## TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	v
TABLE OF CONTENTS	vii
LIST OF ABBREVIATIONS	xiii
LIST OF TABLES	xvi
LIST OF FIGURES	xviii
CHAPTER 1: INTRODUCTION	1
1.1. Filariasis	1
1.2. History	2
1.3. Filariasis in Sri Lanka	3
1.4. Life cycle and transmission	5
1.5. Clinical disease and treatment	7
1.5.1. Acute inflammatory episodes (AIE)	7
1.5.2. Lymphoedema/Elephantiasis	8
1.5.3. Hydrocoele	9
1.6. Burden of the disease	9
1.7. Global mapping of disease burden	10
1.8. Landmark research leading to the global elimination of LF	11
1.8.1. Recent medical advances	11
1.8.1.1. New treatment for interrupting transmission	11
1.8.1.2. New treatment for morbidity	13
1.8.1.3. New diagnostic and rapid assessment tools for surveillance and monitoring	14
1.8.1.4. Other advances	15
1.9. Resources available for country programmes for elimination	17
1.10. Development of a national plan to eliminate LF	17
1.10.1 National plan of action as recommended by WHO	17
1.10.2. Sri Lankan national programme and independent	25
evaluation	
1.11. Objectives	26

CHAPTER 2: Identification of endemic areas of bancroftian	28
filariasis in Hambantota district, Sri Lanka, using	
Rapid Assessment Procedures (RAPs)	
2.1. INTRODUCTION	29
2.2. MATERIALS AND METHODS	32
2.2.1. Study area	32
2.2.2. Administration	32
2.2.3. Rapid Assessment Procedures (RAPs)	33
2.2.4. Evaluation of infection status by professionals	34
2.2.5. Making disease distribution maps using geographic	36
information systems	
2.2.6. Data analysis	36
2.2.7. Cost analysis	37
2.2.8. Ethical considerations	37
2.3. RESULTS	38
2.3.1. General Information obtained from village leaders	38
2.3.2. IndQ and FGD data	38
2.3.3. Clinical and immunological studies	38
2.3.4. Agreement analysis of categorical data of prevalence	39
2.3.5. Hydrocoele distribution on the map	40
2.3.6. Correlation analysis	40
2.3.7. Cost analysis	47
2.4. DISCUSSION	48
2.4.1. Hydrocoele as a marker of filarial endemicity	48
2.4.2. Validation of information on hydrocoele given by	48
local people	
2.4.3. Use of GIS-based map to display distribution and	49
prevalence of filariasis	
2.4.4. Importance of GN as a key informant	<b>50</b> -
2.4.5. Discrepancies in distribution and prevalence data	50
among different methods	
2.4.6. Usefulness of urine ELISA as a supportive test to	51
delimitate LF endemic areas	
2.4.7. Cost effectiveness of the IndQ	52
2.4.8. Concluding remarks	52

CHAPTER 3: A Rapid Assessment Procedure to Assess	53
Distribution of Lymphatic Filariasis Using	
Geographical Information Systems	
3.1. INTRODUCTION	54
3.1.1. Lymphatic filariasis distribution according to	54
national Programme to Eliminate Lymphatic	
Filariasis (PELF)	
3.1.2. Recent advances in tools for mapping the LF	54
distribution	
3.1.3. Aims of the present study	55
3.2. METHODS	57
3.2.1. Study areas and subjects	57
3.2.2. Rapid Assessment Procedure (RAP)	57
3.2.3. Making a digitized map	57
3.2.4. Data management	58
3.2.5. Making a disease zoning map for detailed analyses	59
3.2.6. Statistical analysis and ethical considerations	59
3.3. RESULTS	60
3.3.1. Information obtained from village leaders	60
3.3.2. Distribution and prevalence level of the clinical	60
signs obtained via RAP in each district	
3.3.3. Comparison of disease distribution within three	61
districts—Hambantota, Matara, and Galle	
3.4. DISCUSSION	72
CHAPTER 4: Annual Mass Drug Administration in Walgama,	75
a suburb of Matara, Sri Lanka and its evaluation	
4.1. INTRODUCTION	<b>76</b> ·
4.2. METHODS	78
4.2.1. Study sites	78
4.2.2. Procedures of mass drug administration and	80
treatment recording	
4.2.3. Sampling of households to evaluate MDA effects	80
4.2.4. Parasitological tests	81

