Bangladesh (Rahman and Islam, 1983).

An increase in kala-azar vector population following cessation of mass DDT spraying, together with available human reservoir of infection in both acute and PKDL cases led to reappearence and gradual rise of number of cases since 1970s in Bangladesh and India (Thakur, 1984). The sporadic reappearance of kala-azar did not draw keen attention either of the departments of health or general physicians. Due to lack of attention and timely intervention measures number of cases greatly increased and several outbreaks of kala-azar cases in epidemic form have also been reported. During July 1987 to Nov. 1988, 2577 cases of VL including 45 PKDL case were detected from an endemic area of Bangladesh. The number of kala-azar and PKDL cases is increasing sharply and reaching a level, which could provide a reservoir of sufficient magnitude to spark off a major outbreak (Chowdhury *et al.*, 1988).

After the outbreak of kala-azar at Shahjadpur thana of Sirajganj district, acses had been reported from other districts like Sirajganj, Mymensingh, Pabna, Rajshahi, Dinajpur, Thakurgaon and Tangail which have also been identified as hyper-endemic areas of Bangladesh. With the exception of few districts in the north-east and south-east, increasing number of visceral leishmaniasis and post kala-azar dermal leishmaniasis have been reported from all over the country (Elias *et al.*, 1989). Many of the cases of kala-azar and PKDL remain undetected because of lack of laboratory diagnostic facilities, absence of trained manpower, inadequate reporting system and low-level awareness about the disease among patients themselves in rural Bangladesh. Young physicians were also not quite knowledgeable of the presence of this disease. Kala-azar cases so far reported, mainly passively detected, it is believed that they are grossly under estimated. The reported cases may be the tip of the iceberg and majority of the cases is yet to be detected. So country wide actual incidence is unknown and it needs active surveillance, especially in the endemic areas.

An outbreak investigation at Kalihati thana of Tangail district of Bangladesh in 1987 showed 58.33% to be sero-positive for kala-azar out of 36 blood samples taken from suspected cases using Direct Agglutination Test (DAT) and *Leishman-Donovan* (LD) bodies were found in 3 out of 4 aspirates. One PKDL case and a kala-azar patient with lymph node involvement were also detected (Masum *et al.,* 1990a).

In December, 1987, another outbreak investigation was carried out in Thakurgaon district and 53 chronic fever cases were examined and DAT was used for sero-diagnosis. 31 cases were sero-positive. Bone-marrow was examined for confirmation of the diagnosis. Out of 6 aspirates, LD bodies were found in 4 (Masum *et al.*, 1990b).

In a cross-sectional study, cases were diagnosed parasitologically or serologically and treated, revealed that the prevalence of VL was 4.40% in

Trishal thana of Mymensingh and 6.75% in Shahjadpur thana of Sirajganj compared with 0.34% in non-endemic Teknaf thana of Cox's Bazar district in 1987 (Chowdhury *et al.*, 1990).

One hundred kala-azar cases had attended the Dhaka Shishu Hospital during the year 1987 to 1990. Of them 50 were from Dhaka Division and 50 were from Rajshahi Division (Chowdhary *et al.*, 1991a). Since re-emergence of kala-azar in late 70s, the cases are in a steady rising trend. On the basis of reports received from district hospital and thana health complexes, 15,000 new cases of kala-azar per year in Bangladesh would not be an over estimate (Chowdhury *et al.*, 1991b).

The disease is gradually spreading in Bangladesh and outbreaks of kala-azar are being reported in various parts of the country. Initially 8 thanas reported kala-azar during the period of 1981-85, detected through active case detection (ACD) method carried out by the health authority of the country, the number increased to 62 thanas in 1991 and 107 thanas in 1997 out of total 489 thanas in the country (M&PDC unit, DGHS, Bangladesh, 1997). At present kala-azar cases have been reported from 38 out of 64 districts of Bangladesh. It is suspected that Kala-azar is endemic in most of the districts of Bangladesh. There are even fears of epidemics in some areas. During last few years the kala-azar situation has assumed epidemic proportions with the number of reported cases were 3965, 4214, 6812, 8846, 7032, 5799 and 7640 in the years 1994 to 2000 respectively (M&PDC unit report, DGHS, Bangladesh, 2000).

2.3.4 Epidemiological factors of kala-azar

The three components of kala-azar epidemiology are vector, parasite and host.

i. Vector of kala-azar

The anthroponotic visceral leishmaniasis or Indian kala-azar is caused by *Leishmania donovani* and maintained between man and *Phlebotomus argentipes* species of sandfly (Chatterjee, 1980). No animal reservoir is yet known. The disease shows direct correlation with the distribution of *P. argentipes* (Zahar, 1979).

Sandfly, an insect of warm climate, is abundant during warm part of the year. *P.argentipes,* the vector of Indian kala-azar is strictly synanthropic (found in association with man and habitations). It requires high humid climate. A scientist in earlier days listed that a) monthly temperature 7.5°C-37.8°C, b) annual humidity more than 70%, c) annual rainfall more than 1250mm, d) altitude below 600m, e) alluvial soil, f) high sub-soil water level, g) abundant vegetation are the most favourable factors for prevalence of sandfly (Napier, 1926).

Swaminath *et al.,* (1942) in his historical experiment successfully transmitted kala-azar by the bites of *P.argentipes* to 5 human volunteers in India. The vectorial status of *P.argentipes* was confirmed by the demonstrating experimentally its ability to transmit the infection to man. After feeding on confirmed VL case, the flies were confined in chambers, provided with raisins and kept at a constant temperature of 28°C. Mortality was very high and only 25-30% of the flies were available for feeding on human volunteers. Five healthy volunteers from a non-endemic area were exposed to bites of the surviving flies over night and they were sent back to their area. Later all the five volunteers developed

VL infection, thus the incrimination of *P. argentipes* as vector of kala-azar in India was proved (Swaminath *et al.,* 1942).

Bio climatic condition i.e. temperature, humidity, rainfall, alluvial soil and abundant vegetation with subsoil water of Bangladesh favours vector sandfly. Other factors including overcrowding, poor ventilation and collection of organic materials in houses act as catalysts (Ashford and Bettini, 1987).

Collection of sandflies from fixed catching spots in Dhaka and Rajshahi division for 5 years period, the highest density was recorded in pre-monsoon summer and the lowest in post-monsoon winter (Ameen *et al.,* 1993). The finding is similar to the observation of some earlier workers (Nasiruddin, 1952; Grammicia and Sacca, 1953). The trend was seen for all species except *P. argentipes* whose highest peak was recorded in November. Another report showed the high density of *P.argentipes* from June to November with peak in September (Ahmed *et al.,* 1989).

The reports of host preference of *P. argentipes* are rather conflicting. In some areas, more flies were caught biting cattle, while in other, man was found to be the preferred host. In a study, human blood index was found of 69.6% and 21.5% respectively when sandflies were collected from human dwelling and cowshed respectively. Again, bovid blood index was found of 97.9% and 44% in flies collected in cowsheds and dwellings respectively. The study highlights that *P. argentipes* is an indiscriminate feeder and would feed on host whichever is in the vicinity. The authors called *P.argentipes* an opportunistic feeder (Addy *et al.,*1983). During blood meal analysis of the vector sandfly, *P.argentipes* showed a preference for bovine blood over human blood (Ameen *et al.,* 1993). In another finding it was also reported that it is mainly a cattle feeder, especially near its range and it is more widespread than the disease (Ashford and Bettini, 1987). On the contrary, Das *et al.*, (1976) reported that *P.argentipes* is greatly attracted to man.

P.argentipes is predominantly endophagic (feed indoor) and endophilic (take rest indoor) and bite men and cattle with equal avidity. During the day and after feeding adult sandfly takes rest in sheltered, dark and humid but dry surfaces such as caves, cracks in the ground and inside human and animal habitations. These species are often referred to as domestic or peri-domestic species (Kalra and Bang, 1988).

The larvae of sandflies require moist microhabitat with high humidity as they absorb water with their food and through the skin for survival. Female sandfly lays eggs in soil containing moisture and organic debris. Immature stages are found in loose soil in cracks and crevices in and around the dwelling houses, troughs and cattle shed but the task is really difficult. Larvae have been found in 19% of samples from the corners of cow sheds and under troughs in Burdwan which revealed that the sandfly breeds in decaying organic material around cattle sheds and troughs. The breeding sites were usually within 5 cm of the surface in soil of high organic content and high humidity (Hati *et al.*, 1982).

Kala-azar has been associated with the alluvial soil of the river valley. The effect of flood on larval distribution has been studied in a flood prone area of Bihar. During flood all ground level breeding sites were submerged by up to 60 cm. Larvae were found in earth scrapping as high as 90 cm up house walls. After the flood is over, the larvae returned to ground level. The study demonstrated that larval breeding is not completely prevented by deep flooding (Mukhopadhyay *et al.*, 1990).

Sandflies were collected from different parts of Bangladesh from 1981 to 1988 in order to find out their distribution in the country. Maximum number *P.argentipes* were found in greater Mymensingh, Rajshahi, Pabna and Dinajpur district. *P. papatasi* was found only in greater Rajshahi and Dinajpur. This species is regarded as dry weather species and commonly found in dry areas of Uttar Pradesh and Rajsthan in India and is the vector of cutaneous leishmaniasis (CL). Rajshahi and Dinajpur are also regarded as the hottest and driest part of the country. So far no CL cases are reported in Bangladesh but it needs further surveillance. During those collections, two species of *Phlebotamus, P. argentipes* and *P. papatasi* and three species of *Sergentomyia, S. babu babu, S. shorttii* and *S. barraudi* were identified (Ahmed *et al.*,1989).

During investigation of the outbreak of kala-azar at Khalihati thana of Tangail District, Bangladesh in 1987, the sandfly fauna was checked. The sandfly species as identified in the localities were *P. argentipes, Sergentomyia babu babu, S. barraudi* and *S. shortii* (Masum *et al.*, 1990a). Another outbreak occurred in Thakurgaon district in 1987 and the collected sandflies were *P. argentipes, P. papatasi, S. babu babu* and *S. barraudi* (Masum *et al.*,1990b).

During searching the indoor resting sandflies from fixed localities in Dhaka and Rajshahi division of Bangladesh, two species of *Phlebotamus, P. argentipes* and *P. papatasi* and five species of *Sergentomyia, S. babu babu, S. baghdadis, S. shorttii, S. barraudi* and a new species were identified (Hossain *et al.*,1993)

ii. Parasite of kala-azar

The genus *Leishmania* is specifically characterized by having two phases of development i.e."amastigote" stage (leishmanial or aflagellate form) that occurs in man and other vertebrates and 'promastigote' stage (leptomonad or flagellate form) that develops in the invertebrate host, the sandflies and in artificial culture. (Chatterjee, 1980)

The amastigote form while residing in the cells of the reticulo-endothelial system multiplies by binary fission. Multiplication goes on continuously till the cell becomes packed with the parasites. The parasites liberated as a result of the rupture into the circulation are again either taken up by or invade fresh cells and the cycle is repeated. In this way the entire reticulo-endothelial system becomes progressively infected. The causative agent L.D. bodies can be isolated from aspirates of bone marrow, spleen on liver and at a later stage from skin scrapping of PKDL cases (Chatterjee,1980).

Though causative organism of kala-azar in Bangladesh is thought to be *Leishmania donovani* (sensu stricto), it has never been formally identified and characterised. Organism isolated from patients in Bangladesh were transported to London in culture. These were found to be *L.donovani* (sensa stricto) and similar to that of found in West Bengal and Bihar in India. This is the first report of confirmation of this species identified as the causative agent of VL in Bangladesh (Masum and Evans, 1995).

iii. Host of kala-azar

Man is the most susceptible host to all forms of leishmaniasis. Cell mediated immunity (CMI) is poor in active visceral leishmaniasis and in PKDL. The antiquity stimulus of the countless amastigotes is enormous. Thus, there is a high increase in B cell population of lymphocytes with production of immunoglobulins mainly IgG. Only some of this is specific and even this specifically reactive antibody is lacking in protective effects. This is due to the intracellular habit of the amastigotes (Rahman and Islam, 1979).

The diversion of the body's humoral immune resource in manufacturing useless antibodies reduce the defences against a variety of bacterial infection, the major cause of death in kala-azar cases. Profound immuno-suppressive effect has been observed in kala-azar and this leads to secondary infection, which the patient cannot resist. Thus, if the patient is left untreated, 75 to 95 percent of the patients die within a period of 2 years and death in kala-azar is always due to some complications, such as amoebic or bacillary dysentery, pneumonia, pulmonary tuberculosis and other septic infections (Park, 2000).

2.3.5 Post kala-azar dermal leishmaniasis (PKDL)

Post Kala-azar Dermal Leishmaniasis (PKDL) is usually a non-ulcerative skin lesion, a late sequel to visceral leishmaniasis with chronic dermal granulomatous changes. The symptoms of PKDL appear from 2 to 10 years after an apparent cure from kala-azar and may last for many years. It is assumed that the viscerotropic character of LD bodies appear to change into dermatotropism, possibly due to the altered immune status of the host (Brahmachari, 1922). Post Kala-azar Dermal Leishmaniasis (PKDL) is prevalent in endemic areas of kala-azar in Bangladesh, Nepal and India. The disease is also found in Africa but very rare in China (Khan, 1977).

PKDL often develops one to several years after the apparent cure of visceral leishmaniasis. Visceral cure is followed by dermal resistance to a new infection. But after a varying period of time skin resistance is lost and a resurgence of the old infection develops as PKDL while the original visceral organs remain unaffected (Rahman and Islam, 1979).

PKDL is the reservoir of kala-azar. After cessation of wide spread DDT spraying (1958-70), re-establishment of large sandfly population took place. PKDL cases were present and acted as reservoir. The sandfly feeding on PKDL cases provoked the resurgence of kala-azar in India in late 70s. In a study on 20 PKDL cases at Bihar in India, minimum incubation period was noticed two years and maximum incubation period was seven years. There was no obvious history of kala-azar in 2 cases indicating subclinical cure. Lesions in 14 cases were mainly hypopigmented patches with few papules in 8 cases. In 4 cases they were mainly papules and in 2 cases some hypopigmented patches. Two cases were manifested mainly by nodules with papules as well as hypopigmented patches (Thakur, 1984).

In a study, 10 cases were suspected as PKDL among the skin lesion cases in Post Graduate Institute, Dhaka (recent Bangabandhu Sk. Mujib Medical University) from 1973 to 1976. Seven out of these 10 cases were diagnosed as PKDL by the demonstration of LD bodies in skin scrapping. Papular and nodular lesions showed the presence of L.D. bodies, whereas hypertrophic and hypopigmented lesions did not show the presence of any LD bodies. Except one, all gave post history of kala-azar. Their age varied between 28 and 57 years with only one case of 18 years. Compliment Fixation Test (CFT) for kala-azar and sternal and spleen puncture were negative, hence there was no evidence of concomitant visceral infection. All responded completely to treatment by Sodium Antimony Gluconate (Khan, 1977). During early 80s, Rahman and Islam (1983) reported out of 218 suspected cases of VL from different parts of Bangladesh, 59 were confirmed kala-azar and out of 41 cases with skin lesion, 6 were confirmed as PKDL.

In another study in Mymensingh and greater Pabna districts in 1987, showed 61, out of 5011 patients having a history or suspected history of

CHAPTER 3

MATERIALS AND METHODS

The materials and methods of the studies of the series in the research work have been described as follows according to serial no 3.1 to 3.10

3.1 Clinical features of malaria and effectiveness of different drug regimens in some selected areas of Bangladesh

The study was conducted in 9 villages of three upazilla of Kalitati, Kalmakanda and Baliadangi (Annex B,C,D) under district Tangail, Netrokona and Thakurgaon respectively. These villages were prospectively studied for three years since June 1996 to May 1999 with regular visits by the team under the guidance of principal investigator of the research group. Three villages were selected randomly under each upazilla which were selected purposively. The lands of the villages are plain, undulated or sometimes hilly. Few forested areas are also present. The people are mainly cultivators or woodcutters. The rainy season runs from April to August with a total rainfall of around 2000 to 2500 mm. According to the Upazilla Healh Complex (Upazilla) report malaria transmission is stable in the villages of Kalitati and Kalmakanda. Three villagers of each Upazilla are about 3-6 km apart from each other.

All the villagers of 9 villages were included in the study. Base line survey was conducted by house-to-house visits in the villages during base line study on June 1996. Name, age, sex, religion, marital status, occupation and address were recorded for demographic information. The villagers were followed for three years by a monthly visit by the researchers. Rest of the time the follow up was done by the fellow researchers of the Thana Health Complexes (THC). Cases were diagnosed clinically according to the inclusion criteria by active case detection and then confirmed parasitologically. Treatments were given according to the standard regimen and all cases were followed until recovery or death.

Plate-1 Impregnating mosquito nets in upazilla health complex.

Plate-2 Huts in the village Kristapur, Kalmakanda upazilla.

Plate-3 Mosquitoes collected in paper cups brought to laboratory.

Plate-4 Bioassay test with deltamethrin impregnated mosquito net.

Plate-5 Malaria patients admitted in Kalmakanda upazilla health complex.

Plate-6 A severe malaria patient brought to Kalmakanda upazilla health complex.

Malaria cases were diagnosed according to the three malaria clinical case definitions of Uncomplicated Malaria (UM), Severe Malaria (SM) and Treatment Failure Malaria (TFM). The local people were informed and explained about the treatment and management of three types of malaria. After taking the history from the suspected patients or a relative, physical examination was carried out. Standard malariometric indices were recorded. Spleens were palpated and splenic enlargement was recorded using Hackett's classification. Thick and thin blood slides were made by finger prick from each patient to ascertain the *Plasmodium* species and parasite density. To obtain the parasite count, the thick blood slide was air dried, stained with Giemsa and examined under oil immersion objective. A slide was considered negative if after 200 high power fields (usually 10-15 min) search by a competent technician no trophozoite was seen. In case of positive slides the parasite density was estimated by counting against 200 white blood cells (WBC) and multiplying the obtained figure by 40, assuming WBC count in a Bangladeshi to be 8000 mm/cmm. In suspected cases of jaundice, serum bilirubin was estimated.

After making clinical diagnosis, for uncomplicated malaria cases were given treatment with chloroquine for 3 days and primaquine as single dose on 4th day. Severe malaria cases were admitted in the Upazilla Health Complexes and treated with injection Quinine. Fansider, Sulfadoxin, and Pyrimethamine and Primaquine were prescribed for Treatment failure cases. Treatment was given under the supervision of Medical Officers having MBBS degree. Drug intake was supervised by the investigators and visiting doctors in the health centres. The temperature chart was maintained regularly. All other febrile cases were also included in the study as control group. There were 245 patients in that group. Appropriate antibiotics, analgesic and other symptomatic treatment were given to the control groups.

Statistical analysis of the data was done using McNamar's test for paired data (Fleiss 1973) to find out any significant difference in presenting symptoms and physical signs between case and control groups.

3.2 Entomological surveillance for vectors in a malaria endemic area of Bangladesh

The study was carried out in three villages, Kristapur, Burimari and Kadamtali of Kalmakanda upazilla under Netrokona district. The Kalmakanda upazilla is surrounded by India on the north, Barhatta and Durgapur upazilla on the south and west respectively and Sunamganj district on the east. The river 'Ubadakhali' flows through Kalmakanda to east west corner. The south and east parts of the upazilla consisted of 'Haor' area. Kalmakanda is 30 km northwest from Netrokona district and 150 km north of Dhaka city. The upazilla was selected purposively as it is a malaria endemic area of epidemiological type III. The entomological surveillance was conducted from June 1996 to May 1997. The villages are mainly plain land with small hillocks around. Dwelling houses of the villages are made of mud walls and thatched roof and some tin shaded or semi-'pucca' houses. There is no 'pucca' building in the villages. A small stream 'Mahadhar' flows through the village Kadamtali. The villagers are mainly cultivators. Cutting wood from hilly areas is another common occupation. During rainy season they catch fish and sell. About 62.5% inhabitants had cattle of their own and except a few households, all the rest had separate cattle sheds having 1 to 4 cows or bullocks in each shed. Besides these, villagers possess domestic animals like goats, ducks and chickens. Meghalaya state of India is very close to study area. Many temporary pools form during monsoon, which act as potential breeding grounds of mosquitoes. The monsoon exits from May to September.

On each alternate month from June'96 to May'97, mosquito collections were made from the selected villages. Houses having cattle sheds were identified and then by systematic random sampling every 10th house were selected for collection of mosquitoes. Collections were made in dwelling houses and cattle sheds by hand catch using torch and aspirator in the morning for about 2 hrs starting from sunrise by 2 entomological technicians. All night landing/biting collections were made from sunset to next morning for 15 minutes in each hour using local persons as bait. Simultaneously, collections were made from cattle sheds using cows as bait by hand catch for 15 minutes an hour. Mosquitoes thus collected were kept in paper cups and brought to the field laboratory for identification. All female *Anopheles* mosquitoes were separated and the species identified following keys of Christopher (1933). The results were expressed as number per man-hour.

3.3 Impact of deltamethrin impregnated bed nets on malaria transmission in some rural areas of Bangladesh

The study was carried out in nine villages of Kalihati, Kalmakanda and Baliadangi upozillas under Tangail, Netrokona and Thakurgaon districts respectively. The upozillas were selected purposively and 3 villages were selected randomly in each upozilla. According to upozilla Health Complex annual report, Kalihati, Kalmakanda and Baliadangi upozillas are kala-azar, malaria and filaria endemic areas respectively. The poor people living in clusters inhabit the villages. The main occupation is cultivation. Literacy rate is low (22.4%). The climate is tropical and the land is mainly plain. The young aged people (5-19 years) comprise the maximum proportion (33.81%) of the total population. DDT spraying was withdrawn at least 10 years back. Out of nine, 3 villages (one village in each upozilla - total population 3526) were assigned for deltamathrin impregnated bed nets, 3 villages (total population 3902) for untreated nets and rest 3 villages (total population 4125) were assigned as control where no bed nets were distributed and they were designated as area A, area B and area C respectively. During the base line survey, 675, 759 and 776 households were visited in area A, B and C respectively. The same houses were followed throughout the whole period of study.

The villages were prospectively studied for 3 years since June 1996 to May 1999 with regular visits by the team under the guidance of principal investigator of the research group. Rest of the time the follow up was done by the fellow researchers of the upozilla Health Complexes. All the villagers of 9 villages were included in the study.

The intervention study was conducted into 3 phases: i) Pre-intervention – Base line survey was conducted from June 1996 to May 1997 by house to house visits to collect socio-demographic, entomological and parasitological data. Existing and required mosquito nets were calculated for area A and B so that all the villagers got access to bed nets. In area A, the nets were marked, impregnated with deltamethrin and in area B also the nets were marked separately. ii) Intervention – During this phase, the impregnated and non-impregnated nets were distributed to the households of area A and B. In area C, no intervention was given and these 3 villages were treated as control. iii) Post- intervention – The effectiveness of impregnated bed nets was evaluated on the basis of entomological and parasitological indices.

The steps followed in the study were as follows:

i. Baseline survey:

Survey was conducted by direct interview with the head of the households or in his absence, a representative. Total number of houses in each village and the number of residents were detected. Information about socio-demographic information of the villagers, knowledge about malaria and its cause, practice for mosquito bite protection, bed net present in each house and the habit of bed net use were collected. The interview schedule was prepared with simple questionnaire and finalized after pre-testing.

ii. Entomological survey:

Mosquitoes were collected from morning resting and night landing/ biting collection from houses having cattle sheds selected by systematic random sampling. Collections were done by hand catch method on alternate month. Density of *Anopheles* mosquitoes was calculated as per man hour collection. These were then identified by species.

iii. Parasitological survey:

Malaria cases were diagnosed clinically according to inclusion criteria by active case detection once a month and then confirmed parasitologically by detecting malaria parasites according to species in the blood slide examination. Treatment was given to all the positive cases according to the standard regimen. Cases diagnosed by passive case detection were also included in the study.

iv. Bed net impregnation and distribution:

Nylon bed nets of double size were dipped in an aqueous suspension of deltamethrin wetable powder. The concentration of the suspension was adjusted so as to give a deposit of 25 mg ai/m^2 after dipping and wringing. The health workers under supervision of the research team impregnated the nets in the compound of upazillas health complexes.

v. Bioassay and re-impregnation:

Bioassay was conducted on 25 randomly selected bed nets at 3-month interval in area A and re-impregnation was done at 6-month interval.

vi. Monitoring of bed net use:

Whether the recipients of the ITBN were using the nets properly, that was monitored through nocturnal visits in the houses by the fellow researchers. A pre-designed checklist was used to record the observations made during nighttime visits. Their observation regarding use of bed nets was recorded properly.

vii. Entomological and parasitological data were collected at regular interval throughout the period of study and recorded in properly coded form by the fellow researchers of the upazillas health complexes.

3.4 Bancroftian filariasis in Bangladesh: clinical aspects, diagnosis and chemotherapy for treatment: comparative efficacy of three strategies.

The study was carried out in three villages, Bamunia, Maskuria and Bangavita of Baliadangi upozillas under Thakurgaon district. The district Thakurgaon was selected purposively because of its endemicity for filariasis. It is situated on the northwest corner of Bangladesh. Total area of the district is 1803.42 sq. km. having a population of 11,73,986 of which male 601,499 and female 572,487 and the ratio of M : F is 1.05 : 1 (BBS, 1999). It consists of 5 upozillas, 51 unions and 1016 villages. Total number of households of the villages is 224,428 with an average of 220 households per village. Out of 5 upozillas, Thakurgaon Sadar, Baliadangi, Peergange, Rani Sankail and Haripur, the upozilla Baliadangi was selected randomly for the present study.

Baliadangi upozilla has an area of 284 sq. km. and population of 174,020 of which male 86,508 and female 87, 512 (male and female ratio 0.9 : 1). The upozilla is bounded by India on the north and west, by Thakurgaon Sadar and Rani Sankail upozilla on the east and south respectively. It consists of 8 unions and 150 villages. Although it is a filaria endemic area, kala-azar, is also prevalent in the upazilla. The river Teernai and Nahana flow to the west and north of the upazilla. By multistage random sampling technique, first the union Paria and next three villages named by Bamunia, Maskuria and Bangavita were selected and included in the study. The selected villages are mainly plain and people of low socio-economic condition live there. Some tribal people named as "Sawtal" inhabit in a small number in the study villages. Mud huts are common pictures. Semi-pacca and pacca houses are seldom seen. Almost all households possess domestic animals like cow, goat, buffalo, duck, chickens etc. and the houses are surrounded by different types of trees. The villages are green and contain fields of paddy, jute, sugar cane and tobacco.

The villages were prospectively studied for 3 years since June 1996 to May 1999 with regular visits by the team under the guidance of principal investigator of the research group. Rest of the time the follow up was done by the fellow researchers of the upozilla health complex. All the villagers of 3 villages were included in the study. The households were visited by the members of the research team comprising of the principal investigator as team leader, two physicians and two laboratory technicians, during the baseline survey on June '96-May '97. The team leader collected the socio-demographic data from the head of the household or in his absence, an adult respondent, according to the pre-tested questionnaire. The physicians collected clinical data and examined all the members of the household for any clinical sign and symptoms. The two laboratory technicians collected blood samples from the suspected cases as instructed by the physicians. Patient's blood sample was collected by standard veni-puncture procedure between 10 pm to 4 am. Three drops of free flowing blood (20 cmm) was dropped on numbered slides and thick blood film was prepared and dried overnight. Immunodiagnostic tests detect either antigen or antibody in the sera of filarial patients. The immunochromatographic test (ICT) for filariasis detects *Wuchereria bancrofti* antigen in serum or plasma was done with the serum. Blood was collected in tubes to form clot so that serum became separated. The serum containing tubes were kept in vaccine carrier boxes at temperature of -2^{o} to $-8\ ^{o}$ C and transported to the parasitological laboratory of NIPSOM, Dhaka. Blood slides were used for detecting and counting microfilaria. Slides were stained with Leishman's or 2% Giemsa solution and examined under microscope. In positive slides, total numbers of microfilaria counts were determined per 20 cmm of blood. ICT tests were performed with the serum for rechecking the microscopic results.

The clinical and microfilaria (mf) positive cases were randomly divided into three groups and each group was assigned one strategy of treatment. The first strategy was DEC treatment with a dosage of 6mg/kg body weight given daily for 12 days (standard treatment). The second regimen was 2 single doses of 6 mg/kg body weight given at an interval of 6 months (semi-annual single dose treatment) and the third regimen was monthly dose of 25 mg of DEC for children and 50 mg for adult for 1 year (low dose monthly schedule). All the cases were re-examined at the end of one year of treatment for detecting the clearance of mf and/or improvement of clinical signs.

3.5 Filaria vector surveillance in a filaria endemic area of Bangladesh

The study was carried out in three villages, Bamunia, Maskuria and Bangavita of Baliadangi upozillas under Thakurgaon district. The district Thakurgaon was selected purposively because of its endemicity for filariasis. It is situated on the northwest corner of Bangladesh. Of the five upozillas, Thakurgaon Sadar, Baliadangi, Peergange, Rani Sankail and Haripur, the upozilla Baliadangi was selected randomly for our study. The river Teernai and Nahana flow to the west and north of the upozilla. By multistage random sampling technique, first the union Paria and next three villages named by Bamunia, Maskuria and Bangavita were selected and included in the study. According to the upozilla health complex report of last 10 years, 3790, 400 and 394 patients were diagnosed as filaria, malaria and kala-azar respectively and received treatment from the upozilla health complex during that period. Some tribal people named by "Sawtal" inhabit in a small number in the study villages. This is a plain area with much of the land under rice cultivation. But jute and sugarcane are widely cultivated here. The villages consisted of several hamlets ('Para') scattered in an area of about four square kilometers. Six hamlets, two from each village were selected for mosquito collection work. The villages had number of ground pools, ponds, ditches, rice fields etc. suitable for mosquito breeding. Small canals are also there. The river, Teernai, is found flowing through bordering the north-eastern side of the village, Bangavita. But these canal and river become almost dry during winter months of the year (November to March). Cattle, goats, pigs and poultry were very much common here. Muslim, Hindu and Christian ('Sawtals') community are found here living in houses of thatch or mud built on bamboo frame with earthen floor. There are some houses made of brick wall and tin roof. Cattle are generally kept in sheds. Cultivators, daily labourers and low income group people were the main inhabitants of the study villages. The monsoon lasts from mid June to early October. The yearly average rainfall is 1780mm. The average relative humidity varies from a low of 46% to 84%.

Daytime resting mosquitoes were collected from human dwellings, cattle sheds and natural outdoor shelters. In each room and cattle shed, 15 minutes were spent for collection of mosquitoes during morning and evening. In outdoor shelters, total time of collections was noted. All night collections on human baits placed indoors on human dwelling and landing/biting collection on animal bait in cattle sheds were made for one night in each visit. Half an hour collection and half an hour rest method were adopted for landing/biting collection. Pyrethrum spray sheet method of collections was made from human dwellings only. Six human dwellings and three cattle sheds were selected for this type of collection. In last three visits, CDC light traps were placed between human dwellings and cattle sheds for mosquito collection. Altogether six visits were made on alternate months starting from July 1996 to June 1997. In each visit five days were spent for entomological activities. Efforts were made to collect mosquitoes from fixed human dwelling and cattle sheds. Identification of only *Culex* mosquitoes was made in the field laboratory. As filarial endemicity was still high in that area, a number of *Culex* mosquitoes were dissected for filarial larvae to see the present infectivity rate in vector mosquitoes.

3.6 Mosquito nets impregnated with deltamethrin against lymphatic filariasis and its vector in a filarial endemic area of Bangladesh

The study was carried out in three villages of Baliadangi upazilla under Thakurgaon district. The district Thakurgaon was selected purposively because of its endemicity for filariasis. It is situated on the northwest corner of Bangladesh. By multistage random sampling technique, first the upazilla Baliadangi, next the union Paria and finally three villages named by Bamunia, Maskuria and Bangavita of union Paria were selected and included in the study.

Baliadangi upazilla has an area of 284 sq. km. and population of 174,020 of which male 86,508 and female 87, 512. The upazilla is bounded by India on the north and west, by Thakurgaon Sadar and Rani Sankail upozilla on the east and south respectively. It consists of 8 unions and 150 villages. According to upazilla health complex report, vector borne diseases like filariasis and kala-azar are prevalent there. The river Teernai and Nahana flow to the west and north of the upozilla.

The selected villages are mainly plain and people of low socio-economic condition live there. Mud huts are common pictures. Semi-pucca and pucca houses are seldom seen. Almost all households possess domestic animals. Trees are abundant in the villages. Collections of water are seen hither and thither in the villages, which act as breeding grounds of mosquitoes. Of the three villages Bamunia (area A), Maskuria (area B) were selected randomly as intervention areas for intervention by deltamethrin impregnated mosquito nets and non- impregnated bed nets respectively. Village Bangavita (area C) was kept as control where no nets were distributed.

The villages were prospectively studied for 3 years since June 1996 to May 1999 with regular visits by the team under the guidance of principal investigator of the research group. Rest of the time the follow up was done by the fellow researchers of the upozilla health complex. All the villagers of 3 villages were included in the study.

During the first phase of the intervention study, a base line survey was conducted from June 1996 to May 1997 by house to house visits to collect information about demography and socio-economic condition of the villagers, knowledge about filaria and its cause, practice for mosquito bite protection, bed net present in each house and the habit of bed net use.

Mosquitoes were collected from morning resting and night biting/landing collections from selected houses having cattle sheds selected by systematic random sampling. Collections were done by hand catch method on alternate month. Density of *Culex quinquefasciatus* mosquitoes was calculated as per man-hour collection. Next two years of study, mosquitoes were collected only from human dwellings.

Clinical data were collected at regular interval throughout the study period by examining all the members of the household for any clinical sign and symptoms of filariasis. Blood samples were collected for parasitological examination. Treatment was given to all the positive cases.

During the intervention phase, the existing and required mosquito nets were calculated in area A and B, so that all the villagers got access to the bed nets. All the bet nets were marked according to area. Nylon bed nets of double size were dipped in an aqueous suspension of deltamethrin wetable powder. The concentration of the suspension was adjusted so as to give a deposit of 25 mg ai / m^2 after dipping and wringing. The health workers under supervision of the research team impregnated the nets in the compound of Upozilla Health Complexes. In area A, the bed nets were re-impregnated at 6-month interval.

Whether the recipients of the insecticide treated bed nets (ITBN) were using the nets properly, that was monitored through nocturnal visits in the houses by the fellow researchers. Entomological and parasitological data were collected at regular interval throughout the period of study and recorded in properly coded form by the fellow researchers of the Upazilla Health Complexes. The effectiveness of ITBN was evaluated on the basis of this data.

3.7 Epidemiological, clinical and therapeutic features of visceral leishmaniasis (kala-azar) in a kala-azar endemic area of Bangladesh

The study was carried out in three villages, Bir Basunda, Pachh Joair and Parki of Kalihati upazilla of Tangail district of Bangladesh. Kalihati upazilla was selected purposively as it is a kala-azar endemic area. It is located towards north and 140 km away from Dhaka city. It has an area of 279 sq. km. and a population of appx. 3,84,370 (1991 census) of which 2,04,965 were male and 1,79,405 were female (male and female ratio 1.14:1). The upazilla is bounded by Bhuapur and Ghatail upozillas on the north, Tangail and Bashail upozillas on the south, Shakhipur upozilla on the east and Jamuna river on the on the west. It consists of 12 unions. Although it is a kala-azar endemic area, malaria is also prevalent in the upozilla. By multistage random sampling technique, first the union Bir Basunda and next three villages named by Bir Sunda, Pachh Joair and Parki were selected and included in the study. The area was inhabited people having low socio economic background. The river Lohajang flows through the west of village Pachh Joair and canals originated from river Bansi intersect the village Parki. The main occupation was cultivation. Most parts of the study area are low lying and flood prone. Mud houses are common pictures. Most of the houses were made of mud and bamboo, the walls were plastered with mud and cow dung. Generally cattle sheds were situated very close to huts, sometimes adjacent to those.

The villages were prospectively studied for 3 years since June 1996 to May 1999 with regular visits by the team under the guidance of principal investigator of the research group. Rest of the time, the follow up was done by the fellow researchers of the upazilla health complex. All the villagers of 3 villages were included in the study.

The households were visited by the members of the research team comprising of the principal investigator as team leader, two physicians and two laboratory technicians, during the baseline survey on June 96-May 97. The team leader collected the socio-demographic data from the head of the household or in his absence, an adult respondent, according to the pre-tested questionnaire. The physicians collected history and clinical data and examined all the members of the household for any clinical sign and symptoms. Detail information was taken regarding incubation period. The two laboratory technicians collected blood samples from the cases as instructed by the physicians. Two drops of blood sample were collected in whatman paper. Bone marrow aspirates were taken in slides. These were transported to the parasitological laboratory of NIPSOM, Dhaka. Direct Agglutination Test (DAT) was done and slides examined for presence of parasites and haematological features.

The serologically positive cases were given treatment with Sodium antimony gluconate (SAG) at the dose of 20 mg/kg body weight/ day slow I.V or I.M for 20 days (maximum 850 mg/day) (WHO, 1982) and in some cases additional 10 to 20 doses. PKDL cases were given 6 courses of SAG at an interval of 10 days. SAG is available as a 30% solution of pentavalent antimony, 1 ml containing 100 mg of SB (Pentostam, Welcome Lab). On completion of the 20-day course, the patients were examined clinically and serologically. Initial cure meant abatement of fever, improvement of general health and regression of size of spleen and DAT titre became <1:1600. Those who responded were included in follow up. Those who showed slow response or no response were given another one course of treatment. Patients, who did not respond even after two courses of SAG, were treated with Pentamidine isethionate (Pentamidine, Rhone Polen). 200 mg dry powder in ampoule form and was dissolved in 10 ml of normal saline before adminstration. Injections were given very slowly intravenously in a dosage of 4mg/ kg body weight every second or third day to a total of 15 injections. Blood sugar was estimated during treatment and follow up. Intercurrent infections were diagnosed and treated. Patients were followed for 12 months after initial cure. Final cure means no relapse of clinical features and DAT negative for 12 months.

3.8 Entomological investigation of a kala-azar focus in Bangladesh

The study was conducted in the villages Bir Basundhara, Pachh Joair and Parki of Bir Bashinda union of Kalihati upazilla under Tangail district, which is a kala-azar endemic area. The upazilla was selected purposively according to the upazilla health complex report of 1994-1995. Kalihati has the highest in incidence of kala-azar cases in comparison to other upazillas of Tangail district. The union Bir Basindia and village Pachh Joair (among the villages where at least one kala-azar case was present according to the health complex report) of the union were selected by multi stage random sampling technique. The place is situated 70 miles northeast of Dhaka city and is well communicated to Dhaka.

Kalihati has an area of 279 sq. miles with a population of 3,84,370, of which 2,04,965 were male and 1,79,405 were female, giving a ratio of 1.14:1. It consists of 12 union and 278 villages. The selected villages have no electricity and piped water. Cultivators, daily labourers and low income group people were the main inhabitants of the study villages. The areas are low lying and flood prone. Most of the houses are made of mud and bamboo, the walls are plastered with mud and cow dung. Generally cattle sheds are situated very close to huts, sometimes adjacent to those. The monsoon lasts from mid June to early October. The yearly average rainfall is 1780 mm. The average relative humidity varies from a low of 46% to 84%.

Collections of adult sandflies were carried out in the randomly selected human dwellings and in and around cattle sheds of the study area. Altogether six visits were made on alternate months starting from

July1996 to June 1997. In each visit, four days were spent for entomological investigation. Efforts were made to collect sandflies from the fixed human dwelling and cattle sheds of each village. Collected sandflies were identified and susceptibility test with deltamethrin was carried out with some sandflies.

i. Collection of sandflies: Following methods were applied for collection.

a) Hand catch

Sandflies were collected by hand catch with aspirator and flash light during morning resting collections from human dwellings and cattle sheds between 6 am to 8 am and during evening resting collections from the same places for 2 hours starting just after sunset. In each room and cattle shed, 10-15 minutes were spent for collection of sandflies during morning and evening.

b) Human bait captures

All night collections on human baits placed indoor on human dwelling were made for one night in each visit. Half an hour collection and half an hour rest method were adopted for landing/biting collection.

c) CDC light trap

Two CDC light traps were placed near human dwellings and cattle sheds for sandfly collection for one night in each visit.

d) Adhesive paper trap

Adhesive paper strips (12"x 2") were prepared by making a thin film of caster oil on one side of the stiff paper. Ten such papers were placed with the oily side on the cracks and crevices of human dwellings and cattle sheds on for one night in each visit.

ii. Identification of female sandflies

Sandflies collected from field were transferred to test tubes and brought to the laboratory of NIPSOM, Dhaka. Sandflies were put in petridishes and examined under compound stereoscopic microscope. Male and female sandflies were separated. Female flies were put in hot 5% aqueous caustic potash (KOH) for 4-5 minutes and then washed in water for three times, each time for 15 minutes to get rid of alkalies.

These were then dehydrated by keeping in 50% absolute alcohol for 30 minutes. After cleaning with xylol for another 30 minutes, flies were put on slides. The head of flies were cut off and transferred to drop of Canada balsam with ventral side up. Similarly the terminal portions were cut off and transferred to drop of Canada balsam. The flies were identified using table prepared by Sinton (1932) and Lewis (1978).

iii. Susceptibility tests

Cone bioassay test was conducted with 2.5% emulsifiable concentrate of deltamethrin with adult females of *P. argentipes.* A fixed number of *P. argentipes* were introduced in cone covered with impregnated nets. Knock down within one hour and mortality after 24 hours of sandflies were recorded. Two cones covered with non-impregnated nets were treated as control..

3.9 Impact of deltamethrin impregnated bednet on prevalence of kala-azar in selected villages of a kala-azar endemic area of Bangladesh

1. Place of study:

Kalihati upozilla of Tangail district was selected purposively for the present study as it is kala-azar endemic area in Bangladesh. It is also an ear marked primary health care (PHC) centre. Kalihati upozilla has the highest incidence of kala-azar cases in comparison to other upozillas of the district as per records from upozilla health complex (THC) of Tangail district.

By multistage random sampling technique first the union Bir Basunda and then 3 villages named by Bir Basunda, Pachh Joair and Parki were selected from all the villages where at least one case of kala-azar has been detected in1995 according to upozilla health complex report. The three selected villages are situated 6-9 km. apart. The villages have good communication with Kalihati thana. It was logically feasible to work in the villages. DDT spraying was withdrawn in 1981.

The land of all the villages was mainly alluvial but dry. There were canals intersect the villages. The vegetation was luxuries. The villages were inhabited mostly by poor people living in mud houses or bamboo huts. The huts were usually built over a low platform of pressed earth and each family possess 2 to 4 huts, occasionally more. Each hut was being meant for a different purpose (sleeping room, stable, kitchen, store etc.). The walls of the houses were mostly made of bamboo and plastered with mud mixed with cow dung. Plastering was performed by the inhabitants usually once a year at the end of rainy season, generally during October or November. A small number of houses were made of corrugated tin sheets, bricks or cement. The houses were generally grouped together separated by cultivated lands.

The climate of the study area was sub-tropical with summer and monsoon rains. Three main seasons can be distinguished, namely the cool-dry Winter from November to February, the hot-dry Summer from March to May and the hot-wet rainy season from June to October (Ahmed, 1968). Mean monthly temperature varied from 20^{o} C to 36^{o} C. Rainfall occurring mostly during monsoon (April to September) averaged 2234.00 mm. Relative humidity at 8 AM varies from a monthly averages of 50% to 95 %. The temperature and humidity of the villages favour the growth of sandfly and hence the transmission of kala-azar.

2. Period of Study

The study was of intervention type having experimental design and was conducted from June 1996 to May 1999 in three phases, namely:

Phase - I: Pre-intervention: baseline survey

The epidemiological, parasitilogical and entomological baseline data were collected from all the three villages during June 1996 to May 1997.

Phase - II: Intervention: kala-azar vector control measures

The selected villages were allocated randomly as intervention and control areas. These were followed up for 24 months to determine the impact of deltamethrin impregnated bednets on the prevalence of kala-azar.

Phase - III: Post-intervention: Evaluation

The effectiveness of the intervention was evaluated on the basis of prevalence of kala-azar between the first year and the second and third year in three villages.

3. Study population and sample size

The unit of randomization was the household due to the nature of the risk of contracting the disease. The sandfly vector habitat is restricted to the domiciliary and peri-domiciliary. They are mainly endophilic and endophagus.

The type of intervention (deltamethrin impregnated bed net) also need the unit as household. Subjects allocated to the same household would share either the same risk or protective effect (intervention group). The assumption of independence of subjects is therefore not valid. The villages were mapped and all the households were listed and household number (HH No.) was given to each one starting 001. All the households of the villages Bir Basunda and Pachh Joair received insecticide impregnated and unimpregnated bednets and village Parki did not receive any intervention and was treated as control. All the villagers of the three villages were included in the study. No sample was taken.

4. Study Design

The was carried according to the following steps,

1. Household survey: base line data collection
2. Procurement, treatment with deltamethrin and allocation of mosquito nets to the households of selected villages
3. Information, education and communication (IEC) activities
4. First serological survey:
5. Blood sample collection (finger drop blood on filter paper) from all the member of the houses and serological examination by DAT.
6. Distribution of bed nets:
7. Intervention area (area- A) with insecticide treated bed net (ITBN), area- B with bed net without insecticide treatment and in control area no bed net.
8. Monitoring and supervision of bed net use (random survey of randomly selected households).
9. Re-impregnation of all the mosquito nets of intervention area after 6 months.
10. Second serological survey (sample collection and laboratory examination of all members of households) after 12 and 24 months.

A. Preparatory phase

i. Selection of villages as intervention and control area

The union Bir Basunda was selected randomly from the unions of Kalihati upozilla where kala-azar cases were present. This information was obtained from the records of kala-azar cases in upozilla health complex. The village Bir Basunda, the village Pachh Joair and the village Parki of Bir Basunda union were selected for interventions and control areas by coin test. All the people of villages were followed up for two years after giving intervention with deltamethrin treated bednets and unimpregnated bednets respectively. The village Parki was treated as control. All age groups and both sexes got equal facilities. The numbers of kala-azar cases of the intervention and control areas were compared.

ii. Preparation and pre-testing of Questionnaire

An appropriate questionnaire was developed (Annex A), which was divided into 4 parts as follows:

Demographic information

Socio-economic information

Use of mosquito net

Knowledge on kala-azar and its vector

The questionnaire was finalized after testing in another kala-azar endemic village Silingpur of Kalihati union under Kalihati upozilla.

B. Data collection and other activities

i. Household survey

A house to house survey was carried out, to cover the houses of village Bir Basunda, Pachh Joair and Parki of Bir Basunda union covering the total population of each village, in order to obtain epidemiological, socio-economic information of the households and characteristics of the houses and human population. All the houses were numbered starting as HH No.001 after updating the malaria control maps. The villages were surveyed from June 1996 to May 1997.

During baseline survey demographic information of the household members were collected by direct interview with the household heads. If the household heads were not found available, one responsible adult member of that house was interviewed. If any house was found locked or no adult member was available, interview was taken on the next day. The name of all members, their age, sex, occupation and educational status were documented.

The information about socio-economic and environmental conditions was collected by interview and observation. Monthly income of the family, ownership of land, type of house, presence of cattle shed and condition the surrounding gave an idea about the status of the family.
Information about mosquito net and its use were collected by asking whether they possess any mosquito net, the frequency of net using and washing, number of people slept under net on the previous night. Condition of the net was observed. Enquiry was also made why they were not using net, if anybody did not possess a net.

Knowledge on kala-azar and its vector was assessed. The respondents were asked about the cause, symptoms, transmission and prevention of kala-azar. Whether the rural people had any knowledge on sandfly, its breeding place and feeding habit, were also enquired.

The answers of the questions and the findings of the observations were all noted down in the pre-structured questionnaire. The entire questionnaire was thoroughly checked on the same night to rule out any discrepancy.

ii. Information, education and communication (IEC) campaign for kala-azar

After completion of baseline survey, the information, education and communication (IEC) activities were carried out through interpersonal and group process by holding meeting. During 2-3 weeks period community based activities was organized to change the attitude towards use of bednet and cleanliness in and around the houses. Home visits and group discussion was conducted with the help of local health assistants who had been trained beforehand to disseminate the information concerning:

i. The disease, how to recognise, prevent and seek treatment for kala-azar.

ii. The use of bednet, to keep the cattle sheds, chicken houses and the surrounding of the houses clean and dry, to plaster the crack and crevices of the walls and floor of dwellings and cattle sheds and to place the cow sheds and chicken house away from the dwellings.

iii. Procurement, treatment (impregnation of bednet with deltamethrin) and allocation of bed nets

All the households of villages Bir Basunda and Pachh Joair were coded with a household number starting from 001. Each households received free of charge, the maximum number of double size nylon nets as calculated by the number of members and the nets already present in each household so that at least 3 persons could sleep under each net.

Nylon nets were procured from the local market. Nets were made of nylon with a narrow strip of cotton as reinforcement along the top and bottom hedges. Use of cotton, although popular was minimized as to ensure a satisfactory uptake of insecticide by the nylon component during treatment. Bednets had a small tag on which the households' number was written with a waterproof marker.

During base line survey all the households of village Bir Basunda were asked to clean their bednets and carry them to the THC for dipping with deltamethrin on particular days and also to receive new bed nets.

The double nylon bednets and the cleaned nets of the households were dipped individually in an aqueous suspension of deltamethrin wetable powder [K-Orthine, 25 mg deltamethrin per ml (2.5% ai) from Roussel UCLAF]. The concentration of the suspension was adjusted so as to give a deposit of 25 mg ai per sq. meter after dipping and wringing. The dipping and wringing were done several times, first before distribution and then at 6 months interval at the field station with the help of health assistant of the THC.

iv. Serological survey by Direct Agglutination Test (DAT) and distribution of nets

The DAT is a specific serological test where a kala-azar parasite antigen is tested with the serum of the patient to detect the presence of specific antibodies to that antigen. The humoral immune response measured by the DAT becomes evident shortly after the initial infection and the test may become positive as early as 2 weeks after infection. On average DAT is expected to be positive within a month of infection.

After completion of baseline survey and IEC activities, the first DAT survey was carried out. The DAT was performed on all the population before and after the intervention. Conversion of DAT test from negative to positive indicates new infection. The comparison of the rate of infections at one-year interval in the population of area A, B and C lead to the calculation of the level of protection afforded by ITBN.

During the whole period of study there was no immigrant or emigrant person in the selected three villages. The household information data from the baseline survey was utilized to prepare a household information sheet (Annex C) for follow up. Each person was assigned a code number composed of HH number and individual number. At the time of blood collection for DAT, two finger prick blood drops were collected from each person on two separate filter papers marked with the child code number. One sample was checked in the parasitology laboratory NIPSOM and 5%

of the other samples was selected randomly for recheck for validation purpose.

For ethical reasons, during the DAT sero surveys the sero positive kala-azar cases were referred to the UHC for proper treatment. Besides that, in between the two surveys passive case detection (PCD) and treatment of cases were carried out by the responsible health staff as usual. Although case detection and treatment reduced the number of human reservoir and thus reduce the transmission rate and incidence of the disease, but the effect should be equal in both intervention and control group.

v. Monitoring and Supervision and bednet use

Throughout the intervention period randomly selected households were visited at night time at six months interval to collect essential information concerning the regular and appropriate use of the bednets by the health assistants. A checklist for monitoring and supervision of bed nets was prepared. (Annx D).

vi. Assessment of environment management and knowledge on kala-azar

At the end of one year second set of questionnaires were filled to observe the condition of the houses, cattle shed and surrounding (mud plastering of houses and cattle shed, cleaning the surrounds bushes and drains. Knowledge about kala-azar and its vector was also assessed by asking the same questions as before.

vii. Second and third serological surveys

Second and third serological surveys were conducted at the end of twelve months period. Two finger drops of blood were taken from all persons of the three villages on filter paper to perform Direct Agglutination Test (DAT) as before. All the DAT positive cases were referred to THC for proper treatment.

3.10 Effect of flood on sandfly density and prevalence of kala-azar in a kala-azar endemic village of Bangladesh

The study was carried out in the village Dhalia, a kala-azar endemic area of Dhitpur union in Bhaluka Upazilla under Mymensingh district. The village was situated 80 km. north of Dhaka. It was a low lying alluvial plain with high humidity and situated by the side of a small river. The village having 410 households with a population of 2042 (1991 census). The socio-economic condition of the villagers was poor. Majority houses were made of mud wall and tin/ thatched roof. Cultivation was the main occupation of the villagers (80%). Literacy rate was very low (18%). The area was free from insecticidal pressure for last 10 years. The village was selected purposively as it was a kala-azar endemic area. In 1997, a total of 778 cases of kala-azar were recorded in Mymensingh district of which 146 were in Bhaluka Upazilla and mostly from the selected village (District report, 1998). The village was submerged under water from July to September, 1998.

An epidemiological, entomological and serological survey was conducted on July'1998. Demographic and socio-economic information was collected from randomly selected 100 households among those where the inhabitants were staying even when their houses were flooded.

During entomological survey adult sandflies were collected on searching the selected houses for two hours in the early morning starting from sunrise and two hours in the evening starting 15 minutes before sunset in the corners of the human dwelling and cattle sheds and under the feeding troughs for two consecutive days. Collections were made by hand catch method with aspirator and torch for at least 15 minutes in one house. The sandflies were identified in the entomology laboratory of NIPSOM.

For detection of sandfly larva 1-2 soil samples each weighing about half kg. were scooped from a depth of 5-10 cm. at the level just above the flood water (if present) or from the cracks and crevices of the floor and adjacent wall of the mud houses, plinths, cattle sheds, under feeding troughs of cattle etc. Samples were collected from soil at ground level up to 90 cm height - just above flood water level. The same houses were under follow up for 12 months. The soil samples were brought to the laboratory for searching sandfly larvae. Water was added to each sample and passed through sieves of gradual small sizes to remove debris and sediments were preserved. A saturated sugar solution was added to the sediment on the surface of which the larvae were searched with hand lens up to 20 days and counted.

The rearing of sandfly was observed in positive soil samples which were placed in earthen pots and covered with two folds of mosquito nets and kept for 2 months in the laboratory of NIPSOM. Dry powdered cow dung was given occasionally to the soil. Adult sandflies emerging from larvae were collected and identified.

Serological survey was carried out by using Direct Agglutination tests (DAT) and Aldehyde test (AT) for diagnosis of kala-azar cases during base line survey. Sero-positive cases were confirmed by microscopic examination of bone marrow. Trypsinated coomassie blue stained and formaldehyde preserved promastigote of *Leishmania donovani* was used as antigen for the test. All DAT positive cases were treated with Sodium Antimony Gluconate (SAG) with a regimen of 20 mg/kg/day (not exceeding 850 mg per day) for at least 20 days intravenous injections (Thakur *et al.* 1988, Chowdhury *et al.* 1991).

CHAPTER 4

RESULTS

The findings of the studies of the present research work have been described as follows according to the serial number 4.1 to 4.10.

4.1 Clinical features of malaria and effectiveness of different drug regimen according to the nature of cases in some selected areas of Bangladesh

During the intervention study in 9 villages of Bangladesh, a total 11553 villagers were investigated (Table 1.1). Among them 6033 (52.22%) were male and 5520 (47.78%) were female. On average the maximum population was in the group of 10-19 years (18.49%) followed by age group of 5-9 years (15.32%) and next was of 20-29 years (14.95%).

During June 96 -May 99, a total of 258 patients were confirmed as malaria cases and fulfilled the criteria for inclusion in the study. There were 174 male and 84 female giving a male female ratio of 2.07:1. Out of 258 malaria cases 107 was *P. falciparum* and 99 *P.vivax* and 52 mixed cases (*P.f.* + *P.v*). The age distribution of malaria cases was shown in Fig. 1.1. No case was detected below 5 years of age and maximum numbers of cases were in the age group of 10-19 years (35.65%) followed by age group of 20-29 years (32.55%).

Month wise distribution of total malaria cases in different years of study showed that maximum number of cases occurred during the month of June – November. During winter and early rainy season, the numbers of cases were low (Fig 1.2). The same trend followed in all the three years of study. The trend of malaria cases increased from the month of June and remained high till October and then gradually decreased in the following months. The minimum cases were detected in the months of January and February.

The malaria cases were diagnosed first clinically according to presenting symptoms and physical signs and then were confirmed by blood slide examination and grouped as *P.falciparum, P. vivax* and mixed (P.f + P.v). Table1.2 shows the common presenting symptoms in both the cases and control. All the symptoms were similar in both the groups except that severe headache, vomiting, loose motion, loss of weight and dark urine, which were significantly more common among the malaria cases than the control.

Table 1.3 summarized the common physical signs examined by physician. Anaemia and jaundice were significantly more in malaria cases than control. Hepatomegaly and hepatosplenomegaly also showed similar results. In severe malaria cases the mental state revealed that 11.2% were drowsy, 7.7% confused and 10 % semiconscious. These signs were significantly more common in malaria patients than other febrile cases. A total of 31 (12%) of the patients had stiff neck and 26 (10%) showed positive kernig's sign. 29 patients (11%) were unable to work and 12 (0.4%) developed convulsions. These signs were absent in control group.

Out of 258 cases, 200 cases were admitted into the Upazilla Health Complexes and rests were given treatment at home. A total of 215 cases received treatment regimen of uncomplicated malaria (1st line treatment) (Table 1. 4). It was found that 117 (54.41%) of them became cured both clinically and parasitologically. But 98 cases did not become fully cured and given treatment regimen of treatment failure malaria i.e.2nd line treatment. It was observed that 96(97.9%) of them became cured and 2 (2.04) died. In all 79 patients suffered from severe malaria, treatment of severe malaria (3rd line treatment) was given. Out of them, 71 (89.87%) recovered but 8 (10.12%) died at hospital. All these cases suffered from *P.falciparum* malaria.

Table 1.1 : Distribution of the study population by sex and age group in the selected villages of the study areas during June 1996.

Age range (Years)	Male (%)	Female (%)	Total (%)
<1	464 (4.0)	308 (2.66)	772 (6.68)
1-4	528 (4.6)	553 (4.78)	1081 (9.35)
5-9	937 (8.11)	834 (7.21)	1771 (15.32)
10-19	1131 (9.78)	1006 (8.70)	2137 (18.49)
20-29	893 (7.72)	835 (7.22)	1728 (14.95)
30-39	740 (6.40)	724 (6.26)	1464 (12.95)
40-49	650 (5.62)	542 (4.69)	1192 (10.17)
50-59	377 (3.26)	459 (3.97)	836 (7.23)
60& 60+	313 (2.70)	259 (2.24)	572 (4.95)
Total	6033 (52.22)	5520 (47.78)	11553 (100)

Fig- 1.1 Distribution of different types of malaria cases by study villages of the study areas during June96- May99

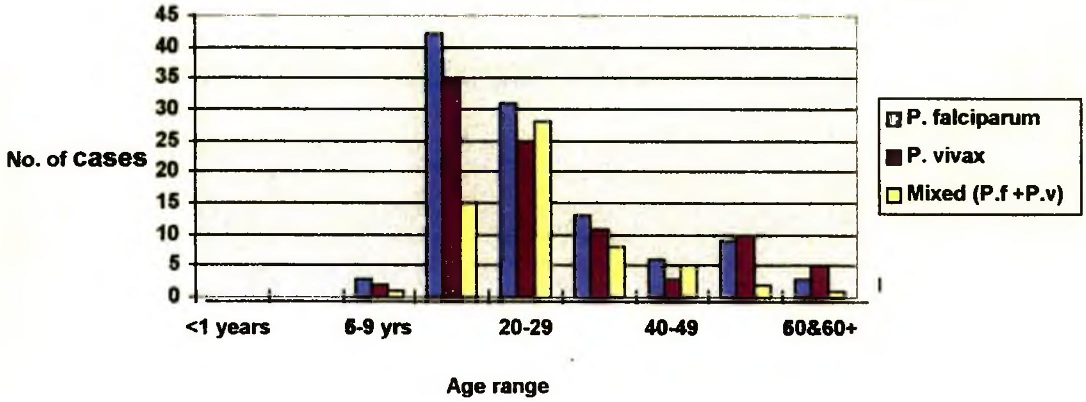


Fig 1.2. Month wise distribution of malaria cases in selected villages of the study areas during June 96-May 99

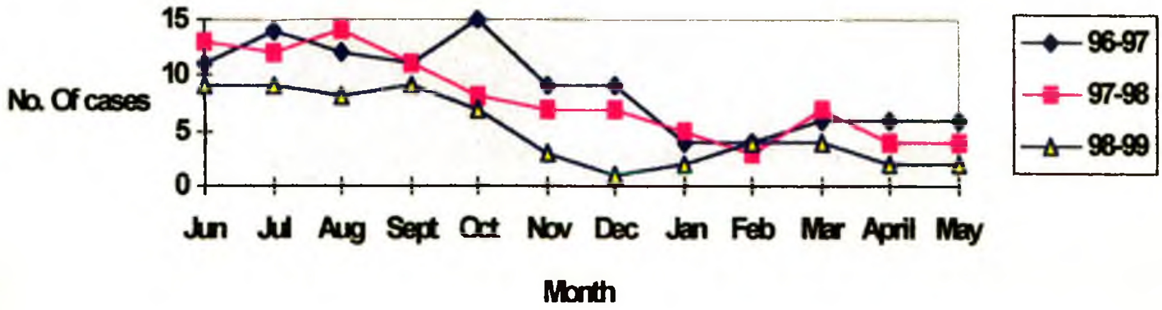


Table 1.2 : Presenting symptoms of Malaria Cases and Controls in selected villages of the study areas during June 1996 - May 1999.

Symptoms	N. of cases (%)	No. of Control (%)	McNamar's test P value
Pyrexia	258 (100)	245 (100)	Ns
Intermittent	120 (46.5)	-	
Remittent	55 (21.3)	-	
Cont. fever with chill	118 (45.7)	-	
Cont. fever with rigor	78 (30.2	-	
Cont. fever without chill and rigor	65(25.1)	-	
Malaise	199 (77)	206 (84)	Ns
Severe headache	158 (61.2)	38 (15)	P<0.05
Body ache	134 (51)	147 (60)	Ns
Abdominal pain	29 (11.2)	38 (15)	Ns
Joint pain	11 (4.2)	14 (6)	Ns
Increased thirst	171(66.2)	176 (72)	Ns
Anorexia	142 (55)	171 (70)	Ns
Vomiting	110 (42.6)	98 (4)	P<0.05
Loss of weight	217 (84.1)	49 (20)	P<0.05
Loose motion	62 (24)	10 (42)	P<0.05
Cough	38(14)	52 (20)	Ns
Haemoptysis	5(1.96)	0	Ns
Dark urine	76 (29.4)	10(4.08)	P<0.05

ns (not significant)=P>0.05

Table 1.3 : Physical signs of Malaria Cases and Controls in selected villages of the study areas during June 96 - May 99

Signs	Number of cases (%)	Number of Control (%)	McNamar's test P value
Elevated temperature	258 (100)	245 (100)	Ns
Anaemia	109 (42.2)	20 (8.1)	p<0.05
Jaundice	86 (33.3)	17 (6.9)	p<0.05
Hypotension	39 (15.1)	50 (20.4)	Ns
Hypertension	26 (10)	25 (10.2)	Ns
Splenomegaly	44 (17)	36 (14.6)	Ns
Hepatomegaly	57 (22)	21 (8.5)	P<0.05
Hepato-splenomegaly	48 (18.6)	98 (4.1)	P<0.05
Dehydration	35 (13.5)	51 (20.4)	N
Irritability	34 (13.1)	46 (18.7)	Ns
Drowsiness	29 (11.2)	13 (0.4)	p<0.05
Confusion	20 (7.7)	0	p<0.05
Semiconscious	26 (10)	0	p<0.05
Stiff neck	31(12)	0	p<0.05
Positive kernig's sign	26(10)	0	p<0.05
Unable to walk	29 (11)	0	p<0.05
Convulsion	12 (0.4)	0	p<0.05

ns (not significant)=P>0.05

Table 1.4 : Response of malaria patients to different lines of treatment in the selected villages of the study areas during June 96- May 99

Treatment schedule	No. of patients	Cure (%)	Death (%)
1st line treatment	215	117 (54.41)	0
2nd line treatment	98*	96 (97.96)	2 (2.04)
3rd line treatment	79	71 (89.87)	8 (10.12)

* These patients received 1st line of treatment but did not respond and then received 2nd line of treatment.

4.2 Entomological surveillance for malaria vectors in an endemic area of Bangladesh

Altogether 4832 female *Anopheles* mosquitoes were collected by morning resting and night landing/biting collection from human dwelling and cattle shed, of which 798 (16.5%) from human dwelling and 4034 (83.5%) from cattle shed and 1976 (37.2%) during morning resting and 3036 (62.8%) during night landing/biting collection (Table 2.1).

The per man-hour collection by morning resting and night landing/biting collection from human dwelling were 5.2 and 3.8 respectively and from cattle shed 19.7 and 24.2 respectively (Fig 2.1).

A total of seventeen species were captured during the one-year period of study (Table 2.2 and 2.3). The following were the species:

Anopheles (Cellia) acontitus Doenitz; *An. (Cel.) annularis* Van der Wulp; *An. (Anopheles) barbirostris* Van der Wulp; *An. (Cel.) dirus* Peyton and Harrison; *An. (Cel.)fluviatilis* James; *An.(Anopheles) hyrcanus* Pallas; *An. (Cel.) jamesii* Theobald; *An. (Cel.) jeyporiensis* James ; *An. (Cel.) karwari* James; *An. (Cel.) kochi* Doneitz; *An. (Cel.) maculatus* Theobald; *An. (Cel.) maculatus* var. willmorei (James); *An. (Cel.) minimus* Theobald; *An. (Cel.) philippinensis* Ludlow; *An. (Cel.) subpictus* Grassi; *An. (Cel.) tessellatus* Theobald; *An. (Cel.) vagus* Doenitz and *An. (Cel.) varuna* Iyengar.

Table 2.2 describes the species by per man-hour collection during morning resting and night landing/ biting collections from dwelling houses. During morning resting collections, 378 female *Anopheles* mosquitoes were captured in 72 man-hours of collection. Among them *An.vagus* (1.45 pmh) was the most prevalent one comprising 30.4% of total collection followed by *An. subpictus* (0.86 pmh). The vector species, *An. annularis, An. philippinensis,* and *An. aconitus* comprised 6.61%, 3.17%, and 1.32% of total collection respectively. *An. dirus* and *An. minimus* were also captured but the number was very low.

A total of 420 female *Anopheles* mosquitoes were captured during 108 man-hour of night landing/biting collections. More than 36% was *An.vagus* (1.4 pmh) followed by *An. annularis* comprising 8.57% of the collections. *An. subpictus, An. jeyporiensis* and *An.hyrcanus* were found in fair number. On the other hand, *An. philippinensis, An. aconitus* and *An. minimus* were found in small number.

Collections from cattle sheds were also done during morning resting and night landing/ biting method (Table 2 3). A total of 1418 female *Anopheles* mosquitoes were captured during morning resting collection from cattle sheds during 72 man-hour period. *An. annularis* (4.91 pmh) was the most common species followed by *An. vagus* (4.76 pmh). The two species comprised about 50% of the total collection. *An. barbirostris* (19.18%), *An. subpictus* (5.99%), *An. philippinensis* (5.78%) were the other common species. *An. aconitus, An dirus* and *An. minimus* were also captured but few in number.

During night landing /biting collections from cattle sheds, 2616 female *Anopheles* mosquitoes were collected in 108 man-hour. The most predominant species was *An. vagus* (6.61 pmh) and next was *An. annularis* (5.63pmh). Similar as morning resting collections, these two species comprised about 50% of the nighttime collections. *An. subpictus* (3.25 pmh), *An. barbirostris* (2.67 pmh) and *An. hyrcanus* (1.64 pmh) comprised more than 30 % of collection though they were not malaria vectors in Bangladesh. *An. philippinensis* (1.08 pmh) was present in good number. *An. aconitus* and *An. minimus* were present but in a small number. *An. dirus* could not be collected during the collection.

Table 2.1 : Female *Anopheles* mosquitoes collected by different methods from selected houses of study villages of Kalmakanda upozilla of Netrokona district during June 1996 – May 1997

Place of collection	Method of collection				Total	
	Morning resting		Night landing/ biting			
	No.	(%)	No.	(%)	No.	(%)
Human dwellings	378	(7.8)	420	(8.7)	798	(16.5)
Cattle sheds	1418	(29.4)	2616	(54.1)	4034	(83.5)
Total	1796	(37.2)	3036	(62.8)	4832	(100.0)

Fig 2.1: Density of female Anopheles mosquito collected by different methods from human dwellings and cattle sheds in the selected villages of Kalmadakanda upazilla during June 96- May 97

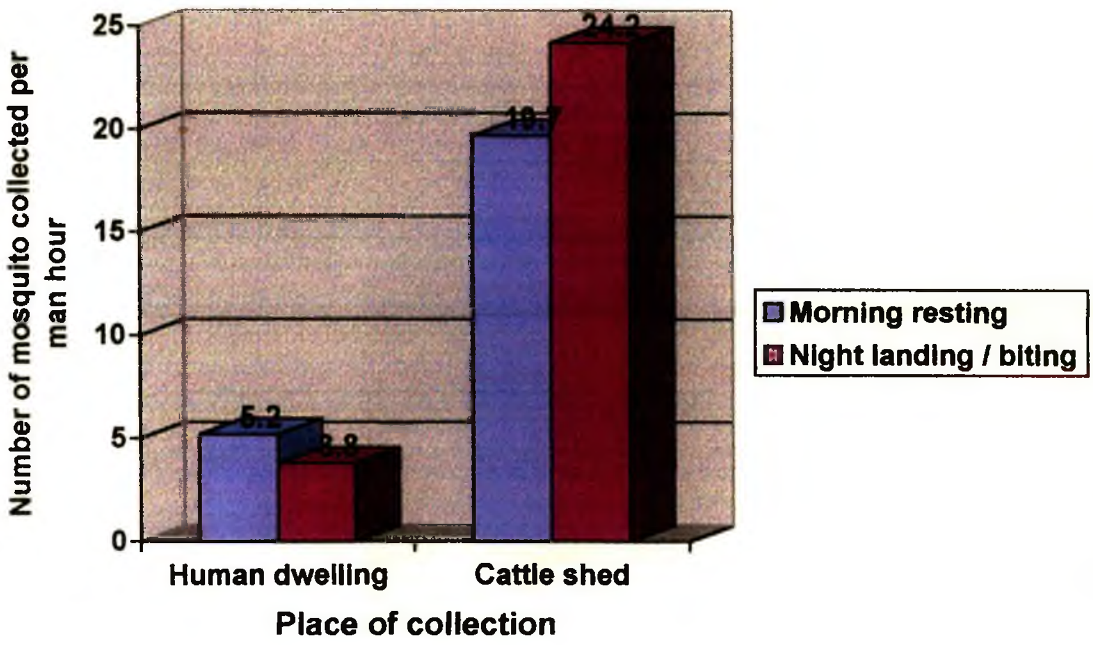


Table 2.2 : Density of female *Anopheles* mosquitoes collected in morning resting and night landing/ biting collections in human dwellings in selected villages of Kalmakanda upazilla of Netrokona district during June 1996 – May 1997.

Name of species	Morning resting collection		Night landing/ biting collection	
	No. (%)	Per man hour	No. (%)	Per man hour
An. aconitus	5 (1.32)	0.06	12 (2.85)	0.11
An. annularis .	25 (6.61)	0.34	36 (8.57)	0.33
An.barbirostris	18 (4.76)	0.25	14 (3.33)	0.12
An. dirus	1 (0.26)	0.01	2 (0.47)	0.01
An.fluviatiles	0	-	4 (0.95)	0.03
An.hyrcanus	29 (7.67)	0.40	32 (7.61)	0.29
An. jamesii	10 (2.64)	0.13	24 (5.71)	0.22
An. jeyporiensis	41 (10.84)	0.56	37 (8.80)	0.34
An.karwari	0	-	7 (1.66)	0.06
An. Kochi	22 (5.80)	0.30	19 (4.52)	0.17
An.maculates	30 (7.93)	0.41	18 (4.28)	0.16
An. minimus	3 (0.79)	0.04	7 (1.66)	0.06
An.philippinensis	12 (3.17)	0.16	18 (4.28)	0.16
An.subpictus	62 (16.40)	0.86	30 (7.14)	0.50
An.tesselatus	0	-	5 (1.19)	0.04
An.vagus	115 (30.42)	1.45	152 (36.19)	1.40
An.varuna	5 (1.32)	0.20	3 (0.71)	0.02
Total.	378 (100)	5.25	420 (100)	3.88

Table 2.3 : Density of female *Anopheles* mosquitoes collected in morning resting and night landing/ biting collections in cattle sheds in selected villages of Kalmakanda upazilla of Netrokona district during June 1996 – May 1997.

Name of species	Morning resting collection		Night landing/ biting collection	
	No. (%)	Per man hour	No. (%)	Per man hour
An. aconitus	18 (1.26)	0.25	28 (1.07)	0.25
An. annularis .	354 (24.96)	4.91	609 (23.27)	5.63
An.barbirostris	272 (19.18)	3.77	289 (11.04)	2.67
An. Dirus	4 (0.28)	0.05	0	-
An.fluviatiles	18 (1.26)	0.25	22 (0.84)	0.20
An.hyrcanus	54 (3.80)	0.75	178 (6.80)	1.64
An. Jamesii	25 (1.76)	0.34	56 (2.14)	0.51
An. Jeyporiensis	28 (1.97)	0.38	43 (1.64)	0.39
An.karwari	18 (1.26)	0.25	31 (1.18)	0.28
An. Kochi	42 (2.96)	0.58	25 (1.03)	0.25
An.maculatus	26 (1.83)	0.36	35 (1.33)	0.32
An. Minimus	2 (0.14)	0.02	4 (0.15)	0.03
An.philippinensis	82 (5.78)	1.13	117 (4.47)	1.08
An.subpictus	85 (5.99)	1.18	351 (13.41)	3.25
An.tesselatus	9 (0.63)	0.12	30 (1.14)	0.27
An.vagus	343 (24.18)	4.76	714 (27.29)	6.61
An.varuna	38 (2.67)	0.52	84 (3.21)	0.77
Total.	1418 (100)	19.69	2616 (100)	24.22

4.3 Impact of deltamethrin impregnated bed nets on malaria transmission in some rural areas of Bangladesh

During the intervention study, a total of 11553 villagers of 9 villages of 3 upozillas were included. Among them, 6033 (52.22%) were male and 5520 (47.78%) were female. It was observed that 100% of the respondents had heard about the disease malaria. Regarding the cause of malaria most of the respondents answered more than one causes respectively (Fig 3.1). Maximum respondents (90%) considered that malaria was caused by mosquito bite but only 15.3% of them correctly knew the name, *Anopheles* mosquito. About 50% of the respondents told that there remained a parasite in the blood that caused the fever of malaria. 40.2% told that it was caused by bad weather i.e. rains and the cold weather following rains. Bad food was considered to be a contributing factor of malaria by 7.9% of the people. An interesting finding was that 31.4% answered that malaria was caused by the curse of Allah, as at the present moment people were becoming disloyal.

Regarding mosquito bite protection practices 100% of the respondents mentioned that use of bed net was the best method. But because of financial constrain only 67.1% actually practiced the method (Fig 3.2). Dhup was the most preferred method. About 81% used dhup just after sunset both in houses and cattle sheds. The poor class of people (54.4%) used only smoke to repel the mosquito. A surprising answer came from 24.4% of the respondents who used kerosene oil to protect themselves from mosquito bite.

During base line survey, the rate of use of net was low (67%). After impregnation and distribution of bed nets, monitoring of net use was done in the selected houses during nighttime visit in impregnated bed net (area A) and non- impregnated bed net (area B) both in the 2nd and 3rd year (Table 3.1). In the 2nd and 3rd year in area A, 86.4% and 93.4% of the checked bed nets were found to be used properly and 5% and 2% of the nets were found in good condition at home but the people were not using the nets. Rest of the bed nets were found to be used improperly. In the non-impregnated area on the 2nd year 91% of the nets were found to be in properly using condition, where as in the next year the percent became 83. One disappointing finding was that the non-use of bed net increased from 4.55% to 13.4%. Only 3-5 percent of nets were not properly used.

The density of female *Anopheles* mosquitoes (expressed as per man-hour) during pre-intervention period (June1996 to May1997) was compared with that during post-intervention period of the second and third year (Table 3.2). In the impregnated bed net area (area A) during the 1st year the density was 12.8 that decreased to 7.2 and 5.1 respectively in the following two years after intervention. The decrease was significant ($p<0.01$) in both years. In the non-impregnated bed net area (area B) the *Anopheles* density was 10.6 during the 1st year that increased to 11.5 in the 2nd year though bed nets were distributed in the villages so that all the villagers got access to the nets. However in the 3rd year of study the mosquito density decreased to 10.1. The differences were not significant ($p> 0.05$). In the control area (area C) the per man hour collection of female *Anopheles* mosquitoes was 11.2 during the pre-intervention period. In the 2nd year that decreased to10.1 but in the 3rd year there occurred slight increase.

The result of parasitological survey as prevalence of malaria cases per 1000 population showed a decreased trend from 10.2 to 5.1 and then 2.8 in the respective three years of survey in area A (Table 3.3). The differences were statistically significant ($p< 0.01$). In the non-impregnated area also the prevalence showed a trend of decrease. In the 1st, 2nd and 3rd years of study, the malaria slide positive cases were 9.9, 7.6 and 6.9 per 1000 population, though the differences were not significant ($p > 0.05$). In the control area the prevalence of malaria cases was 7.7 during baseline survey. In the following year there occurred no change in the prevalence. However in the 3rd year the prevalence became 8.2, showing an increase by 0.5 cases per 1000 population.

Table 3.1 : Observation during nighttime inspection about community compliance of bed net usage in area A and B during June1997 - May1999.

Checking and observation	Area A (impregnated bed net)		Area B (non-impregnated bed net)	
	June1997 - May1998	June1998 – May1999	June1997 - May1998	June1998- May1999
	No. (%)	No. (%)	No. (%)	No. (%)
No. of bed net checked	182 (100)	197 (100)	178 (100)	165 (100)
No. of bed net properly used	158 (86.8)	183 (93.9)	162 (91.0)	137 (83.0)
No. of bed net improperly used	15 (8.3)	8 (4.0)	8 (4.5)	6 (3.6)
No. of bed net not used	9 (4.9)	4 (2.1)	8 (4.5)	22 (13.4)

Table 3.2 : Density of female *Anopheles* mosquito (expressed as per man-hour) during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year in the selected villages of the study areas

Year	Impregnated bed net area			Non-impregnated bed net area			Control area		
	Man-hour spent	Total collec-tion	Per man hour	Man-hour spent	Total collec-tion	Per man hour	Man-hour spent	Total collec-tion	Per man hour
June96-May97	720	9216	12.8	720	7632	10.6	720	8064	11.2
INTERVENTION									
June97-May98	712	5184	7.2	713	8188	11.5	694	7012	10.1
Decrease(D) / Increase(I)	man^1 $hour^1$ 5.6 (D)			man^1 $hour^1$ 0.9 (I)			man^1 $hour^1$ 1.1 (D)		
June98-May99	720	3308	5.1	708	7151	10.1	688	7912	11.5
Decrease(D) / Increase(I)	man^1 $hour^1$ 2.1 (D)			man^1 $hour^1$ 1.4 (D)			man^1 $hour^1$ 1.4 (I)		

Table 3.3 : Differences in the prevalence of malaria cases per thousand populations in selected villages during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year in the selected villages of the study areas

Area	Total population	June96-May97		INTERVENTION	June97- May98			June98-May99		
		No.of cases	Prevalence		No.of cases	Prevalence	Difference (1st-2nd yr)	No.of cases	Prevalence	Difference (2nd-3rd yr)
Area A (impregnated bed net area)	3526	36	10.2		18	5.1	5.1 (decrease)	10	2.8	2.5 (decrease)
Area B (non-impregnated bed net area)	3902	39	9.9		30	7.6	2.3 (decrease)	27	6.9	0.7 (decrease)
Area C (control area)	4125	32	7.7		32	7.7	0 (no change)	34	8.2	0.5 (increase)

Fig 3.1: Distribution of respondents by knowledge about the cause of malaria in selected villages During June 96- May 97

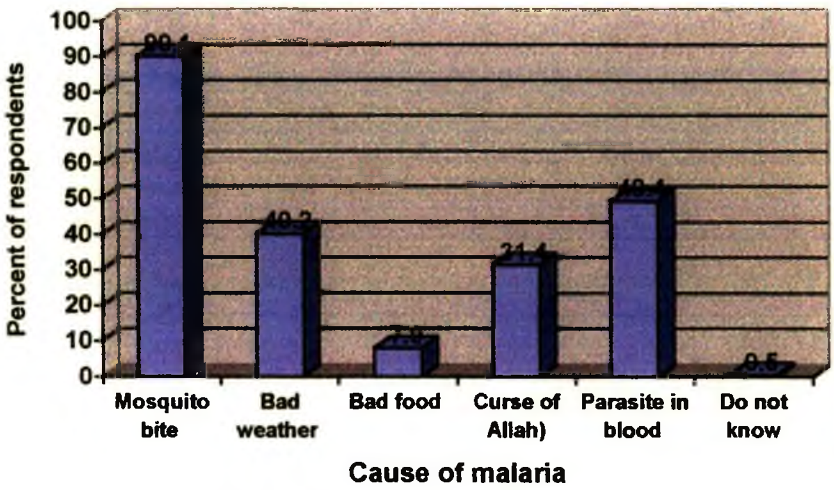
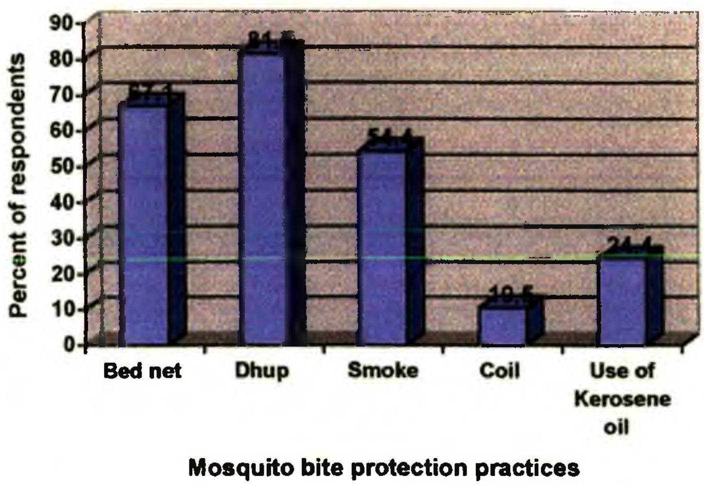


Fig 3.2: Distribution of respondents by practices against mosquito bite protection practices in the selected villages during June 96- May 97



4.4 Bancroftian filariasis in Bangladesh: clinical aspects, diagnosis and chemotherapy for treatment: comparative efficacy of three strategies

A total of 3551 individuals of 3 villages were included in the study. According to the baseline survey during June 1996 to May 1997, the population of the villages named by Bamunia, Maskuria and Bangavita were 1215, 1022 and 1314 respectively (Table 4.1). During the baseline survey on June'96-May'97, 24, 18 and 12 cases were diagnosed as filaria either as clinically and/or microscopically positive in the three villages respectively. The prevalence of filaria in the 1st year of study was 19.7, 17.6 and 9.1 per 1000 populations in the three villages respectively. During the period of June'97 May'98 i.e. the 2nd year of study, 21,15 and10 cases were detected as filaria having the prevalence of 17.2, 14.6 and 7.6 per 1000 populations in the three villages respectively. During the period of June'98 May'99 i.e. the 3rd year of study, 15, 13 and11 cases were detected as filaria having the prevalence of 12.3, 12.7 and 8.3 per 1000 populations in the three villages respectively. During the total period of study, a total of 139 filarial cases were detected which included symptomatic mf +ve and –ve cases and asymptomatic mf +ve cases.

All the inhabitants of the houses occupying clinical cases, those who gave history of prolonged irritating cough, irregular fever, allergic manifestation were considered as suspected cases. Out of total 2570 suspected cases, 60 positive filaria cases were detected in Bamunia village during the period of June'96 May'99 (Table 4.2). Among them, 25 (3.3%) cases were clinically positive filaria cases, 31 (4.1%) were asymptomatic microfilaria (mf) positive and 4(0.5%) were both positive cases. In village Maskuria, out of total 880 samples 46 cases were positive, of which 21 (2.3%) cases were clinical filaria, 20 (2.2%) were mf positive and 5 (0.6%) were both positive cases and in village Bangavita, out of total 938 samples, 33 cases were positive, of which 14 (1.5%) cases were clinical filaria, 16 (1.7%) were mf positive and 3 (0.3%) were both positive cases. The percent distribution of different filarial cases has been shown in Fig 4.1.

Among the 139 filaria cases, 77% (107) were male and 23% (32) were female (Fig 4.2). Out of the male patients 41.1% (57) were clinically positive, 28.8% (40) mf positive asymptomatic cases and 7.1% (10) were both positive cases. Among the total female patients 2.1% (3), 19.5% (27) and 1.4% (2) were symptomatic, asymptomatic with mf positive and both positive cases respectively.

Table 4.3 shows the distribution of clinical filariasis and microfolaria positive cases by age group and sex. The ages of samples were grouped by 10 years. It was found that only 8 male persons (5.7%) above the age of 60 years were clinically positive. No symptomatic and asymptomatic mf +ve cases were found in this group either male or female. In the age group of 51-60 years except 2 mf +ve cases, all females were –ve. In the same age group of male, 12 (8.6%), 4 (2.8%) and 2 (1.4%) were clinically positive, mf +ve and both positive cases respectively. Prevalence was low in early stages of life (1-10 years). It was observed that in male the prevalence of clinical cases, the numbers increased with advancement of age and maximum cases were found above 40 years of age. In case of clinical filaria among male, maximum number of cases (10.1%) was in the age group of 41 to 50 years followed by the age group of 51-60 years (8.6%) and 31-40 years (7.2%). In case of asymptomatic microfilaria positive males, maximum number of cases was in younger group, (7.21%) was in the age group of 21 to 30 years followed by the age group of 31-40 years (6.5%) and 41-50 years (4.3%). Other age groups of both male and female comprised small proportion of cases.

Educational qualifications of filarial patients were noted down (Fig 4.3). It was found that out of 139 patients, 34.5%(48) were illiterate. Among the rest, 27.3% (38) were primary educated (class I-V), 22.3% (31) read up to class VI to X i.e. received education upto secondary level, 10.1% (14) passed either SSC or HSC and only 8 (5.7% (8) were graduate.

Fig 4.4 shows the distribution of filariasis cases by occupation. In the village community 25.2% of the filarial patients were engaged in cultivation, 17.3 % were day labours, 15.1 % were involved some kind of business, 8.5% were service men. About 10.8% of the patients were housewives. Rests were students, child or dependents.

Housing conditions of filarial positive cases were noted down (Fig 4.5). It was found that 30.9% were living in huts, 31.7% were living in mud wall and tin roofed houses, 18.7% in tin houses, 13.7% in semi-pucca and 5% in pucca buildings.

Number of microfilaria were counted in each positive slide and classified as mild, moderate and severe according to mf density per slide as 1-10, 11-100 and 100+ respectively. The result is shown in Fig 4.6. The percent of mild, moderate and severe cases were 40.6%, 46.8% and 12.6% respectively, that mean, out of total 79 positive slides, only 10 slides contained large number of microfilaria (more than 100). 37 slides contained 11-100 mf per slide and 32 slides were positive containing 1-10 mf per slide. Mild and moderate were more or less similar.

Out of total 2570 slides tested, 79 was microfilaria (mf) positive of which 50 was male and 29 was female. Among them 67 was asymptomatic and 12 was symptomatic. Village wise distribution of microfilaria (mf) positive cases were 35 (7.4%), 25 (5.3%) and 19 (4.0%) in the villages of Bamunia, Maskuria and Bangavita respectively. Filarial antigen was detected in

135 samples of which 56 were mf negative and 79 was mf positive. Village wise distribution of ICT positive cases were 58 (12.3%), 44 (9.3%) and 33(7.0%) in the villages of Bamunia, Maskuria and Bangavita respectively (Table- 4.4).

Fig 4.7 shows the distribution of filariasis cases by physical signs. Clinical signs in different parts of the body were recorded and maximum number of persons was found with hydrocele 58.4% (42 out of 72 symptomatic cases). 26.5% (19) of persons had elephanthiasis of lower limbs. 6.9%of cases i.e. 5 females had symptoms of vulval swelling and another 6.9%(5) had lymphangitis and lympadenitis. Only one female (1.3%) was found with swelling of breast.

Treatment according to three different regimens was noted in Table 4.5. Out of total 72 clinically positive cases, randomly selected each 24 was assigned one strategy of treatment and similarly, out of 66 mf positive asymptomatic cases were assigned either one strategy. In the communities 58.4% of patients presenting hydrocele and 26.5 % of individuals presenting elephantiasis before treatment, showed improvements in these conditions 2 years after the start of treatment, either as slight reduction in size or no further progress. Response to treatment of all the strategies were much less in curing physical signs than clearing microfilaria from blood. In strategy I, the cure rate of clinical filarial was 16.6% whereas in strategy II the cure rate was 33.3% and finally 37.5% of cases was cured by strategy III. In case of clearance of mf, the three strategies also showed different response. Clearance of mf by 45.5% in strategy II, 54.5% in strategy I and 60.8% in strategy III. In combined response, strategy III was most effective with cure rate 48.9%, followed by strategy II with cure rate 39.1% and lastly strategy I where cure rate was 37.7% out of total samples (positive patients) allotted.

Table 4.1 : Prevalence of filarial cases (clinical + microfilaria) per thousand population in study villages of Baliadangi upozilla under Thakurgaon district during June '96-May '99.

Village (Area)	Total Population	June'96 to May'97		June'97 to May'98		June'98 to May'99	
		No. of Cases	Prevalence	No. of Cases	Prevalence	No. of Cases	Prevalenc e
Bamunia (area A)	1215	24	19.7	21	17.2	15	12.3
Maskuria (area B)	1022	18	17.6	15	14.6	13	12.7
Bangavita (area C)	1314	12	9.1	10	7.6	11	8.3

Table 4.2 : Distribution of clinical filariasis and microfolaria (mf) positive cases in the study villages of Baliadangi upozilla under Thakurgaon district during June '96-May '99.

Name of Village (Area)	Total population	Total samples examined	No. clinical filaria +ve (%)	No. microfilaria (mf) +ve (%) (asymptomatic)	No. clinical + mf +ve (%)
Bamunia (area A)	1215	752	25 (3.3%)	31 (4.1%)	4 (0.5%)
Maskuria (area B)	1022	880	21 (2.3%)	20 (2.2%)	5 (0.6%)
Bangavita (area C)	1314	938	14 (1.5%)	16 (1.7%)	3 (0.2%)
Total	3551	2570	60 (2.3%)	67 (2.6%)	12 (0.5%)

Table 4.3 : Distribution of filarial cases by sex and age group in the study villages of Baliadangi upozilla under Thakurgaon district during June '96-'May 99.