4.2.5. Analysis	82	
4.3. RESULTS	85	
4.3.1. Drug coverage and consumption in mass drug	85	
administrations		
4.3.2. Baseline microfilaria survey (S[0])	85	
4.3.3. Impact of MDAs on microfilaria prevalence in	86	
each treatment division		
4.3.4. Impact of MDAs on microfilaria density in each	87	
treatment division		
4.3.5. Impact on the age prevalence distribution	88	
4.3.6. Baseline survey (S[0]) for soil-transmitted	96	
helminths (STH)		
4.3.6.1. Study subjects	96	
4.3.6.2. STH infections before MDA (S[0])	96	
4.3.7. Impact of MDAs on STH prevalence in each	97	
treatment area		
4.3.8. Impact of MDAs on helminths intensity in each	99	
treatment division		
4.4. DISCUSSION	108	
4.4.1. Independent assessment of national Programme	108	
to Eliminate Lymphatic Filariasis (PELF)		
4.4.2. Evaluation of drug delivery and consumption in	109	
our study divisions		
4.4.3. Effect of MDAs on microfilaria prevalence and	110	
density		
4.4.4. A critical mf level at which filariasis would disappear	111	
spontaneously: the target of MDAs		
4.4.5. Future of national PELF: possibility of resurgence	112	
and its monitoring		
4.4.6. Beyond filariasis effects	113	
4.4.7. Conclusion	115	

CHAPTER 5.1: Filarial lymphoedema and its management:	116
the situation in three suburbs of Matara,	
Sri Lanka, before the introduction of a morbidity	
control programme	
5.1.1. INTRODUCTION	117
5.1.2. METHODS	118
5.1.2.1. Study Area	118
5.1.2.2. Study Population	118
5.1.2.3. Questionnaire	118
5.1.2.4. Data analysis and ethical considerations	119
5.1.3. RESULTS	120
5.1.3.1. Lymphoedema cases	120
5.1.3.2. Limb pain with fever	122
5.1.3.3. Treatment	123
5.1.3.4. Personal hygiene	124
5.1.3.5. Care of the limbs	124
5.1.3.6. Problems of the lymphoedema cases	125
5.1.3.7. Care and support	125
5.1.3.8. Community gathering	125
5.1.3.9. KAP study	125
5.1.3.10. DLQI	126
5.1.4. DISCUSSION	127
CHAPTER 5.2: Implementation of Community Home Based	130
<b>Care (CHBC) programme for morbidity control:</b>	
evaluation of two, one year follow-up schemes in	
three suburbs of Matara town	
5.2.1. INTRODUCTION	131
5.2.2. METHODS	134
5.2.2.1. Study area	134
5.2.2.2. Study subjects	134
5.2.2.3. Community Home-Based Care (CHBC)	134
approach for management of lymphoedema	

5.2.2.4. Assessment of levels of Knowledge, Attitude	137
and Practices (KAP) on lymphoedema management	
protocol	
5.2.2.5. Baseline and one-year assessments to measure	137
the success of lymphoedema care programmes	
5.2.2.6. Statistical analysis	139
5.2.3. RESULTS	140
5.2.3.1. Comparability of 2 study groups at baseline	140
assessments	
5.2.3.2. Measurements of success	140
5.2.4. DISCUSSION	149
SUMMARY AND CONCLUSIONS	155
REFERENCES	160
ANNEXURES	189

## LIST OF ABBREVIATIONS

<sup>0</sup> C	Celsius
μg	Microgram
ADL	Acute Adenolymphangitis
AFC	Anti-Filariasis Campaign
AFL	Acute Filarial Lymphoedema
AGA	Assistant Government Agent
AIE	Acute Inflammatory Episodes
A.I.	Ascaris lumbricoides
Alb	Albendazole
BL	Bilateral Lymphoedema
CHBC	Community Home-Based Care
DALY's	Disability Adjusted Life Years
DEC	Diethylcarbamazine
DEC+Alb	Combination treatment of Diethylcarbamazine and Albendazole
DFU	Daily Follow-up
DLA	Deramtolymphangioadenitis
DLQI	Dermatology Life Quality Index
DNA	Deoxyribonucleic Acid
ed.	Editor
eds.	Editors
eds. ELISA	Editors Enzyme Linked Immunosorbent Assay
ELISA	Enzyme Linked Immunosorbent Assay
ELISA ELs	Enzyme Linked Immunosorbent Assay Entry Lesions
ELISA ELs ELP	Enzyme Linked Immunosorbent Assay Entry Lesions Episode of Limb Pain

GBD	World Bank Global Burden of Diseases
GIS	Geographical Information Systems
GMD	Geometric-Mean mf Density
GMI	Geometric Mean soil transmitted helminth Intensity
GPELF	Global Programme for Elimination of Lymphatic Filariasis
H.w.	Hookworm
ICT	Immunochromatographic Card Test
IndQ	Indirect Questionnaire Method
IU	Implementation Unit
KAP	Knowledge Attitude and Practices
KIs	Key Informants
Km	Kilometre
Km <sup>2</sup>	Square Kilometre
$L_3$	Infective larvae
LF	Lymphatic Filariasis
Μ	Male
m	Metre
MDA	Mass Drug Administration
mf	Microfilaria
mff	Microfilariae
MFU	Monthly Follow-up
mg	Milligram
mL	Millilitre
n	Number
NTDs	Neglected Tropical Diseases
PELF	Programme to Eliminate Lymphatic Filariasis
PCR	Polymerase Chain Reaction