Age group (years)	Number of clinical filarial +ve (%)		Number of microfilaria +ve (%)		Number of clinical + mf +ve (%)	
	M	F	M	F	M	F
1-10	2 (1.4)	0	4 (2.8)	3(2.1)	0	0
11-20	3 (2.1)	0	5 (3.5)	6(4.3)	0	0
21-30	8 (5.7)	0	10 (7.2)	8(5.7)	0	1(0.7)
31-40	10 (7.2)	2(1.4)	9 (6.5)	4(2.8)	5 (3.5)	1(0.7)
41-50	14 (10.1)	1(0.7)	6 (4.3)	4(2.8)	3 (2.1)	0
51-60	12 (8.6)	0	4 (2.8)	2(1.4)	2 (1.4)	0
60 +	8 (5.7)	0	2 (1.4)	0	0	0
Total	57 (41.1)	3(2.15)	40(28.8)	27(19.4)	10(7.2)	2(1.4)
All cases(clinical filaria+ asymptomatic mf positive + both positive) =139 (100%)						

Table 4.4 : Distribution of microfilaria (mf) positive cases (both symptomatic and asymptomatic) and ICT positive cases in the study villages of Baliadangi upozilla under Thakurgaon district during June '96-May '99.

Name of Village (Area)	Total population	Total no. of filaria cases (%)	No. of microfilaria (mf) +ve cases (%)	No. of ICT positive cases (%)
Bamunia	1215	60 (43.1%)	35 (7.4%)	58 (12.3%)
Maskuria	1022	46 (7.4%)	25 (5.3%)	44 (9.3%)
Bangavita	1314	33 (7.4%)	19 (4.0%)	33 (7.0%)
Total	3551	139 (100%)	79 (16.8%)	135 (28.7%)

Table 4.5 : Respond to treatment of clinical filaria and microfilaria +ve cases according to three different treatment strategy in the study villages of Baliadangi upozilla under Thakurgaon district during June '96-May '99.

Treatment strategy	Clinical filarial + both (cli +mf) positive			Microfilaria +ve			Total samples	
	Samples allotted	Cured No(%)	Not cured No. (%)	Samples allotted	Cured No(%)	Not cured No. (%)	Total samples allotted	Cured No. (%)
Strategy I	24	4 (16.6)	20 (83.4)	22	12 (54.5)	10 (45.5)	46	16 (37.7)
Strategy II	24	8 (33.3)	16 (66.7)	22	10 (45.5)	12 (54.5)	46	18 (39.1)
Strategy III	24	9 (37.5)	15 (62.5)	23	14 (60.8)	9 (39.1	47	23 (48.9)

Fig 4.1: Distribution of different types of filaria cases in study villages of Baliadangi upazilla during June96- May97

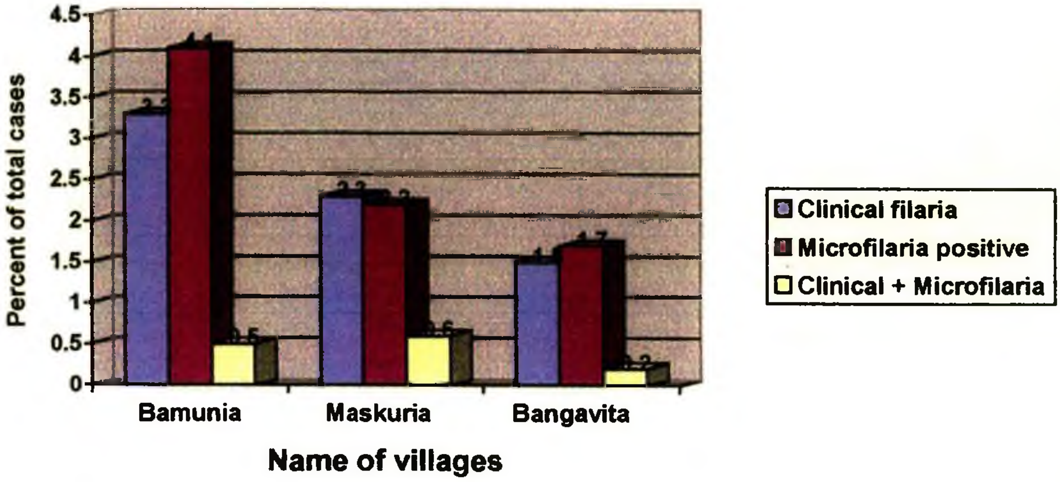


Fig 4.2 : Distribution of filaria cases by sex in the study villages of Baliadangi upazilla during June 96- May 97

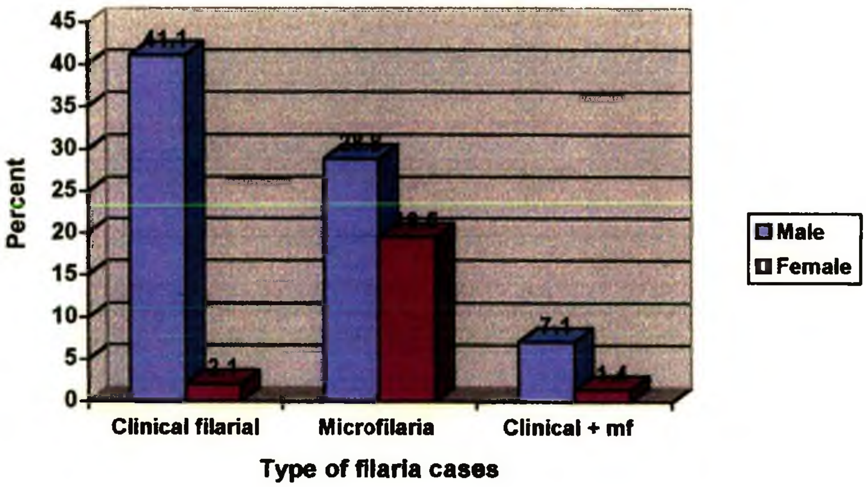


Fig 4.3 : Distribution of filarial cases by educational qualification in the study villages of Baliadangi upozilla during June 96-May 99

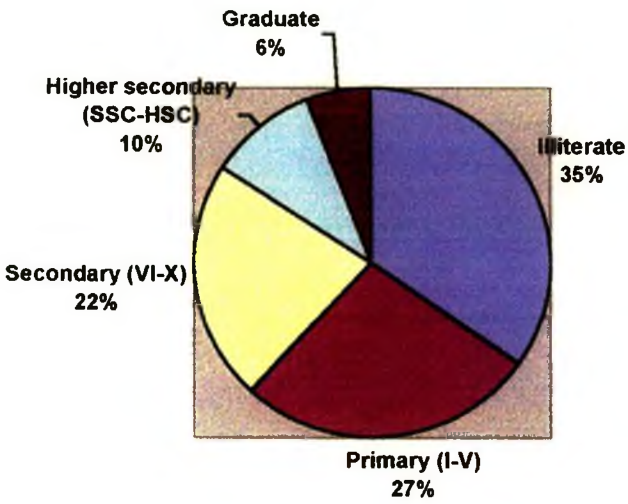


Fig 4.4 : Distribution of filaria cases by occupation in the study villages of Baliadangi upozilla during June 96-May 99

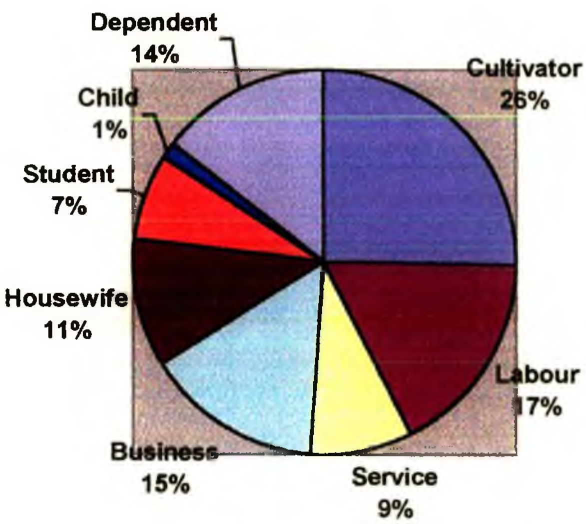


Fig 4.5: Distribution of filaria cases by housing conditions in the selected villages during June 96-May 99

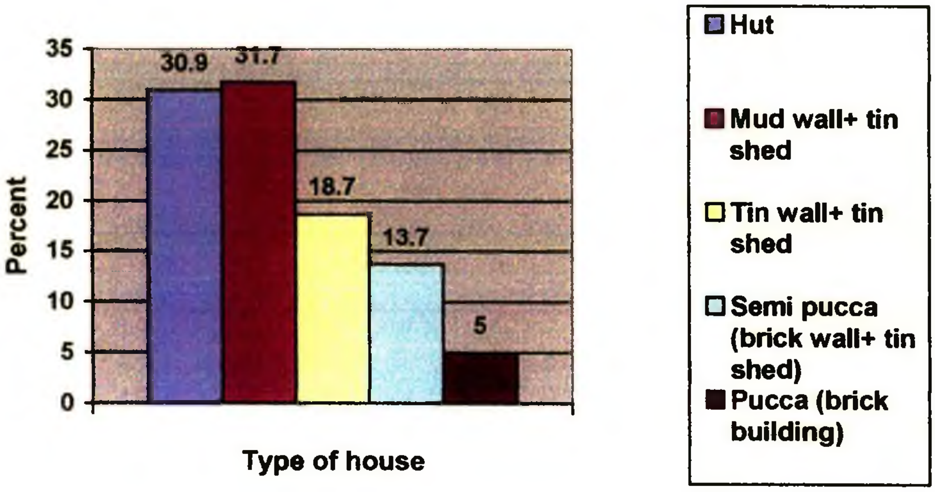


Fig 4.6: Distribution of positive slides by density of microfilaria per20 microlitre of blood in the study villages of Baliadangi upazilla during June 96- May 99

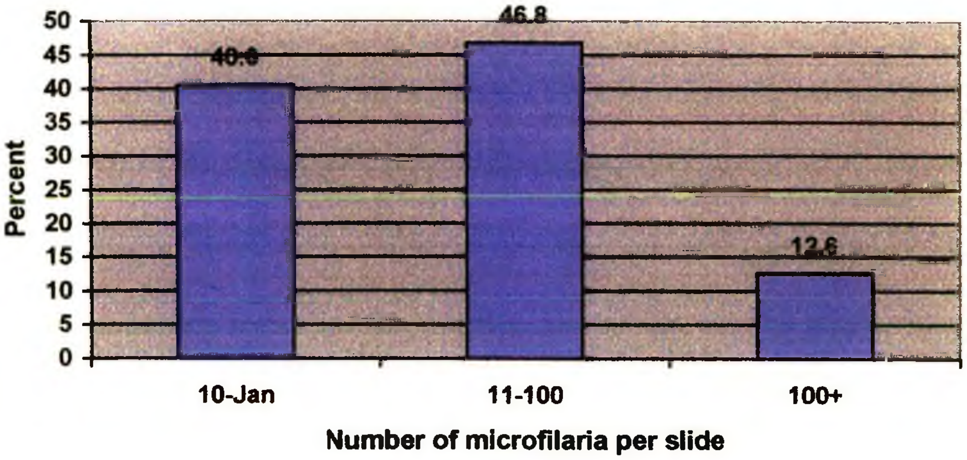
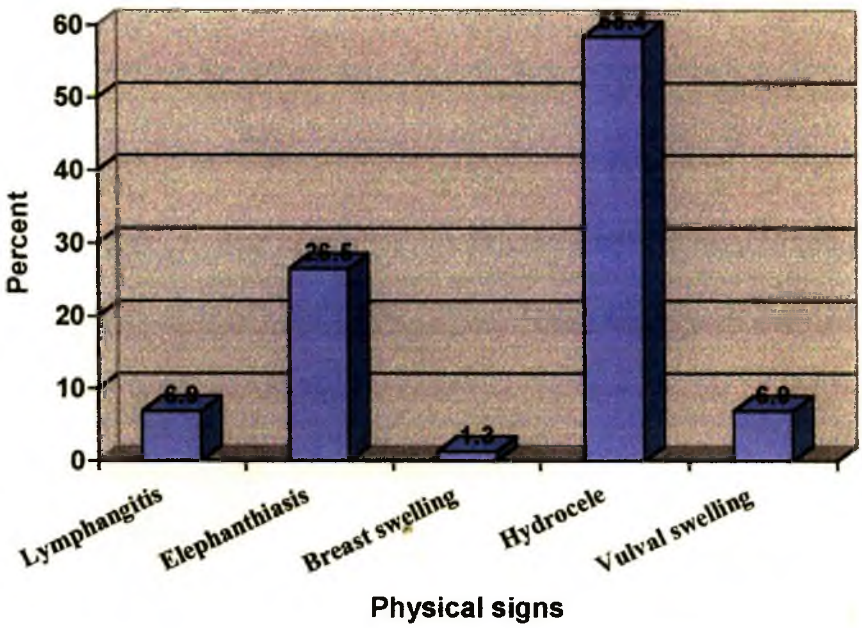


Fig 4.7: Distribution of clinical filariasis cases by physical signs of in the study villages of Baliadangi upozilla during June 96-May 99



4.5 Filaria vector surveillance in a filaria endemic area of Bangladesh

During the year long the study period, a total number of 2,608 female mosquitoes were collected. In this paper only the female mosquitoes were dealt with, as they are only involved in biting and disease transmission. The total collected female mosquitoes belonged to the sub families, Anopheline and Culicine. Altogether four genera were found in different biotopes (Fig 5.1). Among the different genera, maximum numbers of mosquitoes were in genus *Culex* (70.40% of the total capture). Genus *Anopheles* formed 26.58%, genus *Aedes* formed 2.07% of the total capture and genus *Mansonia* formed less than one percent (0.95%).

Species identification of only the *Anopheles* and *Culex* mosquitoes was done. Out of total 693 *Anopheles* mosquitoes, *An. annularis* topped the list occupying 30% of collection, followed by *An. vagus* (25.1%), *An. aconitus* (23.5%), *An. peditaeniatus* (12.3%), *An. philippinensis* (8.1%) and rest 1% belonged to some other species of very negligible number (Table-5.1).

Among the species of *Culex* mosquitoes, *Culex quinquefasciatus* was the most predominant species (72.0%) followed by *Cx. vishnui* (8.3%), *Cx. gelidus* (6.3%), *Cx. fuscocephala* (5.8%), *Cx. tritaeniorhynchus* (2.1%) and others formed rest 5.5% of the collection (Table-5.2).

Table-5.3 shows the number of *Anopheles* and *Culex* mosquitoes collected in human dwellings by different methods. 22.3% and 52.5% of total *Anopheles* and *Culex* mosquitoes captured were from human dwellings. Spray sheet collection method appeared to be the most satisfactory of the methods used in human dwelling's mosquito collections. 65.8% of *Anopheles* mosquitoes were collected by this method. Next method observed was morning resting (19.4%) followed by evening resting collection method (11.6%). Landing/ biting collection by bait was only (3.2%). Regarding *Culex* also, in spray sheet collection method maximum number were collected (34.2%). Morning resting collection (23.3%) and evening resting collection (29.2%) yielded almost similar number. Landing/ biting collection was at the bottom of the list (13.3%).

Table-5.4 shows the number of mosquitoes collected in cattle sheds by different methods. Here the picture is somewhat different than that of human dwellings. 60.7% and 24.4% of total *Anopheles* and *Culex* mosquitoes captured were from cattle sheds. Here only three methods of collection, morning resting, evening resting and landing/ biting collection using animal bait were used. In evening resting collections maximum number of *Anopheles* mosquitoes was collected (66.5%) followed by morning resting collections (23.5%). Only few mosquitoes were collected by landing/ biting method (1.0%). In case of *Culex,* the predominant collection method was the morning resting collection (48.7%). Evening and bait collections yielded (40.2%) and (11.1%) respectively.

The outdoor collection was difficult and made from outdoor shelters like bushes, pits, firewood houses etc. Only negligible number of mosquitoes was collected here. In light trap collections also very few mosquitoes were collected.

Out of total 1836 captured *Culex* mosquitoes, 855 were dissected but only *Cx. quinquefasciatus* was found positive with filarial larvae. Of 800 *Cx. quinquefasciatus* dissected, 65 (8.1%) were found infected with all stages of filarial larvae. A total of 55 *Cx. vishnui* were dissected but not a single one was found positive with filarial larvae (Table 5.5).

The seasonal distribution of *Culex quinquefasciatus* mosquitoes collected during the year long period was plotted in Fig 5.2 as the percent of total collection. A total of 1836 female *Cx. quinquefasciatus* mosquitoes were collected on alternate months during six visits. Out of total collection, during July 1996, 11.2% i.e. a total of 204 *Cx. quinquefasciatus* were collected by all types of collections spending 60 man-hour period in 3 days. On the second visit on September 1996, 9.3% (172) mosquitoes of the same species were collected spending the same period. On the next collections on November 1996, January1997, March 1997 and May 1997, out of total collection, 22.8%, 26.1%, 20.4% i.e. a total of 455, 516, 301 and 188 *Cx. quinquefasciatus* mosquitoes were collected spending same period in each visit. Maximum number was collected on January and minimum on September.

Table 5.1 : Distribution of *Anopheles* mosquitoes by species in selected villages of Baliadangi upazilla of Thakurgaon district during the period of July, 1996 to June,1997

Name of species	Number	Percent
An. annularis	208	30.0
An. vagus	174	25.1
An. aconitus	163	23.5
An. peditaeniatus	85	12.3
An. philippinensis	53	8.1
Others	7	1.0
Total	693	100.0

Table 5.2 :Distribution of *Culex* mosquitoes by species in selected villages of Baliadangi upazilla of Thakurgaon district during the period of July, 1996 to June,1997

Name of species	Number	Percent
Cx. quinquefasciatus	1322	72.0
Cx. vishnui	152	8.3
Cx. gelidus	115	6.3
Cx. fuscocephala	108	5.8
Cx. tritaeniorhynchus	39	2.1
Others	100	5.5
Total	1836	100.0

Table 5.3 : Distribution of mosquitoes collected in human dwellings by different methods in selected villages of Baliadangi upazilla of Thakurgaon district during the period of July, 1996 to June,1997

Methods of collection	Anopheles	*(%)*	*Culex*	(%)
Morning resting	30	(19.4)	224	(23.3)
Evening resting	18	(11.6)	282	(29.2)
Spray sheet	102	(65.8)	330	(34.2)
Landing/biting	5	(3.2)	128	(13.3)
Total	155	(100.0)	964	(100.0)

Table 5.4 : Distribution of mosquitoes collected in cattle sheds by different methods in selected villages of Baliadangi upazilla of Thakurgaon district during the period of July, 1996 to June,1997

Methods of collection	Anopheles	*(%)*	*Culex*	(%)
Morning resting	99	(23.5)	216	(48.7)
Evening resting	280	(66.5)	180	(40.2)
Landing / biting	42	(1.0)	52	(11.6)
Total	421	(100.0)	448	(100.0)

Table 5.5 : Number of *Culex* mosquitoes positive for larvae of *Wuchereria bancrofti* in selected villages of Baliadangi upazilla of Thakurgaon district during the period of July, 1996 to June,1997

Mosquitoes species	Total number of mosquitoes dissected	Samples positive for *W. bancrofti* larvae			
		1st and 2nd stage	3rd stage larvae	Total	
				number	percent
Cx. quinquefasciatus	800	38	27	65	8.1%
Cx. vishnui	55	0	0	0	-

Fig 5.1 : Distribution of mosquitoes by Genus in selected villages of Baliadangi upozilla during July 96 to June 97

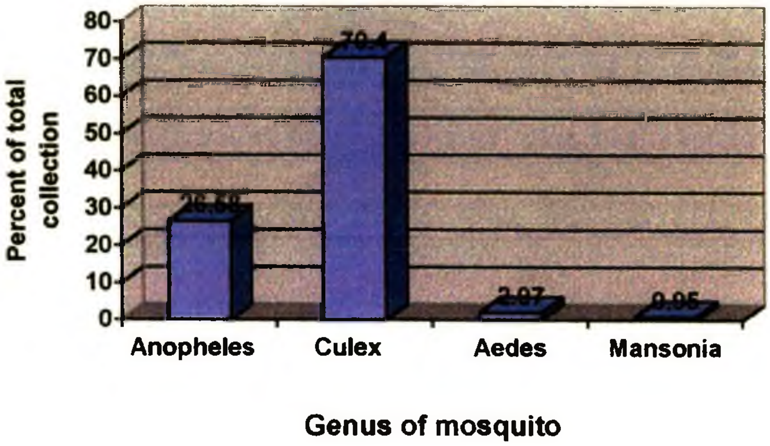
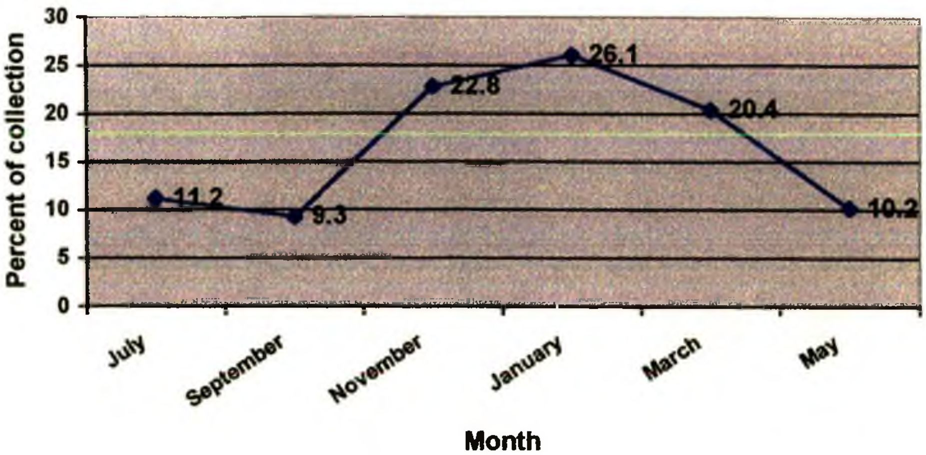


Fig 5.2 : Seasonal distribution of Culex quinquefasciatus mosquitoes in selected villages of Baliadangi upozilla during July 96 to June 97



4.6 Mosquito nets impregnated with deltamethrin against lymphatic filariasis and its vector in a filarial endemic area of Bangladesh

During the intervention study, a total of 3551 villagers of 3 villages of Baliadangi upozilla were included. Among them, 1816 (51.14%) were male and 1735 (48.86%) were female. 96% of the respondents were not well aware of the word 'filariasis' in their communities. They called this disease as "Goad Rog" or "elephant leg" and recognize by its clinical manifestations as hydrocele and elephanthiasis. 14.3% of the respondents told that a parasite in blood was responsible for filariasis, 5.7% mentioned about mosquito bites and 15.3% did not know any cause of the disease (Fig 6.1). Not a single person could say the name of the mosquito. The most common answer was that it was a family disease (46.6%) followed by working in the fields bare footed (36.8%) and curse of Allah (21.4%). Few persons (5%) told that the disease was caused by unfair habits. People's knowledge about transmission and prevention of filariasis was also very poor. To answer the question 'how the disease is transmitted and how it can be prevented', only 10% mentioned that mosquito transmitted "Goad Rog" and they were using mosquito nets to prevent it. About 90% of the respondents answered that they knew nothing about the transmission of the disease from one person to other and they were not taking any preventive measures.

During nighttime visit the acceptability to and practice of using impregnated bed nets by the rural people were observed in some randomly selected houses. In village Bamunia where deltamethrin impregnated bed nets were distributed, a total of 125 houses were checked (Table 6.1). In those 125 houses, out of 340 distributed bed nets, 95.2% nets were available. Among these available nets, 86.4% were observed in using condition. But almost all the nets (98.7%) were very dirty or sometimes in torn condition. Again in the village Maskuria where non-impregnated bed nets were distributed, a total of 176 houses were visited. Similar percent of nets were found available in the houses (94.3%). Maximum people were using the nets (89.0%). About 64% of these nets were dirty or sometimes torn.

Female *Culex quinquefasciatus* mosquitoes collected from human dwelling (expressed as per man-hour) during the pre-intervention period and the post-intervention period of the second and third year in the field trial villages are given in Table 6.2. In the impregnated bed net area (area A) during the 1st year the density was 7.3, which decreased to 4.6 and 2.6 respectively in the following two years after intervention. In the non-impregnated bed net area (area B) the *Cx quinquefasciatus* density was 6.5 during the 1st year that increased to 10.0 in the 2nd year though bed nets were distributed in the villages so that all the villagers got access to the nets. However in the 3rd year of study the mosquito density decreased to 7.9 per man-hour. In the control area (area C), per man-hour collection of *Cx quinquefasciatus* mosquitoes was 9.8 during the pre-intervention period. In the next two years that increased to11.6 and 11.7.

The result of parasitological survey as prevalence of filaria cases per 1000 population (Table-6.3) showed a decreased trend from 18.1 to 17.2 and 13.9 in the respective three years of survey in the village Bamunia (area A). In the non-impregnated area also the prevalence showed trend of decrease. In the 1st, 2nd and 3rd years of study, the prevalence of filaria cases per 1000 population in the village Maskuria were 17.6, 14.6 and 12.7 per 1000 population. In the control area, village Bangavita, the prevalence of filaria cases per 1000 population was 9.1 during baseline survey. In the following year, the prevalence decreased to 7.6.However in the 3rd year there occurred an increase in the prevalence to 8.3.

Table 6.1: Distribution of households according to the practice of using mosquito nets as observed during night-time visits in the study villages of Baliadangi upozilla under Thakurgaon district during June '97- May '99.

Name of Village (Area)	Total number of households visited	Number of nets supplied in those households	Number of nets available in house (%)	No. of nets found in use (%)	No nets found torn /dirty (%)
Bamunia (area A)	125	340	324 (95.2%)	280 (86.4%)	320 (98.7%)
Maskuria (area B)	176	212	200 (94.3%)	182 (89.0%)	128 (64.0%)

Table 6.2: Density of female *Culex quinquefasciatus* mosquito collected from human dwelling (expressed as per man-hour) during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year (June 1997-May 1999) in the selected villages of Baliadangi upozilla under Thakurgaon district

Year	Impregnated bed net area			Non-impregnated bed net area			Control area		
	Man-hour spent	Total collec-tion	Per man hour	Man-hour spent	Total collec-tion	Per man hour	Man-hour spent	Total collec-tion	Per man hour
June96-May97	36	265	7.3	34	224	6.5	28	275	9.8
INTERVENTION									
June97-May98	36	168	4.6	30	302	10.0	25	289	11.6
Decrease(D) / Increase(I)	man^{1} hour^{1} 2.7 (D)			man^{1} hour^{1} 3.5 (I)			man^{1} hour^{1} 1.8 (I)		
June98-May99	36	94	2.6	32	254	7.9	27	317	11.7
Decrease(D) / Increase(I)	man^{1} hour^{1} 2.0 (D)			man^{1} hour^{1} 2.1 (D)			man^{1} hour^{1} 0.1 (I)		

Fig 6.1: Distribution of respondents by knowledge about the cause of filaria in study villages of Baliadangi upozilla during June 96-May 97

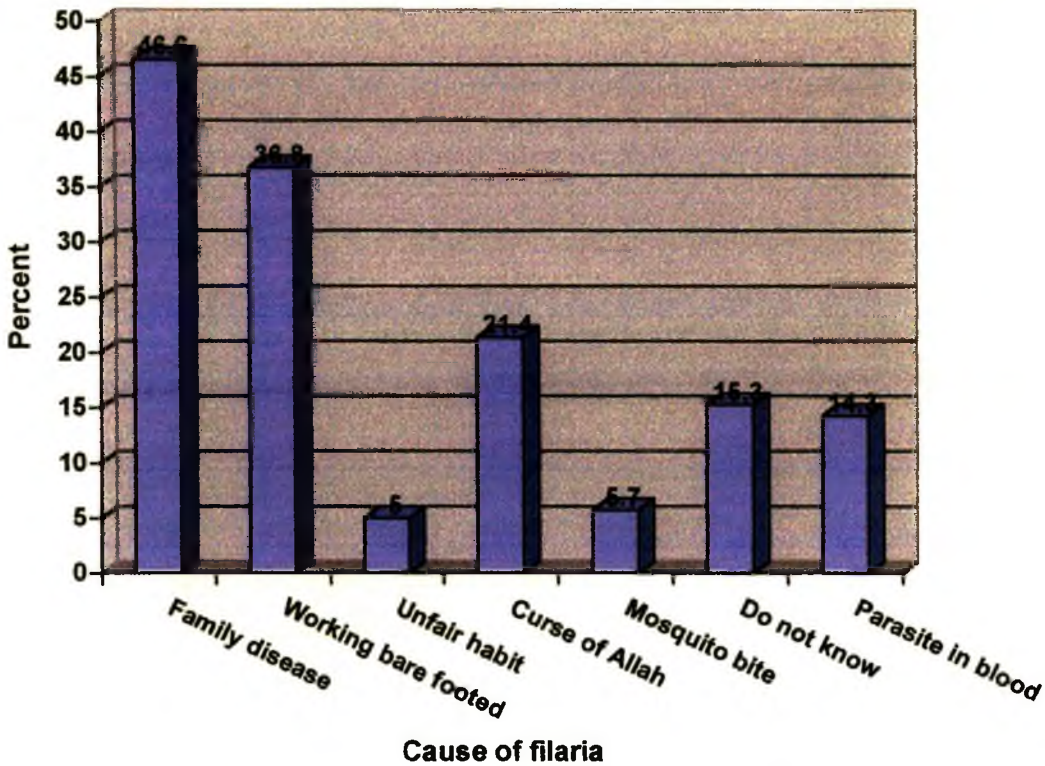


Table 6.3: Prevalence of filaria cases per thousand populations in selected villages during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year in the selected villages of Baliadangi upozilla under Thakurgaon district during June 1997-May 1999

Village Area	Total population	June96-May97		INTERVENTION	June97- May98			June98-May99		
		No.of cases	Prevalence		No.of cases	Prevalence	Difference (1st-2nd yr)	No.of cases	Prevalence	Difference(2nd-3rd yr)
Bamunia Area A	1215	22	18.1		21	17.2	0.9 (decrease)	17	13.9	3.3 (decrease)
Maskuria Area B	1022	18	17.6		15	14.6	3.0 (decrease)	13	12.7	1.9 (decrease)
Bangavita Area C	1314	12	9.1		10	7.6	1.5 (decrease)	11	8.3	0.7 (increase)

4.7 Epidemiological, clinical and therapeutic features of visceral leishmaniasis (kala-azar) in a kala-azar endemic area of Bangladesh

A total of 228 of cases were diagnosed as kala-azar in 3 villages of Khalihati upazilla from June 1996 to May 1999 (Table-7.1). They were diagnosed clinically and serologically by Direct Agglutination Test (DAT). Total population of the three villages, Bir Basunda, Pachh Joair and Parki were 1279, 1346 and 1151 respectively. During the base line survey from June '96 to May '97, a total of 33, 24 and 26 cases were diagnosed as kala-azar in the three villages respectively. During the second year 26, 25 and 27 cases and in the third year 15, 22 and 30 cases were diagnosed similarly as kala-azar in the same villages respectively.

The prevalence of kala-azar cases per 1000 population in the three villages in the three successive years of study was plotted in Fig 7.1. In village Bir Basunda the prevalence were 25.8, 20.3 and 11.7 in the three years respectively. In village Pachh Joair the prevalence were 17.8, 18.6 and 16.3 respectively and in village Parki the prevalence were 22.5, 23.4 and 26.1 respectively.

Distribution of kala-azar patients by sex and age group in the study areas of Birbasinda union of Kalihati upozilla under Tangail district during the period June 96-May 99 are shown in Fig 7.2. Among the 228 patients, 136 were male and 92 were female occupying a ratio of M:F 1.5:1. Although patients belonged to all age groups, maximum cases (33.8 %) were in the age group of 11-20 years followed by age group of 0-10 years (28.9%). Patients of age group 21-30 and 31-40 occupied the mid-position containing 14.5% of the cases each group. Minimum cases were among older people, 7% belonged to age group 41-50 years and 1.3% to 50 years of age or above. The disease was thus found to be much more frequent in the paediatric and young age groups.

In the villages, Bir Basunda, Pachh Joair and Parki, a total of 281, 290 and 244 households were surveyed in each of the three years (Table 7.2). In the village Bir Basunda, total houses inhabited by infected persons were 28, 23 and 12 in the three years respectively. The percent of affected houses were 9.9, 8.1 and 4.2 respectively. In village Pachh Joair the number of infected houses were 22, 22 and 18 having the percent of 7.5, 7.5 and 6.5 in the three years respectively. In the control village, Parki the number of infected houses were 25 (10.2%), 25 (10.2%), and 28 (11.5%) during base line survey and following two years respectively.

Table 7.3 shows the distribution of households by presence of cattle sheds in each area and the number of kala-azar cases in respective area during the base line survey. In area A, B and C, 71.2%, 76.6% and 79.5% of the total households possessed cattle sheds. These sheds lied close to dwelling houses. During the base line survey from June 96 to May 97, a total of 33, 24 and 26 kala-azar cases were diagnosed from 28, 22 and 25 houses in the three villages respectively. It indicates that in many houses more than one patient were present.

During the three years of study, out of 3776 people, a total 1275 people gave the history of irregular fever and DAT were performed (Table 7.4). In the village Bir Basunda, 74 persons had DAT titre of 1:3200 or more and diagnosed as kala-azar. In village Pachh Joair, out of 463 febrile patients, 71 cases and in the village Parki, out of 418 suspected cases, 83 cases were diagnosed as kala-azar by DAT during the three years of study.

Regarding symptoms of kala-azar patients, fever was the predominant one, which was present in 100% of cases (Table 7.5). Some patients were not suffering from fever exactly at the time of interview but they gave history of irregular fever in the past. Each patient suffered from more than one type of fever specially before and during treatment. All types of fever were present, continuous, intermittent and remittent. Some intermittent cases showed double rise a day. Few fever cases with chill and rigor resembled malaria and most of the cases were without chill and rigor. Many patients (41.6%) complained of loss of weight in spite of good appetite. Other two common complains were swelling of abdomen (47.8%) and gradual dark colouration of skin (43.8%). Cough, swelling of feet and loose motion were less common symptoms. Many patients complained of different vague symptoms that actually had no relevant association with kala-azar.

Physical signs of kala-azar patients as described by the physicians also were different (Table 7.6). Each patient showed two or more physical signs. The two common signs were anaemia and splenomegaly, which were present in 82.9% and 69.7 % cases. Duration of fever was not directly related to size of spleen. Hepatomegaly was present in 42.9% of cases. 29.8% of patients had hepatosplenomegaly. There occurred changes in hair and skin of many patients. Hairs of 24.1% patients became sparse and brittle, skin of 21.5% cases were dry and rough and 30.7% cases showed dusky gray pigmentation of face, hand and feet. Other signs like jaundice, oedema and ascitis were present in less number of cases. Some patients had potbelly and general lethargy. However, majority of the patients despite of fever for long time, were ambulatory, had good appetite and were usually nontoxic.

Bone marrow examinations were performed in 20 cases and spleen aspiration in 5 cases. These were among the patients who were admitted in the Upazilla Health Complex. Iliac crest puncture showed LD bodies abundantly in some cases and very scanty in others. Out of 20 cases of marrow aspiration, 14 became positive and all 5 cases of spleen aspiration were negative. The youngest bone marrow positive case was a child of 5 years and the eldest being 54 years of age.

A total of 77.6% cases responded well to one course of pentavalent antimony (SAG) and 85.9% cases became cured after 10 to 20 more injections (Table 7.7). Patients who responded well to one course means initial cure and those who did not present any signs or symptoms or signs and DAT were negative after 12 months period of follow up means final cure. 17 cases (7.4%) did not show any response even to 40 doses of antimony. DAT remained positive in those cases. 12 cases (5.2%) had relapse of symptoms and showed increase of DAT titre within 12 months of follow up. During the period of study, three deaths occurred. The non-responsive and relapsed cases were given treatment regiment with pendamidine given under supervision. All patients responded remarkable well to pentamidine. The anaemic cases were treated with iron, folic acid and anti-helminthic drug. Prognosis was excellence in majority of cases. Among the three patients who died, two during the course of treatment and the other after one course of SAG was over. These two patients were cachectic and developed jaundice and the exact cause of death could not be ascertained. The second patient had history of pulmonary tuberculosis and also was receiving treatment for that. He had high temperature and most probably died of secondary infection.

During the period of 3 years of study a total of 12 post kala-azar dermal leishmaniasis (PKDL) cases were diagnosed. The age distribution was from 20 to 72 years, of which 8 (eight) of were male and rests were female. 9 (nine) of them had previous history of kala-azar. 3 (three) could not give any previous history of kala-azar. 8 (eight) patients had been given treatment with Brammachary injection (as they mentioned the name of injection). However, they could not mention the exact dose of the injection. The minimum incubation period was 5 years and maximum 20 years. 9 (nine) cases presented with scattered hypo-pigmented rashes on the faces, trunks and less on limbs. 3 (three) cases presented with rashes with small papules and 1 case had few nodules on the trunk. All cases were treated 6 courses of SAG injections with an interval of 10 days. 8 (eight) cases responded remarkably well to that. There occurred disappearance of signs of hypo-pigmentation, papules and nodules. 4 (four) cases responded slowly. However after 12 months period, all became cured.

Table 7.1 Distribution of kala-azar cases per 1000 populations in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 99

Village name	Total popul.	June96-May 97		June97-May 98		June98-May 99	
		N.cases	Prevalence	N.cases	Prevalence	N.cases	Prevalence
Bir Basunda	1279	33	25.8	26	20.3	15	11.7
Pachh Joair	1346	24	17.8	25	18.6	22	16.3
Parki	1151	26	22.5	27	23.4	30	26.1

Table 7.2 : Infection rates of kala-azar cases by households in the study villages of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 99

Village name	No. of houses surveyed each year	No. of affected houses (%)		
		June'96 to May'97	June'97 to May'98	June'98 to May'99
Bir Basunda	281	28 (9.9)	23 (8.1)	12 (4.2)
Pachh Joair	290	22 (7.5)	22 (7.5)	18 (6.5)
Parki	244	25(10.2)	25(10.2)	28 (11.5)

Fig 7.1: Prevalence of kala-azar cases per 1000 populations in the study villages of Kalihati upazilla during June 96- May 99

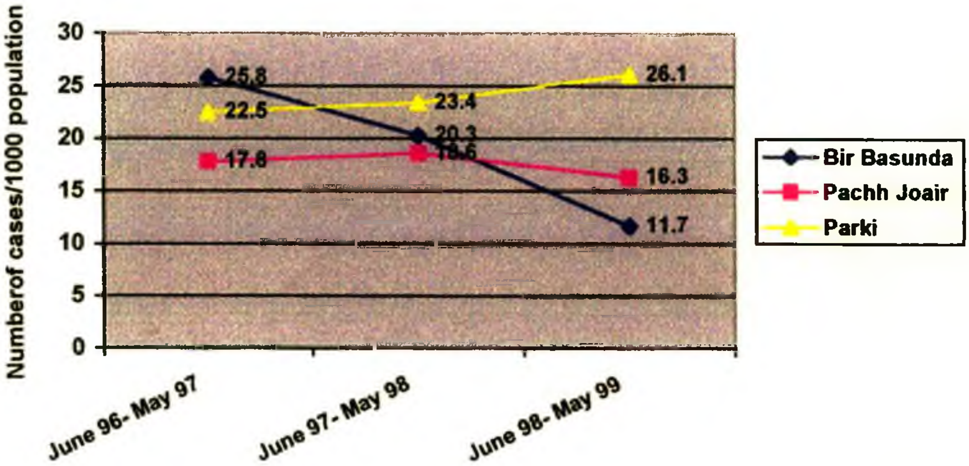


Fig 7.2 : Distribution of kala-azar patients by sex and age group in the study villages of Kalihati upozilla during June 96 -May 99

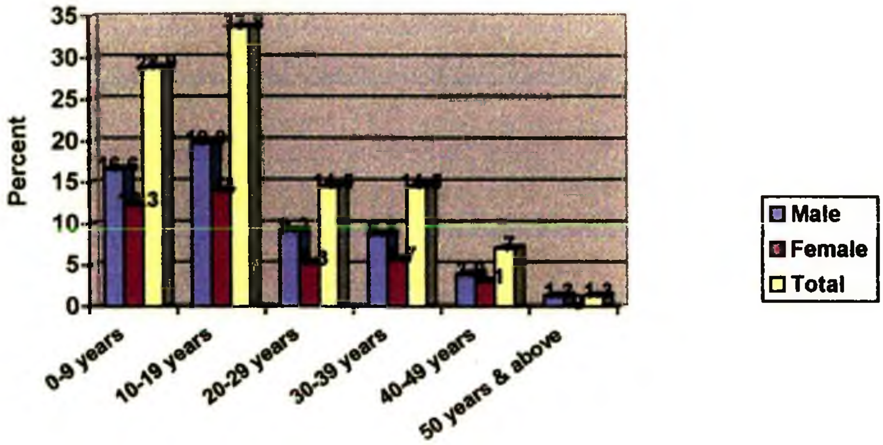


Table 7.3 : Distribution of kala-azar cases by households having cattle sheds in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 97

Village name	Total house	No. houses with cattle shed		No. houses with kala-azar case	
		Present (%)	Absent (%)	Present	Absent
Bir Basunda	281	200 (71.2)	81 (28.8)	28	201
Pachh Joair	290	231 (76.6)	59 (23.4)	22	268
Parki	244	194 (79.5)	50 (20.5)	25	219

Table 7.4 : Distribution of kala-azar cases by serological test (DAT) in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 99

Village name	Total popul.	H/O irregular fever cases	DAT titre		
			< 1:1600	1:1600	1:3200 or more
Bir Basunda	1279	394	215	105	74
Pachh Joair	1346	463	308	84	71
Parki	1151	418	263	72	83
Total	3776	1275	786	261	228

Table 7.5 : Distribution of kala-azar patients by symptoms in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 99

Symptoms	No. of patients	Percent
1. Fever	228	100.0
i. Continuous	126	55.2
ii. Intermittent	75	32.9
iii. Intermittent with double rise	56	24.6
iv. With chill and rigor	34	14.9
vi. Without chill and rigor	161	70.6
2. Loss of weight	95	41.6
3. Cough	34	14.9
4. Swelling of feet	23	10.0
5. Dark colour of skin	100	43.8
6. Swelling of abdomen	109	47.8
7. Loose motion	24	10.5

Table 7.6 : Distribution of kala-azar patients by physical signs in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during the period June96-May 99

Physical signs	No. of patients	Percent
1. Anaemia	189	82.9
2. Jaundice	3	1.3
3. Oedema	68	29.8
4. Ascitis	12	5.2
5. Splenomegaly	159	69.7
6. Hepatomegaly	98	42.9
7. Hepatosplenomegaly	68	29.8
7. Sparse and brittle hair	55	24.1
8. Dry and rough skin	49	21.5
9. Dusky gray pigmentation of skin	70	30.7
Total patients	228	100.0

Table 7.7 : Response of kala-azar patients to treatment with Sodium antimony gluconate (SAG) in the study areas of Birbasunda union, Kalihati upozilla, Tangail, during June96-May 99

Response to treatment by SAG*	No. of patients		Percent	
	Kala-azar	PKDL	Kala-azar	PKDL
Initial cure	177	8	77.6	66.7
Final cure	196	4	85.9	33.3
No response	17	0	7.4	-
Relapse	12	0	5.2	-
Death	3	0	1.3	-

* One course of SAG for kala-azar cases and 6 courses for PKDL cases.

4.8 Entomological investigation of a kala-azar focus in Bangladesh

A total of 1140 female adult sandflies were collected by different catches in selected human dwelling and cattle sheds (Table 8.1). Negligible numbers of sandflies were collected from night landing/biting collection and adhesive paper trap. Two genera of sandflies, *Phlebotomus* spp (38.4%) and *Sergentomyia* spp (61.6%) were captured. Among *Phlebotomus* genus, 437 *Phlebotomus (Euphlebotomus) argentipes* (Annandale and Brunetti) species were collected. *Sergentomyia* genus contained three species. A total of 648 *Sergentomyia babu babu* (Annandale), 25 *Sergentomyia (Parrotomyia) barraudi* (Sinton) and 30 *Sergentomyia (Parrotomyia) shorti* (Adler and Theodor) were captured.

Distribution of female sandflies by different methods from human dwelling (HD) and cattle shed (CS) in percent of total collection are shown in Fig 8.1. *P. argentipes* were less than *Sergentomyia* spp. in all types of collection. Out of total collection, 17.5% and 28.6% were collected from HD and CS in morning resting collection. Again 20% and 33% were collected from HD and CS in evening resting collection. Night landing/ biting and adhesive paper trap yielded only 0.6% and 0.3% of total collection.

Morning resting collections of adult sandflies in human dwellings are shown in Table 8.2. In a total 39.5 man hour of collection 200 sandflies were collected, out of which *Phlebotomus* spp (38.0%) were much less than *Sergentomyia* spp (62.0%). The per man-hour catch (pmh) from inside houses was 5.1. All the above-mentioned four species were present in this collection.

Morning resting collections in cattle sheds are shown in Table 8.3. A good number (326) of sandflies were collected in 28 man-hours with pmh collection 11.6. Predominent spp was S*ergentomyia*. *Phlebotomus* spp consisted 43.3%) and *Sergentomyia* spp 56.7%. The pmh collection in cattle shed was more than in human dwelling in the morning time. But in this collection, in addition to *Phlebotomus argentipes*, only *Sergentomyia babu babu* was collected.

Evening resting collection of sandflies from human dwelling (Table 8.4) and in and around cattle sheds (Table 8.5) yielded 226 and 377 sandflies of the two genera respectively. In human dwelling, the pmh collection was 7.0 and in cattle shed 8.3. *Sergentomyia* spp was the predominant during these collections being, 61.1% and 65.5% of total collections respectively.

Night biting collections yielded few sandflies. Only 2, 3 and 2 sandflies were found during collection in the month of May, July, and September respectively. Of these 7 (seven) sandflies, 2 (two) were *P. argentipes* and rests were *Sergentomyia.* No sandfly was found during the rest three visits. Adhesive papers traps also yielded only 4 (four) *Sergentomyia* spp, in the month of July. Many adhesive trap were found full of dead ants. No sandfly was collected from CDC light trap.

The results of the susceptibility tests to deltamethrin indicated that *P. argentipes* was susceptible to deltamethrin (Table 8.6). Of the sandflies under test, on average, 60.0% were knocked down immediately (within 30 minutes) and had 100% mortality after 24 hours on three successive days.

Table 8.1: Distribution of female sandflies by species collected in the study villages of Bir Bashinda union, Kalihati upozilla, Tangail district during July 1996 - May 1997

Name of sandfly species	Number	Percent
Phlebotomus argentipes	437	38.4
Sergentomyia babu babu	648	56.8
Sergentomyia barraudi	25	2.2
Sergentomyia shorti	30	2.6
Total	1140	100.0

Table 8.2 : Morning resting collections of female sandflies in the selected human dwellings of the study villages of Bir Bashinda union, Kalihati upozilla, Tangail district during July 1996 - May 1997

Months	Total man hour collec.	Total number collec. (per man hour)	Species of sandfly	
			P.argentipes (pmh)	*Sergentomyia* spp. (pmh)
July 1996	6.0	40 (6.6)	16 (2.6)	24 (4.0)
September1996	6.5	35 (5.3)	10 (1.5)	25 (4.1)
November 1996	8.0	37 (4.6)	12 (1.5)	25 (4.4)
January 1997	6.0	14 (2.3)	5 (0.8)	9 (1.5)
March 1997	7.0	26 (3.7)	10 (1.4)	16 (2.3)
May 1997	6.0	48 (8.0)	23 (3.8)	25 (4.1)
Total	39.5	200 (5.1)	76 (1.9)	124 (3.1)
Total percent of collection		200 100%	76 38.0%	124 62.0%

Fig 8.1: Distribution of female sandflies by different methods of collection in the study areas of Kalihati upazilla during July 96 - May 97

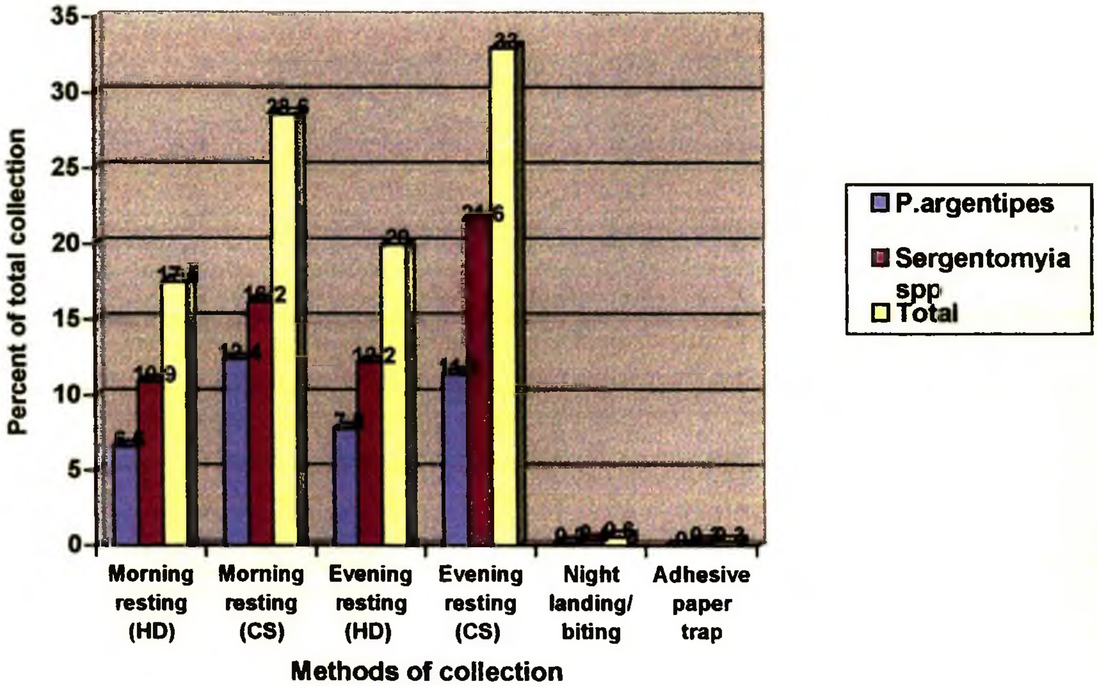


Table 8.3 : Morning resting collections of female sandflies in the selected cattle sheds of the study villages of Bir Bashinda union, Kalihati upozilla, Tangail district during July 96-May 97

Months	Total man hours collec.	Total number collec. (pmh)	Species of sandfly	
			P.argentipes (pmh)	*Sergentomyia* spp. (pmh)
July 1996	4.0	104 (18.5)	46 (11.5)	58 (14.5)
September1996	4.5	45 (11.2)	22 (4.4)	23 (4.5)
November 1996	5.0	38 (7.6)	28 (7.0)	10 (2.5)
January 1997	4.5	22 (5.5)	4 (1.0.)	43 (4.5)
March 1997	4.0	39 (9.7)	10 (2.5)	29 (7.2)
May 1997	6.0	78 (13.0)	31 (5.1)	47 (7.8)
Total	28.0	326 (11.6)	141 (5.0)	185 (6.6)
Total percent of collection		326 100%	141 43.3%	185 56.7%

Note : pmh= per man hour catch

Table 8.4 : Evening resting collections of female sandflies in the selected human dwellings of the study villages of Bir Bashinda union, Kalihati upozilla, Tangail district during July 1996 - May 1997

Months	Total man hours collec.	Total number collec. (pmh)	Species of sandfly	
			P.argentipes (pmh)	*Sergentomyia* spp. (pmh)
July 1996	5.0	44 (8.8)	16 (3.2)	28 (5.6)
September1996	4.5	25 (5.5)	10 (2.2)	15 (3.3)
November 1996	5.0	38 (7.6)	17 (3.7)	21 (4.3)
January 1997	4.5	42 (9.3)	22 (4.4)	20 (4.7)
March 1997	6.0	39 (6.5)	11 (1.8)	28 (4.6)
May 1997	7.0	38 (5.4)	12 (1.7)	26 (3.7)
Total	32.0	226 (7.0)	88 (2.7)	138 (4.3)
Total percent of collection		226 100%	88 38.9%	138 61.1%

Note : pmh= per man hour catch

Table 8.5 : Evening resting collections of female sandflies in the selected cattle sheds of the study villages of Bir Bashinda union, Kalihati upozilla, Tangail district during July 1996 - May 1997

Months	Total man hours collec.	Total number collec. (pmh)	Species of sandfly	
			P.argentipes (pmh)	*Sergentomyia* spp. (pmh)
July 1996	7.0	78 (11.1)	26 (3.7)	52 (7.4)
September1996	7.5	59 (7.8)	17 (2.2)	42 (5.6)
November 1996	8.0	73 (9.1)	22 (2.7)	51 (6.4)
January 1997	7.5	54 (7.2)	24 (3.2)	30 (4.0)
March 1997	7.0	39 (5.5)	10 (1.4)	29 (4.1)
May 1997	8.0	74 (9.2)	31 (3.9)	43 (5.3)
Total	45.0	377 (8.3)	130 (2.8)	247 (5.5)
Total percent of collection		377 100%	130 34.5%	247 65.5%

Note : pmh= per man hour catch

Table 8.6: Susceptibility of *P.argentipes* to deltamethrin

Insecticide	No. *P.argentipes* exposed	Period of exposure	No. (%) knock down after 30 minutes	No (%) mortality after 24 hours
Deltamethrin	60	30 minutes	48 (60.0%)	60 (100%)
Control	30	30 minutes	0 (0%)	2 (3.3%)

4.9 Impact of deltamethrin impregnated bednet on prevalence of kala-azar in selected villages of a kala-azar endemic area of Bangladesh

1. Demographic characteristic

The age and sex distribution of the villagers of the selected three villages, Bir Basunda, Pachh Joair and Parki of Bir Basunda union of Kalihati upozilla under Tangail district during the baseline survey on June 1996 to May 1997 has been shown in Table 9.1. In total there were 3776 members in 815 households of the three villages giving a figure of 4.6 persons per house. The figure coincides to our national figure (BBS, 1999). Among them, 1951 (51.7%) were male and 1825 (48.3%) were female, giving male female ratio 1.07:1.

Regarding age wise distribution, children of age group 0-9 comprised 28.0% and those of 10-19 age group comprised 23.4% of total population of the villages. More than 50% of the people are below 20 years of age, which indicates the population growth is still in increasing trend in the rural area of the country. The proportion gradually decreased with older and older age group. 15.5% and 12.2% of the population were in the age group of 20-29 and 30-39 years respectively. Only 4.5% of the whole population were of 60 or more than 60 years of age.

2. Socio-economic condition

i. Education level

The education level of the household members has been shown in Fig 9.1. The literacy rate was calculated among members of 7 years or above (BBS, 1999) and upto 6 years were considered children, which consisted 15.9% of the total population. The literacy rate in the study areas was 33.2%. Among the literate members, 18.7% had education of primary level (class 1-V), 8.1% of secondary level (Class VI-X), 3.4 % passed SSC or HSC and only 1.2 % had education of graduation level or above. 1.8 % of people had informal education i.e. they were able to read and write Bengali but did not go to school. A big proportion of people (50.9 %) were found illiterate. They did not know how to sign their names even.

ii. Occupation

The occupation of the people has been shown in Fig 9.2. Out of total populations of the three villages, 15.9% were children, 16.3% were students and 24.1% were housewives. Only about 40% of the populations were engaged in some income generating activities. 22.0% were found to have cultivation as the main occupation. Among them 5.6% cultivated their own land and 16.4 % cultivated others land either only or in addition to their own land. They were followed by day labours (10.9%). 3.1% of the people were engaged in business and service holders were 2.8%. 4.9% of the people were just dependents on the family or of old age.

iii. Average monthly income

The average monthly incomes of the families have been shown in Fig 9.3. Out of a total 815 households, the highest number (47.8%) was in the income group of range Tk.3001 –5000. The second highest number was in the income upto Tk.3000 per month comprising 41.5% of the families. Only 10.7% of the families had income of Tk.5001 – 7000. None found to have income more than Tk.7000 per month.

iv. Land ownership

Distribution of households by agricultural land ownership has been shown in Fig 9.4. About 25% of the families had no agriculture land and 45.7% had less than 5 bigha land. 19.5 % had 6-15 bigha agriculture land. Only 9.8 % had more than 15 bigha land.

v. Housing condition

The housing condition of 815 households has been shown in Fig 9.5. It was observed that the highest number (44.4%) of houses was made of hatch and mud. The next highest number (34.8 %) of houses was made of tin and mud, 13.9 % of houses made of tin only. Rest 6.1% was semi-pacca buildings. Only 0.8% of houses was found to be built of bricks.

vi. Cattle shed and its proximity to the living room and presence of kala-azar case

The presence of cattle sheds in households and its proximity to living room and presence of kala-azar in the houses has been shown in Table 9.2. Out of 815 households, 625 (76.7%) possessed cattle sheds. Of the sheds 378 (60.8%) were built in close proximity to the dwelling house. 247 (39.2%) cattle sheds were situated at a distance of more than 5 meters. Walls of the cattle sheds were made of mud and roofs either of thatch or tin. During the base line survey a total of 83 kala-azar cases were diagnosed in the three villages, of them 69 (83%) were from the dwellings possessing cattle sheds.

vii. Surrounding of the houses

The presence of bushes and drains surroundings of the houses and presence of kala-azar in the houses has been shown in Table 9.3. Both the bushes and drains were present within 5 meter of the surroundings of the houses in 24.5% cases. Only bushes or drains were present in 38.5% and 20.6% dwellings respectively. 17.3% houses had neither bushes nor drain. The surroundings were dirty i.e. collection of water was present in 80 % of the houses.

3. Mosquito net related behaviour

i. Possession of mosquito nets

During baseline survey, it was observed that out of total households, 88.4% households possessed mosquito nets either one or more than one and 11.6% households did not possess any net (Fig 9.6). Financial constrains was the main reason of not using nets as the respondents described. Of those who possessed mosquito nets, 26% families had only one net each, 43.9% two to three nets and 18.5% possessed more than three nets. The only single nets in the houses of 26%of the families were generally used for the babies or children. Grown up persons used to sleep without nets. The well to do families had sufficient nets for all the members to sleep under nets and they purchased the nets of their own. From the information received during the survey, it is known that a total of 1500 nets were available in using condition in the villages.

ii. Use of mosquito net

Practice of people about use of mosquito net has been shown in Fig 9.7. During baseline survey, it was observed that out of total households, 88.4% households possessed mosquito nets either one or more than one. Out of them, 52% households used the nets regularly, 27% irregularly and 15% occasionally. 6% households did not use nets any time.

iii. Sleeping time of the people

Table 9.4 shows the sleeping time of the members of the households. It was found that most of the children (up to 9 years) (60%) used to go to bed just after sunset or within 2 hours of sunset and the remaining children (40%) used to go to bed within 2-5 hours of sunset. Sometimes few children remained awake up to mid night, but that was on rare occasion.

Amongst young and adults males, 60.4% used to go to bed within 2-5 hours of sunset, 27.5% within 2 hours of sunset and only 12.1% slept after 5 hours of sunset. Amongst young and adult female 17 % used to go to bed within 2 hours of sunset, 70 % slept 2-5 hours after sunset and 13% nearly about midnight.

iv. Washing practice of the nets

Fig 9.8 shows the washing practice of the mosquito nets by the respondents of the households. The households that possessed nets, all their respondents used to wash the nets with soap and water. Maximum (73.3%) used to wash the mosquito nets within 2-6 months interval, 16.9% of the households either monthly or on alternate months and 9.8% at more than 6 months interval.

4. Knowledge, attitude and practice regarding kala-azar

i. Knowledge about the cause of kala-azar

Fig 9.9 shows the knowledge of the respondents of the households about the cause of kala-azar. 100% of the respondents knew the name of the disease kala-azar. There were some local names of kala-azar like 'peelai', 'kala barum' etc. Most of the respondents were confused about the cause of kala-azar. When they were given some hints and asked them to give one answer, still 31.7% told that they could not mention any cause. Maximum people (42.4%) answered that mosquito bite was the cause of kala-azar. 4.4% of the respondents had the idea that sand fly bite was responsible for kala-azar. However none of them knew any further about the breeding, resting or feeding behaviour of sandfly. Rest of the respondents mentioned different causes like 8.7% answered dirty surrounding was responsible for kala-azar, 5.5% and 6.1% told that it was an air borne and water borne disease respectively.

ii. Practices for prevention and control of kala-azar

Practice for prevention and control of kala-azar by the respondents has been shown in Fig 9.10. About 19% of the respondents told that they were not practicing any method, 45.4% answered that they were using mosquito nets. However many of them had the idea that DDT spraying would be better method to control kala-azar. They thought that mosquito nets only prevented mosquito nuisance, but did not kill mosquito and so could not control kala-azar. 35.6% told environmental management like filling the water collection were the best method for controlling kala-azar as dirty environment, air or water were responsible for kala-azar.

5. Observation from night visit

i. Bed net usage

The night visits were performed between 9 am to 11 PM without any notice to the residents of some randomly selected houses. The night-time inspection done to observe the community compliance of bed net usage in area A and B (Table 9.5). During the visits acceptability and practice of impregnated bed nets to the rural people were observed. It was observed mosquito nets were available in all the houses. In village Bir Basunda where deltamethrin impregnated bed nets were distributed, a total of 524 bed nets were checked during June 1997 to May 1998. Out of 524 nets, 83.6% nets were available in properly using condition, 14.1% nets were noticed not in hanging position, 2.3% nets were not used at all. On the next year, 90.9% nets were observed in properly using condition and 7.7% were observed improperly used. But almost all the nets were very dirty or sometimes in torn condition. Again in the village Pachh Joair where non-impregnated bed nets were distributed, a total of 500nets were checked during June 1997 to May 1998. Only 77.2% of the nets were found in proper position and 21.0% in improper condition. Next year there occurred improvement in use of nets. 82.3%. Of the checked nets were found in properly using condition and 14% nets were in that condition.

It was further observed that all the children of the visited houses were found sleeping under nets. Nearly 50% of the adults were found to sleep under net, 50% awake and negligible number sleeping without net.

ii. Reimpregnation

During rechecking the nets of the households of the village Bir Basunda at the end of two years, it was observed that 34.9% of the households reimpregnated their nets four times, 48.4% three times, 11.4% two times and 3.6% respondents reimpregnated only once. Only 1.7% families did not reimpregnate anytime after the initial impregnation during distribution (Table 9.6).

6. Effect of ITBN on the density of sandfly and prevalence of kala-azar

To evaluate the effect of the impregnated mosquito net on the prevalence of kala-azar, the difference of the density of *Phlebotomus argentipes* and prevalence of kala-azar cases between the 1st, 2nd and 3rd year were calculated.

The records of collection of female *Phlebotomus argentipes* sandflies collected from human dwelling (expressed as per man-hour) during the pre-intervention period and the post-intervention period of the second and third year in the three villages, Bir Basunda, Pachh Joair and Parki of Bir Basunda union of Kalihati upozilla are given in Table 9.7. In the impregnated bed net area (area A) during the 1st year the density was 2.3, which decreased to 0.5 and 0.05 respectively in the following two years after intervention. In the non-impregnated bed net area (area B) the female *Phlebotomus argentipes* density was 2.0 during the 1st year that increased to 2.4 in the 2nd year though bed nets were distributed in the village so that all the villagers got access to the nets. However in the 3rd year of study the sandfly density remained same (2.4 pmh). In the control area (area C), per man-hour collection of female *Phlebotomus argentipes* was 2.6 during the pre-intervention period. In the next two years that increased to 3.6 and 3.7 respectively.

The result of parasitological survey as prevalence of kala-azar cases per 1000 population (Table-9.8) showed a decreasing trend from 25.8 to 20.3 and 11.7 in the respective three years of survey in area A where deltamethrin impregnated bed nets were distributed. In the non-impregnated area (area B) the prevalence of kala-azar cases per 1000 population was 17.8 during baseline survey. In the following year there occurred an increase in the prevalence to18.6. However in the 3rd year the prevalence decreased to 16.3. In the control area, the prevalence showed higher trend in the subsequeny years. In the 1st, 2nd and 3rd years of study, the prevalence of kala-azar cases per 1000 population were 22.5, 23.4 and 26.1 per 1000 population.

Table 9.1: Distribution of population of the study villages of Bir Basunda union of Kalihati upozilla under Tangail district by sex and age group during the baseline survey June 1996- May 1997.

Sex	Age in years							Total (%)
	0-9	10-19	20-29	30-39	40-49	50-59	60 & +	
Male	570	449	314	264	175	110	69	1951 (51.7)
Female	487	436	268	196	194	141	103	1825 (48.3)
Total (%)	1057 (28.0)	885 (23.4)	582 (15.5)	460 (12.2)	369 (9.7)	251 (6.7)	172 (4.5)	3776 (100)

Table 9.2 : Distribution of households by possession of cattle sheds and presence kala-azar cases in the study villages of Bir Basunda union of Kalihati upozilla under Tangail district during the baseline survey June 1996-May 1997.

Kala-azar cases	Cattle shed		Total
	Present	Absent	
Present	69	14	83
Absent	556	176	732
Total	625	190	815

Fig 9.1: Distribution of population by educational qualification in the study villages of Kalihati upazilla during June 96- May 97

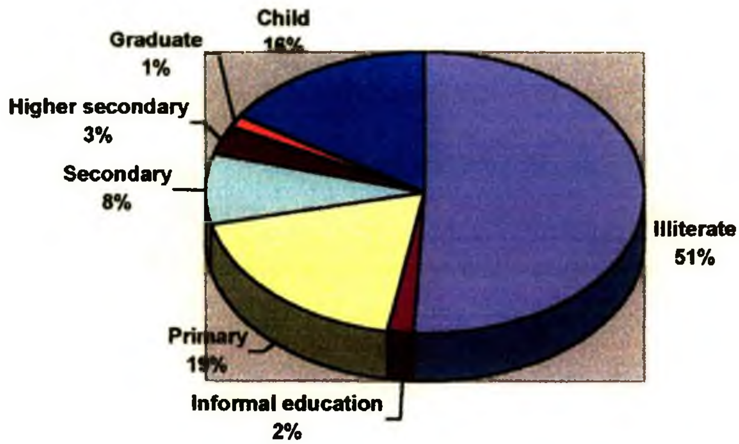


Fig 9.2 : Distribution of population by occupation in the study villages of Kalihati upozilla during June 96-May 97

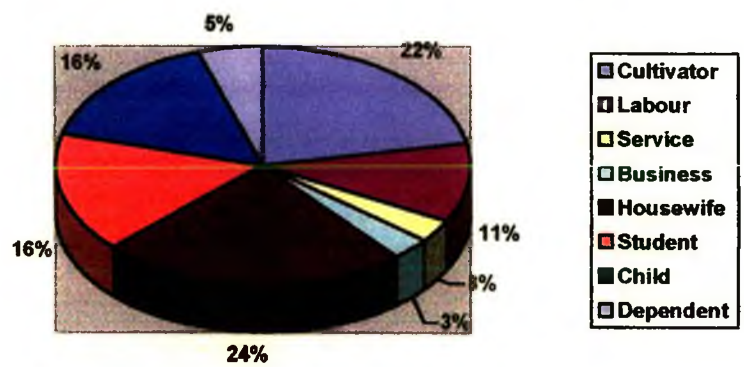


Fig 9.3: Distribution of households by average monthly income in Taka in the study villages of Kalihati upozilla during June 96-May 97

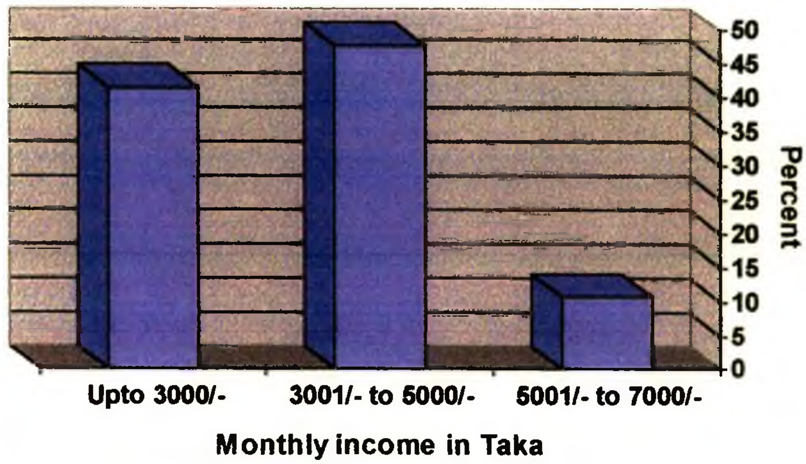


Fig 9.4: Distribution of households by agricultural land ownership in the study villages of Kalihati upalila during June 96-May 97

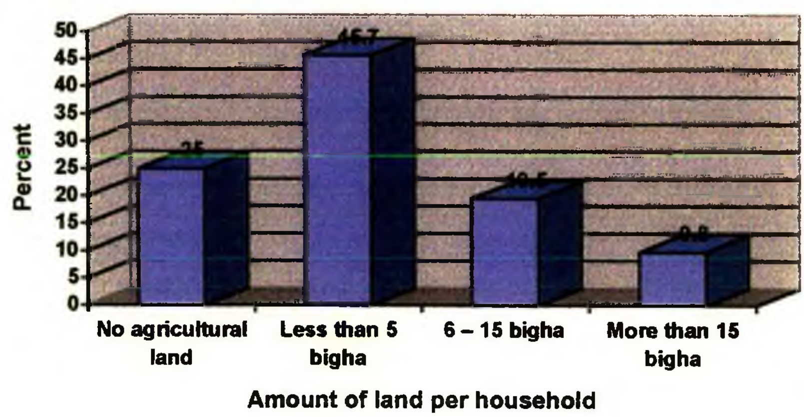


Fig 9.5: Distribution of households by housing conditions in the study villages of Kalihati upozilla during June 96-May 97

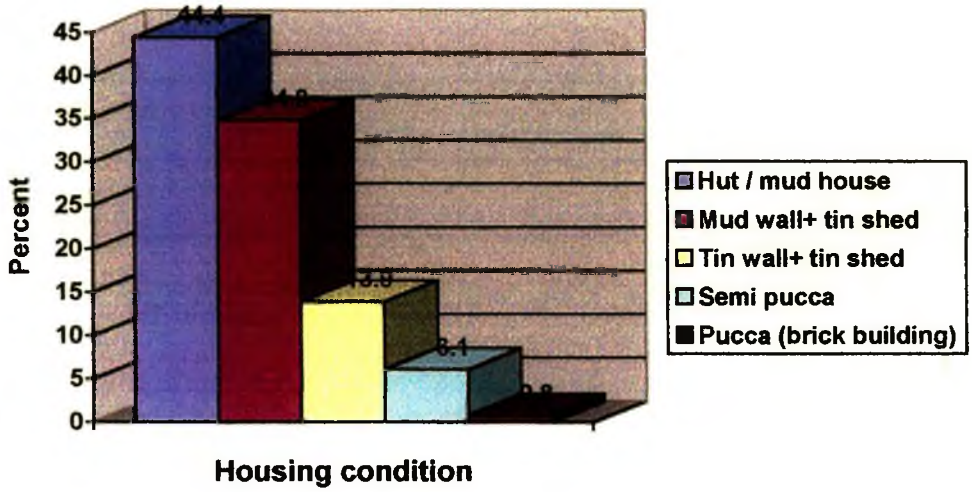


Fig 9.6: Distribution of households by possession of bed nets in the study villages of Kalihati upozilla during June 96-May 97

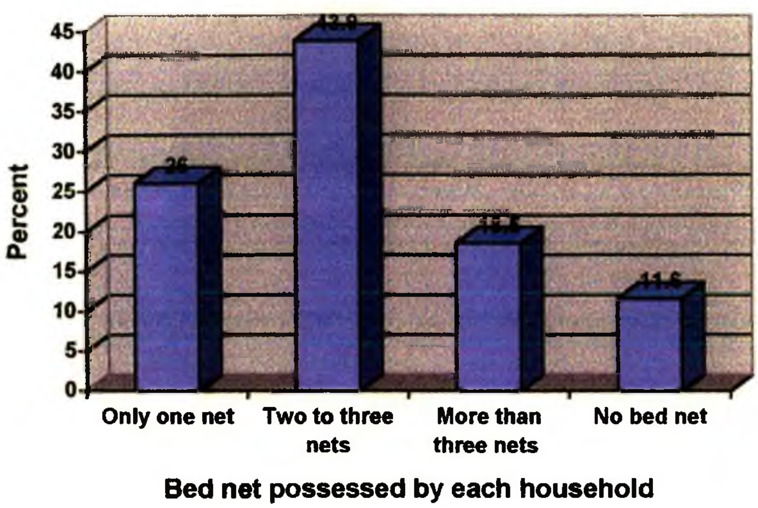


Fig 9.7: Distribution of households by use of mosquito net in the study villages of Kalihati upozilla during June 96-May 97

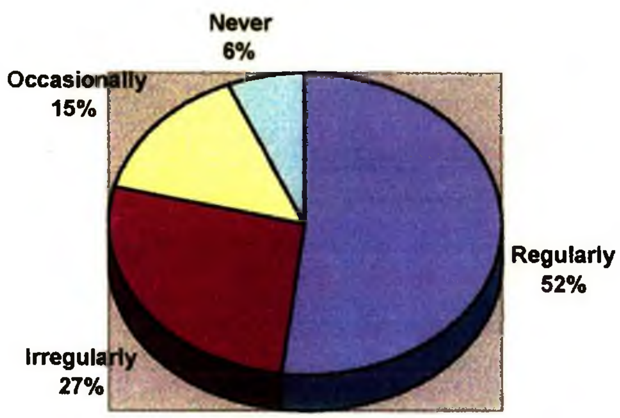


Fig 9.8 : Distribution of households by washing practice of the mosquito nets in the study villages of Kalihati upazilla during June 96-May 97

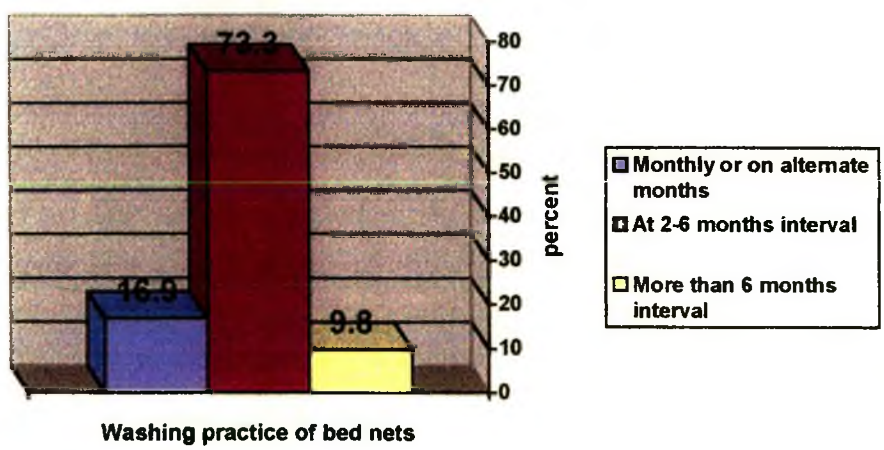


Table 9.3 : Distribution of households by possession of bushes and drains and presence kala-azar cases in the study villages of Bir Basunda union of Kalihati upozilla under Tangail district during the baseline survey June 1996-May 1997.

Kala-azar cases	Bushes and drains				Total
	Both present	Bush	Drain	Both absent	
Present	18	25	17	23	83 (10.2%)
Absent	182	289	151	118	732 (89.8%)
Total	200 (24.5%)	314 (38.5%)	168 (20.6%)	141 (17.3%)	815 (100.0%)

Table 9.4: Distribution of population by sleeping time in the study villages of Bir Basunda union of Kalihati upozilla under Tangail district during the baseline survey June 1996-May 1997.

Sleeping time	Children		Young and adult male		Young and adult female	
	No.	(%)	No.	(%)	No.	(%)
Within 2 hours of sunset	634	(60.0)	380	(27.5)	227	(17.0)
Within 2-5 hours of sunset	423	(40.0)	833	(60.4)	938	(70.0)
After 5 hours of sunset	0	-	168	(12.1)	175	(13.0)
Total	1057	(100.0)	1381	(100.0)	1338	(100.0)

Table 9.5 : Observation during night time inspection about community compliance of bed net usage in area A (impregnated bed net) and area B (non-impregnated bed net) during June1997 – May1999

	Area A (impregnated bed net)		Area B (non-impregnated bed net)	
	June1997 - May1998	June1998 – May1999	June1997 - May1998	June1998- May1999
	No. (%)	No. (%)	No. (%)	No. (%)
No. of bed net checked	524 (100.0)	286 (100.0)	500 (100.0)	350 (100)
No. of bed net properly used	438 (83.6)	260 (90.9)	386 (77.2)	288 (82.3)
No. of bed net improperly used	74 (14.1)	22 (7.7)	105 (21.0)	49 (14.0)
No. of bed net not used	12 (2.3)	4 (1.4)	9 (1.8)	13 (3.7)

Table 9.6 : Distribution of households by re-impregnation of mosquito nets in area A (impregnated bed net) of Bir Basunda union of Kalihati upozilla under Tangail district during the period of June 1997-May 1999.

Re-impregnation done	Number of households	Percent
Four times	98	34.9
Three times	136	48.4
Two times	32	11.4
One time only	10	3.6
Never	5	1.7
Total	281	100.0

Fig 9.9: Distribution of respondents by knowledge about the cause of kala-azar in the study villages of Kalihati upazilla during June 96-May 97

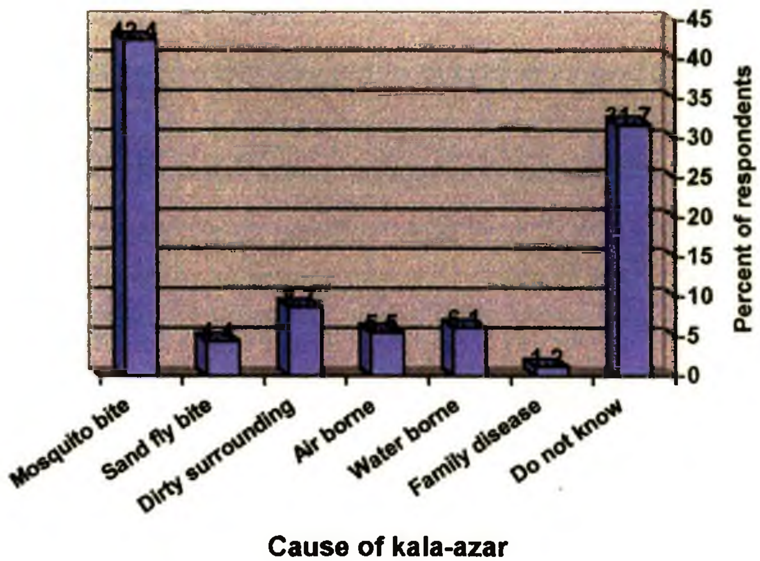


Fig 9.10: Distribution of households by practices for prevention and control of kala-azar in the study villages of Kalihati upazilla during June 96-May 97

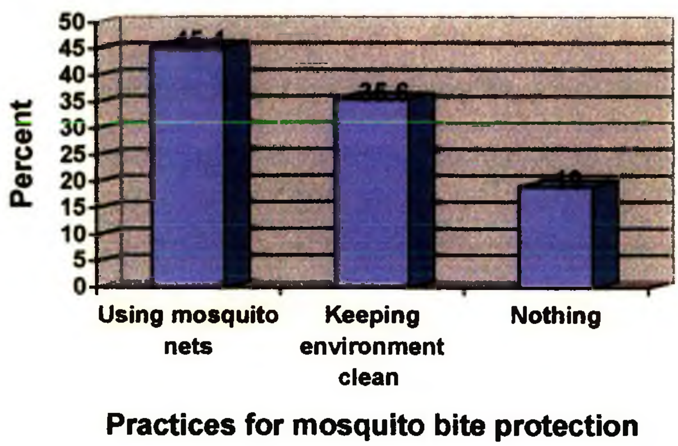


Plate-7 Cattle shed situated close to human dwelling.

Plate-8 Trough- a common breeding place of sandfly.

Plate-9 Collecting soil samples for detecting sandfly larva.

Plate-10 Collecting blood sample from a kala-azar patient.

Plate-11 Examining a kala-azar patient.

Plate-12 Examining a kala-azar patient.

Table 9.7: Density of female *Phlebotomus argentipes* sandfly collected from human dwelling (expressed as per man-hour) during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year (June 1997-May 1999) in the selected villages of

<table>
<tr><td rowspan="2">Year</td><td colspan="3">Impregnated bed net area</td><td colspan="3">Non-impregnated bed net area</td><td colspan="3">Control area</td></tr>
<tr><td>Man-hour spent</td><td>Total collec-tion</td><td>Per man hour</td><td>Man-hour spent</td><td>Total collec-tion</td><td>Per man hour</td><td>Man-hour spent</td><td>Total collec-tion</td><td>Per man hour</td></tr>
<tr><td>June 96-May 97</td><td>24</td><td>55</td><td>2.3</td><td>24</td><td>48</td><td>2.0</td><td>23.5</td><td>61</td><td>2.6</td></tr>
<tr><td colspan="10">INTERVENTION</td></tr>
<tr><td>June 97-May 98</td><td>26</td><td>14</td><td>0.5</td><td>30</td><td>72</td><td>2.4</td><td>25</td><td>89</td><td>3.6</td></tr>
<tr><td>Decrease(D) / Increase(I)</td><td colspan="3">Per man-hour 1.8 (D)</td><td colspan="3">Per man-hour 0.4 (I)</td><td colspan="3">Per man-hour 1.0 (I)</td></tr>
<tr><td>June98-May99</td><td>36</td><td>2</td><td>0.05</td><td>32</td><td>77</td><td>2.4</td><td>27</td><td>100</td><td>3.7</td></tr>
<tr><td>Decrease(D) / Increase(I)</td><td colspan="3">Per man-hour 0.45 (D)</td><td colspan="3">Per man-hour no change</td><td colspan="3">Per man-hour 0.1 (I)</td></tr>
</table>

Table 9.8: Differences in the prevalence of kala-azar per thousand populations during pre-intervention period (June1996 to May1997) and the post-intervention period of the second and third year in the selected villages of the study areas

Village name	Total population	June96-May97		INTERVENTION	June97- May98			June98-May99		
		No. cases	Prevalence		No. cases	Prevalence	Difference (1st-2nd yr)	No. cases	Prevalence	Difference (2nd-3rd yr)
Bir Basund	1279	33	25.8		26	20.3	5.5 (decrease)	15	11.7	8.6 (decrease)
Pachh Joair	1346	24	17.8		25	18.6	0.8 (increase)	22	16.3	2.3 (decrease)
Parki	1151	26	22.5		27	23.4	0.9 (increase)	30	26.1	3.6 (increase)

4.10 Effect of flood on sandfly density and prevalence of kala-azar in a kala-azar endemic village of Bangladesh

Sandfly larvae detected in soil samples collected during and post flood period from July '98 to June '99 in the village Dhalia of Bhaluka Upazilla and the adult sandflies emerged were noted in Table-10.1. The table shows that in the month of July to September'98, all the possible breeding places from ground level up to 60cm. height were submerged under water. Immature stages were searched from the mud wall of human dwelling and cattle sheds at the height of 60+ to 90 cm. from ground level and 2.7%, 2.4% and 2.2% of the wall scrapings were found positive during the month of July, August and September'98 respectively. While water was coming down from October '98 no larva was detected at that level since then. Positive scrapings were found in 5.2% and 5.6% samples at 30-60 cm. and up to 30 cm. heights in October '98 while the ground levels were still lodged with water. In the month of November '98 the village was totally free from floodwater and the ground level became dry with optimum humidity and 6.6% samples from ground level became positive. The study revealed that the longevity of egg of sandfly may lasts up to 3-4 months even under water, as the larvae were detected even while flood is over. During the follow up study from November '98 to June '99, no larva was detected above 30 cm. level. Except the month of January and May '99, larvae were detected from earth scrapings as 3.2%, 2.3%, 2.2%, 3.2% and 1.4% in the month of December '98, February, March, April and June '99 respectively as high as 30 cm. up house walls. In that study, 7.2%, 4.4%, 3.2%, 4.2%, 4.5%, 4.3% and 4.3% of soil samples became positive in the breeding of larvae at ground levels in the month of December '98 to June '99 respectively. Table-1 also shows that out of total 48 larvae detected during the whole period of observation, 13 emerged to adult of which 6 (46%) were identified as *Phlebotomus* *argentepes,* the proven vector of kala-azar in this subcontinent (Swaminath *et al.* 1942). Highest percentage of adult sandflies from immature stages was 50% in the month of May and June '99 and next highest (33.3%) in December '98 and April '99.

Sandfly density was calculated as per man-hour collection during the study period, which was compared with our previous study in the same place and was plotted in Fig-10.1. During flood period sandfly density was lowest on July and August '98. On October and November '98 the density increased but again decreased during the winter months and then gradually increased and became maximum on June '99. On the previous year peak density was observed in July '97. It was high from July to October '97 and then gradually decreased in the cold months. With the onset of warm weather its density started to increase (Fig-1). The trend of sandfly density during both studies was similar but there was significant difference as detected by paired sample T test [95% confidence interval of the difference- lower 2.70 and upper 9.56, t value 3.93, df-11 and Sig (2 tailed) .002].

About 80% of populations in the selected houses were tested serologically using Direct Agglutination Test (DAT) and Aldehyde test (AT). A total of 652 blood samples were tested and 32 became serologically positive. Among them 21 (65.6%) were male and 11(34.4%) were female (Table 10.2). Age distribution of the cases shows that children under 5 years of age were not victim to kala-azar whereas among the young of 16-20 years of age maximum (<50%) cases were detected followed by age group 6-15 years (Table-2) and the next were among 21 +years of age. Regarding occupation, 43.7% of the positive cases were cultivators or day labours followed by jobless (18.7%), students (15.6%), child (12.5%) and housewives (9.5%). The 32 sero-positive cases were confirmed by observing *Leishmania donovani* by microscopic examination of bone marrow. Of them, 5(15.6%) were asymptomatic, 20 (62%) were clinically positive and 7 (21.9%) were both clinically and bone marrow positive. Total number of DAT +ve cases during the previous 12 months was 40. The monthly trend was plotted in Fig 10.2. The difference between the prevalence of kala-azar is not statistically significant as detected by paired sample T test [95% confidence interval of the difference- lower -.32 and upper 1.66, t value 1.48, df-11 and Sig (2 tailed) .166].

Among the 32 DAT +ve cases, who received chemotherapy (SAG with a 20 day regimen of 20mg/ kg/ day, not exceeding 850 mg per day), 30 (93.75%) became completely cured and the rest needed 20 more injections at the same doses.

Table 10.1 Positive for breeding of sandfly larvae in soil samples collected at different heights in flood and post-flood months (July '98 - June '99) in village Dhalia of Bhaluka Upazilla under Mymensingh District

Month/Year	No. of scrapping samples/(No. of larvae)/positive %				Total soil samples	No. of adult
	60-90 cm level	30-60 cm level	Up to 30 cm level	On ground level	(Total sandfly larvae)	emerged (%)
July'98	108 (3) 2.7%	LW	LW	LW	108 (3)	0
August'98	124 (3) 2.4%	LW	LW	LW	124 (3)	0
Septem'98	92 (2) 2.2%	LW	LW	LW	92 (2)	1 (25%)
October'98	32 (0)	38 (2) 5.2%	53 (3) 5.6%	LW	123 (5)	1 (20%)
Novem'98	28 (0)	35 (1) 2.8%	38 (2) 5.2%	30 (2) 6.6%	131 (5)	0
Decem'98	15 (0)	24 (0)	62 (2) 3.2%	55 (4) 7.2%	165 (6)	2 (33.3%)
January'99	12 (0)	38 (0)	44 (0)	68 (3) 4.4%	162 (3)	0
February'99	10 (0)	40 (0)	42 (1) 2.3%	62 (2) 3.2%	154 (3)	0
March'99	9 (0)	32 (0)	44 (1) 2.2%	70 (3) 4.2%	155 (4)	1 (25%)
April'99	9 (0)	24 (0)	62 (2) 3.2%	88 (4) 4.5%	183 (6)	2 (33.3%)
May'99	8 (0)	18 (0)	54 (0)	92 (4) 4.3%	172 (4)	2 (50%)
June'99	10 (0)	12 (0)	68 (1) 1.4%	104 (5) 4.8%	194 (6)	3 (50%)

Note : LW - Lodged under water

Table10.2 Age distribution among male and female kala-azar cases in village Dhalia of Bhaluka Upazilla under Mymensingh District during the period July '98 to June'99

Sex	0-5 years age	6-15 years age	16-20 years age	21+ years age	Total
Male	1 (4.76%)	5 (23.6%)	12 (57.14%)	3 (14.28%)	21 (65.56%)
Female	0	2 (18.18%)	7 (63.64%)	2 (18.18%)	11 (34.44%)
Total	1 (3.12%)	7 (21.87%)	19 (59.37%)	5 (15.62%)	32 (100%)

Fig-10.1 : Sandfly density in village Dhalia of Bhaluka thana under Mymensingh district during the period of July 97 to June 99

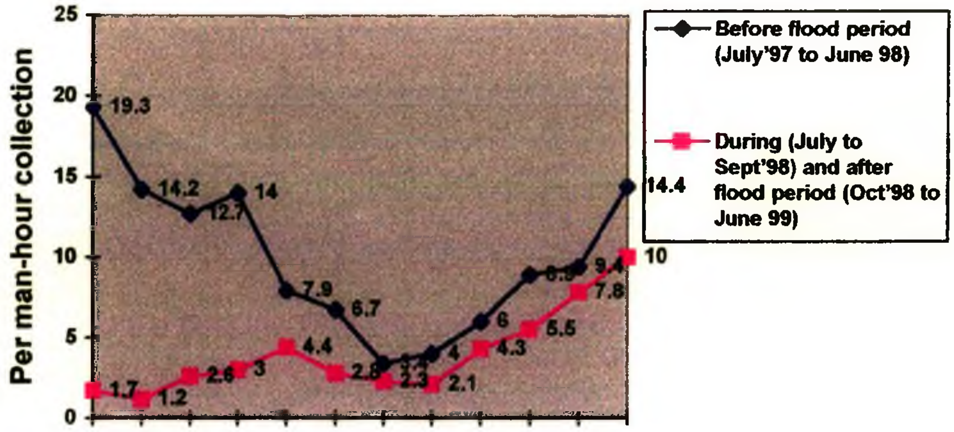
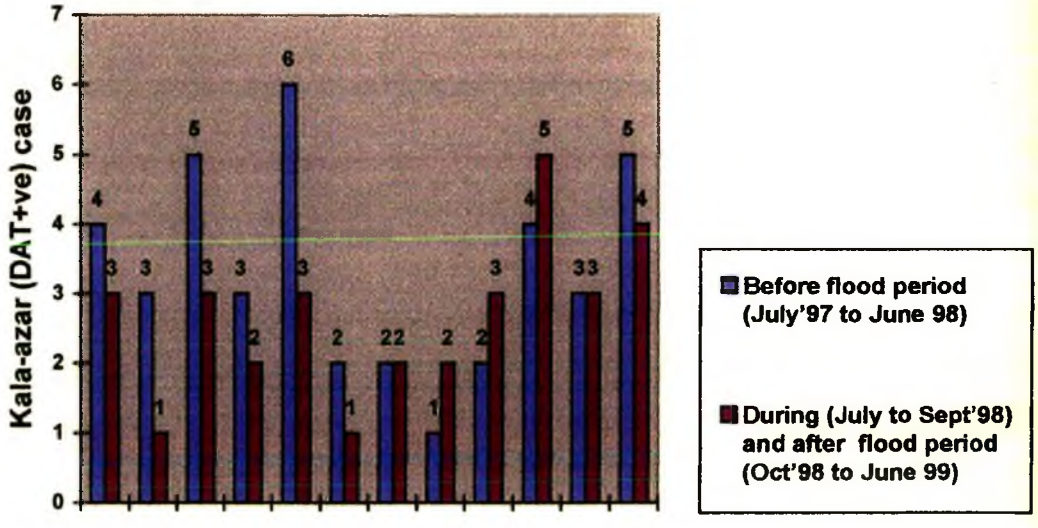


Fig 10.2 : Kala-azar (DAT +ve) cases in the village Dhalia of Bhaluka thana under Mymensingh district during the period of July97 to June 99



CHAPTER 5

DISCUSSION

General discussion

Malaria, filaria and kala-azar are three vector borne diseases in Bangladesh. From the epidemiological reports concerning the above mentioned diseases from the Upazilla Health Complexes (UHC) to the control room of the Director General Health Service, it has been observed that these three diseases are still endemic in some parts of the country (DGHS Report, 2000). According to the health delivery system of the country, maximum service delivery in the Government sector are supposed to be delivered free of charge. As the total treatment expenditure of the diseases prevailing in Bangladesh is high, it is not possible to provide the whole cost of all the diseases by the Government. The literacy rate of the rural people is very low (BBS, 1999). So people are reluctant to take active participation to prevent these diseases. They are more concerned to curative aspect than prevention of the diseases.