PHIs	Public Health Inspectors
PHMs	Public Health Midwives
pp.	Pages
PRGMD	Percentage Reduction of Geometric-Mean mf Density
PRmfP	Percentage Reduction of microfilaria Prevalence
PRP-STH	Percentage Reduction of Soil transmitted helminth Prevalence
RAPs	Rapid Assessment Procedures
QoL	Quality of Life
RS	Remote Sensing
SD	Standard Deviation
SE	Standard error
Sq/Km	Square Kilometer
STH	Soil transmitted helminths
TPE	Tropical Pulmonary Eosinophilia
T.t	Trichuris trichiura
UL	Unilateral Lymphoedema
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization
WHODAS II	World Health Organization DAS II
yrs	Years

## LIST OF TABLES

	Page
Table 2.1 Prevalence of hydrocoele obtained by Grama Niladhari (IndQ),	46
Focus Group Discussion (FGD) and clinicians (CE) at 24 Grama Niladk	ari
divisions, and urine ELISA prevalence at 15 Grama Niladhari divisions	
Table 2.2 Cost (Sri Lankan Rupees *) required for different RAP procedures	, 47
and urine IgG4 ELISA according to expenditure category	
Table 3.1 The number of GN divisions reporting elephantiasis/lymphoedema	69
analysed by prevalence level and distance from coast in Hambantota dis	trict
Table 3.2 The number of $GN$ divisions reporting hydrocoele analysed by	69
prevalence level and distance from coast in Hambantota district	
Table 3.3 The number of GN divisions reporting elephantiasis/lymphoedema	70
analysed by prevalence level and distance from coast in Galle district	
Table 3.4 The number of GN divisions reporting hydrocoele analysed by	70
prevalence level and distance from coast in Galle district	
Table 3.5 The number of GN divisions reporting elephantiasis/lymphoedema	71
analysed by prevalence level and distance from coast in Matara district	
(Weerasooriya et al., 2008)	
Table 3.6 The number of GN divisions reporting hydrocoele analysed by	71
prevalence level and distance from coast in Matara district	
(Weerasooriya et al., 2008)	
Table 4.1 Treatment schemes of MDAs in Phases I and II, and schedule	84
of microfilaria surveys	
Table 4.2 Treatment schemes of MDAs in Phases I and II, and schedule of	84
stool surveys	
Table 4.3 Drug coverage and comsumption analysed for all mass drug	89
administartions (MDAs) in 4 treatment areas	
Table 4.4 Analysis of study subjects enrolled in the blood surveys to	90
evaluate MDAs according to sex and age	
<i>Table 4.5</i> Changes in microfilaria (mf) prevalence <sup>a</sup> following MDA's over	91
six years from June 2001 to June 2007	
Table 4.6 Geometric mean microfilaria density (GMD) calculated for (1) the	94
total population ( <b>bold</b> figures) (2) the microfilaria positives only following	ng
MDA's over six years from June 2001 to June 2007	

Table 4.7 Study subjects enrolled in the stool surveys to monitor the effects	100
of MDAs on helminth infection according to age and sex, infection here	
means any of A. lumbricoides, hookworm and T. trichiura	
Table 4.8 Changes in prevalence <sup>a</sup> of Soil-transmittd helminths (STH)	101
following MDA's over five years from June 2001 to Dec. 2006	
Table 4.9 Geometric Mean Intensity (GMI) and Percentage Reduction of	107
GMI (PRGMI) of soil-transmitted helminths (STH) following MDAs over	
five years from June 2001 to Dec. 2006	
Table 5.1.1 Characteristics of the 101 lymphoedema cases investigated	120
Table 5.1.2 The frequencies of episodes of limb pain (ELP) with fever during	122
the previous 12 months, in relation to the grade of lymphoedema and the	
presence of entry lesions	
Table 5.2.1 Assessments of leg volume, entry lesions (EL) and acute	144
inflammatory episodes (AIEs) before and 1 year after lymphoedema	
management in Daily follow-up (DFU) and Monthly follow-up (MFU)	
groups	
Table 5.2.2 Levels of KAP score on lymphoedema management techniques	145
assessed 1 year after the self-care programme in Daily follow-up (DFU)	
and Monthly follow-up (MFU) groups	
Table 5.2.3 Levels of various benefits gained after one year of lymphoedema	147
managements in DFU and MFU groups	