To control these diseases, in addition to sustained political commitment from all levels and sectors of the Government, full partnership of the rural community people are essential. To implement any method to control the transmission of the vector borne diseases and the vectors in any selected area of the country, knowledge on the prevalence of the diseases and vector density, bionomics (breeding, feeding and resting habits) of the vectors in that area, is essential. In the present research work, a series of study has been conducted to evaluate whether in addition to early diagnosis and prompt treatment of malaria, filaria and kala-azar, community based integrated vector control approach by using impregnated mosquito nets would be an effective measure in reducing the indoor vector population responsible for transmission of these diseases and the risk of acquiring infection in rural Bangladesh.

Discussion of the findings of the individual study of the series have been detailed chronologically as 5.1 to 5.10 following the titles of the study.

5.1. Clinical features of malaria and effectiveness of different drug regimens in some selected areas of Bangladesh

Malaria is one of the six diseases against which World Health Organization has global eradication campaign. It is endemic or sporadic throughout most of the tropics and subtropics. North and Eastern part of Bangladesh are endemic for malaria. Severe malaria leads to medical emergency and is responsible for maximum mortality.

During demographic study it was found that about 50% of the population was in the young age group (5-30 years). This shows that the young people occupy the major portion of the population chart indicating that Bangladesh is still in the high growth rate trend. More emphasis is recommended to the family planning sector.

Concerning malaria it was observed that babies (<5 years) were not susceptible to malaria and maximum number of cases (68.20%) were in the young age group (10-29 years). It indicates that young aged people are vulnerable to this type of serious disease. This finding correlates with the findings of the study of Waiz and Chakraborty (1990) and Waiz *et al.*, (1991), in which the age group of 18-29 years were mostly affected. As the young persons are the future of the country, thorough and proper surveillance mechanism should be carried out to detect the cases early for prompt treatment.

Seasonal prevalence shows that maximum cases were during July - October, the post monsoon period. This coincides with the study of Rahman (1991) showed the peak incidence of cerebral malaria in the months of June to August.

The presenting symptoms of malaria in the study that showed significant difference from other febrile cases were severe headache, vomiting, diarrhoea, loss of weight and dark urine. In the study of Waiz *et al.,* (1991) major clinical manifestations were fever, chills and rigor, headache with bodyache, nausea, vomiting, convulsion and disturbance of consciousness. Diarrhoea was not a common manifestation in that study, though in the present one it was a significant manifestation. Other manifestations were jaundice, hepatosplenomegaly and dehydration. Waiz *et al.,*(1991) in their study commented that convulsion, vomiting, jaundice, oliguria etc. were bad prognostic signs.

In another study on 29 cases of cerebral malaria at Chittagong Medical College Hospital and Cox's Bazar hospital, Rahman (1991) showed that the predominant findings in cerebral malaria coincided with the signs of meningeal irritation. Mostafa (1994) in a study endeavoured the management of cerebral malaria by a combination of therapy of Quinine, Tetracycline and Co-trimoxazole and the regimen showed good result with prompt recovery and reduction of mortality.

In the present study, fatality rate was 10.12% in severe malaria cases and 2.04% in uncomplicated cases. Waiz *et al.,* (1991) in their study showed 13.2% mortality. Mortality rates in some studies carried out in seventies and eighties were high. Schmitsz *et al.,*(1976); Mitra *et al.,*(1977) and Alberto *et al.,*(1982) observed the mortality rates from malaria were 36.66%, 28.57% and 20% respectively. In comparison to the early studies, the mortality rate was lower in the present study. This could be due to early diagnosis, prompt treatment and meticulous care of the patients. Early diagnosis and prompt treatment lowered the morbidity and mortality as observed in the study. It may be recommended that the anti-malarial drug regimen suggested by Malaria and Parasitic Disease Control unit of DGHS, Bangladesh, to clinical cases of Uncomplicated Malaria (UM), Severe Malaria (SM) and Treatment Failure Malaria (TFM) proved effective.

5.2. Entomological surveillance for malaria vectors in an endemic area of Bangladesh

Malaria is a major problem in Bangladesh. At present about 10% of the population (approx. 12.8 million) is considered to be at risk of acquiring *P. facliparum* and *P. vivax* malaria infections. The total laboratory confirmed malaria cases in 64 districts of Bangladesh were 166564, 152729, 100864, 68584, 60023 and 63738 in the years 1994-1999 respectively (DGHS Report, 2000). Out of total cases, 90-98% cases have been detected in 13 malarious districts namely Bandarban, Cox's Bazar, Rangamati, Khagrachari, Chittagong, Habigong, Moulavibazar, Sylhet, Sunamganj, Netrokona, Mymensingh, Sherpur and Kurigram. These districts represent the forested, hilly and adjacent areas and are situated in the north and north- eastern border belt areas that account for 97% of all laboratory confirmed and 99% of all *P. facliparum* cases reported in the country. Netrokona is one of these 13 districts. The reported laboratory confirmed malaria cases in Netrokona were 19740, 8573, 2500, 1919, 1515 and 1660 in the year '94 to '99 respectively. According to the Upazilla Health Complex report, Kalmakanda is the most endemic area in Netrokona district. The northern border areas of Netrokona including Kalmakanda upazilla have been remaining a great malarious problem due to a) regular cross border population movement which favour introduction of *P.falciparum* strains from hilly areas (Garo hills) of India, b) high morbidity and mortality in case of outbreaks in all age groups, c) presence of moderate level of chloroquine and fansidar resistant *P. falciparum* strains, d) presence of newly incriminated vectors

An. aconitus, An. annularis and *An. vagus* as well as the suspected vector *An. maculatus.*

Among the 34 *Anopheles* species recorded from Bangladesh (Ahmed 1987); four are considered relatively important vectors: *An. dirus, An. minimus, An. philippinensis* and *An. sundaicus* (Elias *et al.,*1982, 1992b). *An. aconitus, An. annularis* and *An. vagus* have recently been incriminated as epidemic malaria vectors (Maheswary *et al.,* 1992, 1993 and 1994). Among these seven vectors in Bangladesh, except *An. sundaicus,* rest six has been captured from the study villages. Though the number of all the vectors was low, presence of so many vector species may be responsible for making the study villages as malarious area. There is possibility of presence of other vector species that has not yet been incriminated as vector. As collections were made from dwelling houses and cattle sheds simultaneously, abundance of mosquitoes was detected. It would be richer if outdoor collections had made.

Indoor mosquitoes were fewer in number than that of cattle shed, which may be the due effect of previous indoor residual spraying (IRS). IRS might have changed the behaviour of mosquitoes from being endophilic to exophilic. DDT has got refractory effect, which might have compelled many mosquitoes to rest and bite out of door.

The finding that maximum number of *Anopheles* mosquitoes collected from landing/biting collections in cattle sheds (24.22 pmh) correspondents with the findings of another study carried out in Srimangal tea garden areas (Ahmed *et al.,*1991). Among the collected *Anopheles* mosquitoes, *An. vagus* was the most predominant species both in houses and cattle sheds. In that study 52 species of mosquitoes of eight different genera were collected. As in the present study mosquitoes of other genera were not considered, a thorough comparison could not be made. They also collected mosquitoes from out of door but no species were found in large number. In another study by Ahmed *et al.* (1989) in the jungle area of Modhupur, 29 species of 6 different genera were collected. Two Anopheline, *An. vagus* and *An.annularis* were found in large number in human dwelling and cattle shed respectively. Both are regarded as secondary vectors of malaria in Bangladesh.

In the present study, 1057 *An. vagus* mosquitoes were captured from cattle sheds whereas from houses only 267, giving a ratio about 4:1. It was observed that *An. vagus* was zoophilic in nature. Though cattle sheds were found more attractive to this species, it also preferred to take human blood. The finding does not correspond to the finding of Ameen *et al.,* (1982). Ahmed *et al.,*(1991) also found this species to be a cattle feeder. It is an epidemic vector in Bangladesh (Maheswary *et al.,*1994) but not a malaria vector in India (Rao, 1984).

An. annularis was another predominant species collected both in houses and cattle shed. Of course it showed preponderance to cattle sheds. In the present collection, 963 *An. annularis* were captured from cattle sheds and only 61 from houses. The ratio was 16:1. It is regarded as predominantly cattle feeder. In a study it was observed that cattle sheds yielded about 30% more mosquitoes than human dwelling (Senior White *et al.,*1943). It is also an epidemic vector in Bangladesh (Maheswary *et al.,* 1993). In India this species occurs very extensively but it is not regarded as a major malaria vector, it acts as a local vector in Bengal (Iyengar, 1942) and Assam (Viswanathan *et al.*, 1941). The study villages are very close to Assam or Meghalaya states of India. It may be a cross border issue.

Another epidemic vector, *An. aconitus,* was also found both in human dwellings and cattle sheds of the study villages but in low number. Only 46 were collected from cattle sheds and 17 from houses. Harrison (1980) observed it as exophagic, exophilic and preferred to feed on bovines to man at ratio 5:1 or higher. *An. aconitus,* which is closely related to *An. minimus,* is one of the most widely distributed *Anopheles* in Asia and has been incriminated as vector in Thailand (Gloud *et al.,* 1967) and India (Rao, 1984). Because of its zoophilic habit its role as a vector is not consistent as that of the more homophagic *An. minimus.*

In the present study *An. minimus* was collected in a low number, but showed slight preponderance to human dwelling. Macan, (1949) found higher number resting in houses as compared to cattle sheds. He stated that large proportion of adults left the houses after feeding and sought outdoor shelters. He found that in the forested areas *An. minimus* was rare in houses but in villages in open cultivated land it was common inside houses. It is one of the anthropophilic oriental anopheline mosquitoes. However, the species is not averse to feeding on cattle blood when the need arises. It acts as a vector in malaria transmission in Bengal (Iyengar, 1942) and Assam (Viswanathan *et al.*, 1941) of India. *An. minimus* is a proven vector with two peak seasons of transmission in the Chittagong hill tracts of Bangladesh (Khan and Talibi, 1972). Dev (1996) identified *An. minimus* as a primary vector of malaria in Assam. He found it as highly anthropophilic and fed indoor but rest outdoor.

An. philippinesis are present in plain area of the country and acts as vector (Elias *et al.*, 1992b). In the present collection, a total of 199 *An. philippinesis* were collected from cattle shed and 30 from houses. It is predominantly a zoophilic species but quite good numbers also bite man (Ramasay, 1936). It acts as vector in Assam and Bengal (Sen, 1948).

An. dirus is actually a wild species infrequently present in houses and cattle shed. It is largely an outdoor resting species. It is the most efficient vector of human malaria in Bangladesh in the areas of epidemiological types I and II (Elias *et al.,* 1982). Of course in the present study only seven *An. dirus* was collected which may bear no significant role in malaria transmission in that area.

According to the annual report of Kalmakanda Health Complex, the study villages are malaria endemic areas. A good number of female *Anopheles* mosquitoes were collected of which six out of seven vectors of Bangladesh were present. Again from the finding of incrimination *An. aconitus, An. annularis* and *An. vagus* as epidemic malaria vectors (Maheswary *et al.,* 1992, 1993 and 1994), it may be appreciated that virtually any Anopheline, in suitable or right condition, may be an epidemic vector. So further investigations are recommended, which might incriminate a new vector.

5.3. Impact of deltamethrin impregnated bed nets on malaria transmission in some rural areas of Bangladesh

One objective of the present study was to assess the knowledge of rural people about the cause of malaria and to document the practices for preventing mosquito bites. The communities under study were found quite knowledgeable about the cause of malaria. The same observation was found in another survey in Bangladesh where 92% people expressed that mosquito bite was the cause of malaria (Elias *et al.,* 1997a). On the contrary in some African communities, only half of the respondents considered mosquito bites as the cause of malaria, though malaria was a real problem in those areas (Aikins *et al.,* 1994).

excellent effect on bed bug, head lice and other nuisance arthropods (Lindsay *et al.,*1989b; Charlwood *et al.,*1989; Rozendaal *et al.,* 1989).

During the night visit about community compliance of the use of bed nets indicated that increase in the use of bed nets in area A was a hopeful event. The people perceived some beneficial effect of using impregnated bed net and that was that in addition to mosquito bites, they got relieved from some other insects like cockroach, bedbugs, head lice etc. In the study of Lindsay *et al.,*(1989b), it was found that bedbugs, chicken ticks, head lice were reduced by 90-99% from homes in which bed nets had been impregnated with permethrin as compared to placebo treated nets. These additional benefits of ITBN might have contributed to their widespread acceptance and utilization by the community for personal protection. In the present study proper use of impregnated bed net increased from 86.8% to 93.9% from 2nd to 3rd year whereas in area B use of simple bed nets decreased from 91% to 83% in the same time. It indicates the well acceptance of the impregnated bed net by the rural community though some households used the nets as bed sheet, fishing nets, window screen etc. If health education program could be included nearly cent percent people would have been able to use net. In the face of drug resistance to malaria parasites, health education campaigns should aim to encourage the use of physical barrier, which might reduce the transmission of malaria.

Mosquito nets or bed nets have been used world wide to protect people from biting insects mainly mosquitoes. When bed nets were impregnated with insecticide it gives more protection by its repellent and toxic action to mosquitoes. When the impregnated bed nets were introduced in a wide scale, large number of mosquitoes coming in contact of nets would be killed while trying to feed, thereby reducing the vectorial capacity of the species offering partial protection even to the people outside the nets

(Curtis *et al.,* 1991). The impact of deltamethrin-impregnated bed net was evaluated by noting the difference in the density of *Anopheles* mosquitoes and the prevalence of malaria cases per 1000 population in the study villages. It was found that the density of female *Anopheles* mosquitoes decreased significantly ($p<0.01$) in the villages where deltamethrin impregnated bed nets were distributed and people were motivated to use regularly. The finding corresponds to that of a study where it was observed that entomological rates were consistently highest in the control area, intermediate in DDT zone and significantly lowest in the impregnated bed net zone (Jeffry *et al.,*1993). In another trial with deltamethrin impregnated bed nets in China it was reported that the landing/biting collection *An. dirus* on human bait by hand catch, dropped from 39 to zero, one year after the introduction of impregnated bed nets (Li *et al.,* 1987). Deltamethrin impregnated bed nets also proved their efficacy against other malaria vectors, *Anopheles sinensis* and *An. anthropophagus* (Li *et al.,* 1989). In an entomological survey, the man biting density showed an average reduction of 71% after the intervention with impregnated bed nets compared to before intervention. The control village showed no change (Kere *et al.,* 1993). In another study, it was recorded that indoor resting density, man biting rate and the exiting rate of mosquitoes reduced significantly in hamlets having permathrin treated bed nets compared to placebo treated nets (Lindsay *et al.,*1989c).

The result of blood survey in the present study areas showed a steady decline in the prevalence of malaria in the impregnated area whereas in non-impregnated and control area the findings were uneven, occasional increase or decrease. The decrease in the prevalence of malaria was significant ($p<0.01$) in impregnated area. Similar results were observed in a study in the Gambia both the morbidity and mortality from malaria were reduced where use of impregnated mosquito nets was high (Alonso *et al.*,1993). In Bangladesh an observation was made where self reported malaria reduction was 2.6 fold in deltamethrin impregnated village compared to the 1.86 and 1.01 fold reduction with unimpregnated and DDT sprayed villages respectively (Elias *et al.*, 1997b). However, in a trial by permethrin impregnated bed nets in Solomon Islands, similar decline in the *P. falciparum* infection was observed in both the intervention and the control areas (Kere *et al.*, 1993). A malariological blood smear surveys of children showed that after 18 months of introduction permethrin impregnated bed nets, the *P. falciparum* infection rate in children was lowest in the impregnated bed net zone, intermediate in untreated zone and highest in the DDT zone (Jeffry *et al.*, 1993).

The present showed significantly more reduction of the density of female *Anopheles* mosquitoes and the prevalence of malaria by using deltamethrin impregnated mosquito nets than using non-impregnated deltamethrin impregnated mosquito nets exerted bed nets and in the control areas. Deltamethrin treated mosquito nets are therefore recommended as a means of effectively reducing the risk of exposure to malaria transmission.

5.4. Bancroftian filariasis in Bangladesh: clinical aspects, diagnosis and chemotherapy for treatment: comparative efficacy of three strategies

Filarial infection is prevalent in several parts of the Indian sub-continent including Bangladesh with different degree of endemicity though adequate information regarding the prevalence and distribution of filariasis in Bangladesh is scanty. In the survey by Wolfe and Aslam Khan (1971), positivity of microfilaria in the peripheral blood of the inhabitants of selected areas of the greater districts of Dinajpur, Pabna, Barisal, Chittagong, Rajshahi and Rangpur were found at a rate of

11.6%, 5.2%, 4.5%, 3.08%, 3.2% and 3.05% respectively. In another survey by the same authors, in Dinajpur district, microfilaria and clinical filarial rates were 14.81% and 9.49% respectively and in Rangpur district the microfilarial rate was 7.72% and clinical filarial rate was 7.86% (Wolfe and Aslam Khan, 1972). These studies indicate that filariasis is prevalent in the northwestern parts of Bangladesh since long. One possible reason of large number of filarial cases in the northwestern parts of the country may be that the areas is very close to Bihar state of India which is a highly filaria endemic area of India.

The present study carried out in the three villages of Baliadangi upazilla under Thakurgaon district, which is situated in the northwestern part of the country. During the base line survey (June 1996- May 1997), the positivity rate of clinical filarial cases was 16.8 and microfilaria positivity rate was 18.8 per 1000 populations. It indicates that regarding prevalence of filariasis not much improvement occurred in the northwestern part of the country for a long thirty years. It is known that there is no filarial control programme in the country. People usually do not take treatment for filariasis because of ignorance and lack of awareness about the asymptimatic stage of the disease, inadequate diagnostic facilities and the long treatment procedure. As a consequence, large number of positive cases may remain undetected and untreated and the prevalence does not decline.

In the present study filaria is more common in male than female having a ratio of 3.34 : 1. The finding of predominance of filaria in male correlates with the findings of other studies (Wolfe and Khan, 1971; Ahmed *et al.*, 1986). Statistical analysis shows males suffer significantly more than female from filaria (chi sq. test df 2, p=.000). However, regarding only microfilaria positivity rate, there is no significant difference between sex (independent sample T test t = -1.021, sig (two tailed) .309.

Though filariasis is a mosquito borne disease, till now it is not known certainly, how many infected bites are necessary for causing filaria, but it is assumed that hundreds of bites is prerequisite. Males have chance of more mosquito bites than females because of their outside working pattern, type of dresses with more exposed parts and thus may become infected more.

In the present study it was observed that in male the prevalence of clinical filaria increased with advancement of age and maximum cases were found above 40 years of age. Maximum number of cases was in the age group of 41 to 50 years followed by the age group of 51-60 years. In case of asymptomatic microfilaria positivity, young aged males (21-30 years) topped the list. The finding does not correlate with the finding of a longitudinal study of Bancroftian filariasis by Weil *et al.*, (1999) in the Nile delta of Egypt. During the base line survey of that study, the prevalence rate for microfilaremia was maximum in subjects of about 10 years of age. Microfilaria counts and microfilaraemia incidences during the next year period were significantly lower in older people. The authors suggested that humans develop partial immunity to *Wuchereria bancrofti* with advancement of age.

In another survey by Simonsen *et al.*, (1995) in villages in Tanzania, microfilaraemia was rare in children below five years. The mf. positivity increased with age, reaching from 35.9% to 49.2% in individuals aged 45 years and above. No association between mf density and age was observed in any of the villages. In the present study also there was no association between age groups and density of microfilaria (one way ANOVA test $F=2.277$, df 6, $p=.050$).

In lymphatic filariasis cases, a wide range of clinical manifestations were observed, including chronic lymphadenitis, swelling of dependent limbs, hydrocele, asymptomatic microfilaremia and hypereosinophilia or occult filariasis (Partono, 1988). The lymphatic pathology in filariasis results mainly from the host's immune response to the parasites and also from the direct action on the lymphatic tissue by the parasites or the molecules they release (WHO Bull, 1993). The most prominent clinical manifestations of infection like lymphedema, elephantiasis and hydrocele are result from chronic lymphatic damage (Macarthy *et al.*, 1995).

In the present study, regarding clinical signs maximum number of persons 58.9% was found with hydrocele followed by 26.5% of persons with elephanthiasis of lower limbs. Others had symptoms of lymphangitis and lympadenitis. Few females had vulval swellings and only one female was found with swelling of breast. Similarly in a cross-sectional survey for Bancroftian filariasis conducted by Pedersen *et al.*, (1999) in Pemba Island, elephantiasis and hydrocele were the common symptoms. Hydrocele was the most common chronic clinical manifestation, with prevalence ranging from 14.5 to 21.3% for all males and from 52.9 to 62.1% for males aged 45 years and above. The older people also had elephantiasis, which most often affected the legs. In the study microfilaraemia was common in young males with hydrocele. In males of 45 years and above, there was no significant difference in mf prevalence between males with (42.5%) and without (55.2%) hydrocele. In contrast, microfilariaemia was detected in the blood of only one of 18 individuals with elephantiasis. In the present study, 0.5% of the samples were both clinically and parasitologically positive. The findings of the study and of Pedersen *et al.*, (1999) do not support recently forwarded hypotheses described by Simonsen *et al.*,(1995) assuming a general negative relationship between microfilaraemia and chronic clinical manifestations in Bancroftian filariasis. They mentioned that clinically positive cases were microfilaraemia negative.

The determination of prevalence of filaria infection in a community is important and necessary for implementing any public health program. The effective control of filariasis depends on early detection of cases by surveillance and monitoring of the disease. Detection of microfilaria by thick film examination of blood collected at night is practiced in Bangladesh, which is time consuming and tedious and difficult for handling large samples. Moreover, there is possibility of false negative result. It appears that recently introduced serodiagnostic test is highly relevant. Serological tests that identify the micorfilaraemic individuals within populations in endemic areas without the need for night blood collection. It also identifies actively infected individuals without microfilariaemia. Following treatment it constitutes a valuable tool for monitoring the effectiveness of treatment. In the present study an immunochromatographic test (ICT Filariasis) was used to detect *Wuchereria bancrofti* antigen in serum or plasma. The test is really simple, easy to carry out and does not need night blood and detects more positive cases than detected parasitologically. In the contest of rural Bangladesh, ICT filariasis test may be recommended for diagnosis specially for community survey.

Although lymphatic filariasis is not associated with high mortality rate, chronic filarial infection causes enormous suffering to the infected persons. The socio-economic impact due to long term disability and deformity is extraordinally great. The clinically positive cases with elephanthiasis or hydrocele become burden to the family, society and the country. So, emphasis should be given to the control of filariasis.

In Bangladesh, the drug of choice for treatment of filariasis is still diethylcarbamazine citrate (DEC). It is usually effective in killing microfilaria and to some extent adult worms and reduces the parasite load in the human reservoir (Cartel *et al*, 1990). The WHO expert committee on filariasis has recommended dosage of DEC in the Indian subcontinent is 6 mg/kg/day for 12 days (WHO, 1984).

In the present study, in addition to the standard treatment, the efficacy of two other strategies of treatment, semi-annual single dose treatment and low-dose monthly schedule, were assessed and compared. In the second and third regimen the treatment was repeated at specified intervals for maintenance of amicrofilaraemic state as the microfilaria clearance with DEC may be incomplete at times even after adequate treatment. The other reason is that people living in endemic areas are exposed to re-infection. All the clinical and parasitologically positive cases were re-examined at the end of one year of treatment for detecting the clearance of mf and/or reduction of symptoms. Strategy III proved most effective with cure rate followed by strategy II and lastly strategy I. In Bangladesh, the strategy 1 is followed and the drugs are supplied from Government health complexes. Unfortunately, a good number of patients do not complete the full course of treatment. So the cure rates as observed from the health complex reports is much less than observed in the present study. The findings of the study correlate with those of the trial in four communities by Meyrowitch *et al.*, (1998). The efficacy of different strategies for control of Bancroftian filariasis using mass diethyl carbamazine (DEC) chemotherapy was evaluated in that trial, where DEC-medicated salt treatment and monthly low dose treatment proved equally effective, and superior in clearing microfilaria from blood and in reducing mf density compared to semi-annual single dose treatment and standard 12-day treatment. The rate of occurrence of new cases of microfilariaemia among individuals who were amicrofilariaemic during the pre-treatment surveys was negligible over study period in all communities.

In addition to specific treatment of filaria cases, mass chemotherapy by DEC monthly dose of 25 mg and 50 mg for children and adult population respectively for 1 year has been tried in different countries. In India this approach was tried during 1958-1960 but had little success because of operational difficulties and was abandoned (WHO, 1984). However, in Indonesia, with the mass treatment, the microfilaria rate decreased dramatically and remains low for 2-3 years both in case of Brugian and Bancroftian filariasis. Similarly, useful result was reported by the use of DEC medicated common salt in chemotherapy at Kinmen Island in China, where a Bancroftian filarial control programme was conducted with DEC medicated salt from 1970-1982. DEC supplemented salt was administered to whole population of the area for a period of six months and the population was followed subsequently for 10 years. The microfilaria rate and density reduced from 6.9% and 14.4/20 μl of blood to 0.3% and 1.9/20 μl of blood respectively. It has also been reported that levamisol hydrochloride showed promising filaraecidal properties either alone or in combination with DEC (WHO, 1984).

The combination of long life of adult parasite (several years) and infectiousness of patient with low parasitaemia represent a serious obstacle to control programmes based on chemotherapy. Recently trials on a new drug Ivermectin have been given in different parts of the world. Recent new strategy aims both at transmission control through community-wide mass treatment programmes and at disease control through individual patient management. It has been reported that Ivermectin, a new microfilaraecidal drug administered orally as a single dose (150-200 μg/kg) once a year proved really effective (Jenkin, 1990).

Mass treatment with Ivermectin also significantly reduced mosquito survival period (Bockarie *et al.*, 1999). However, low dose Ivermectin treatment followed by standard dose of DEC has more macrofilaraecidal effect in *W. bancrofti* infection (Weil *et al.*, 1991 and Goa *et al.*, 1991). A trial with Ivermectin 400 µg/kg plus DEC 6mg/kg reduced the microfilaraemia level one-year after treatment was 96% (Moulia *et al.*,1995). The authors recommended the combination Ivermectin and DEC a powerful tool for the control of lymphatic filariasis.

A trial by an annual single dose co-administration of two drugs (ivermectin + diethylcarbamazine (DEC) or albendazole) reduces blood microfilariae by 99% for a full year (Ismail *et al.*,1998). Field studies confirmed that such reduction of microfilarial loads and prevalence could interrupt transmission. The authors recommended that even a single dose of one drug (ivermectin or DEC) administered annually could result in 90% reductions. In an endemic area of Polynesia, Bancroftian filariasis was controlled by twice-yearly doses of ivermectin (400 µg/kg) for 3 treatments. This dose was well tolerated and compliance was excellent (Nguyen *et al.*, 1996).

Unfortunately the new drug ivermectin is not available in our country. A trial with an annual dose of combination of ivermectin (400 µg /kg) and albendazole (600 mg) or ivermectin (400 µg/kg) and DEC (6mg/kg) is highly recommended in our country. However, improvement of socio-economic condition is an associated factor to achieve good response with trial by the drug.

5.5. Filaria vector surveillance in a filaria endemic area of Bangladesh

The bimonthly yearlong entomological study carried out at some fixed human dwellings, cattle sheds and natural outdoor shelters at Bamunia, Maskuria and Bangavita villages of Baliadangi upozilla under Thakurgaon district, a dry and plain area in the northwestern part of the country, yielded a large number of mosquitoes with different density.

Entomological findings in this particular ecological zone have been discussed on their vectorial role, density, resting and feeding habits and seasonal pattern of mosquitoes belonging to different genera.

a) *Anopheles* species

Among the 34 *Anopheles* species recorded from Bangladesh (Ahmed 1987), maximum number of *Anopheles* mosquitoes belonged to four species, *Anopheles annularis* (30.0%) followed by *An. vagus* (25.1%), *An. aconitus* (23.1%) and *An. peditaeniatus* (12.3%). The first three have been incriminated in early 90's as malaria vectors in Bangladesh (Maheswary *et al.,* 1992, 93, 94). The researchers found that these three species transmitted malaria and caused an outbreak/epidemic in deltaic plain lands of Bangladesh. Reid (1968) and Rao (1984) observed that all these species were mainly zoophilic, exophilic and exophagic. In the present study also, all these species were mainly found feeding cattle or resting in cattle sheds than human dwellings. The previous researchers mentioned the possible reasons of the unusual role of these three mosquitoes as epidemic malaria vector. They noticed the very low cattle density in the outbreak areas, which forced these zoophilic mosquitoes to bite man or it might be possible that in some particular climatic conditions or ecological situations, the density of these species increased manifolds, which might bite man and play a role in the disease transmission. Among these three species, *An. annularis,* found transmitting malaria in some locality of West Bengal, Assam and Meghalaya states of India and Terai region of Nepal (Rao, 1984). Positive *An. annularis* was also found in tea garden area in Bangladesh (Rosenberg and Maheswary, 1982a,b). *An. aconitus* is regarded a secondary vector in India and found positive in Assam (Vishwanathan *et al.* 1941). *An. vagus* is not regarded a vector of malaria in India (Rao, 1984). At present malaria is not common in deltaic plain land areas of Bangladesh still some sporadic cases and outbreaks occur as such more elaborate studies are needed to find out the exact role of these species in malaria transmission in Bangladesh.

An. philippinensis, the recognized malaria vector in Bangladesh (Elias 1982) was also collected here. But its density was low. This species once found abundantly in Bangladesh is gradually vanishing from deltaic plain land of Bangladesh (Ahmed *et al.*, 1989). Neogy and Sen (1962) did not find this species in West Bengal in India even in sixties. Rajagopal (1976) collected this species in large number in neighbouring Meghalaya state of India. Ahmed *et al.*, (1991) also found this species in good numbers in eastern districts of Bangladesh. The eastern districts of Bangladesh and the adjacent Indian states have some similar topography. Both areas are forested and hilly. The exact cause for the absence or lowering of density of this species in deltaic areas but not in hilly and forested areas in Bangladesh and Assam/Meghalaya are not known or conclusively explained. May be they are the member of a species complex or cytogenetically different. But one thing is clear that due to effect of DDT indoor house spraying during MEP, this species has changed its habit from indoor resting and man biting to resting in cattle sheds and biting cattle as seen in the present study. As such, the exact role of the newly incriminated and other malaria vectors in the transmission of malaria in the present period need careful study.

b) *Culex* species

Out of total mosquitoes collected in the study villages of Baliadangi upozilla under Thakurgaon district, more than two third (70.40%) were *Culex* species. Almost in all types of collections, it topped the list. Both in human dwelling and cattle sheds it was found in good number. Comparatively more *Cx. quinquefasciatus* were found in human dwelling. This mosquito is regarded an anthropophilic in nature i.e. prefer human blood and as such few mosquitoes were found in cattle sheds. Horsefall (1955) described that it is mainly available in dwelling houses. Abdulcader (1967) termed this species as a domestic one. It is present in almost equal number during morning and evening resting collection. This indicates that they are equally capable of transmitting diseases any time of the day. This mosquito was found in high density all through the year. Maximum numbers were found in March, a dry and late winter month of Bangladesh. In this period, most of the temporary water sources, created during rainy months, become dry and water of the remaining breeding sources become polluted, which is preferred by this species. After March, the density started decreasing slowly and become lowest in September and again started increasing and reach peak in March. This observation concurs with other works (Ameen *et al.* 1984, Ahmed *et al.* 1986). Low density in rainy months may be attributed to the cause of flushing action of rainwater as found by other workers (Abdulcader 1967, Ameen and Moizuddin 1973). It is known that seasonal changes help in changing the breeding places quantitatively and qualitatively, which ultimately influence the breeding mosquitoes.

Culex gelidus and *Cx. vishnui* were the two other species of genus *Culex* were found in fair number. Among with these two species, two other species, *Cx. fuscocephala* and *Cx. tritaeniorhynchus*, were also found in the study area. All these four species are recognized vector of Japanese Encephalitis (JE) in this oriental region (Tigertt and Hammon 1950, Gould *et al.*, 1962, Carey *et al.*, 1968). JE was not reported in the study area. It was once reported by Khan *et al.* (1981) in Modhupur forest area of Tangail district in Bangladesh. Together all these four species formed about 31% of the total capture. It can be mentioned that a large number of 'Sawtals' live here who keep pig as one of the domestic animals. Pigs are the main amplifier host of the JE. JE cases are often reported in the bordering states of India. As such, spreading of JE cases and future outbreaks cannot be ruled out. A constant epidemiological-entomological surveillance is needed to be carrying out in these areas.

Filaria larvae

During the survey,only *Culex. quinquefasciatus* was found positive with filarial larvae. More than 30 years back, this mosquito was found infective for filariasis in areas near the study area in Thakurgaon district during 6 months of the year when the weather was hot, humid and rainy (Khan and Wolfe, 1972). Larvae were not found in ponds or other permanent water collection, but only from small, polluted peridomestic pools, sewerage pits and open dirt drains. The authors discussed that extensive production and processing of sugarcane in the area might be an important contributory factor for the prevalence of filariasis and also possibly favouring the vector. That mosquito is still spreading the disease as found in the study. No other species was found positive with filarial larvae though other workers found *Culex vishnui* complex to contain infective indistinguishable from *W. bancrofti* (Khan and Wolfe 1972). The infection rate (8.1%) was found quite high during the survey in comparison to other places of neighbouring countries (Gubler and Bhattacharya 1974). Infective mosquitoes were found only in rainy and hot months (May through September). This correlated with climatic condition favourable for parasite development in mosquitoes (Khan and

Wolfe 1972). Infected mosquitoes were found all through the year. Similar trend was also found in a study in Dhaka (Ahmed *et al.* 1986).

As a high infection rate (8.1%) of filarial was observed in the study villages of Thakurgaon district. A control programme must be taken in those areas from the health sector, as the sufferers belong to the low privileged group. The chronic disease makes their condition from worse to worst.

5.6. Mosquito nets impregnated with deltamethrin against lymphatic filariasis and its vector in a filarial endemic area of Bangladesh

Simple preventive knowledge can reduce the mortality and morbidity of a disease. Existing level of knowledge and practice act as a guideline to implement a control programme. With this view in mind, the study was conducted to find out the level of knowledge about the cause of filaria and the practices to prevent it. It was observed that the knowledge regarding the cause of lymphatic filariasis of the respondents was really poor. Only 14.3% knew filaria is caused by a parasite in the blood. They learnt the massage from physicians of upazilla health complex when they went there for treatment either of themselves or for relatives. 5.7% told that it was caused by mosquito bite. All of them also told that the disease was transmitted by mosquito from one person to other person. 15.3% did not have any idea about the cause and rest had different wrong ideas. Ignorance or inadequate knowledge about lymphatic filariasis of the people is mainly responsible for the endemicity of filariasis in the area. The matter of knowledge is inseparably involved with the level of literacy.

The literacy rate of our country is very low (32%). The literacy rate of females is less than that of males. In rural areas the picture is very much disappointing.

Ramaiah *et al.,* (1996) in their study in rural areas of south India found the knowledge about transmission, prevention and control of lymphatic filariasis was very poor. Only 9% of those with and 20% of those without the disease knew that filariasis is caused through mosquito bites, the rest attributed it to many other causes. However, people were found well aware of filariasis in their communities and recognize its different clinical manifestations.

In the present study it was found that people's knowledge about transmission and prevention of filariasis was also very poor. About 90% of the respondents did not know how the disease was transmitted from one person to other. Maximum persons had the idea that it was a hereditary disease and so they were not taking any preventive measures.

In another study, knowledge, attitudes, and perceptions about Bancroftian filariasis of 104 residents of an endemic area in Haiti were assessed by interview (Eberhard *et al.*, 1996). Fewer than 50% of residents had heard the name of filariasis and only 6% of them knew that it was transmitted by mosquitoes. Their findings correspond to the present study. In contrast, all persons were aware of the clinical conditions of hydrocele and elephantiasis. They thought that hydrocele was caused by trauma or trapped gas and elephantiasis by walking bare foot on soil or water or because of using ceremonial powder that had been sprinkled on the ground.

In the present study, impregnation of bed nets was performed with deltamethrin. WHO/VBC (1989) reported that photo stable pyrethroids (deltamethrin or permethrin) developed as molecular analogue of natural pyrethrum, were applicable for impregnation of mosquito nets, because they were relatively safe to human, had rapid insecticidal effect and low volatility with consequent long persistence on netting and lack of odour. Deltamethrin is many times as active, weight for weight, against mosquitoes as DDT (Zebra 1988).

Efforts have been made to assess the impact of deltamethrin impregnated bed nets in comparison to non- impregnated nets and controls in selected filaria endemic rural areas of the country. Impregnated nets give better protection than unimpregnated nets. The usual life of the net would be extended. Even if it is torn or holes develop, insecticide would hinder the mosquitoes to enter. By killing the mosquitoes that contacted the net, the insecticide would reduce the attack rate. The treated net would also be a toxic resting site during daytime when they are not in use.

The impact of impregnated nets on density of female *Culex quinquefasciatus* mosquito collected from human dwelling during pre-intervention and the post-intervention period were expressed as per man-hour. In the impregnated bed net area (area A), the density (pmh) was 7.3,which decreased to 4.6 and 2.6 respectively in the following two years after intervention, though the decrease was not significant ($p>0.05$) in both years. In the non-impregnated bed net area (area B) the *Culex quinquefasciatus* density increased from 6.5 to10.0 per man-hour in the 2nd year and decreased to 7.9 in the 3rd year of study. In the control area (area C), the density showed an increasing trend. The per-man hour collection of female *Culex* mosquitoes increased from 9.8 to 11.6 and 11.7 in the 2nd and 3rd year respectively. The result indicates that deltamethrin impregnated bed nets reduces the density of *Culex* thoufh not significantly. It was called a domestic mosquito because of its endophilic and endophagic habit, which might have changed.

In a study, where the impact of permethrin impregnated bednets on resting and feeding behaviour of mosquito vectors of *Wuchereria bancrofti*, causing human lymphatic filariasis in six pairs of highly filaria endemic villages (treated and untreated in Kenya before and after intervention) (Bogh *et al.*,1998). Introduction of impregnated bednets significantly reduced the number of indoor-resting *An. gambiae* and *An. funestus*, but there was no significant change in the number of *Cx. quinquefasciatus* collected indoors. These results suggest that permethrin impregnated bednets give effective personal protection against transmission of *W. bancrofti* by *An. gambiae, An. funestus* and but not so by *Cx. quinquefasciatus* in East Africa.

The prevalence of filaria cases per 1000 population was detected by parasitological survey. In impregnated bed net area, there occurred a decreased trend in the respective three years of survey. The differences of the 1st and 2nd years and of the 2nd and 3rd years were not statistically significant ($p< 0.05$) but the differences of the 1st and 3rd years were significant ($p>0.05$). In the non-impregnated area also the prevalence showed trend of decrease and the differences were not significant ($p> 0.05$), even between 1st and 3rd years. In the control area the prevalence of filaria cases per 1000 population did not follow any pattern of increase or decrease.

In rural Papua New Guinea, where filariasis was transmitted by *An. punctulatus* impregnated bed net use was suggested for the control of filariasis (Charlwood and Dagaro, 1987). There was significant difference between the number of mosquitoes caught in houses with and without treated nets. This indicates that impregnated bednet may have the potential for controlling filariasis.

Bancroftian filariasis was once endemic in Australia and USA but disappeared spontaneously with improved socio-economic circumstances. However, this is unlikely to occur for many years in developing countries where filariasis is endemic. In fact, filariasis is thought to be increasing due to rapid urbanization without constructing perfect sewerage system providing breeding sites for *Culex quinquefasciatus* (Curtis and Feachem, 1981).

As the acceptance of mosquito nets in rural Bangladesh showed high, a programme of distributing ITBN at low cost would be welcome. In controlling filariasis in Bangladesh, the impact of impregnated bednet might be effective particularly in rural areas in reducing the disease as transmission occurs at night because of nocturnal periodicity of both the parasite *Wuchereria bancrofti* and the vector *Culex quinquefasciatus* mosquito. As the efficiency of transmission of filariasis is low, disease control by controlling its vector is possible provided that vector control can be maintained for years together.

5.7. Epidemiological, clinical and therapeutic features of visceral leishmaniasis (kala-azar) in a kala-azar endemic area of Bangladesh

The resurgence of kala-azar including PKDL occurred in several parts of Bangladesh during eighties after the large scale spraying of DDT was discontinued (Ahmed and Ahmed, 1983). The sporadic reappearance of kala-azar did not draw keen attention either of the departments of health or general physicians. Due to lack of attention and timely intervention measures, the number of cases greatly increased and several outbreaks of kala-azar were reported (Rahman and Islam, 1983; Chowdhury *et al.* 1988; 1991b,c; Elias *et al.* 1989). Till now, the incidences of cases are in a steady rising trend. According to reports of Malaria and Parasitic Disease Control (M&PDC) unit, Directorate General of Health Services, Bangladesh (DGHS report, 2000), many cases of kala-azar and PKDL remain undetected in rural Bangladesh because of low-level awareness about the disease among patients themselves, inadequate laboratory diagnostic facilities, lack of trained manpower, inadequate reporting system. The comments of the reports coincide to the findings of the baseline study. Kalihati upazilla of Tangail district is a kala-azar endemic area. Through active cases detection both clinically and serologically, the prevalence of kala-azar cases were detected as 10 to 25 per thousand populations in the villages under study. The level could provide a reservoir of sufficient magnitude to spark off major outbreaks. Epidemiological surveillance system almost does not exist in Bangladesh. The findings of the present study highly indicate the need of a countrywide epidemiological surveillance system.

Kala-azar patients were detected 4 to 10% of the houses surveyed of three villages. The number of persons infected per house also varied. In some house one person and in other houses more than one was affected. During the epidemic in Bihar, India, similar observation was noted (Thakur, 1984). In another study by Desowitz, (1991) the disease pattern was found to be extremely focal with most cases reported from rural areas, exhibiting a familial and contiguous household clustering pattern among the lowest socioeconomic groups. One study in Kenya suggests that sleeping longer period in infested houses play a role in having visceral leishmaniasis (Shaefer *et al.,* 1994).

Presence of cattle sheds was a common scene in the study area. Most of the cattle sheds were very close to dwelling houses and some were adjacent to the walls. Statistical analysis showed that there was a significant association between the presence of cattle sheds and presence of kala-azar patients in houses ($p<0.05$). Thakur (1984) also noticed that in the villages of Bihar, India, where the houses were crowded with cowsheds between, the incidence of kala-azar was higher. *P. argentipes* density was very high in the cattle sheds. The disease was confined predominantly in rural areas.

Regarding the socio-economic condition of the kala-azar patients, all cases had a poor socio-economic background. The occupations of adult males were agriculture or labour. Landless agricultural labours were the main sufferers. The affected housewives or children also came from those houses. Through several visits in different parts of Bangladesh at different times WHO experts observed that generally the kala-azar patients are nutritionally deficient and live in mud houses with poor environmental sanitation (WHO, 1984). People working in agriculture, forestry, mining and fishing have a great risk of being bitten by sandfly (Rashid and Hyder, 1992). Low socio-economic conditions, housing (mud houses), cattle sheds in close proximity to the dwellings, population movement from endemic to non-endemic areas play important role in the transmission of disease. The epidemiological pattern refers to invasion of new areas every year particularly which are in close proximity to the existing foci. Kala-azar usually strikes the poorest of the poor (Park, 2000).

Kala-azar can occur in any age including infants below 1 year of age, but children and young adults are mostly affected and peak age of kala-azar in India is 5-9 years (Park, 2000). Because of the zoophilic nature the vector of kala-azar (*P. aregentipes*) stays more in cattle shed. In the rural areas of Bangladesh, the young people remain in cattle sheds for a long time during evening and morning time for keeping and feeding cattle and have more chance to get bitten by vector. In the present study although cass belonged to all age groups, but much more frequent in the paediatric and young age group. Maximum cases were in the age group of 11-20 years followed by age group of 0-10 years. Minimum cases were among older people. The finding coincides with that of a study conducted at Dhaka where 47% patients were in 9-12 years of age group (Chowdhury *et al*, 1991a). In Bihar epidemic in India, 63.4% cases were aged between 10-29 years (Thakur, 1984). In another study, Basu and Mallick (1995) found that the mean age of kala-azar patients in some endemic areas of India was 20 (16-35) years, much higher than previously reported. The higher age incidence was probably related to fall of herd immunity in the young adults. During their childhood when kala-azar in India has been largely controlled since 1970s, there might be less chance of natural infection among them.

Among the 201 positive cases, Male female ratio was 1.5: 1. Males were affected more than females due to greater outdoor exposure (Park, 2000). At Bihar epidemic in India, male to female ratio was 5.5:1 (Thakur, 1984). Male to female ratio was 2:1, as observed in the study at Tangail district in Bangladesh, (Masum,1990a). Another study in Thakurgaon district also revealed 2.1 male female ratio (Masum,1990b). In the study on chemotherapy of kala-azar patients in Mymensingh district, male female ratio was 1.9:1(Chowdhury *et al*, 1990b). The study in Shishu hospital in Dhaka city showed male female ratio was 1.94:1(Chowdhuary *et al*, 1991a). Shaefer *et al.* (1994) found women and children suffering more than male members of the family. But they did not discuss the reasons of that situation. They found that kala-azar cases positively increase with ages. Of course their finding on sex contradicts with the findings mentioned earlier, where males were found more affected than females.

Kala-azar has been regarded as a house disease and houses seemed to form a microfocus of infection. Yet, the females who were more or less confined to the house apparently escaped. It seems the slight male preponderance may be attributed to the practice of the male members sleeping and working near cattle sheds, which have very high density of vector of kala-azar, *P.argentipes.*

The spectrums of disease ranged from asymptomatic to self-healing to severe clinical illness. It is expected that due to sub-clinical infection in children and young adults, they may develop natural immunity. In the present study, fever was the most common feature which was continuous, intermittent, remittent or irregular in type. Occasionally it showed double rise in 24 hours. The present findings coincide as the description of Chatterjee (1980). In a study of 100 kala-azar patients admitted to Shishu Hospital, the type of fever was continuous in 50%, remittent 30%, intermittent 20% and 10% had shown fever associated with chills and rigors. Duration of fever varied from 1 week to 2 years, average period was 6 months (Chowdhury *et al.,* 1991a).

Another striking feature was splenomegaly. The spleen enlarged progressively with the progress of the disease. It extended from just palpable to several inches below the costal margin to almost filling the entire abdomen. In the present study, 70% of the kala-azar cases suffered from splenomegaly. During investigating the patients of kala-azar in Shishu Hospital, Chowdhury *et al.,* (1991a) found that cent percent of the patients had enlarged spleen. 46% had enlargement less than 3 cm, 31% in between 3-5 cm and rest 23% had more than 5 cm. In another study at Shahjadpur Thana Health Complex of Sirajganj district, splenomegaly was found in 80% cases (Islam, 1991).

Liver was also found enlarged but not as much as the spleen. In 33.8% of cases, both liver and spleen were enlarged. Jaundice occurred in a minority of cases. Out of 80 kala-azar patients attending at Shahjadpur Thana Health Complex, 20% had hepatomegaly (Islam, 1991). Out of the patients of Shishu Hospital 54% had hepatomegaly, of them 21% had less than 3 cm enlargement, 15% had 3-5 cm and 18% had more than 5 cm enlargement (Chowdhury *et al.*, 1991a).

Anaemia was another striking feature of kala-azar in the study. Tongue was found clean and moist which was a very striking feature in spite of prolonged fever. The patients usually had good appetite. Malaise or apathy was less common and the patients were quite unaware of the fever. However, weight loss was a common feature in many cases. Poor nutritional status and chronic disease process itself may be the contributory factors.

No case with lymphadenopathy was observed in the present study. In an outbreak of kala-azar at Tangail in Bangladesh, parasites (LD) were detected from axillary lymphnode aspirate of a patient (Masum *et al.*,1990b). It is common in Africa and China, but very rare in Bangladesh and India.

Oedema was another presenting feature in 33.8% cases. Malnutrition and anaemia may be the two crucial factors for the development of oedema. Rahman and Islam, (1979) observed 4% to 30% of the kala-azar patients had oedema. In more advanced cases skin over the entire body became dry, rough, harsh and also darkened. The dark colouration of the skin is due to development of pigments of the skin. In many cases hair became brittle and fell out. These findings were present at advanced cases. Dry irritating cough was also present in some cases though not a prominent feature. Unproductive cough was prominent feature in 36% of patients in the study in Shishu Hospital (Chowdhury *et al.*,1991a).

Among other febrile case, malaria was not common. It was observed that malaria and kala-azar did not co-exist. Whether VL makes an individual more resistant to malaria infection, is a disputed point.

For diagnosis of kala-azar, in addition to clinical findings, Direct Agglutination Test (DAT) was performed. The base line titre of 1:3200 or more is taken to be an indicative of kala-azar. In the study of Ahmed and Islam (1984), the same titre was accepted. DAT can detect the case earlier than the appearance of signs and symptoms of kala-azar. In one study in Bangladesh, the sensitivity of DAT was 99.1% and specificity was 99% (Harith *et al.*, 1986).

Demonstration of *Leishmania donovani* by direct microscopy from thick blood film, bone marrow, spleen and lymph node aspirates or skin scraping followed by culture of the materials in NNN media is the 100% confirmatory test (Chatterjee, 1980). However, at the context of rural Bangladesh, the feasibility of parasitological test for diagnosing kala-azar is still questionable.

Treatment should be started after parasitological confirmation of kala-azar. But unfortunately it is not feasible to perform the test in field condition in rural area of the country. When a clinically suspected case became serologically positive, treatment may be started according to the recommendation of WHO expert committee (1984). In the present study, except 15%, rest of the patients responded well to one course of Sodium Antimony Gluconate (SAG). Occasionally the course was repeated. For treatment of kala-azar in rural Bangladesh, it may be recommended as the 1st line of drug. The other alternative drug for treatment was

Pentamidine isethionate injections. Though diabetes mellitus was a common side effect but no patient had that one.

A study on chemotherapy at primary health centre in Mymensingh revealed that 94% showed immediate response, 3.4% showed delayed response for which additional doses were required for cure and only 0.8% did not response to SAG even with 40 injections (Chowdhury *et al.*, 1991c). The response proved its excellent efficacy.

5.8. Entomological investigation of a kala-azar focus in Bangladesh

During the present yearlong study in the villages, Bir Basunda, Pachh Joair and Parki of Kalihati upazilla, only four species of sandflies were collected. The prominent species was *Sergentomyia babu babu.* Nasiruddin (1952) mentioned this species as *Phlebotomus minutus* var and Ahmed and Ahmed (1983) mentioned as *Phlebotomus minutus* group. The name of this species has been changed and at present being identified as *Sergentomyia (Parrotomyia) buba babu* (Lewis, 1978). Nasiruddin (1952) in Iswarganj upazilla of Netrokona district collected four species. Besides *P. minutus* or *S. babu babu,* the other species were *P. africanus, P. argentipes* and *P. theodori.* In the present collection, no *P.arfricanus* or *P. theodori* was collected.

In addition to *P. minutus (S. bubu babu)* and *P. argentipes* Ahmed and Ahmed (1983) detected *P. malabaricus* in Madla village of Shahjadpur thana under Sirajgonj district which was not present in the present observation. Present observation corresponds to the observation of Ahmed *et al* (1995) who identified all the four species in Valukjan village of Fulbaria thana under Mymensingh district.

Sergentomyia baba babu was the most common species collected. The next abundant species in the study villages was *P. argentipes*. This species is the only common species found in all the entomological survey in Bangladesh by different workers (Sinton, 1932; Nasiruddin, 1952; Grammiccia and Sacca, 1953; Ahmed and Ahmed, 1983; Ahmed *et al.*, 1989; Masum *et al.*, 1990a,b; Hossain *et al.*, 1993; Ahmed *et al.*, 1995).

Only few *Sergentomyia shortii* were collected in the present sites of collection. Grammicia and Sacca (1953) mentioned this species as *Phlebotomus shorttii*. The name of the species has been changed to *Sergentomyia shorttii* (Lewis, 1978).

A few *Sergentomyia barroudi* was found in only human dwelling though Ahmed *et al.* (1995) found this species both in human dwelling and cattle shed in a negligible number. The earlier workers collected some more species, which was not found in the present collection. According to the report of Lewis (1978) the names of many species of sand flies have been changed.

Hossain *et al.* (1993) reported two more species *S. baghdadis* and *S. ameeni*. *S. ameeni* is a new species identified for the first time during that survey. In addition to the above-mentioned four species, Ahmed *et al.* (1989), Masum *et al.* (1990a) and Hossain *et al.* (1993) recorded *P. papatasi* in their surveys in Rajshahi region, which is a species of dry weather. The weather of the study villages of Bir bashunda union of

Tangail district is not dry, so it was unlikely to get *P. papatasi* in that wet plain land.

P. argentipes is the proven vector of kala-azar in the Indian subcontinent (Swaminath *et al.* 1942). The previous workers of Bangladesh detected *P.argentipes* in all the kala-azar endemic areas and during outbreaks of the disease. Grammiccia and Sacca (1953) got only one *P. argentipes* in the kala-azar endemic area, but they did not explain the reason of getting such low density of sandfly in that endemic area. Ahmed and Ahmed (1983) found that out of total sandflies, maximum number (34.2%) was female *P. argentipes* in Shahjadpur thana of Sirajganj district. Masum *et al.* (1990a) found 34.5% of collection was *P. argentipes* in Kalihati thana of Tangail district and Ahmed *et al.*, (1995) found 39.08% in Fulbaria thana of Mymensingh district. All those studies were performed in places where outbreaks of kala-azar took place. Present study villages, Bir Basunda, Pachh Joair and Parki are kala-azar endemic area where *P.argentipes* density was 33.8% of the total collection of sandfly.

By hand catch method, sandflies were collected from dark corners of the rooms, underneath and behind the furniture and cracks and crevices of walls and floor of human dwelling and cattle sheds in the early morning. Ahmed and Ahmed (1983) could not collect any sandfly from cattle shed by hand catch at daytime, as the sheds were open. Smith *et al.*, (1936) reported that *P. argentipes* was rarely found in open cattle sheds and outdoor resting places. However, in the present study, a good number of sandflies were collected during morning collection from cattle shed, each of which had mud wall and thatched or tin shed.

During evening resting collection also, sandflies were collected from both human dwellings and cattle sheds. By hand catch methods, sandflies were collected from corners and cracks and crevices of the walls of human dwellings. In cattle sheds, most sandflies were found resting on the bamboo poles of the cattlesheds. Das and Mukhergee (1969) also observed that cattle shed are the preferred resting places of *P. argentipes.*

It was observed that during light trap collections, no sandfly was attracted to light. The reason was not clear. Adhesive paper traps also yielded almost negative result, though it is one of the best methods of collection of sandfly. May be during the collection, the papers were not placed in proper places. Ahmed and Ahmed (1983) also could not collect any sandfly in this collection.

Very few sandflies were collected during night landing/biting collections, though sandflies were found to be present in the same places where the bait was placed. The reason of this was not clear.
The result of the susceptibility test to deltamethrin indicated that *P. argentipes* is susceptible to deltamethrin. In many tropical and subtropical countries, there has been some success in using bednet impregnated with deltamethrin insecticide against malaria vectors (Curtis *et al.,* 1991; Jefry *et al.,* 1993; Alonso *et al.,* 1993). Because of small size of sandfly, ordinary mosquito nets cannot provide any protection against them. So small-scale trial may be conducted with deltamethrin impregnated bed net to observe the efficacy of ITBN on sandfly density in the villages under study area, as good number of *P. argentipes* species were collected there and these were found susceptible to deltamethrin.

5.9. Impact of deltamethrin impregnated bednet on prevalence of kala-azar in selected villages of a kala-azar endemic area of Bangladesh

As the treatment of kala-azar is really troublesome and costly for the poor people of the epidemic or endemic areas of Bangladesh, the strategy of 'prevention' is better to be adopted to control the disease. Moreover, as observed during MEP, the decrease of vector population was directly proportional to the disappearance to kala-azar, emphasis to be given on vector control for controlling the disease rather than to treat the cases alone. The epidemiological pattern also refers to invasion of new areas every year particularly in nearby areas of the existing foci. Low socio-economic conditions, housing (mud houses), cattle sheds in close proximity to the dwellings, population movement from endemic to non-endemic areas also seem to play important role in the transmission of disease.

There are different options for vector control. Before the discovery of DDT people put screen in windows and doors, produced smoke as physical barrier to prevent man mosquito contact. After the 2nd world war, DDT was produced and it created such situation that individual, people, community and the whole country tried DDT to kill pests of all kinds. They used it in the agricultural sectors and also in public health field. During sixties, WHO persuaded different countries of the world to take vertical programmes to eradicate malaria by spraying DDT in houses, which killed the vectors of malaria. With this, the era of insecticide use came. Big companies tried to manufacture other insecticides when some pests including malaria vector mosquitoes, developed resistance or tolerance to DDT. Presently individuals, community and health departments including municipalities/city corporations are using insecticides to kill pests, including mosquitoes.

Vector control is an essential component of a kala-azar control programme. Residual DDT spraying is very much effective in controlling sandfly. Insecticide spraying should be undertaken in human dwellings, animal shelters and all other resting-places of sandflies up to the height of 6 feet from the floor level. It should be repeated at regular interval. Spraying should be preceded and followed by an assessment of susceptibility. In case of any sign of resistance in vector against DDT, should lead to an immediate change in insecticide to a susceptible one.

To control a vector borne disease use of mosquito net or screening of the house is a necessity. Use of ground floor for sleeping purpose should be avoided. Use of insect repellents in the form of lotion or cream may be applied over the exposed parts of the body for temporary protection. Dwelling environment should be kept clean. Plastering of the mud houses and cattle sheds at regular interval is effective to decline sandfly population. Periodic fumigation of sleeping room is helpful. The use of impregnated bed nets was intended to improve personal protection conferred by the nets. Another objective of introducing wide spread use of impregnated bed nets was to kill sandflies coming in contact with the nets while trying to feed, thereby reducing the vectorial capacity of the species offering partial protection even to the people outside the nets.

Kala-azar vector, the very tiny sandfly is very much susceptible to all kinds of different group of insecticides like, chlorinated hydrocarbons, organophosphorus compounds, synthetic pyrethroides, carbamates etc. But very few countries took any kala-azar vector control programmes by insecticides. The vector sandfly got killed as a collateral effect of DDT spraying, which started in early 60's to kill malaria vectors. But DDT has been banned now in Bangladesh. Use of other insecticides in indoor spraying is no more feasible due to different reasons. Recently WHO recommended insecticide treated bed (ITBN) nets for malaria vector mosquito control. And it is now adopted in many places of the world. In Bangladesh also it is being tried in some places specially in highly malaria endemic and epidemic prone areas. Whether man might get rid off sandfly biting by ITBN that has been assessed in the present study, in limited scale in a kala-azar endemic area. ITBN method of vector control strategy depends upon several factors, whether people can effort the bed net, whether people are regularly using them, whether they are using them in proper manner by all the family members, how frequently they are washing them, whether they are regularly reimpregnating them etc. During present study all these factors have been looked into in details.

During the baseline survey it was observed that respondents who possessed mosquito nets in their households, maximum of them used to wash the net more than two times a year. Before distribution of impregnated bednets, all the respondents were asked to wash the nets only on the previous days of impregnation. But 90% of them did not follow the advice of the health personnel. From different studies it was evident mosquito net washing practice varied from country to country. It was done as frequently as weekly in Surinam (Rezendaal *et al.,* 1989) to once a year in China (Curtis *et al.,* 1991). Findings of the present study also showed that washing practice varied from 12 to 2 times a year among the respondents. Rozendal *et al.,* (1989) showed that there occurred major loss of active ingredient of the various pyrethroids due to washing. The effectiveness of impregnation of nets which were washed more than 2 times a year might have reduced and the factor needs due consideration.

Kroeger *et al.,* (1995) found that high coverage and regular use of impregnated mosquito nets in Ecuador, Peru and Colombia was the main factor for the success of the programme. In the present study, all the households were included under impregnated bed net in area A and during night visit, it was further observed that a good percent of nets were in using condition which might be a cause of reduction of cases.

It was detected during initial impregnation and distribution of nets that on average three household members would use one net. During rechecking only a minor variation occurred which was possibly due to loss or replacement by untreated nets. However in Bangladesh sharing of net is a common phenomenon and depends on factors like age, sex marital status and relationship between the members of the household. Considering these aspects increased number of impregnated mosquito net might be supplied on supplementary price to cover the whole population of the community. During survey, it was found that high proportions of the respondents were willing to buy the impregnated nets if supplied on reduced price.

The main purpose of ITBN use was to observe whether it controlled/ killed vector sandfly which would ultimately affect the occurrence/ spread/ transmission of kala-azar. The study showed that due to regular use of impregnated bed net, the number of cases came down significantly in subsequent years in the impregnated area. In non-impregnated area the situation remained static and in the control area the prevalence increased rather than remaining static. The normal bednet mesh is usually large enough, through which the tiny sandfly can easily enter and bite man inside mosquito net. Probably that was the reason why in areas where non-impregnated bed nets were supplied and people were using them, yet cases were occurring. The same types of mosquito nets were used in both the impregnated and non-impregnated area. The only difference was that these nets were impregnated and the others were not. It was observed during malaria eradication time that mere smell of DDT or slight touch of it (DDT) killed the tiny sandfly. Same thing happened in case of treated bed net area in the present study. It was instructed that bed nets at daytime should remain in hanging position in one corner of the bed, so that the hopping sandfly could easily come in contact with the treated bed nets. 52% of the respondents were using the mosquito nets regularly even before the distribution of nets i.e. the use of mosquito net was already in practice in the rural area of Bangladesh. Among the sample households checked, more than 90% of the mosquito nets were observed in using condition. No difference was observed in using impregnated or non-impregnated bed nets, which indicated the acceptance and satisfactory rate of using of impregnated mosquito nets. Most of the households had no complain concerning impregnation of mosquito net. Only few persons complained of some tingling sensation in the nose. In spite of complains they were using the impregnated nets. It was also evident that the rate of use of insecticide-impregnated mosquito nets in the sample household was high. Elias *et al.,* (1995) also found high rate of use of impregnated mosquito net in a study conducted in 7 villages in Hobigonj and Moulovibazar district of Bangladesh. Alonso *et al.,* (1993), during his study in rural areas of the Gambia, also found high acceptance of insecticide impregnated mosquito nets in the study area and attributed the success of the programme because of its operation through Primary Health Care system. Carnebale *et al.,* (1991) after conducting studies in the Gambia, Burkino Faso and Tanzania found high acceptance of impregnated mosquito nets by the population, which is similar to the finding of the present study.

During the base line survey many cases were diagnosed as kala-azar. It was found that about 14% household possessed not a single bed net, 40% houses had only one bed nets. Therefore not all the members of the family were using the bed nets. Members of these types of houses were more prone to get the disease. More than half of the study population was illiterate, 25% had no land of their own and 44.4% were living in mud houses. The illiterate and the poor did not understand the cause of kala-azar and also not aware of the problem. They did not have idea how to get rid of the problem. Poor and illiterate were seen indifferent to the disease problem and lived with them.

Another contributing factors of sandfly biting to man was the close proximity of cattle shed from their dwellings. Sandflies usually remain associated with cattle sheds as it was found zoophilic i.e. tendency to feed animals. They bite man by chance. Sometimes they remain in dwelling houses (Ahmed *et al.,* 1989). On the contrary it was observed in another study by Addy *et al.,* (1983) that sandflies living in house bites more human that sandflies remains in cattle sheds. The sandflies remain in cattle sheds bites more cattle than human. That's why the workers termed the sandfly as an indiscriminate feeder and would feed on the host whichever is in the close vicinity. Present study showed that maximum (81%) kala-azar cases were living in such houses that got cattle shed in close vicinity. The statistical analysis showed that association between presence of cattle shed in the household and presence of kala-azar was significant (Pearson Chi square value=5.231^b. p=0.013). That's why for prevention and control of kala-azar in the rural community of the country, people should be advised to keep their cattle sheds away from human dwellings. Mud houses are the most preferred breeding and resting places of sandflies as most of the houses had crack and crevices and the environment remains dirty. If it is not possible to have tin or brick build houses, instead of mud houses in the villages, care should be taken regarding proper maintenance of the houses. The environment around the houses should be cleaned and houses should be mud plastered at regular intervals. Houses should be well ventilated, as sandflies prefer dark untidy places in the rooms. If there are rat holes, tree holes, animal burrows and deep cracks and fissures in around the houses and cattle shed, those should be filled destroyed or plastered.

Presence of bush or drain close to human dwellings is a common scene in rural area of the country. However, one-way analysis (ANOVA) showed that there was no significant association between the presence of bush or drain and presence of kala-azar cases in the same houses (p=1.0).

The study showed that ITBN method of sandfly control was effective in reducing the density of sandfly. Before the distribution of ITBN in the community, during the base line survey, sandfly density was 2.3 pmh of collection. On the 2nd and 3rd year the pmh collection became 1.4 and 0.5. The statistical analysis by paired sample T test showed that there was significant decrease in density of sandfly between 1st and 2nd year (t=6.034, p=0.002) and also highly significant between 2nd and 3rd year (t=6.598, p=0.001). It proved that sandfly got killed easily due to just presence of ITBN in houses. That ultimately helped in lowering down the number of kala-azar cases.

There is scanty published information regarding the impact of ITBN on kala-azar vector or the disease (Majori *et al.,* 1989; Malori *et al.,*1991; Alexander *et al.,* 1995). Many studies were available regarding trials with impregnated mosquito nets against mosquito. Elias *et al.,*(1995) in his study in Moulavibazar and Hobiganj districts, Bangladesh, found 2.6 fold reduction of self reported malaria compared to pre-intervention period. Trials with impregnated mosquito nets have been conducted in different parts of the world particularly in Sub-Saharan Africa, Latin America and Asia. Choi *et al.,* (1991) found that the nets were effective in prevention of malaria and the incidence rate of malaria decreased by 50%. Ititch *et al.,* (1994) in a study in rural Zambia found that the impregnated mosquito net caused 74% to 78% reduction in weekly reinfection rate. Kroeger *et al.,*(1995), after conducting trials with impregnated mosquito nets in Equator, Peru and Colombia, found that there was 40% reduction in malaria incidence.

In the present study, during the baseline survey the prevalence of kala-azar was high in all the three areas. After the intervention with impregnated bed net, reduction was observed in area A, but not in area B and C. In area A, the prevalence of kala-azar per 1000 population became 20.3 and 11.7 in the 2^{nd} and 3^{rd} year of intervention. The statistical analysis by paired sample T-test between the baseline (1^{st}) year and the 2^{nd} year shows that there is not significant reduction between the two years (t= 2.445, p=0.058) but the difference between the 2^{nd} and 3^{rd} year of intervention is statistically significant (t= 3.051, p=0.028). It may be concluded that regular using of ITBN by all the family members and plastering of mud houses and cattle sheds minimize the sandfly density level, which will ultimately help in reducing the transmission of kala-azar to a great extend even if not eradicated.

5.10. Effect of flood on sandfly density and prevalence of kala-azar in a kala-azar endemic village of Bangladesh

Sandfly breeds in decaying organic material around mud houses, cattle sheds and troughs. The breeding sites are usually within 5 cm. of the ground level. Short *et al.* (1930) detected the larvae of *P.argentipes* from a number of different types breeding soils in nature. Smith *et al.*(1936) found sandfly larvae up to 60 cm. of dwelling and also observed that the type of breeding sites varied with season. In dry season, larvae were found near the tanks and in wet season they shifted closer to houses. Hati *et al.* (1934) also developed a new technique for detection of sandfly larvae in nature and detected larvae in soil samples from human dwelling and cowsheds in West Bengal, India. In the present study sandfly larvae were detected at different heights of the wall, from ground level up to 90 cm., during and post flood period. Detection of sandfly larvae on floors and walls after shifting of floodwater indicates *P.argentipes* can withstand the highest percentage of humidity even deep flooding. Similar observation was found in a study in a flood prone area of Bihar, India (Mukhopadhaya *et al.*1990). During that study all ground level breeding sites were submerged up to 60 cm. Larvae were found in soil samples as high as 90 cm. After the floods, the larvae returned to normal level. It demonstrated that larval breeding is not completely prevented by flooding.

The village Dhalia is a kala-azar endemic area. Record of Bhaluka Thana Health Complex showed that the prevalence of kala-azar cases were 87, 123, 172 and 146 in 1993, '94, '95, '96 and '97 respectively. The point prevalence of kala-azar in the selected village in July '98 was 3 (4.6%) out of 65 cases tested serologically. Positive cases were detected in each of the following 11 months during follow up period.

The study showed that kala-azar in more common among male. The male female ratio for sero-prevalence was 1.9:1. This is possibly due to more exposure of the male to sandfly bite as in rural Bangladesh mainly the males work in cattle sheds specially in evening time, use comparatively less clothing and sleep more in the open particularly in summer time. The observation corresponds with the findings of Masum *et al.* (1990); Chowdhary *et al.* (1991).

Regarding age Sanyal *et al.* 1979 and Chowdhury *et al.* 1991 observed that disease affected all age group but highest in the age group of 15-20 years. Observation of the present study is also similar to them as the highest cases in the age group of 16-20 years (59.3%).

The causal observation revealed that most of the inhabitants of the villages are of low-income group. Professionally they are mostly cultivators and daily labourers. The villagers being poor cannot provide mosquito nets and thus the exposed to the bites of kala-azar vector at night. During collection, sandfly were available throughout the whole year. Most of the partition walls of the cattle shed and some of the dwelling houses were mud plastered. Mud floors and moist and dirty room environment created favourable condition for the phlebotomine (vector) to stay and breed. Cattle sheds and poultry houses were generally kept attached with dwelling house. The study also revealed that the cowsheds were within 5 meters or attached to the main house in 80% of the households. Sometimes it was also observed that men and cows were sleeping together in the same room. Most of the kala-azar cases were from that type of dwelling house.

Harith *et al.* (1987) observed the sensitivity of DAT was 89.84 but in the present observation it was 96.5. The simplicity and reliability of DAT in the study findings suggests that the test (DAT) may be applicable for mass screening in the rural set up of Bangladesh.

There have been a number of changes in the treatment schedule of kala-azar. It was believed that the Indian strain of LD body was less virulent type and responded well to SAG with a dose schedule of 10 mg/kg body weight for 10-15 days. However treatment with that schedule showed a failure rate of 13% in India (Sengupta, 1953). It is presumed that due to the above-mentioned dose schedule relapse or PKDL developed. By prolonging to duration of treatment relapse rate reduced from 13% to 0.5% (Thakur *et al.* 1984). Chowdhury *et al.* (1991b) used 20 mg/kg body weight per day for 20 days for adult and 10 mg/kg body weight/day for 20 days in case of children and found a failure rate of 7.4%. In the present study it was observed that 93.75% cases showed complete cure with 20 mg/kg body weight for 20 days regimen. In remaining 2 cases (6.25%) cure was achieved by giving a total of 40 injections at the same doses. The side effects were minimum and in no case treatment had to be stopped.

During flood when almost all houses were submerged under water, sandfly larva was detected in soil samples just above water and the prevalence of kala-azar did not show any significant change before and after flood which indicates that flood does not act as a natural intervention to control kal-azar or its vector.

CHAPTER 6

SUMMARY

SUMMARY

A series of study was conducted during the fieldwork on the prevalence of malaria, filaria and kala-azar, abundance of the vectors and impact of deltamethrin treated bed net on the density of vector and prevalence of diseases during the period of June 1996 to May 1997. The 1st study of the series was on the significant clinical features of malaria and effectiveness of different scheduled drug regimens suggested by revised malaria control strategy (1992) in 9 (nine) selected villages of Kalihati, Kalmakanda and Baliadangi upazilla of Tangail, Netrokona and Thakrgaon district of Bangladesh respectively during the period of June 1996 to May 1999. A total of 258 malaria cases were diagnosed clinically and parasitologically among 11,553 villagers during the period of study and classified as Uncomplicated Malaria (UM), Severe Malaria (SM) and Treatment Failure Malaria (TFM). Fever with headache, vomiting, loose motion, anaemia, jaundice, splenomegaly, hepatomegaly were significant symptoms and signs of malaria patients. Severe malaria patients suffered from drowsiness, confusion, semi-consciousness and convulsion. Malaria was most common among people of 10-19 years of age (35.65%) followed by age group 20-29 years (32.55%). Male female ratio was 2:1. Maximum number of cases occurred during the month of June to November. Malaria cases were treated according to the standard drug regimen for UM. SM and TFM. Except 3.87% mortality, rest became cured with that regimen, which proved its efficacy. Malaria is a serious disease with fatal outcome, if untreated. As it is more common among younger, early diagnosis and prompt treatment (EDPT) according to the set up criteria would be affective in reducing the morbidity and mortality due to malaria in Bangladesh.

In the **2nd study** of the series, an entomological surveillance for malaria vectors was carried out in three villages, Kristapur, Burimari and Kadamtali of Kalmakanda upazilla under Netrokona district from June 1996 to May 1997. During the one-year period of study, a total of 4832 female *Anopheles* mosquitoes were collected from. Of these 798 (16.52%) were from human dwellings and 4034 (83.48%) from cattle sheds. *An. vagus* was the most predominant species in dwelling houses both in morning resting and night landing/ biting collections comprising 30.42% and 36.19% of total collection respectively. *An. annularis* was another prominent species in both the collections (6.61% and 8.57%). During morning resting collections from cattle sheds *An. annularis* was found in maximum proportion (24.96%) followed by *An. vagus* (24.18%) and during evening collections the same two species, *An. vagus* (27.29%) and *An. annularis* (23.27%) were most common. The other malaria vector species of Bangladesh, *An. philippinensis, An. aconitus, An. minimus* and *An. dirus* were also collected in the study villages of Kalmakanda and comprised 4.73%, 1.30%, 0.33% and 0.14% of the total collections respectively. Out of seven malaria vectors in Bangladesh, six were found to be present in the study villages but the density of all was low. As *An. aconitus, An. annularis* and *An. vagus* have been incriminated as epidemic malaria vectors, it may be appreciated that virtually any Anopheline, in suitable or right condition for them, may act as vector. So, further investigations are recommended, which might incriminate a new vector. As the available vector mosquitoes differ in their bionomics, to reduce transmission of malaria, main emphasis are to be given to prevent man-vector contact. Insecticide impregnated bed net (IIBN) may come up, if found feasible.

The **3rd study** was carried out to evaluate the acceptability of bed net by rural people, socio-cultural behaviour pattern of the bed net users and the effectiveness of village scale use of deltamathrin impregnated bed nets in comparison to that of use of non-impregnated bed nets and control area in 9 (nine) selected villages of Kalihati, Kalmakanda and Baliadangi upozilla under Tangail, Netrokona and Thakurgaon districts respectively during the period of June 1996 to May 1999. The villages were assigned into area A, B and C. Intervention with deltamathrin impregnated bed nets and non-impregnated bed nets were given in two areas designated as area A and B. Area C was the control zone where no bed nets were distributed. 90% of the respondents considered mosquito bite as the cause of malaria and 49.4% thought parasites in blood caused malaria. To protect from mosquito bite, 67.1% practiced bed nets. Uses of dhup, smoke, coil, kerosene oil were the other methods. Acceptance of bed nets was high in both area A and B. In area A, the use became 86.8% and 93.9% and in area B it was 91% and 83%in the 2nd and 3rd year respectively but in area B though decreased from 91% to 83%, still high. The density of female *Anopheles* mosquitoes decreased significantly in area A during the post intervention period whereas no significant changes occurred in non-impregnated or control areas. Similar findings were observed in three areas regarding the prevalence of malaria cases. The significant decrease of density of malaria mosquitoes and prevalence of malaria cases suggests the effectiveness of deltamethrin impregnated bed net in reducing the transmission of malaria. Of course, the proper concentration of insecticide, the integrity of bed nets and regular use of nets are the other contributing factors for this achievement.

Besides malaria, other two endemic vector borne diseases in Bangladesh are filaria and kala-azar. The **4th study** was on bancroftian filariasis in 3 villages, Bamunia, Maskuria and Bangavita of Baliadangi upazilla under

Thakurgaon district in Bangladesh during the period of June 1996 to May 1999. The objectives were to determine the clinical aspects, diagnose by traditional and recent immuno-chromatographic (ICT) methods and evaluate the comparative efficacy of three strategies of treatment. During the period of study, a total of 139 lymphatic filariasis cases including both clinically and/or parasitologically positive were detected among 3551 villagers of the study villages. The prevalence in different villages ranged from 8.3 to 18.1 per 1000 population. Male female ratio was 3.3:1. The number of cases increased with advancement of age. Maximum cases were among persons of 21-50 years of age. The disease was prevalent amount people having no or less educational background and low socio-economic status. Among the 72 clinically positive cases, hydrocele (58.4%) was the most common clinical feature followed by elephanthiasis (26.5%). Moderate (11-100/slide) and mild (1-10/slide) microfilaria (mf) density were found among 46.8% and 40.6% of total 79 mf positive cases. Three regimens of treatment, i. Standard therapy ii. Semi-annual single dose therapy and iii. Low dose monthly schedule, were assigned to randomly selected groups. Responses to treatment of all strategies were less in curing physical signs than clearing mf from blood. With any regimen, the clinical signs did not disappear completely except slight reduction or no further increase. Regarding parasitological cure, strategy III proved most effective (60.1%) followed by strategy I (54.5%) and lastly strategy II (45.5%) among the 67 only mf positive cases. Field trials with ivermectin and diethyl carbamazine or albendazole in other countries were discussed. Improvement of socio-economic status and a trial with ivermectin drugs were recommended in Bangladesh.

The 5th **study** was conducted to find out the vector density in the endemic area of filaria. In the one-year period of study (June 1996 to May 1997), a total of 2608 female mosquitoes were collected by different methods from the three selected villages of Baliadangi upazilla of Thakurgaon district, of which 1836 (70.4%) belonged to genus *Culex* followed by *Anopheles* (26.5%). Two other genera, *Aedes* and *Mansonia* comprised a negligible proportion (3.1%). Out of total 693 *Anopheles* mosquitoes, *An. annularis, An. vagus, An. aconitus, An. peditaeniatus* and *An. philippinensis* comprised 99% and rest 1% belonged to some other species of very negligible number. Among the *Culex* mosquitoes, *Culex quinquefasciatus* was the most predominant species (72.0%) followed by *Cx. vishnui* (8.3%), *Cx. gelidus* (6.3%), *Cx. fuscocephala* (5.8%), *Cx. tritaeniorhynchus* (2.1%) and others formed rest 5.5% of the collection. 52% and 24% of total *Culex* mosquitoes were captured from human dwellings and cattle sheds respectively. *Cx. quinquefasciatus*, a truly anthropophilic species was found in large number in human dwellings. On March, maximum number of *Culex quinquefasciatus* was collected and minimum on September. Among the dissected 855 mosquitoes, only *Cx. quinquefasciatus* was found positive with filarial larvae and the infectivity rate was 8.1%. As *Cx. quinquefasciatus* was found in large number in human dwellings and the infection rate of filaria (8.1%) was high in the study villages of Thakurgaon district, there is possibility of spreading the disease or even an outbreak. Moreover the sufferers belong to the low privileged group. A control programme may be taken in those areas from the health sector without delay.

On the other hand, the **6th study** was assessed the knowledge of the local people about filaria before the intervention study with deltamethrin impregnated mosquito nets (DIMN). The study evaluated the impact of DIMN on lymphatic filariasis and its vector in the villages, Bamunia, Maskuria and Bangavita of Baliadangi upazilla under Thakurgaon district. The inhabitants of those villages called the disease filaria as 'Goad Rog' or 'Elephant Leg' and recognized it by its clinical manifestations of hydrocele and elephanthiasis. People's knowledge regarding the cause and transmission of filaria was very poor. Only 14.3% told that a parasite in blood and 5.7% mentioned that mosquito bite was the cause of filaria. The villages were assigned as deltamethrin impregnated bed net area (A), non-impregnated bed net area (B) and control area (C). The acceptability and practice of using of impregnated and non-impregnated bed net was high in both area A and B. Density of *Culex quinquefasciatus* mosquitoes collected from human dwelling showed a significant decrease ($P< 0.05$) during the period of study in area A. In area B, density did not follow any trend and in control area then occurred some increase in density of filaria vector mosquito. The prevalence of filariasis in area A, showed a decreasing trend, though not significant ($P>0.05$) between 2 consecutive years, but slightly significant ($P=0.055$) between 1st and 3rd year of study. In other two areas the difference in prevalence between 1st and 3rd year was not significant ($P>0.05$). As the acceptance and use of bed net by rural people was high and deltamethrin impregnated bed net showed statistical significant decrease in filaria vector mosquito density; in controlling the disease impregnated bed net may be distributed at a low cost by Government, would be an effective measure if maintained for years together.

During the **7th study** on epidemiological, clinical and therapeutic features of visceral leishmaniasis (kala-azar) in three villages, Bir Basunda, Pachh Joair and Parki of Kalihati upazilla under Tangail district during the period June 1996 to May 1999, a total of 228 cases of were diagnosed as kala-azar by clinical and Direct Agglutination Test (DAT) out of the 3776 inhabitants of three villages. Male female ratio of kala-azar patients was 1.5:1. Maximum cases were in the age group of 11-20 years (33.8%) followed by age group 0-10 years (28.9%). All cases had poor socio-economic background. >70% of the houses of the villages possessed cattle sheds, which lied very close or adjacent to dwelling houses. Case distribution showed more than one positive case in infected houses. 100% of the patients gave history of irregular fever. Swelling of abdomen (47.8%), dark colouration of skin (43.8%) and loss of weight (41.6%) were the main complains. Common physical signs were anaemia (82.9%), splenomegaly (69.7%), hepatomegaly (42.9%), hepato-splenomegaly (29.8%) and oedema (20.0%). 86% of the patients responded well to Sodium Antimony Gluconate (SAG) at a dose of 20mg/kg body weight/day IM or slow IV for 20 to 40 days. 12.6% of the patients did not respond or relapse occurred, who were treated with Pentamidine Isethionate and became cured. Mortality rate was 1.3%. 12 (twelve) cases with hypopigmented rashes, small papules or nodules were diagnosed as PKDL by skin scrapings, which were parasitologically positive. All responded well to 6 (six) courses of SAG.

In the **8th study** an entomological investigation for kala-azar vector was conducted in three kala-azar endemic villages, Bir Basunda, Pachh Joair and Parki of Kalihati upazilla of Tangail district. During the year long period (July 96- June 97), collection of sandflies, a total of 1140 female adult sandflies were collected by different catches from selected human dwellings and cattle shed. Out of total collection 38.4% was *Phlebotomus argentipes* and rests were *Sergentomyia* spp. It consisted of *S. babu babu, S. barraui* and *S. shorti.* Morning and evening resting collection from human dwelling yielded 5.1 and 7.0 per man-hour (pmh) collection of sandflies. Same collections from cattle sheds yielded 11.6 and 8.3 pmh respectively. Very negligible number of sandflies were collected from night landing / biting collection and adhesive paper trap. Sandflies were collected mainly from cracks and crevices near the corners and walls of houses and cattle sheds. Regular plastering of walls would help to reduce sandfly breeding. Seasonal distribution showed the peak on May – Sept. and lowest during winter. *P. argentipes* was found very susceptible to deltamethrin. Recently advocated deltamethrin impregnated bed net may be recommended for control of kala-azar transmission in rural areas of Bangladesh.

The **9th study** was conducted to assess the impact of deltamethrin-impregnated bednet on prevalence of kala-azar and its vector. The intervention study was conducted in three kala-azar endemic villages of Bibasunda union of Tangail district during the period of June1996 to May 1999. During the base line survey it was observed that younger group of people (<20 years) occupied more than 50% of the total population. Literacy rate was 32.2%. Cultivation was the main occupation (20%) in the study villages. About 80% of the houses in the villages were hut or mud houses with thatched or tin shed. 76.7% of the houses possessed cattle sheds. A significant association ($P<0.05$) was observed between the presence of cattle shed and kala-azar cases in the same house. Presence of bush or drain had no significant association with kala-azar infection ($p>0.05$). Use of mosquito net was common practice. Kala-azar was a known disease to the inhabitants of the villages. 42.4% of the people had the idea that mosquito bite was the cause of kala-azar. Use of mosquito net (44.4%) and environmental management (35.6%) were the common practices to prevent mosquito bites. Deltamethrin impregnated bed nets and non-impregnated bed net were distributed in two villages and third one was kept as control. Density was sandfly was 2.3 pmf in area A, during base line survey. It showed highly significant decrease in the 2nd and 3rd year of study ($P<0.01$). No significant change in the density of sandfly was observed in area B. In the control area there occurred an increase in sandfly density. In area A, prevalence of kala-azar showed a decreasing trend from 25.8 to 20.3 and 11.7 per 1000 population in the 3 years respectively which is statistically significant ($p<0.05$). In area B, an increase in 2nd year and slight decrease in the 3rd year was observed. In area C, prevalence showed higher trend. If ITBN is used properly by all the family members in an endemic zones, kala-azar can be controlled to a great extend if not eradicated. Mud houses should be plastered regularly to minimize the density level, which will ultimately help in reducing the kala-azar transmission along with ITBN.

The **10th study** was conducted to find out the effect of flood on sandfly density and prevalence of kala-azar. During the period of July to September 1998 when the whole village Dhalia of Bhaluka thana was under flood water, sandfly larvae were detected from 2.7%, 2.4% and 2.2% of soil samples collected above 60 to 90 cm. height respectively. After the flood was over no larvae was detected at that level. However, positive samples were found in 5.2% and 5.6% cases at 30 to 60 cm. and up to 30 cm. level respectively on October 1998. It revealed that the longevity of eggs of sandfly might last up to 3-4 months even under water, as the larvae were detected from wall scrapings after flood. A total of 48 larvae were detected throughout 12 months period of which 13 emerged to adult and 6(46%) were *Phlebotomus argentipes,* the known vector of kala-azar. Adult sandflies as calculated by per man-hour showed that during flood period the density was lowest (1.25 pmh) which increased on following months. With a reduction in winter it became maximum (10.4 pmh) on June 1998. Though the trend was similar with that in previous 12 months, there was significant difference [Sig (2 tailed) .002] in the sandfly density. Among the 32 DAT positive cases, 21 (65.6%) were male and > 50% cases were detected among age group of 16 - 20 years. Occupationally highest cases (43.7%) were from cultivators and day labours followed by dependants (18.7%). Among the sero-positive cases, five (15%) cases were asymptomatic and rest showed symptoms of prolonged fever and enlarged spleen. Bone marrow was positive for *Leishmania donovani* in seven (25%) symptomatic cases. During the previous 12 months 40 cases were detected as DAT positive but the difference between the prevalence of kala-azar is not statistically significant [Sig (2 tailed) .166]. The sensitivity of DAT was observed as 96.5% and the finding suggested that the test may be applicable for mass screening in rural set up. Treatment with 20 days regiment of SAG (20mg/kg/day) to all DAT+ve cases, 93.75% showed complete cure and the remaining needed 20 more injections. In conclusion it can be said that flood acts as a natural intervention in reducing sandfly density, though effect is not long lasting. Moreover, flood does not have any beneficiary impact on the prevalence of kala-azar.

CHAPTER 7

CONCLUSION and RECOMMENDATIONS

In spite of much efforts and measures to control the vector borne communicable diseases like malaria, kala-azar and filaria, these are common in the rural population of Bangladesh. Whatever information we get from the regular channel, the real situation in the country regarding these diseases is more serious. A series of studies has been conducted on the prevalence of these the vector borne diseases- malaria, kala-azar and filaria and the densities of their vectors in some selected areas of Bangladesh.

During baseline survey about the demography and socio-economic condition of the rural people of the study areas, a misearable situation was observed. In the population pyramid, the young people occupy the major portion which indicates that the growth rate of Bangladesh is still high. The literacy rate of the rural people of the study areas was lower than the national figure and people were ignorant about many aspects of the diseases under study. An extensive family planning programme is strongly recommended. But no vertical programme would be successful without active participation of the community people and for this participation, an willingness to of the people to join and bring success of the programme is a pre-requisite and that comes from literacy. To remove the ignorance of the people about malaria, kala-azar and filaria, a health education or imformation, education and communication (IEC) programme is also highly recommended.

To control the vector borne diseases, trials have been made with nets impregnated with deltamethrin and compared wth non- impregnated and controls. From the findings of the trials and the respected studies the following colclusions and recommendations are drawn.

Malaria due to *Plasmodium falciparum* causes more mortality than by other malaria causative pathogens and also higher in number. It is more common among young aged people. As such, cases should be detected early through proper surveillance mechanism. Early diagnosis and prompt treatment will lower down the morbidity and mortality. In the 1st study, the anti-malarial regimen according to the case definition of uncomplicated, severe and treatment failure malaria proved effective. But many physicians working at rural areas are not fully aware of the regimen. Training course regarding the modern treatment to all the physicians of Upazilla Health Complexes (UHC) are recommended so that the severe malaria may be diagnosed early and proper treatment may be started without delay. It will ultimately lower the morbidity and mortality due to malaria in the country.

Both recognized and epidemic malaria vectors are abundantly available in the favourable ecological situation in Bangladesh. From the findings if the 2nd study, it is apprehended that any anopheline species may act as either primary or secondary vector in the changed global ecological condition. Only vector control strategy like RIS as a routine like is not feasible any more due to different reasons. Thorough investigations to incriminate new vector(s) are recommended and an integrated control programme is necessary.