xvii

## **LIST OF FIGURES**

	Page
Figure 1.1 Distribution of endemic areas of W. bancrofti and B. malayi as	4
obsevered in the microfilaria surveys conducted in 1947, 1962, 1967-68 and	
1990	
Figure 1.2 Life cycles of Lymphatic-dwelling Filariae (obtained from CDC,	6
Atlanta)	
Figure 2.1 Map of Sri Lanka, indicating endemic districts: 2001	31
Figure 2.2 Grama Niladhari division map of Hambantota, Sri Lanka,	41
illustrating the hydrocoele prevalence by IndQ	
Figure 2.3 Grama Niladhari division map of Hambantota, Sri Lanka,	42
illustrating the hydrocoele prevalence by FGD	
Figure 2.4 Grama Niladhari division map of Hambantota, Sri Lanka,	43
illustrating the hydrocoele prevalence by CE and IndQ	
Figure 2.5 Grama Niladhari division map of Hambantota, Sri Lanka	44
illustrating the urine ELISA prevalence and hydrocoele prevalence by	
IndQ	
Figure 2.6 Relationship between hydrocoele prevalence (% males) by	45
clinicians (CE) and prevalence (%) by urine ELISA at 15 GN divisions	
Figure 2.7 Relationship between hydrocoele prevalence (/1,000 males)	
obtained by Grama Niladhari at 24 GN clusters and by clinicians at the	
corresponding GN divisions (CE)	
Figure 3.1 Lymphatic filariasis endemic areas by district (Source –	56
Anti Filariasis Campaign—1999)	
Figure 3.2 Prevalence and distribution of elephantiasis/lymphoedema	63
cases in Hambantota district	
Figure 3.3 Prevalence and distribution of hydrocoele cases in Hambantota	64
district	
Figure 3.4 Prevalence and distribution of elephantiasis/lymphoedema cases	65
in Galle district	
Figure 3.5 Prevalence and distribution of hydrocoele cases in Galle district	. 66

Figure 3.6 Hambantota (a), Matara (b), and Galle (c), prevalence	e maps of
Elephantiasis/lymphoedema according to distance from the	e 67
coastline	
Figure 3.7 Hambantota (a), Matara (b), and Galle (c), prevalence	e maps of 68
hydrocoele according to distance from the coastline	
Figure 4.1 Map of Walgama suburb showing 3 Grama Niladhari di	visions 79
included in the study	
Figure 4.2 Precentage reduction of microfilaria prevalence (PRmf	P) at A) 92
Hamugewatta, B) Matotagama[sd], and C) Walgama throu	igh five
MDA's from 2001 to 2007	
Figure 4.3 Precentage reduction of geometric mean microfilaria d	ensity 93
(PRGMD) computed for the total population at A) Hamuge	ewatta <b>B)</b>
Matotagama[sd] and C) Walgama through five MDA's fro	m 2001 to 2007
Figure 4.4 Microfilaria prevalence analysed by age groups before	the first 95
MDA and following the last S[72] in the treatment division	18
a.) Hamugewatta, b.) Matotagama and c.) Walgama. (n=nu	umber of
participants per group)	
Figure 4.5 Precentage Reduction in Prevalence of Soil Tansmitted	l 102
Helminths (PRP-STH) at A) Hamugewatta, B) Matotagan	18,
C) Walgama and D) Walgma Central; S[0]/2001.Jun, S[12	]/2002.Jun,
S[18]/2002.Dec, S[30]/2003.Dec, S[42]/2004.Dec and S[6	6]/2006.Dec
Figure 4.6 Intensity of soil-transmitted helminths (STH) in Hamus	gewatta 103
Figure 4.7 Intensity of soil-transmitted helminths (STH) in Matota	agama 104
Figure 4.8 Intensity of soil-transmitted helminths (STH) in Walga	ma 105
Figure 4.9 Intensity of soil-transmitted helminths (STH) in Walga	ma 106
Central	
Figure 5.2.1 Mean DLQI scores before and after one year of follow	w-up in 146
2 groups (DFU and MFU)	
Figure 5.2.2 An example of successful managements of lymphoed	ema with 148
daily follow-ups, before (a) and after one year (b). (Case N	<i>(o. 11</i> )

- Figure 5.2.3 An example of reduction of lymphoedema grade by managements
   148

   with daily follow-ups, before—Grade III with shallow skin creases in red
   148

   circles (a) and after one year—Grade II without skin creases (b).
   (Case No. 8)
- Figure 5.2.4 Mossy lesion (red circle) and EL (red arrows) on the foot, before148(a) and after one year of managements with daily follow-ups (b).(Case No. 12)