Personal protection by the rural people with mosquito nets impregnated with suitable insecticides (deltamethrin) may hinder the vector mosquitoes to come into human contact and thus interrupt transmission. Members of the rural community should be motivated for regular use of impregnated bed nets, which will help them not to get malaria. Simple bed net protects people from mosquito biting by preventing man mosquito contact. The impregnated bed nets give more protection to people by its repellent and toxic action to mosquito. Moreover, when used in a wide scale, large number of mosquitoes coming in contact with ITBN would be killed, thus reducing the vectorical capacity of the species offering partial protection even to people outside the net. During the 3rd study, deltamethrin impregnated bed net showed significant impact on reducing both the density of female anopheles and the prevalence of malaria in comparison to simple bed net and control. Deltamethrin treated mosquito net is therefore recommended as a means of effectively reducing the risk of exposure to malaria transmission. Use of impregnated bed net may be extended to the forested hilly and forest fringe malaria endemic areas. Primary Health Care support and community participation are essential for this operation. As the people of rural Bangladesh are very poor, Government should make the impregnated bed net available to them at an affordable price, which may ensure highest possible coverage.

Before starting operation with ITBN in an area, training of the basic health workers and supervisors on different aspects of impregnated bed net distribution and monitoring the use is recommended. Education of the users about the proper use and washing internal is also recommended. Further research on insecticide-impregnated bed net is strongly advocated.

Filariasis is much common in northwestern part of the country though the endemicity is spread all over the country. In the 4th study on epidemiological factors of filaria, more than 60% of the cases were found illiterate or had education maximum upto class V. It is strongly recommended to increase the literacy rate even by informal education to elevate awareness regarding the prevention and control of filaria. Though it a poor man's disease, yet all class of people may be affected in rural community. In the study, filariasis was observed as a disease of low privileged group. Male are more vulnerable than women. Filariasis is more common in middle-aged group of people, less educated and poor socio-economic condition. Only 6.7% of the patients had educational qualification up to graduation and 5% lived in pucca (brick) building. Bancrofilaria filariasis once endemic is Australia and USA disappeared spontaneously with improvement of socio-economic circumstances. So improvement of socio-economic conditions is recommended to control filaria in Bangladesh also.

In the filaria endemic areas, people should be motivated for regular blood check up to detect the presence of microfilaria, as asymptomatic cases are many who ultimately act as carrier of the diseases. Night time blood collection is tedious and difficult. Immunochromatographic test (ICT) is simple, easy to carryout and does not need night blood collection, which is found more sensitive and specific than parasitological procidure. The (ICT) is recommended for filariasis diagnosis specially for community survey.

Though filariasis does not cause high mortality but it causes morbidity and social problem due to body deformity and long-term disability. In Bangladesh only diethyl carbamazine citrate (DEC) is available for treatment of filariasis. DEC is much effective in clearing microfilaria (mf), not so much in curing clinical filaria. To maintain the amicrofilarimic state, repeated treatment is recommended as DEC therapy may incompletely clear cent percent mf from blood or people living in endemic areas may be reinfected. Moreover, due to side effects of DEC in general, incomplete treatment rate is also high.

The combination of long life of adult parasite (several years) and infectiousness of patient with low parasitaemia represent a serious obstacle to control program based on chemotherapy. Recently the new microfilaraecidal drug ivermection alone or combination of ivermectin and/or DEC or albendazole gives very good result. Trials with ivermectin and albendazole or ivermectin and DEC are highly recommended in

Bangladesh. Early diagnosis of cases and use of specific combination drug therapy are recommended to reduce the endemicity which will ultimately eradicate the disease.

A *Culex* species, *Culex quinquefasciatrus* is found transmitting the disease, filaria, as also proved in the 5th study. Due to its widespread breeding habitats and high density it is difficult to control this species with conventional methods like indoor spraying and breeding place management. It is observed that personal protection through regular use of deltamethrin-impregnated mosquito nets is the only choice. It helps in lowering down the vector mosquitoes as they die when come in contact with the insecticide treated bed nets. As a single mosquito bite does not cause filariasis and which require thousands of infective mosquito bites to acquire the disease, personal protection by insecticide treated bed net (ITBN) may definitely lowers down the transmission. There occurred significant decrease in density of *Cx. quinquefasciatrus* mosquito in the following two years of intervention with ITBN.

Results of the present longitudinal study (6th study) showed that impregnated bet nets protected people more from getting filariasis than without impregnated bed nets. In impregnated bed net area there occurred a decreasing trend in the prevalence of filaria and showed significant decrease on the 3rd year. Use of deltamethrin treated bed nets is strongly recommended in the filariasis endemic zone for controlling filariasis which ultimately helps in controlling filariasis from the country in the long run. People bring their bed nets and regular insecticides impregnation should be provided by the health authority or NGOs.

There is a common belief that regularly occurring flood in rural plain land of Bangladesh help in lowering down the sandfly density as it usually remains near the floor due to its non-flying habit. People are in the opinion that flood zones are free from kala-azar. In a flood prone area, where kala-azar was found endemic, a regular entomological investigation was carried out on sandfly. Information on kala-azar prevalence and incidence were collected before and after the flood. Results showed that though flood reduced the sandfly density, still a good number of them were found in cracks and crevices of the walls. Larvae of sandfly were found above 30, 60 to 90 cm from the floor level. As soon as the floodwater went down, the density level of sandfly reached the pre-flood time level. Disease prevalence data also showed that flood has no beneficiary impact on the prevalence of kala-azar. As such it is concluded that vector control measures and epidemiological surveillance mechanisms must include the flood zones of the country as it not free from kala-azar as the study results showed.

Once spread all over the country (before 60's), kala-azar has again becoming established in the rural areas of Bangladesh. In the 7th study, maximum cases (62.7%) were found in young-adult age group (11-20 years) in the poor community. In the longitudinal study, a significant association was observed between the presence of cattle shed close to dwelling houses and the presence of kala-azar in that house. Moreover, in many houses more than one case were present. Constructing cattle sheds far away and keeping them dry and clean is strongly advised.

Direct Agglutination Test (DAT), a serological method of test for confirmation of kala-azar cases were proved highly specific and sensitive. It is recommended to perform DAT in the epidemiological surveillance system in Bangladesh. Diagnostic facility by DAT should be developed all upazilla health complexes. Awareness and motivation on kala-azar to be initiated through IEC (information, educaiton and communication) activities by health education bureau and mass media.

Treatment with sodium antimony gluconate at the proper regular dose is found still effective in 94% cases as observed in the study. In some cases additional doses may require and in few cases pentamidine may be needed under direct supervision of professional. Kala-azar cases should be detected early through proper epidemiological surveillance system and prompt treatment should be given as inadequatly treated cases or refractory cases remain as reservoir and act as the best source of transmissions of disease. Clinicians need increased awareness about the prevalence of disease and concept of proper dose of 1st, 2nd and 3rd line chemotherapy. Kala-azar is a fatal disease, if not treated. Establishment of epidemiological surveillance by active case search and proper referral system is recommended. Supervision should strengthen from field to central level. Regular orientation of physicians about management and treatment of kala-azar case, follow up, maintenance of records, prevention and control activities should be arranged.

The recognized vector of kala-azar is abundantly found in old mud houses and adjacent cattle sheds, as observed in the 8th study. Mud houses should be plastered regularly to minimize the sandfly density. Though the vector sandfly is found still susceptible to DDT, regular indoor insecticide spraying is not feasible due to many reason like refusal of house dwellers to DDT spraying, frequent mud plastering of walls, abuse of insecticides for agricultural purpose, development of physical resistance to vectors, refractory behaviour of vectors, environmental pollution etc. An alternative appropriate approach or method to control vector is urgently needed especially in the endemic areas of the country. An integrated vector control program with malaria is recommended to arrange and that might be the use of ITBN.

It was found in the 9th study that that regular use of untreated bed nets could not protect persons from sandfly bites but deltamethrine impregnated bed net could. Regular use of impregnated bed nets not only protected an individual from sandfly bites but also showed that the accumulative effect of use of impregnated bed net by the members of the community prevented the transmission and lowered down the prevalence of kala-azar in the area. Considering the ban of DDT which was harmful to environment and public health, the changing behaviour of some vector mosquito, continued ecological changes and socio-cultural factors that affect malaria, a new approach for vector and parasite control including environmental management is necessary. More then 80% of people Bangladesh live in rural communities and malaria is prevalent in rural area. As quoted by Russel (1963) that 'malaria is the cause of poverty and poverty is the cause of malaria' is remarkable in this concern. So a simple method is needed to recommend for the poor rural people which would be acceptable to them and also effective.

Normal mosquito nets usually could not inhibit the tiny sandfly to enter into the bed nets but insecticide impregnated bed net could not only prevent them from entering but also kill them as soon as they come into contact with nets. The result of the susceptibily test to deltamethrin against *P.argentipes* showed that it was highly susceptible to insecticide, deltamethrin. The longitudinal study showed that ITBN method of sandfly control is effective against sandfly, as the sandfly got killed easily due to just presence of ITBN in house. The lowering of sandfly density will ultimately help in lowing down the number of kala-azar case, which was found in the study where significant decrease in the prevalence of kala-azar in the impregnated area and not in the other two areas.

In case of vector borne communicable diseases, early detection and prompt treatment of the cases is recommended. Vector borne diseases will be prevented and controlled if regular use of deltamethrin-impregnated bed net by the community members is ensured. Before the implementing regular measures, community members must be motivated regarding regular use of bed nets by every member of the family.

As was observed in the studies, the impact of ITBN on malaria, filaria and kala-azar vector density and the prevalence diseases is significant. Distributing ITBN on supplementary cost to the rural people, monitoring of proper use and reimpregnating at regular intervalwill ultimately help to control malaria, filaria and kala-azar in the rural endemic area of the country.

More research activities are recommended with the assistance of collaborative institutions. Technical and financial support provided by WHO, UNDP and bilateral donors should be solicited.

CHAPTER 8

REFERENCES

References

1. Abdel Hameed AA, Harith AE, Abdel Rahim IM. Direct agglutination test (DAT) for detection of visceral leishmaniasis in an endemic area in Sudan. Trop. Med. Parasit. 1989; 40: 470-71.
2. Abdulcader MHM. The significance of the *Culex pipiens fatigans* Weidemann problem in Ceylon. Bull. Wld. Helth. 1967; 37: 245-47.
3. Addy M, Mitro AK, Ghosh KK, Hati AK. Host preference of *Phlebotomus argentipes* in different biotopes. Trop. Geogr. Med. 1983; 35: 343-45.
4. Adles S, Theodor O. Transmission of disease agents by phlebotomine sandflies. Ann. Rev. Ento. 1951; 2: 203-26.
5. Ahmed ANN, Islam KMN, Rahman MT. Prevalence of malaria in the urban population of Dhaka city: an experience based on microscopic study of peripheral blood film. Bang. Med. Res. Coun. Bull. 1985; 14(4): 23-7.
6. Ahmed S, Begum SMKN, Bhaduri J, Islam MS, Azhar MA, Rafiqueuddin AKM. Filariasis presenting atypically and diagnosed by urine examination. TAJ (Rajshahi) 1996; 9(2): 117-18.
7. Ahmed TU. Checklist of mosquitoes of Bangladesh. Mosq. Sys. 1987; 19: 187-200.
8. Ahmed TU. Bionomics vector of kala-azar in Bangladesh. International Evaluation of the Program Activities for Control of Visceral Leishmaniasis in Bangladesh - A report, NIPSOM, DGHS & WHO/UNDP collaboration, Dhaka, Bangladesh, June 1987 to July 1988: 29-31.
9. Ahmed TU, Ahmed RU, An entomological investigation of kala-azar focus in Bangladesh. J. Prev. Soc. Med. 1983; 2(2): 31-36.
10. Ahmed TU, Ahmed RU, Dewan ZU, Molla MAS, Akhter S, Khoda ME. Prevalence of sandflies in a kala-azar endemic area of Bangladesh. J Zool. 1995-96; 10& 11: 19-30.
11. Ahmed TU, Joshi GP, Ahmed RU, Dewan ZU, Begum MN, Akhter S, Khoda ME. Seasonal density of common mosquitoes in Jungle area of Modhupur, Tangail. J. Zool. 1989; 4: 1-14.
12. Ahmed, TU, Joshi GP, Ahmed RU, Akhter S, Hakim MA, Bhuiyan MKR, Khoda ME. Observation on the abundance of mosquitoes in tea-garden area of Bangladesh. J Zool. 1991; 6: 30-42.
13. Ahmed TU, Masum MA, Ahmed RU, Akhter S. Phlebitominae sandflies (Diptera: Psychodidae) of Bangladesh (scientific note). J Zool. 1989; 4: 61-64.

14. Ahmed TU. Maheswary NP, Khan NI. Filariasis in Mirpur area of Dhaka city. BMRC Bull. 1986, Dec. 83-94

15. Aikat BK, Shaya S, Pathania AGS, Bhattachargee PK, Desai N, Prasad LSN, Mishra S, Jain S. Clinical profile of cases of kala-azar in Bihar. Indian J. Med. Res. 1979, 70: 563-70.

16. Aikins MK, Pickering HA, Alonso PL, D' Alessandro U, Lindsay SW, Todd J, Greenwood BM. Perceptions of the causes of malaria and its treatment and prevention in the study area of West Africa. Trans. Roy. Soc. Trop. Med. Hyg. 1991; 87 Suppl 2: 25-30.

17. Aikins MK, Pickering HA, Greenwood BM. Attitudes to malaria, traditional practices and bed nets as vector control measures: a comparative study in five West African countries. J. Trop. Med. Hyg. 1994; 97: 81-87.

18. Alam MN, Chowdhury MAJ, Rafiquddin AKM, Hussain A, Rahman MH, Siddique AB, Nazir FH, Rahman KM. Kala-azar in Bangladesh. Bang. J. Med. 1990; 1(1): 5-8.

19. Alberto KA, Rechard LB, Clsar VV, John HC. Cerebral malaria at Sanhazard Hospital, Maniala, Philippines. South East Asian J. Trop. Med. Pub. Hlth. 1982; 13 (4): 563-569.

20. Alexander B, Usma MC, Cadena H, Quesada BL, Solarte Y, Roa W, Travi BL. Evaluation of deltamethrin-impregnated bednets and curtains against phlebotomine sandflies in Valle-del-Cauca, Colombia. Med. Vet. Entom. 1995; 9: 279-83.

21. Alonso PL, Lindsay SW, Armstrong JRM, Conteh M, Hill AG, David PH *et al.* The effect of insecticide treated bed nets on mortality of Gambian children. Lancet 1991; 337: 499-502.

22. Alonso PL, Lindsay SW, Armstrong S, Schellenberg JR, Konteh M, Keita K *et al.* The effect of malaria control trial using insecticide treated bed nets and targeted chemoprophylaxis in a rural area of the Gambia. Trans. Roy. Soc. Trop. Med. Hyg. 1993; 87(2): 31-36.

23. Ameen M, Hossain MI, Khan MDH. Resting behaviour, biting activity pattern and host preference of the common mosquitoes of Dacca city. Bang. J. Zool. 1982; 10:35-48.

24. Ameen M, Hossain MI, Khan MDH. Seasonal prevalence of the common mosquitoes of Dhaka city. Dhaka University Studies, 1984 B, XXXII (2): 79-89.

25. Ameen M, Moizuddin M. Bionomics of common mosquitoes of Dhaka. J. Nat. Hist. 1973; 7: 1-21.

26. Ashford RW, Bettini S. Ecology and epidemiology: Old world. In the Leishmaniasis in Biology and Medicine, 1987; 1: 365-424.

27. Assessment Report. International Assessment of Malaria Control in Bangladesh. 1989; p 55 (Unpublished document).

28. Assessment Report. International Review of Malaria Control in Bangladesh.1982; p 45 (Unpublished document).

29. Bandyopadhyay L. Lymphatic filariasis and the women of India. Soc. Scien. Med. 1996; 42 (10): 1401-10.

30. Barry C, Ahmed A & Khan AQ. Endemic filariasis in Thakurgaon, East Pakistan Am J. Trop. Med. Hyg. 1971; 20(4): 492-97.

31. Basio RG. The mosquito fauna of the Philippines (Diptera : Culicidae). National Museum of the Philippines. 1971Monograph No. 4.198 pp.

32. Beach MJ, Streit TG, Addiss DG, Prosper R, Roberts JM, Lammie PJ. Assessment of combined ivermectin and albendazole for treatment of intestinal helminths and *Wuchereria bancrofti* infection in Haitian school children. Am. J. Trop. Med. Hyg. 1999; 60(3): 479-86.

33. Beaver PC. Filariasis without microfilaria. Am. J. Trop. Med. Hyg. 1970; 19(2): 181-198.

34. Bell D. Visceral Leishmaniasis- Lecture notes on Trop. Med. Blackwell Scientific Publication. Oxford, 1981; 38.

35. Bhiyan MR, Chowdhury ZU, Ahmed I, Chowdhury MS. Knowledge attitude and practice (KAP) among physicians in selected thana health complexes about standard treatment schedule of malaria. J. Pub. Hlth. Asso. Bang. 1993; 6(2): 12-7.

36. Birley MH. Review: An historical review of malaria, kala-azar and filariasis in Bangladesh in relation to the flood action plan. Ann. Trop. Med. Parasite. 1993; 87(4): 319-34.

37. Bjorkmen A, Rombo L, Hetland G, Willcoy M. Susceptibility of *Plasmodium falciparum* to chloroquine in northern Liberia after 20 years of chemo repression and therapy. Ann. Trop. Med. Parasit. 1985; 79: 603 - 606.

38. Bockarie MJ, Hii JL, Aolexander ND, Bockarie F, Dagoro H, Kazura JW, Alpers MP. Mass treatment with ivermectin for filariasis control in Papua New Guinea: impact on mosquito survival. Med. Vet. Entomol. 1999; 13(2): 120-3.

39. Bogh C, Pedersen EM, Mukoko DA, Ouma JH. Permethrin-impregnated bednet effects on resting and feeding behaviour of lymphatic filariasis vector mosquitoes in Kenya. Med. Vet. Entom. 1998 ; 12(1): 52-9.

40. Bradley AK, Greenwood AM, Byass P. Bed nets (mosquito nets) and morbidity from malaria. Lancet 1986; 2: 204-7.

41. Bryson ADM. Text Book of Medicine. 2nd eds. London: Oxford University Press; 1987.

42. Burkot T, Garner P, Paru R, Dagoro H, Barnes A, McDougall S, Wirtz RA, Spark R. Effects of untreated mosquito nets on the transmission of *Plasmodium falciparum, P. vivax, Wachereria bancrofti* in Papua New Guinea. Trans. Roy. Soc. Trop. Med. Hyg. 1990; 84: 773-79.

43. Carey DE, Reuben R, Myers RM. Japanese encephalitis studies in Vellor, South India. Part I. Virus isolation from mosquitoes. Indian J. Med. Res. 1968; 56: 1309-18.

44. Cartel JI, Celerier P, Spiegel A. Burucoca C, Roux JE. A single diethyl-carbamazine dose for treatment of Wuchereria-bancrofti carries in French Polynesia: Effecacy and side effects. Southeast Asia J Trop Med Pub Health 1990; 21(3): 465-70.

45. Charlwood JD. A differential response to mosquito nets by *Anopheles* and *Culex* mosquitoes from Papua New Guinea. Trans. Roy. Soc. Trop. Med. Hyg. 1986; 80: 958-60.

46. Charlwood JD, Dagaro H. Impregnated bed nets for the control of filariasis transmitted by *Anopheles punctulatus* in rural of Papua New Guinea. Papua New Guinea Med. J. 1987; 30:199-202.

47. Charlwood JD, Dagaro H. Collateral effects of bed nets impregnated with permethrin in controlling bed bugs (Cimicidae) in Papua New Guinea. Transactions of the Royal Society of Tropical Medicine and Hygiene 1989; 83: 261-66.

48. Chatterjee KD. Parasitology (Protozoology and Helminothology) in relation to clinical medicine, 12th ed. Calcutta: Chaterjee medical Publishers, 1980.

49. Chaturvedi P, Gawdi A. Ddy S. Occuolt filarial infection. National Med. J. Ind. 1990; 3(1): 7-9.

50. Cheesbrough M. technique used to identify parasite, medical Laboratory Manual for Tropical Countries Vol. 12th Ed. Tropical Health Technology England: Butterworths, 1987:548-564.

51. Chitprarop U, Shevasant S, Renard AS. Malaria self-prevention practices of Northern Thai villagers. South East Asian J.Trop.Med.Pub.Hlth. 1986; 17(3): 432.

52. Choi HW, Breman JG, Teutsch SM, Liu S, Hightower AW, sexton JD. The effectiveness of insecticide impregnated bed nets in reducing cases of malaria infection: a meta-analysis of published results. Am. J. Trop. Med. Hyg. 1995; 52(5): 377-82.

53. Chowdhury A, Guru PY, Saxena KC. Enzyme Linked Immunosorbent assay in the diagnosis of kala-azar in Bhadohi (Varanasi) India. Trans. R. Soc. Trop. Med. Hyg. 1990, 84: 363-366.

54. Chowdhury AHK, Rahman AJM, Khan NI. Post Kala-azar Dermal Leishmaniasis (PKDL), Study of 8 cases. Bangl. Med. J. 1983, 17 (1&2): 27-33.

55. Chowdhury MAJ, Alam MN, Rofiquddin AKM, Hossain A, Rahman H, Siddique AB, Nazir MFH, Rahman KM, Biswas A. Clinical Profile of Kala-azar in Rajshahi: A prospective study of 273 hospitalized patients during one year. J. Bangl. Colleg. Phys. Surg. 1990, 8(1): 18- 28.

56. Chowdhury MS, Ahmed R, Ahmed T, Karim E, Hossain MAZ. Factors responsible for natural control of fialriasis in the northern part of Bangladesh J. Prev. Soc. Med. 1990a; 4-9(2): 34-37.

57. Chowdhury MS, Hoq MS, Khan WA, Masum MA. Kala-azar in children in Bangladesh. A study of 100 patients. Dhaka Shishu (Children) Hosp. J. 1991a, 7(1): 17-23.

58. Chowdhury MS, Huda G, Waliullah, Khandoker AK. Some important aspects of kala-azar. Internal evaluation of the programme activities for control of visceral leishmaniasis in Bangladesh. A report, NIPSOM, DGHS & WHO/UNDP Collaboration, Dhaka, Bangladesh, June 1987 - July 1988: 19-28.

59. Chowdhury MS, Karim E, Masum MA, Jahan Y, Alam MR. Micro Elisa test for diagnosis of visceral leishmaniasis in Bangladesh. Medicine Today, 1991b. 3(11): 45-47.

60. Chowdhury MS, Masum MA, Harith AE, Karim E, Hossain Z. Post Kala-azar Dermal Leishmaniasis in Bangladesh. J. Prev. Soc. Med. 1991c, 10(1): 18-21.

61. Chowdhury MS, Rahman AJMM, Masum MA, Karim E, Nargis, Nurjahan. Chemotherapy of Kala-azar at Primary Health Centre in Bangladesh. Bang. Med. J. 1990b; 19(2) : 51-55.

62. Chowdhury S, Datta M, Srivastava L, Sarti KC, Mandal SP. Current outbreaks of kala-azar in Maldah and Murshidabad districts in West Bengal. Jour Comm. Dis. 1982, 14: 263-73.

63. Chowdhury S, Haque F, Masum MA, Harith AE, Karim E. Positive response to sodium antimony gluconate administration in Visceral Leishmaniasis sero-positive patients. Am. J. Trop. Med. Hyg. 1991; 44: 390-93

64. Christopher SR. The fauna of British India, including Ceylon and Burma. Diptera; Vol4, Family Culicidae. Tribe Anophelini London. Taylor and Francies. London XII: 877 pp.

65. Curtis CF, Feachem RGA. Sanitation and *Culex pipiens* mosquitoes: a brief review. J. Trop. Med. Hyg. 1981; 84:17-25.

66. Curtis CF, Lines, JD, Carnevale, P. Robert, V. Boudin, C. Halna, J-M, Pazat, L.Gazin, P. Richard, A. Mouchet, J. Graves. Impregnated bednets and curtains against malaria mosquitoes, Ch.2, in 'Appropriate technology for vector control', Curtis CF, editor. Boca Raton, Florida: CRC Press; 1991.

67. Danish Bilharziasis Laboratory, Charlottenlund, Denmark. Med. Vet. Entom. 1998; 12(1): 52-9.

68. Darriet F, Robert V, Tho Vein N, Carnevale P. Evaluation of the efficiency of permethrin impregnated bed nets against vectors of malaria. 1984.Geneva: WHO, mimeographed document no. WHO/VBC. 84-899.

69. Das Gupta B, Roy HN, Sen Gupta PC. Experiments with the sandfly *Phlebotomus argentipes*. Infectivity of resistant cases of kala-azar. Development of the leptomonads of *L. donovani* in the sandfly. Bull. Calcutta Sch. Trop. Med., 1955, 3: 168.

70. Das S, Mukharjee AM. Sandfly survey in Calcutta and neighbouring districts. Bull. Calcutta Sch. Trop. Med. 1969, 17: 13-14.

71. Desotiwz P. Information on the epidemiology and Control of the leishmaniasis by country or territory WHO/Leish/91-30: 6-7.

72. Dey RK, Elias M. Impact of the operational use of insecticide treated mosquito nets in malaria control programme in Bangladesh. J. Prev. Soc. Med. 1997; 16(2): 101-6.

73. Eberhard ML, Walker EM, Addiss DG, Lammie PJ. A survey of knowledge, attitudes, and perceptions (KAP) of lymphatic filariasis, elephantiasis, and hydrocele among residents in an endemic area in Haiti. Am. J. Trop. Med. Hyg. 1996; 54(3): 299-303.

74. Ei-Sofi SH, Peters W, Evans DA. A comparison of the direct agglutination test fand enxyme - linked immunosorbent assay in sero-diagnosis of leishmaniasis in the slum. Tran. Roy Soc. Trop. Med. Hyg., 1983, 83: 343-47.

75. Elias M. *Anopheles dirus*. Peyton & Harrison: its ecology and evaluation of some malaria control measures in certain sylvan areas of Bangladesh. PhD Thesis. Univ. of Dhaka. Aug. 1995; 191.

76. Elias M. Larval habitat of *Anopheles philippinensis*. A vector of malaria in Bangladesh. Bull. WHO 1996; 74(4): 447-450.

77. Elias M. Susceptibility of the malaria vector *Anopheles philippinensis* Ludlow (Diptera Culicidae) to insecticides in Bangladesh. Bang. J. Zool. 1997; 5(1): 1-23.

78. Elias M, Ameen M. Nomenclature of the malaria vector *Anopheles dirus* Peyton & Harrison. J. Prev. Soc. Med. 1997; 16(1): 56-60.

79. Elias M, Rahman M. DDT - susceptibility status of *Anopheles balabacensis balabacensis* (Diptera: Culicidae) in Bangladesh. Bang. Med. Res. Coun. Bull. 1981; 7(1): 1-6.

80. Elias M, Ameen M, Leonard RC, Maheswary NP, Islam MS, Faruque MMS, Taher MA. Socio-cultural impact of bed net usage against malaria mosquito. J. Prev. Soc. Med. 1997b; 16(1): 29-36.

81. Elias M, Ameen M, Maheswary NP, Islam MS, Faruque MMS, Taher MA. Insecticide treated mosquito nets in controlling *Anopheles dirus* transmitted malaria in sylvan areas of Banhladesh. J. Prev. Soc. Med. 1997a; 16(2): 107-30.

82. Elias M, Bari MA, Farooque MMS. A note on entomological studies in malarious areas of south-western districts of Bangladesh. J. Prev. Soc. Med. 1982a; 1(1): 59-64.

83. Elias M, Dewan ZU, Ahmed RU. Vectors of malaria in Bangladesh. J. Prev. Soc. Med. 1982b; 1(2): 20-25.

84. Elias M, Maheswary NP, Bangali AM, Hassan MM. Current malaria situation in Bangladesh. In "Proceedings of the 1st Annual conference" The Bangladesh Society for Parasitology 1992a, Dhaka. pp 28-41.

85. Elias M, Maheswary NP, Bangali AM, Hassan MM, Kabir H. Malaria in Bangladesh. Jour. Prev. Soc. Med. 1992b; 11(2): 79-84.

86. Elias M, Maheswary NP, Islam MS, Rahman MK. Susceptibility of the malaria vectors to insecticides in Bangladesh. Bang. Med. Res. Coun. Bull. 1998; 24(1): 1-5.

87. Elias M, Rahman AJM, Ali MM, Begum J. Chowdhury AR. The ecology of malaria carrying mosquito *Anopheles philippinensis* Ludlow and its relation to malaria in Bangladesh. Bang. Med. Res. Coun. Bull. 1987; 13(1): 15-28.

88. Elias M, Rahman AJM, Khan NIP. Visceral Leishmaniais and its control in Bangladesh, Bull. WHO. 1989; 67: 43-49.

89. Elias M, Rahman M, Rahman AHM. DDT susceptibility status of *Anopheles philippinensis* a mosquito vector of malaria in Bangladesh. Bang. Med. Res. Council Bull. 1985; 11(1): 1-7.

90. Elliot M, Farham AW, Janes NF, Needham PH, Pulman DA, Stevenson JH. A photostable pyrethroid. Nature 1973; 246: 169-76.

91. Elliot M, Janes NF, Potter C. The future of pyrethroids in insect control. Ann. Rev. Entom. 1978; 23:443-69.

92. Fleiss JL. ed. Statistical Methods for Rates and Proportions. N.Y. Wiley, Chapter 8. 1973.

93. Foyezuddin M.M. Control measures of Kala-azar. International Evaluation of the programme Activities for control of visceral leishmaniasis in Bangladesh. A report. NIPOM, DGHS and WHO/UNDP collaboration. Dhaka, Bangladesh. June 1987 to July 1988: 33-34.

94. Gloud DJ, Esah D, Pranith U. Relation of *Anopheles aconitus* to malaria transmission in the central plain of Thailand. Trans. R. Soc. Trop. Med. Hyg. 1967; 61: 441-42.

95. Goa KL, Tavish DM, Clissold SP. Invermectin: A review of its antifilarial activity, pharmacokinetic properties and clinical efficacy in Onchocerciasis. Drug 1991; 42(4): 640-658.

96. Gon A, Chatterjee GH, Hazara A, Das T, Roy S. Kala-azar. J. Ind. Med. Assoc. 1975; 65: 83-84.

97. Gosh TK. Problem in filariasis controls. J. Com. Dis. 1985; 17 (Suppl. NO.1): 110-112.

98. Gouck HK, Godwin DR, Schreck, Smith N. Field tests with repellent treated netting against salt-marsh mosquitoes. J. Economic Entom.1967; 60: 1451-52.

99. Gouck HK, Moussa MA. Field tests with bed nets treated with repellent to prevent mosquito bites. Mosquito News 1969; 29: 263-64.

100. Gould DJ, Barnett HC, Suyemoto W. Transmission of Japanese encephalitis virus by *Culex gelidus* Theobald. Trans. R. Soc. Trop. Med. Hyg. 1962; 56: 429-35.

101. Gramiccia,G, Sacca G. Notes on Kala-azar and its control in Iswargonj Thana, Mymensingh district. East Pakistan. Indian. J. Mal. 1953; 7(1): 93-99.

102. Graves PM, Brabin BJ, Charlwood JD, Burkot TR, Cattani JA, Ginny M, Paina J, Gibson FD, Alpers M. Reduction in incidence and prevalence of *Plasmodium falciparum* in under-5 year old children by permethrin impregnation of mosquito nets. WHO Bull. 1987; 65: 869-77.

103. Grothaus RH, Weidhaas DE, Jackson SC. Wide mesh netting, an improved method of protection against blood feeding Diptera. Am. J. Trop. Med. Hyg. 1974; 23: 533-37.

104. Harinath BC. Immunodiagnosis of filariasis. J. Com. Dis. 1985; 17(Suppl.No.1): 113-16.

105. Harith AE, Kolk AHJ, Leeuwenburg J, Muigai R, Heigen E. Jeslma T. Kagar P. Improvement of a direct agglutination test for field studies of visceral leishmaniasis. J. Clin. Microbiol. 1988; 26: 1321-25.

106. Harith AE, Kolk AHJ, Leeuwenburg J, Muigai R, Kiugu, S. Laapman, JJ. A simple and economic direct agglutination test for serodiagnosis and sero-epidemiological studies of visceral leishmaniasis. Trans. Roy. Soc. Trop. Med. Hyg. 1986, 80: 583-87.

107. Harrison BA. The Myzomyia series of *Anopheles (Cellia)* in Thailand, with emphasis on intra/inter-specific variation (Diptera: Culicidae). Contrib. Am. Entom. Ins. 1980: 17(4): 1-195.

108. Hati AK, Auddy M, Das S, Ghosh KK. A new sample technique for detection of sandfly larvae in nature. WHO/VBC/1982. No. 855.

109. Hati AK, Dc N. Quantitative grading of Leishmania donovani amastigotes in bone marrow aspirates smear. Ind. J. Med. Res. 1986; 48: 275-78.

110. Hati AK, Nandy A, Chowdhury AB. An epidemic outbreak of kala-azar in a district in West Bengal, India, 1985, WHO/VBC/85: 911.

111. Hawking F. The distribution of human filariasis throughout the world. Part IV America. Trop. Dis. Bull. 1976; 73: 967-1016.

112.Hawking F. The distribution of human filariasis throughout the world. Part III Africa. Trop. Dis. Bull. 1977; 74: 649-679.

113.Hawking F. The distribution of human filariasis throughout the world. Part IV America. Trop. Dis. Bull. 1979; 76: 693-710.

114.Hii JLK, Vun YS, Chin KF, Chua R, Tambakau S, Binisol ES, *et al,* The influence of permethrin- impregnated bed nets and mass drug administration on the incidence of *Plasmodium falciparum* malaria in children in Sabah, Malaysia. Med. Vet. Entom. 1987; 1: 393-407.

115.Horsfall WR. Mosquitoes: Their Bionomics and Relation to Disease. The Ronald Press Company, New York, 1955; 723 pp.

116.Hossain MI, Curtis CF. Behavioral and killing effects of permethrin impregnated bednets – a laboratory evaluation. Med. Vet. Entom. 1989; 3: 367-76.

117.Hossain MI, Khan SA, Ameen M. Phlebitominae sandflies of Bangladesh; recent surveys. Med. Vet. Entom. 1993; 7: 99-101.

118.Hossain MS, Rashid AM. Prevalence of kala-azar on the sides of River Buriganga. Bang. Med. J. 1987, 16(2&3): 54-57.

119.Islam AFMS. Kala-azar in Barisal. Bangladesh Med. Rev. 1982; 8(1&2): 1-3.

120.Islam MN. Study on the follow of findings among diagnosed and treated kala-azar patients at three selected unions of Shahjadpur upazilla, Sirajgonj. J. Prev. Soc. Med. 1991; 10(2): 28-32.

121.Ismail MM, Jayakody RL, Weil GJ, Nirmalan N, Jayasinghe KS, Abeyewickrema W *et al.* Efficacy of single dose combinations of albendazole, ivermectin and diethyl carbamazine for the treatment of Bancroftian filariasis. Trans. Roy. Soc. Trop. Med. Hyg. 1998; 92(1): 94-7.

122.Iyengar MOT. Studies on malaria in the deltaic region of Bengal. J. Mal. Inst. Ind. 1942; 4: 435- 45.

123.Jeffry LK, Hii L, Kanai L, Foligela, Kan SKP, Burkot TR *et al.* The impact of permethrin impregnated bed nets compared with DDT house spraying against malaria transmission by *Anopheles farauti* and *An. punctulatus* in the Solomon Islands. Med. Vet. Entom. 1993; 7: 333-38.

124.Jenkin DC. Ivermectin in the treatment of filarial and other nematode diseases of man. Trop. Dis. Bull. 1990; 87(9): R 1-9.

125.Joshi GC, Kaul SM, Wattal BL. Susceptibility of sandflies to Organochlorine insecticides in Bihar (India) Further reports. J. Com. Dis. 1979; 11(4): 209-13.

126.Kalra NL, Bang YH. Manual on Entomology in Visceral Leishmaniasis WHO/SEA/VBC/35, 1988; 88.

127.Kaul SM, Wattel BL, Bhatnagar VN, Mathur KK. Preliminary observations on the susceptibility of *Phlebotomus argentipes* and *P. papatasi* to DDT in two districts of North Bihar (India). J. Com. Dis. 1979; 10(4): 208-12.

128.Kaul SM, Wattal BL, Sanyal RK. Phlebotominae sand flies (Dipteria: Psychology of Bihar Estate (India). J. Com. Dis. 1980; 11(4): 188-97.

129.Kere NK, Parkinson AD, Samarawickerema WA. The effect of permathrin impregnated bed nets on the incidence of *Plasmodium falciparum* in children of North Guadalcanal, Solomon Islands. Southeast Asian J. Trop. Med. Hyg. 1993; 24 (1): 130-37.

130.Khan AM, Khan AQ, Desowitz RS, Joshi GP, Aung M. A Japanese encephalitis focus in Bangladesh. Am. J. Trop. Med. Hyg. 1981 ; 30: 41-44.

131.Khan AQ. Epidemiology and Disease Control. 1st ed. Dhaka: World University Service Press; 1989.

132.Khan. AQ, Talibi SA. Epidemiological assessment of malaria transmission in an endemic area of East Pakistan and the significance of congenital immunity. Bull. Wld. Hlth. Org. 1972: 46: 783-92.

133.Khan AM, Ahmed TU. Dengue status in Bangladesh. Dengue News Letter 1986, WHO. 11.

134.Khan NI, Desowitz RS. A comparison of CIE and IHA test for immuno-epidemiological Investigation of Kala-azar. South-East Asian Jour. Trop. Med. Hlth. 1985; 16(3): 387-89.

135.Khan HM. Post Kala-azar Dermal Leishmaniasis (A review of 10 cases). Bang. Med. Res. Coun. Bull. 1977; 3(2): 130-36.

136.Kroegar A, Mancheno M, Alarcon J, Pesse K. Insecticide impregnated bed nets for malaria control: varying experiences from Ecuador, Colombia and Peru concerning acceptability and effectiveness. Am. J. Trop. Med. Hyg. 1995; 52(5): 313-23.

137.Kumal K, Rahman SJ, Singh K, Rajagopal R. Biology of *Phlebotomus and Sergentomyia* group of sandflies under laboratory conditions. J. Com. Dis. 1986; 18: 45-50.

138.Le-Goff G, Robert V, Fondjo E, Carnevale P. Efficacy of insecticide impregnated bed nets to control malaria in a rural forested area in Southern Cameroon. Mem. Inst. Oswaldo. Curz. 1992; 87(3): 355-59.

139.Lewis DJ. The Phlebitominae sandflies (Diptera: Psychodidae) of the Oriental region. Bull. British Museum Natural History 1978; 37: 133-36.

140.Lewis DJ, Young DG, Fairchild GB, Minter DM. Proposals for Stable classification of the phlebotomine sandflies (Diptera: Psychodidae). Sys. Ent. 1977; 2: 319-32.

141.Li Z, Xu J, Li B, Zhu T, Li M. Mosquito nets impregnated with deltamethrin against malaria vectors in China. WHO Mimeographed Document 1987; WHO/VBC/87, 939.

142.Li Z, Zhang M, Wu Y, Zhong B, Lin G, Huangi H. Trial of deltamethrin impregnated bed nets for the control of malaria transmitted by *Anopheles sinensis* and *An. anthropophagus.* Am. J. Trop. Med. Hyg. 1989; 4: 356-59.

143.Lindsay SW, Gibson ME. Bed Nets Revisited- Old Idea, New Angle. Parasitology Today1988; 4(10): 270-71.

144.Lindsay SW, Shenton FC, Snow RW, Greenwood BM. Response of *Anopheles gambiae* complex mosquitoes to the use of untreated bednets in the Gambia. Med. Vet. Entom. 1989a; 3: 253-63.

145.Lindsay SW, Snow RW, Armstrong JRM, Greenwood BM. Permethrin impregnated bed nets reduce nuisance arthropods in the Gambian houses. Med. Vet. Entom. 1989b; 3: 377-83.

146.Lindsay SW, Snow RW, Broomfield GL, Semegajanneh M, Wirtz RA, Greenwood BM. Impact of Permethrin impregnated bed nets on malaria transmission by the *Anopheles gambiae* complex. Med. Vet. Entom. 1989c; 3:363-71.

147.Lines JD, Myamba J, Curtis CF. Experimental hut trials of permethrin impregnated mosquito nets and eaves of curtains against malaria vectors in Tanzania. Med. Vet. Entom. 1987; 1: 37-51.

148.Macan TT. Malaria survey of the Arakan region of Bengal and Burma. Parasitology 1949; 110: 290-97.

149.Macarthy JS, Guinae A, Weil GJ, Ottesen EA. Clearance of filarial antigen as a measure of Microfilariacidal activity of Diethy carbamazine in *Wuchereria bancrofti* infection. J Infect. Dis, 1995; 172: 521-26.

150.MacCormack CP, Snow RW. Gambian cultural preferences in the use of insecticide treated bed nets. J. Trop. Med. Hyg. 1986; 89: 295-302.

151.Maheswary NP, Habib MA, Elias M. Incrimination of *Anopheles aconitus* as vector of epidemic malaria in Bangladesh. South East Asian J. Trop. Med. Pub. Hlth. 1992; 23 (4): 798-801.

152.Maheswary NP, Khan Z, Mollah FR, Haq MI. Incrimination of *Anopheles annularis* as vector of epidemic malaria in Bangladesh, South east Asian J. Trop. Med. Pub. Hlth. 1993; 24 (4): 776-78.

153.Maheswary NP, Majumdar S, Chowdhury AR, Faruque MS, Montanari RM. Incrimination of *Anopheles vagus* Dontiz, 1902 as an epidemic malaria vector in Bangladesh. Ind. J. Malariology 1994; 31: 47-50.

154.Majori G, Maroli M, Sabatinelli G and Fausto AM. Efficacy of permethrin-impregnated curtains against endophilic phlebotomine sandflies in Burkina Faso. Med. Vet. Entom. 1989; 3: 441-44.

155.Manson - Bahr, PEC and Bell Dr. Manson's tropical diseases. 19th Edition ELBS and Bailliere Tindall and Cassel Ltd. 1987: 87-113.

156.Marinkelle CJ. The control of Leishmaniasis. WHO Bull. 58: 807-18.

157.Maroli M, Lane RP. The effect of permethrin-impregnated nets on Phlebotomus (Diptera: Psyehodidae) in central Italy. In: Proceedings of NATO-ASIA conference on Leishmaniasis, Zakintos, Greece. 1987; 20-27.

158.Maroli M, Majori G. Permethrin impregnated curtains against phlebotomine sandflies (Diptera: Psychodidae): Laboratory and field studies. Parasitology 1991; 33(Suppl.1): 399-401.

159.Mashaal H. Clinical Malariology. South East Asian Medical Information Centre, Tokyo, Japan. Siamic publication, 1986, No. 48: 2-10.

160.Masum MA, Alam B, Ahmed RU. An epidemiological investigation of kala-azar outbreak at Kalihati upazila of Tangail District, Bangladesh. J. Prev. Soc. Med., 1990a; 4-9(1): 13-15.

161.Masum MA, Alam B, Ahmed RU. Kala-azar outbreak in Dinajpur district of Bangladesh. The Hygieia, 1990b; 4(3): 122-24.

162.Masum MA, Chowdhury MS, Ahmed RU, Mia MAH. Outbreak of Visceral leishmaniasis in Thakurgaon district, Bangladesh. J. Prev. Soc. Med. 1990c; 4-9(2): 38-41.

163.Maxwell CA, Mohammed K, Kisumku U, Curtis CF. Can vector control play a useful supplementary role against Bancroftian filariasis? Bull. World. Hlth. Org. 1999; 77(2): 138-43.

164.Meyrowitsch DW, Simonsen PE. Long-term effect of mass diethyl carbamazine chemotherapy on Bancroftian filariasis, results at four years after start of treatment. Trans. Roy. Soc. Trop. Med. Hyg. 1998; 92(1): 98-103.

165.Ministerial Conference on malaria, Amsterdam, Netherlands, 26-27 October 1992: 3-8 (Unpublished document).

166.Misra M, Biswas UK, Sha DN, Khan AB. Amphotericin versus pentamidine in Antimony unresponsive kala-azar, Lancet 1992; 340: 256-57.

167.Mitra NK, Kunte AB. A Profile of malaria cases observed in a service hospital. Med. J. Armed Forces India 1977; 33 (i): 25-28.

168.Mostofa M. Effectivity of triple drug therapy with Quinine, Tetracycline and Co-trimoxaxole in cerebral malaria. A study of 45 cases. (Dissertation) FCPS: BCPS; 1994.

169.Moulia PJP, Nguyen LN, Hascoet H, Luquiaud P, Nicolas L. Advantage of annual single dose of Ivermectin 400 microgram/kg plus diethyl carbamazine for community treatment of Bancroftian filariasis. Trans. Roy. Soc. Trop. Med. Hyg. 1995; 89(6): 682-85.

170.Mukhopadhyay AH, Rahman SJ, Chakravarty AK. Effect of flood control on immature stages of sandflies in a flood prone kala-azar endemic village of north Bihar, India. Document WHO/VBC 1990, 986. Geneva: WHO.

171.Mwandawiro CS, Fujimaki Y, Mitsui Y, Katsivo M. Mosquito vectors of Bancroftian filariasis in Kwale District, Kenya. East. Afr. Med. J. 1997; 74(5): 288-93.

172.Napier L. An epidemiological consideration of the transmission of kala-azar in India. Ind. Med. Res. Memoir, 1926; 4: 216-65.

173.Napier L. The principle and practice of Tropical Medicine, New York; The Memillan Co: 1946.

174.Napier L, Krishnan KV. Kala-azar in Madras and its bearing on epidemiology of the diseases in India. Ind. Trop. Med. Res. 1933; 11(1), July: 155-67.

175.Narahasi T. Nerve membrane as a target of pyrethroids. Rev. Appl. Entom. Series B 1977; 65(4): 350.

176.Narasimhan MVVL, Naidu YD, Rao CK. Comparative study of thick smear examination and membrane filter technique in parasitological diagnosis of bancroftian filariasis. J. Com. Dis. 1981: 13(3): 204-206.

177.Nasiruddin M. DDT in the prevention of kala-azar in East Pakistan. Pak J. Hlth. 1952; 2(1): 21-24.

178.Neogy BP, Sen AK. *Anopheles stephensi* as a carrier in rural Bengal. Ind. J. Malariol 1962;. 16: 81-85.

179. Ottesen EA, Duke BO, Karam M, Behbehani K. Strategies and tools for the control/elimination of lymphatic filariasis. Bull.World Hlth. Org. 1997; 75(6): 491-503.

180. Pandya AP, Mehta NR, Niyogi AK. The development of resistance in sand fly to hydrocarbon insecticides in Guzrat state. J. Ind. Ass. Prev. Soc. Med. Annual Number, 1975; 111-114.

181.Park K. Text Book of Preventive and Social Medicine. 16th eds. Jabalpur, India: Bhanarshidas Bhanot Publishers; 2000.

182.Partono F. Lymphatic filariasis. Med. Int. 1988; 3: 2270-73.

183.Pedersen EM, Kilama Wl, Swai AB, Kihamia CM, Rwiza H, Kisumku UM. Bancroftian filariasis on Pemba Island, Zanzibar, Tanzania: an update on the status in urban and semi-urban communities. Trop. Med. Int. Hlth. 1999; 4(4): 295-301.

184.Plan of operation, 1960. Plan of operation for malaria eradication program in East Pakistan (1960-74). A signed document of the Govt. and WHO; 1-147 (unpublished document).

185. Rahman KM. Use of different saphrophyric and acid fast bacilli in complement fixation test of kala-azar. Bangladesh Med. Res. Coun. Bull., 1975; 1(1): 32-38.

186.Rahman KM. Use of different saphrophyric and acid fast bacilli in complement fixation test of kala-azar. Bangladesh Med. Res. Coun. Bull., 1975; 1(1): 32-38.

187. Rahman KM. Threat of leishmaniasis in Bangladesh. Unpublished paper presented to the UNDP/World Bank/WHO special program Training seminar on

Epidemilogical methods for leishmaniasis, Moscow, Samarkand, Baku, USSR, 28 May - 19 June, 1980.

188. Rahman KM, Islam N. Recent advances in kala-azar. Bang. Med. J.1979; 8(1):13-14.

189. Rahman KM, Islam N. Resurgence of visceral leishmaniasis in Bangladesh, WHO Bull. 1983; 61(1): 113-16.

190. Rahman L. Filariasis, vaginal hydrocele and social status. Medicine Today 1992; 4(2): 66-67.

191. Rahman M. Cerebral malaria. Study of 64 cases. Bangladesh Armed Forces Med. J. 1991; xv (i): 18-21.

192. Rahman M, Elias M, Ameen M. Bionomics of *Anopheles balabacensis balabacensis* (Diptera: Culicidae) in Bangladesh and its relation to malaria Bangladesh J. Zool. 1977; 5(1): 1-23.

193. Rahman R, Ghosh A, Samad R, Hasan R, Baqi A, Faiz A, Yunus EB. Implementation of new National Malaria Control Strategy: An analysis of data from a pilot project. J. Ctg. Med. College Teachers Assoc. 1996; 7(S3): 16-31.

194. Rajagopal R. Studies on persistant transmission of malaria in Burnihat, Meghalaya. J. Com. Dis.1976; 8: 235-45.

195. Ramaiah KD, Guyatt H, Ramu K, Vanamail P, Pani SP, Das PK. Treatment costs and loss of work time to individuals with chronic lymphatic filariasis in rural communities in south India. Trop.Med. Int. Hlth. 1999; 4(1): 19-25.

196. Ramaiah KD, Kumar KN, Ramu K. Knowledge and beliefs about transmission, prevention and control of lymphatic filariasis in rural areas of south India. Trop. Med. Int. Hlth. 1996; 1(4): 433-8

197. Ramsay GC, Macdonald G. The species control of anopheline in India. Ind. Med. Gaz. 1936; 71: 699-710.

198. Rao CK, Chandrasekharan A, Cherian C, Rao CHC, Russel S. Effects of diethyl carbamazine treatment of Brugia malayi microfilaria carriers. Indian J. Med. Res. 1981; 73(Suppl.): 87-92.

199. Rao TR. The Anophelines of India. Malaria Research Centre. Indian Council of Medical Research, New Delhi, 1984; 518 pp

200. Rashid KM, Khabiruddin M, Hyder Syed, Text Book of Community Medicine and Public Health, 3rd Edition . Dhaka: RKH Publishers ;1999.

201. Regis L, Silva FMH, Oliveira CM, Rios EM, Silva SB, Furtado AF. Integrated control measures against *Culex quinquefasciatus*, the vector of filariasis in Recife. Mem. Inst. Oswaldo.Cruz. 1995; 90(1): 115-9.

202. Reid JA. Anopheles mosquitoes of Malaya and Borneo. Stud. Inst. Med. Res. Malaysia 1968; 13. 520 pp.

203. Reuben R. Studies on the mosquitoes of North Arcot district, Madras state India, Part-1. Seasonal densities. J. Med. Entom. 1971; 8(2) : 119-26.

204. Rosenberg R and Maheswary NP. Forest malaria in Bangladesh. 1:Parasitology. Am. J. Trop. Med. Hyg. 1982a; 31 (2): 172-82.

205. Rosenberg R and Maheswary NP. Forest malaria in Bangladesh. 11: Transmission by *Anopheles dirus*. Am. J. Trop. Med. Hyg. 1982b; 31 (2): 183-91.

206. Rosenberg R, Maheswary NP. Forest malaria in Bangladesh. III. Transmission by *Anopheles dirus*. Am. J. Trop. Med. Hyg. 1982c; 31(2) : 183-91.

207. Rozendaal JA. Impregnated mosquito nets and curtains for self-protection and vector control. Trop. Dis. Bull. 1989a; 86(7): 1-41.

208. Rozendaal JA. Self-protection and vector control with insecticide treated mosquito nets (a review of present status) WHO/VBC/1989b,3.

209. Rozendaal JA, Voorrham J, Vanhoof Jpm, Oostburg BFJ. Efficacy of local mosquito nets treated with permethrin in Surinam. Med. Vet. Entom. 1989; 3: 353-59.

210. Russel PF. Practical Malariology.2nd ed. London: Oxford University Press; 1963.

211. Sanyal RK, Alam SN, Kaul SM, Wattal BL. Some observations on epidemiology of current outbreak of kala-azar in Bihar. J. Com. Dis. 1979; 11(4): 170-81.

212. Sarker PC, Rahman AKM, Sarker CR, Islam KMN, Sayeed A. Filarial chyluria: two case reports. Northern Med. J. 1996a; 5(1): 40-43.

213. Sarker PC, Rahman AKM. Comparative efficacy of ELISA, Nucleopore membrane filtration and thick blood film examination for the diagnosis of lymphatic filariasis. Northern Med. J. 1996b; 5(2): 56-60.

214. Schmitsz B, Gelford MA. Study of the clinical features of malaria in Rhodesha patients. Afr. J. Med. 1976; 2(8): 155-60.

215. Schreck CE, Self LS. Bed nets that kill mosquitoes. Wrld Hlth Forum 1985; 6: 342-44.

216. Sehgal S, Bhatia R. Kala-azar, current status and evaluation of control activity in India, national Institute of communicable Disease (NICD), Delhi, India, 1988.

217. Sen P. Records of natural infectivity of Anopheles in West Bengal. Ind. J. Malarialogy 1948; 2: 239-245.

218. Sen P. Studies on Insecticide resistance of Public Health Importance in West Bengal, India. Ind. J. Mal. 1959; 13: 19-33.

219. Senior White R, Adhikati AK, Ramakrisna V, Ray BM. Malaria transmission in Orissa coasted plain. J. Mal. Inst.Ind. 1943; 5: 159- 86.

220. Service MW. Lecture notes on Medical Entomology. London: Blackwell Scientific Publications; 1986.

221. Sexton JD, Trenton KR, Bennett ADB, Breman JG, Roberts JM, Odera JS *et al.* Permethrin impregnated curtains and bed nets prevent malaria in Western Kenya. Am. J. Trop. Med. Hyg. 1990; 43(1): 11-18.

222. Shortt HE, Craighead AC, Swaminath CS. *Phlebotomus argentipes* caught in nature infected with Leishmania donovani. Indian J. Med. Res, 1929; 17. 913-914 (Quoted from Studies on Leishmaniasis WHO/VBC/80-786).

223. Shortt HE, Smith ROA, Swaminath CS. The breeding nature of *Phlebotomus argentipes*. Bull. Ent. Res.1930; 81, 269-271.

224. Simonsen PE, Meyrowitsch DW, Makunde WH, Magnussen P. Bancroftian filariasis: the pattern of microfilaraemia and clinical manifestations in three endemic communities of Northeastern Tanzania. Acta. Trop. 1995; 60(3): 179-87.

225. Sinton JA. Notes on some Indian species of the genus *Phlebotomus angentipes* Part XXX. Diagnostic table for the female of the species recorded from India. Ind. Jour. Med. Res. 1932; 20(1): 55-74.

226. Smith ROA, Mukherjee S, List JC. Bionomics of *P. argentipes*. Part I. The duration of life in nature Ind. J. Med. Res. 1936; 24: 295-301.

227. Smith ROA, Mukherjee S, Lal JC. Bionomics of *P.argentipes* Part II. The breeding sites of *P.argentipes* and an attempt to control these insects by antilarval measures. Ind. J. Med. Res. 1936; 24, 557-62.

228. Snow RW, Rowan KM, Lindsay SW, Greenwood BM. A trial of bed nets (mosquito nets) as a malaria control strategy in a rural area of the Gambia, West Africa. Trans. Roy. Soc. Trop. Med. Hyg. 1988; 82: 212-16.

229. Srivastava L, Suri JC, Sanyal RK. Elisa test in diagnosis of kala-azar in current epidemic in Bihar. J. Com. Dis., 1979; 11(4): 183-87.

230. Statistical Pocketbook of Bangladesh. 1999. Bangladesh Bureau of Statistics. Government of Bangladesh. November 2000.

231. Stick AH, Maxwell CA, Hazi AA, Hazi DM, Mechamo AY, Mussa JK *et al.* Insecticide-impregnated bed nets reduce malaria transmission in rural Zanaibar. Trans. Roy. Soc. Trop. Med. Hyg. 1994; 88: 150-52.

232. Swaminath CS, Scortt HE, Anderson LAP. Transmission of Indian kala-azar to man by the bites of *Phlebotomus argentipes*. Ind. Jour. of Med. Res. 1942; 30: 473-77.

233. Taylor AER, Dentham R. Diagnosis of filarial infections. Trop. Dis. Bull 1992; 98(2), R-1, R-33.

234. Thakur CP. Epidemiological, clinical and therapeutic features of Bihar kala-azar. Trans. Roy. Soc. Trop. Med. Hyg. 1984; 78(3): 391-98.

235. Thakur CP, Kumar M, Kamal P, Misra BN, Paudey AK. Rationalization of regimen of treatment of kala-azar with sodium stibogluconate in India, a randomized study. Brit. Med. J. 1988; 196: 1557-61.

236. Tigertt WD, Hammon WM. Japanese-B encephalitis: Complete review of experience on Okinawa 1945-1949. Am. J. Trop. Med. 1950; 30: 686-722.

237. Udonsi JK. Filariasis in the Igween river basin, Nigeria: An epidemiological and clinical studywith a note on vectors. Ann. Trop. Med. Parasitol 1988; 82(1): 75-82.

238. Viswanathan DK, Das S, Oomen AV. Malaria carrying Anophelines in Assam with special reference to the results of 12 months dissections. J. Mal. Inst. Ind. 1941; 4: 297-306.

239. Waiz A, Chakraborty B. Cerebral malaria. An analysis of 55 cases. Bang Med J 1984; 73: 47- 50.

240. Waiz A, Hossain R, Chakraborty B, Shahjahan M. Mode of death in cerebral malaria. An analysis of 24 fatal cases. Bangladesh Armed Forces Med. J. 1991; xv (i): 1-2.

241. Waiz A, Siddiqui M, Hossain SMM. An analysis of 7318 malaria cases. Bangladesh Armed Forces Med. J. 1990; 14(1): 15-19.

242. Watt CH, Bruce JL. Essential Malariology., 1st ed. 1990; 129-49.

243. Weil GJ, Lammiel PJ, Richard FO, Eberhard ML. Changes in circulating parasite antigen level after treatment of Bancroftian filariasis with Diethyl carbamazine and Ivermectin. J. Inf. Dis. 1991; 164: 814-6.

244. Weil GJ, Ramzy RM, Setouhy M, Kandil AM, Ahmed ES, Faris R. A longitudinal study of Bancroftian filariasis in the Nile delta of Egypt: baseline data and one-year follow-up. Am. J. Trop. Med. Hyg. 1999; 61(1): 53-8.

245. WHO. (1974). Tech. Report. Ser. NO. 629.

246. WHO (1979). Tech. Report. Ser. No. 637.

247. WHO (1984). The leishmaniasis. Tech. Report Ser. No. 701.

248. WHO (1996). World Health Report. Report of the Director General, WHO.

249. WHO (1998) World Health Report 1998. Life in the 21st Century. A vision for all. Report of the Director General, WHO.

250. WHO (1999) Health situation in the South East Asia Region 1994-1997, Regional Office of SEARO, New Delhi.

251. WHO (1999) Health situation in the South West Asia Region 1994-1997. Regional Office of SEARO, New Delhi.

252. WHO (2000a) Tech. Report Series No. 892.

253. WHO (2000b) World Health Report–1999. Making a difference, Report of the Director General WHO-1999.

254. WHO (2000c) South East Asia Progress Towards Health for All 1977 – 2000. Regional Office, SEARO, New Delhi.

255. WHO Bulletin. Lymphatic filariasis. Diaagnosis and Pathogenesis 1993; 71(2): 135-141.

256. WHO Technical Report Series, No. 540, Third Report of the WHO Expert Committee on filariasis 1974: 44-45.

257. WHO Technical Report Series, No. 702, Fourth Report of the WHO Expert Committee on filariasis 1984: 38-45.

258. WHO. Epidemiological consideration for planning malaria control in South West Asia Region. WHO Regional Office, SEARO, New Delhi, 1989, p 411.

259. WHO. Safe Use of Pesticides. World Health Organization. Technical Report Series 1985, No.737.

260. WHO/VBC. The use of impregnated bed net and other materials for vector borne disease control. 1989; p 45.

261. Wolfe MS, Aslam Khan M. Filariasis in East Pakistan. Trans Roy Soc. Trop. Med. Hyg. 1971; 65(1): 63-69.

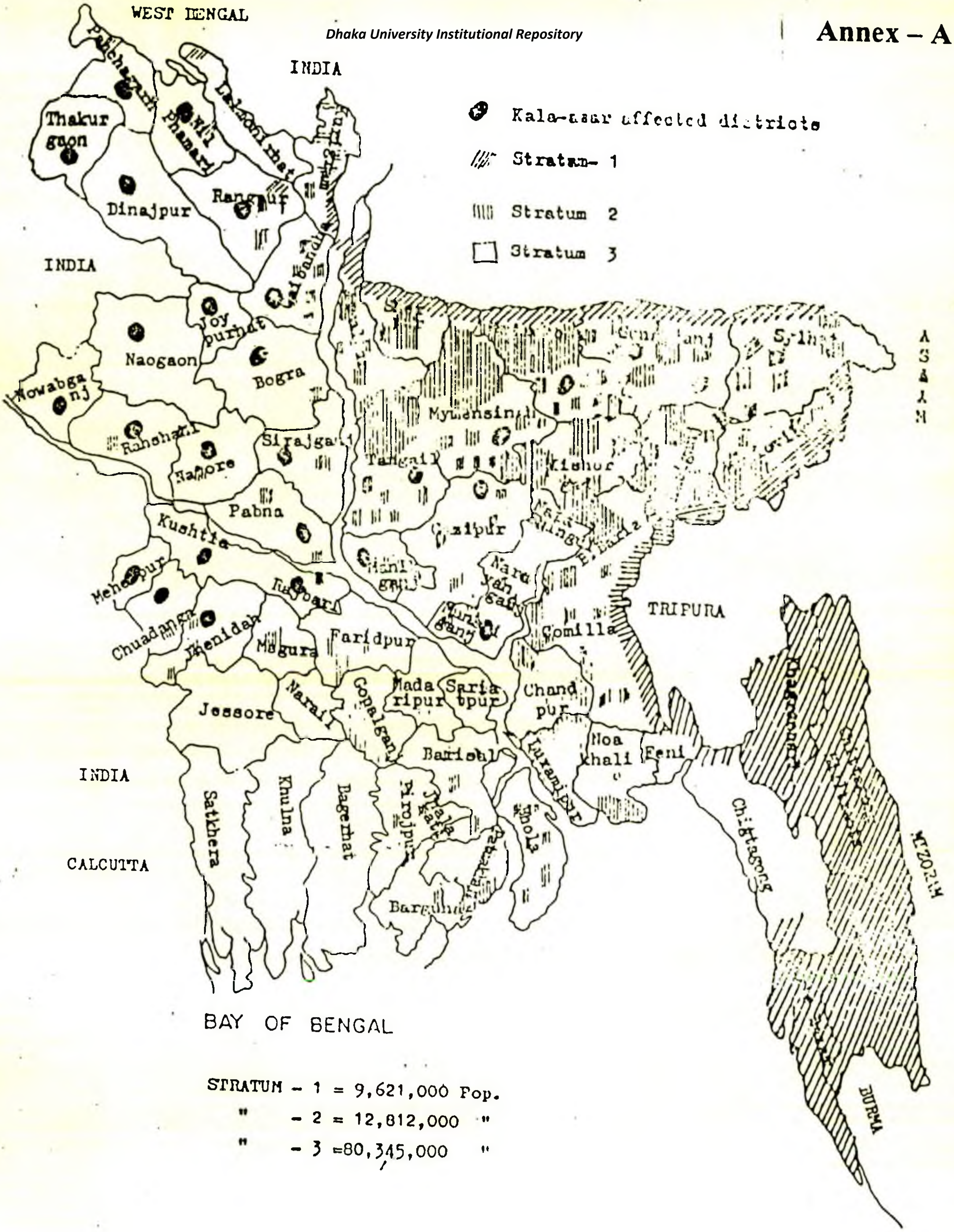
262. Wolfe MS, Aslam Khan M. Bancroftian filariasis in two villages in Dinajpur district, East Pakistan, 1. Infections in man. Am. J Trop. Med. Hyg. 1972; 21(1): 22-29.

263. World Health Organization. Fact Sheet N. 1996: 94 (Revised).

264. Zerba E. Insecticidal Activity of pyrethroids on insects of medical importance. Parasitology Today, 1988; 38(4): 559-62.

Annexures

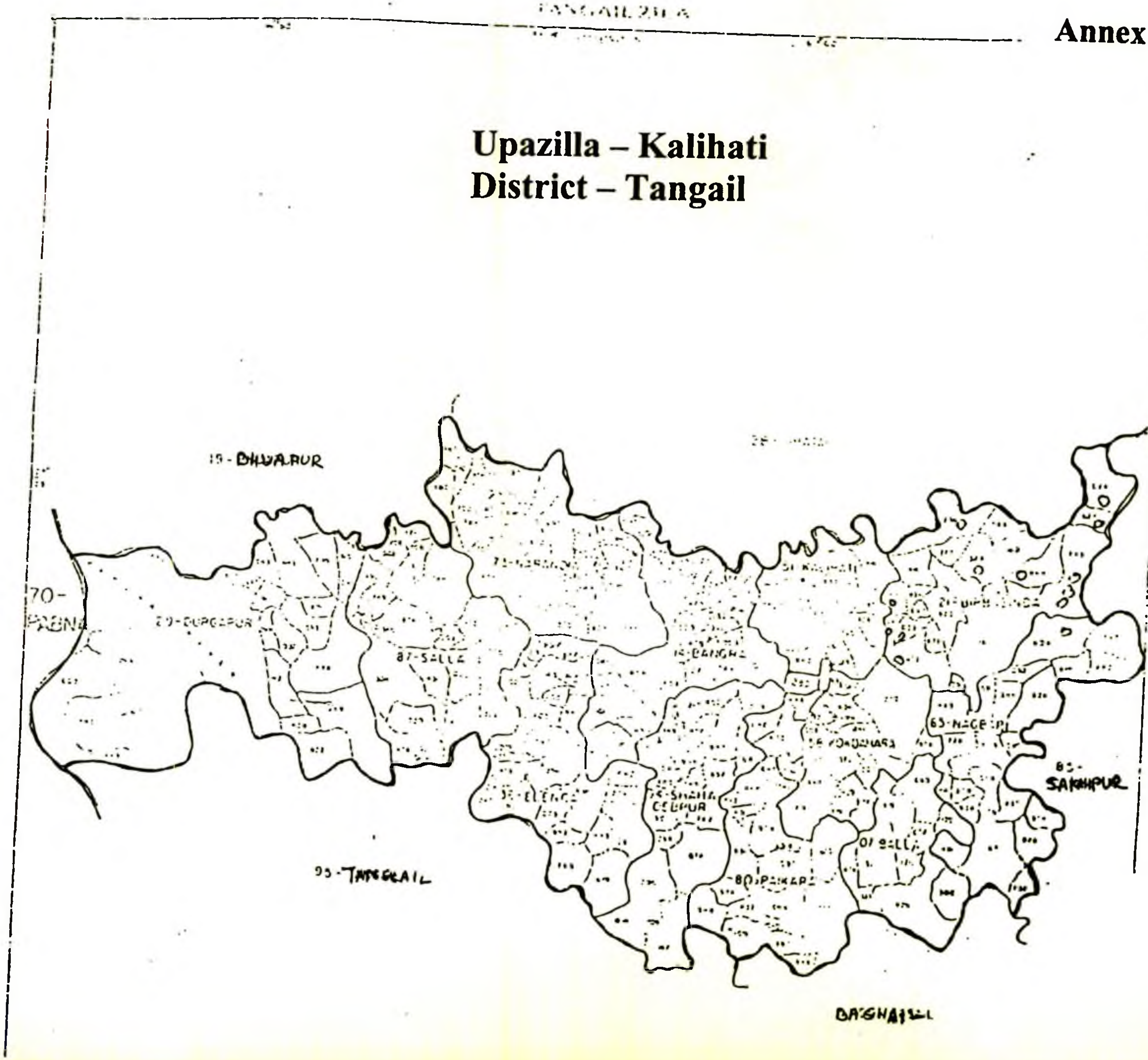
Map of the Study Areas



MAP OF BANGLADESH SHOWING THE STUDY AREAS

Annex – B

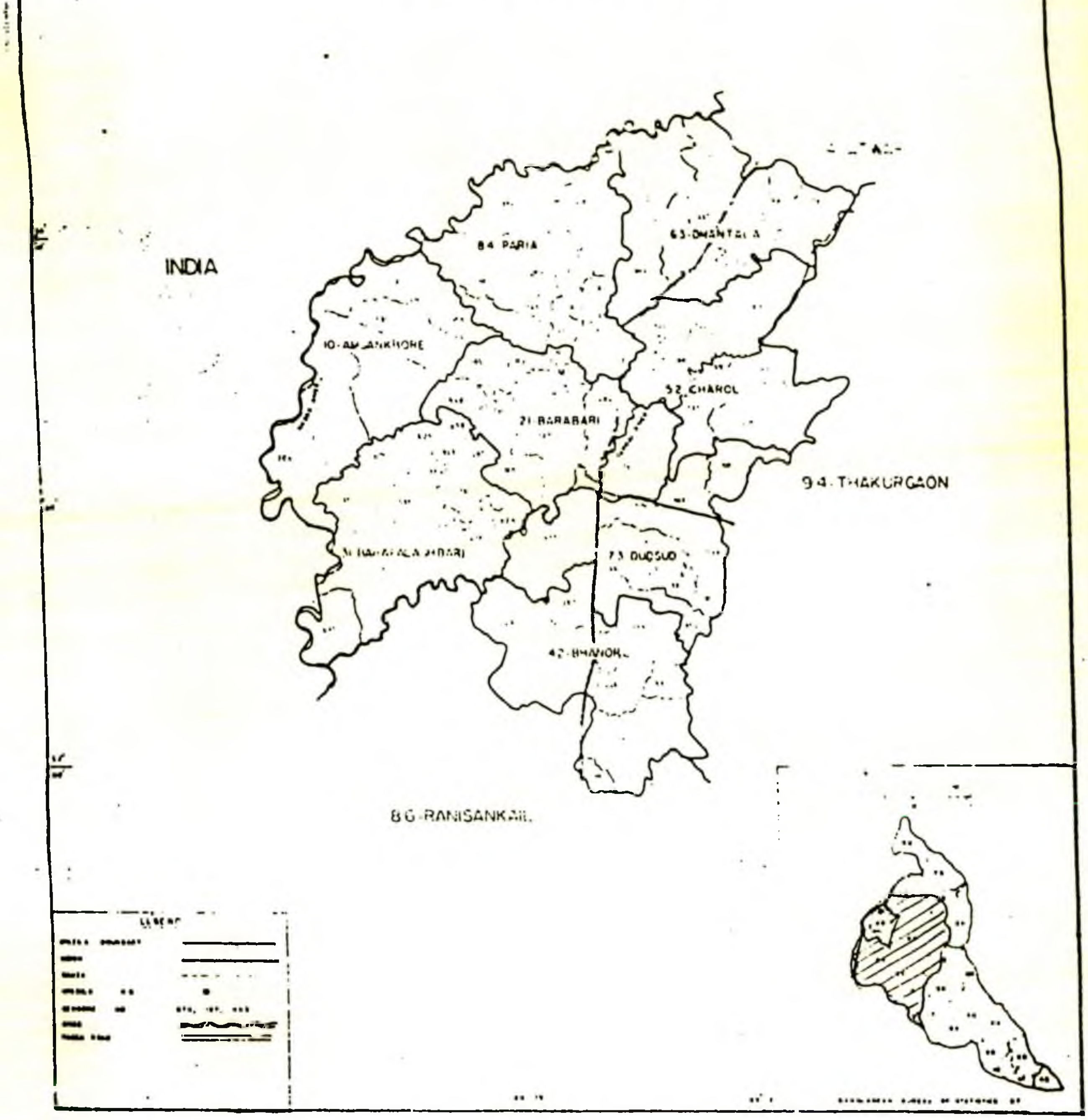
Upazilla – Kalihati
District – Tangail



Upazilla – Kalmakanda
District – Netrokona

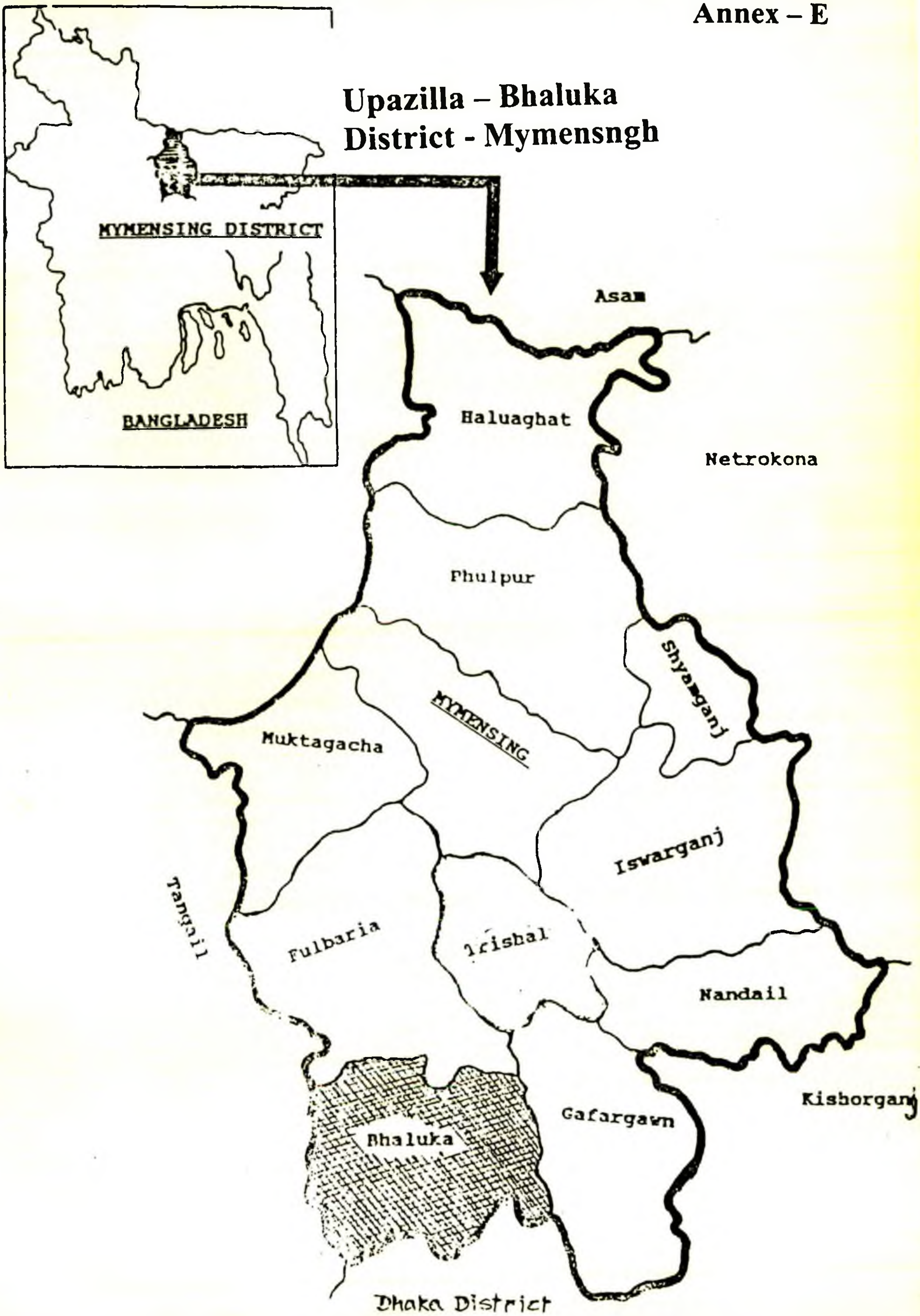
Annex - D

Upazilla – Baliadangi
District – Thakurgaon



Annex – E

Upazilla – Bhaluka
District - Mymensngh



QUESTIONNAIRE

Annex-F

Demographic, Socio-Economic and Knowledge Survey

regarding Malaria, Filaria and Kala-azar at …… upazilla of …… District, 199..

Part – I

Area No. ……..

Household (Khana) Information

Sl. No. [| | |]   House I.D. No.[| | | |]

Name of Household head __________________

Name of the respondent ___________________

Name of Village _________________ No. ____ Name of Union _______________ No.____

Sl. No	Name (start from Household Head)	Relation with Household Head	Age		Sex Male=1 Female=2	Marital status	Occupation	Education
			Year	Mon				
a	b	c	d		e	F	g	H

Instruction for filling in column c,f,g,h

c. Relation with Household Head:	f. Marital Status:	g. Occupation:
1=Self 2=Spouse 3=Offspring 4=Brother/Sister 5=In law (Brother/Sister) 6=Grand child 7=Father/Mother 8=In law (Father/Mother) 9=Nephew/Niece 10=Others (specify) ………………………	1=Unmarried 2=Married 3=Widow/ 4=Divorced **h. Education:** 1-10=Class I to X 11=SSC 12=HSC 13=Graudate or more 14=Illiterate 15=Informal education 16=Child (upto 6 yrs) 17=Others(specify) ………………………	1=Farmer (own land) 2=Cultivator(own land + other's land or only other's land) 3=Day labour 4=Business 5=Service 6=Jobless (Age 16-56 yrs) 7=Student 8=Dependent(Below 16 yrs but not student, above 56 yrs) 9=Housewife 10=Servant 11=Others(specify) …………………………

Part II

Socio-economic Information

Instruction: Please give ✓ (tick mark) or circle in only one correct answer)

Question No.

1. How much land do you or your family own ?
   None = 0, 1-15 bigha=1, 16-30 bigha=2, 30 bigha + = 3 ☐

2. What is your monthly income (in Taka) ?
   Upto Tk.2000=1, Tk.2001-5000=2, Tk.5000 + = 3 ☐

3. Do you have domestic animal ?
   Yes=1, No=2, If no skip to Q.No.5 ☐

4. What type of animal do you have? ☐
   Goat=1, Sheep=2, Cow=3, Goat+Sheep=4, Goat+Cow=5, Goat+Sheep+Cow=6

5. From where do you'take drinking water ? (Source of drinking water)
   Tube well=1, Piped water=2, Pond=3, Canal/River=4 ☐

6. Where do you defeacate?
   Bush=1, Hanging Latrine=2, Fixed well=3, Water Sealed Latrine
   (Well maintained)=4, Water Sealed Latrine(not well maintained)=5 ☐
   Sanitary Latrine(covered)=6, Sanitary Latrine(open)= 7

7. What is the distance of the defecation place?
   1-5 mtr=1, 6-10 mtr=2, 10 mtr + =3 ☐

8. How long are you staying in this place? ☐
   1-3months=1, 4-12months=2, 1-5years=3, 5-10yrs=4, Permanently=5

By Observation:

9. What is the type of house?
   Hut/Mud house=1, Tin+Mud=2, Tin=3, Tin + Cement(Semi- pacca)=4
   Cement(Pacca)=5 ☐

10. How many cracks & holes on the walls & plinths of the main room
    (Bed room) of the house? None=0, 1-5=1, 6-15=2, 15 + =3 ☐

11. Is there any cattle shed/poultry house ?
    Yes Cattle shed=1, Yes Poultry House=2, Yes Cattle Shed+Poultry House=3 ☐
    If no, skip to Q No. 13

12. Is it close to the dwelling house? Yes = 1, No = 2 ☐
    Yes mean less than 5 meter distance)

13. Are there bushes present surrounding the house (within 5 meters) ?
    Yes = 1, No = 2 ☐

14. Is there any drain or ditch in the surrounding of the house ?
    Yes = 1, No = 2 If no skip to Q.No.16 ☐

15. What is the condition of the drain or ditch ?
    Clean = 1, Dirty = 2 ☐

Part III

(About mosquito net)

16. Do you have any mosquito net in your house ?
Yes = 1, No = 2 If no, skip to Q No.25

17. How many bed nets do you have in your house ? Number ....

18. How do you use mosquito net ?
Regularly=1, Occasionally=2, Rarely=3

19. Where did you sleep last night ?
Inside house=1, Varendah=2

20. How many members slept under bed net last night ?
All =1, Some = 2, None = 3

21. At what interval do you wash your net ?
Every month=1, 2-3 months=2, 4-6 months=3, 6+ months=4

22. When did you wash your own net last time ?
Within 1 month=1, 2-3 month=2, 4-6 months=3, 6 months+=4

23. What is the cost of mosquito net (In Taka) ? Double ...., Single ....

24. What is date of purchasing the mosquito net?
....

25 .Why do you not use mosquito net ?
Can't afford=1, Feel discomfort under mosq.net=2, Other (Specify)..................

Annex -G

Morbidity Survey

regarding Malaria, Filaria and Kala-azar at ...... upazilla of ...... District, 199

Case definition:

Malaria - High fever, intermittent with chills, anaemia, sweating confirmed by microscopy – MP +ive.

Kala-azar - low grade and continuous or double rise temperature within 24 hours, lasting for more than 4 weeks and Splenomegaly, confirmed by demonstration of LD body or DAT + ive.

Filariasis - Periodic attacks of fever with lymphangitis and lymphadenitis. Confirmed by microfilaria in blood (Microscopic).

1. Did you have any experience like these? Yes = 1, No = 2 If no, stop the interview here ☐

2. How long was the duration of your last attack? ☐
   Don't Know=1, 7 days=2, 1-4 weeks=3, 2-3 months=4, More than 1year=5

3. During the past illness did you have any medication? ☐
   Yes=1, No=2 If no skip to Q.No 31

4. What type of medicine? ☐
   Analgesic=1, Antibiotic=2, Antimalarial=3, Anti-tubercular=4, Anti-Kala-azar=5
   1+2=6, 1+2+3=7, 1+2+3+4=8, All = 8

5. What was the result of the treatment? ☐
   Analgesic resposded=1, Analgesic no response=2, Anti-malarial drug responded=3,
   Anti-malarial drug no response=4, Anti-tuberculosis responded=5,
   Anti-tuberculosis no response=6, Antibiotic respondant=7,
   Antibiotic no response=8, Anti Kala-azar responded=9,
   Anti kala-azar no response=10

6. Distance of the nearest health facilities from the house .... ☐

7. Have you ever visited the health facility ? Yes=1, No=2 If no stop the interview ☐

3. How do you visit the health facility ? ☐
   On foot=1, Rickshaw/Van=2 Cost ...., Tempu=3 Cost ....,
   Other=4.................................. Cost ....

Monthly Questionnaire for screening

Date of interview ______/_______/_________/_______/________/

Interviewer name.................................

Subject name .... ID no............... H.H.No..................

1. At the present time are you sick and have fever ?
   Yes=1, No =2.(If no move to Q. No.7)
   Yes, I am sick but don't know whether I have fever or not=1(if no, move to Q.No.6),
   Yes, I am sick and have the fever=2

2. What type of fever do you have ?
   Periodic=1, intermittent fever with double rise=2, continuous fever=3, intermittent fever=4

3. Is the fever associated with chill & rigor ? Yes=1, No=2, DK=3

4. What is the date of onset ?
   Specify the exact date ___/___/_____/_____/_____/

5. What is the duration of fever ?
   1-4 weeks=1, 1-3 months=2, 4-6 months=3, more than 6 months=4

6. Did you visit a doctor and you know the diagnosis ?
   DK=1, yes malaria=2, yes kala-azar=3, Yes filaria=4, other=5.................

7. Has there been any birth in the family since last visit ?
   Yes=1(number)___ Specify the date ...., No=2

8. Has there been any death in the family since last visit?
   Yes=1(number) ___ Specify the date .... , No=2

9. Have any of your family member/s been suffering from malaria, Filaria, kala-azar since last visit?
   Yes=1, No=2, If no skip to Q.No.11

10. From which disease ?
    Malaria=1, Filaria=2, Kala-azar=3, Malaria + Filaria=4
    Malaria + Kala-azar=5, Filaria + Kala-azar=6, Malaria + Filaria + Kala-azar=7

11. Do you regularly use the mosquito net that was given to you? Yes=1, No=2

12. How many people slept under the net last night?
    All=1, Some=2, None=3

13. Could you show me the net **(by observation).**
    Condition: Tom=1, Intact=2

Patient Examination

Date: ________________

By observation:

	Yes(1)	No(2)
14. Emaciation present ?	_____	_____
15. Anaemia present ?	_____	_____
16. Oedema present ?	_____	_____
17. Jaundice present ?	_____	_____

Physical Examination

18. Pulse rate - _______/min,

19. Temp. _______°C,

20. Wt. ________kg

21. Spleen by palpation in cm: Spleen measured from the costal margin at left axillary line to tip.
    Not palpable=1, Just palpable=2, Palpable 1-2=3, Palpable 3-5=4, Palpable >5=5

22. Liver by palpation in cm. Measured from the costal margin at right mid clavicular line to edge.
    Not palpable=1, Just palpable=2, Palpable 1-2=3, Palpable 3-5=4, Palpable >5=5

23. Lymph node palpable ? Yes=1, No=2

24. Tongue condition. Moist & clean=1, Dry & coated=2

25. Hair condition. Normal=1, Brittle=2

26. Skin condition
    Normal=1, Hypopigmentation=2, Erythematous=3
    Nodular(Single)=4, Nodular (Multiple)=5, Nodular + Ulcerated=6
    Rough=7, Nodular + Hypopigmentation=8

27. Skin sensation. Absent=1, Present=2

28. Site of the pigmentation in the body.
    No=0.Nose/Face=1, Trunk=2, Upper extremities=3, Whole body=4,
    Lower extremities=5, Face+Trunk=6, Trunk+ extremities=7

29. At present time do you have any medication?
    No=1. Antibiotic=2, Analgesic drug=3, Anti malaria drug=4
    Anti Kala-azar drug=5, Other drug(specify)=6...........................

30. Cost of the drug ....

LABORATORY TEST

Name...................................... **Date: ....**
House ID No.............. **Cost (Tk) for the test**

1. Demonstration of parasite
   None=0
   LD body present microscopy in bone marrow=1, [ ] ______
   LD body present microscopy in spleen aspiration=2,
   LD body present microscopy in skin scraping=3,
   LD body present in culture =4,
   Mf. present microscopy in night blood =5, [ ] ______
   Mf. present microscopy in day blood =6,
   MP. present microscopy blood =7, [ ] ______

2. Haemoglobin in g/100 ml
   <4=1, 4-7.9=2, 8-12=3, >12=4 [ ] ______

3. Total leukocyte count/cu.mm of blood
   <2500=1, 2501-3000=2, 3001-4000=3, 4001-5000=4, [ ] ______
   5001-7000=5, 7001-10,000=6, >10,000=7

4. W. test Negative=1, Positive=2 [ ] ______

5. Urine – Albumin Absent=1, Present=2 [ ] ______

Serology

6. DAT [ ] ______
   1:100=1, 1:200=2, 1:16=3, 1:800=4, 1:16005
   1:3200=6, 1:6400=7, 1:12800=8, 1:25600=9
   1:51200=10, 1:102400=11, <1:102400=12

7. IFAT
   1:4=1, 1:8=2, 1:16=3, 1:32=4, 1:64=5, 1:128=6, 1:156=7 [ ] ______

8. ELISA – direct absorbency Value: _______ ______

Treatment

Treatment review with diagnosis with dose and duration

	Drug	Dose	Duration	Cost
Kala-azar				
Filaria				
Malaria				

Interview Schedule

Questionnaire on the operational use of Insecticide treated mosquito nets in selected areas of ---------- upazilla of --------- District.

Part - 1

Sl. No. [| | |] House I.D. No. [| | | | |]

1. Name of Household head ____________________
2. Name of the respondent ____________________
3. Name of Village ____________________ No. ____
4. Name of Union ____________________ No.____

5. Educational qualification [ ]
   Illiterate = 1, Primary (I-V) =2, Secondary (VI-X)=3,
   Higher Secondary=4, Graduate=5, Informal education=6, Child=7
6. Occupation
   Cultivation=1, Labour=2, Service=3, Business=4, Housewife=5
   Student=6, Dependent=7
7. Monthly income of the family
   Upto Tk. 2000=1, Tk.2001-5000=2, Tk.5001+ =3
8. Type of house [ ]
   Hut/Mud house=1, Tin+Mud=2, Tin+Tin=3, Tin+Cement=4
   Cement (Pacca)=5
8. Any cattle shed near the house [ ]
   Yes=1, No=2
9. Any bushes surrounding the house (within 5 meter) [ ]
   Yes=1, No=2
10. Any drain surrounding the house [ ]
    Yes=1, No=2
11. The condition of the surrounding [ ]
    Dry and clean=1, Dirty (collection of water present)=2
12. Monthly income of the family [ ]
    Upto Tk. 2000=1, Tk.2001-5000=2, Tk.5001+ =3

Part - 2
Regarding mosquito net

1. Number of mosquito net in the house :
   Own ______, Distributed by research team _______________, Total: __________

2. Number of impregnated and unimpregnated nets:
   Impregnated __________ unimpregnated ______________

3. When the impregnated nets distributed first : ___________________ year

4. How many times the nets reimpregnated ______________________

5. When the nets reimpregnated last _____ month _______ year.

6. Do you use impregnated nets regularly? Yes=1, No=2 [ ]

7. If not, why ?
   Out of habit=1, Feel discomfortable=2, Bad small=2, Others--------- =4(specify) [ ]

8. Approximate time of family member go to bed under net

	Children	Adult Male	Female
a. Just after sunset	[ ]	[ ]	[ ]
b. Just after sunset	[ ]	[ ]	[ ]
c. 2-5 hours after sunset	[ ]	[ ]	[ ]
d. More than 5 hours after sunset	[ ]	[ ]	[ ]

9. Whether the mosquito nets were washed after last impregnation
   Yes=1, No=2

Part - 3
Knowledge and Practice about malaria/filaria/kala-azar

1. What is the cause of malaria/filaria/kala-azar? [ ]
2. How do you prevent malaria/filaria/kala-azar ? [ ]
3. Do you use any other method to control mosquito bite other than mosquito net ?
   Coil =1, DDT=2, Smoke (Dhup)=3, Other(specify)=4 [ ]
4. In future will you purchage impregnated ne if supplied at low cost. Yes=1, No=2 [ ]

Check List

Night observation about mosquito net use (9 pm to 11 pm)

Sl. No. [| | |]   House I.D. No [| | | |]

1. Name of Household head ____________________
2. Name of the respondent ______________________
3. Total number of members in the household [ ]
4. Total number of mosquito net in the house [ ]
5. Total number of mosquito net in the house [ ]
6. Where did you sleep last night ? Inside hosue=1, Varendah=2 [ ]
7. How many family member slept [ ]
   a. under impregnated net ____
   b. under unimpregnated net ____
   c. with any mosquito net _____

3. Check each room
   a. number of impregnated nets in hanging position [ ]
   b. number of unimpregnated net in hanging position [ ]
   c. number of net not in hanging position [ ]
   d. number of children found sleeping under mosquito net [ ]
   e. number of adult family member found sleeping mosquito net [ ]
   f. number of member found sleeping without net [ ]