Contents

12

ļ

.

Init order chain Out-a Chapter 02 Uiterature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3 Groundwater pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 ± 21 2.8 How salt water intrusion happens in coast 2.81 Factors affecting to salt infiltration 26 2.09 Soil salinity 29 2.10 Soil pH 32 2.11 Environmental parameters of Study area 34 2.12: Conclusion of literature survey 38 Chapter 3				Page No
List of Figures VII Abbreviations X Acknowledgements XI Abstract XII Chapter 01 Introduction 01-0 Chapter 02 Literature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 2.3 Ground water pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 21 2.8 How salt water intrusion happens in coast 24 2.8.1 Factors affecting to salt infiltration 26 2.09 Soil salinity 29 2.10 Soil pH 32 2.111 Environmental parameters of Study area 34 2.121: Conclusion of literature survey 38 Chapter 3 Methodology Mater Study area 34 34 36	Table	of cont	ents	Ι
Abbreviations	List of Tables		V	
Active via lossXIAcknowledgementsXIAbstractXIIChapter 01IntroductionChapter 0201-0Chapter 02Chapter 02Literature Review04-32.1 World water budget and groundwater resources042.2Ground water quality052.2.1 Water quality assessment criteria072.2.2 Classification of groundwater082.3 Groundwater pollution092.3.1 Common Groundwater pollutants102.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21282.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.111 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology	List of	f Figure	S	VII
Abstract XII Abstract XII Chapter 01 Introduction 01-0 Chapter 02 Literature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 200 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 21 2.8 How salt water intrusion happens in coast 24 2.8.1 Factors affecting to salt infiltration 26 2.09 Soil salinity 29 2.10 Soil pH 32 2.11 Environmental parameters of Study area 34 2.11.1 Geology of study area 34 2.12: Conclusion of literature survey 38 Chapter 3	Abbre	viation	S	Х
Chapter 01 01-0 Chapter 02 04-3 Literature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.1.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3.3 Groundwater pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 / 21 24 2.8 How salt water intrusion happens in coast 24 2.8.1 Factors affecting to salt infiltration 26 2.09 Soil salinity 29 2.10 Soil pH 32 2.11.1 Geology of study area 34 2.12: Conclusion of literature survey 38 Chapter 3 Ketheodogy <td>Ackno</td> <td colspan="2">-</td> <td>XI</td>	Ackno	-		XI
Introduction 01-00 Chapter 02 02-00 Litter> Image: 02 04-30 1 Under public and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3.1 Common Groundwater pollutants 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 10 2.4 Un-king water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 14 2.8 Iwater intrusion happens in coast 24 2.8 Iwater intrusion happens in coast 24 2.8 Iwater intrusion bappens in coast 24 2.90 Iwater intrusion bappens in coast 24 2.10 Iwater intrusion filterature survey 34 2.11 Iwater intrusion filterature survey 34 <td colspan="2">Abstract</td> <td>XII</td>	Abstract		XII	
Introduction 01-00 Chapter 02 02-00 Litter> Image: 02 04-30 1 Under public and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3.1 Common Groundwater pollutants 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 10 2.4 Un-king water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 14 2.8 Iwater intrusion happens in coast 24 2.8 Iwater intrusion happens in coast 24 2.8 Iwater intrusion bappens in coast 24 2.90 Iwater intrusion bappens in coast 24 2.10 Iwater intrusion filterature survey 34 2.11 Iwater intrusion filterature survey 34 <td>Chan</td> <td>ter 01</td> <td></td> <td></td>	Chan	ter 01		
Chapter 02 Itterature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3.3 Groundwater pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 13 2.8 How salt water intrusion happens in coast 24 2.8.1 Factors affecting to salt infiltration 26 2.09 Soil pH 32 2.10 Soil pH 32 2.11.1 Geology of study area 34 2.12: Conclusion of literature survey 38 Chapter 3 Ketheology				01-03
Literature Review 04-3 2.1 World water budget and groundwater resources 04 2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3.3 Groundwater pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 16 2.8 How salt water intrusion happens in coast 24 2.8.1 Factors affecting to salt infiltration 26 2.09 Soil pH 32 2.11 Environmental parameters of Study area 34 2.11.1 Geology of study area 34 2.12: Conclusion of literature survey 38				
2.1 work water obliger and geometricity052.2Ground water quality052.2.1 Water quality assessment criteria072.2.2 Classification of groundwater082.3 Groundwater pollution092.3.1 Common Groundwater pollutants102.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21282.8 How salt water intrusion happens in coast242.09 Soil salinity292.10 Soil pH322.111 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			eview	04-39
2.2 Ground water quality 05 2.2.1 Water quality assessment criteria 07 2.2.2 Classification of groundwater 08 2.3 Groundwater pollution 09 2.3.1 Common Groundwater pollutants 10 2.3.2 Un-common Groundwater pollutants 11 2.4 Drinking water Availability in Sri Lanka 12 2.5 Earthquake and Indian ocean Tsunami, 2004 13 2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka 16 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 13 2.6 Degree of Tsunami affecting to salt infiltration 26 2.7 Some groundwater studies in India and Maldives after the tsunami 2004 21 2.8 How salt water intrusion happens in coast 24 2.8 I Factors affecting to salt infiltration 26 2.09 Soil pH 32 2.10 Soil pH 32 2.11 Environmental parameters of Study area 34 2.12: Conclusion of literature survey 38 Chapter 3 J J		2.1 W	orld water budget and groundwater resources	04
2.2.2 Classification of groundwater082.3 Groundwater pollution092.3.1 Common Groundwater pollutants102.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 212.8 How salt water intrusion happens in coast242.9 Soil salinity292.10 Soil pH322.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			-	05
2.3 Groundwater pollution092.3 Groundwater pollution102.3.1 Common Groundwater pollutants102.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21212.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			2.2.1 Water quality assessment criteria	07
2.3.1 Common Groundwater pollutants102.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 212.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			2.2.2 Classification of groundwater	08
2.3.2 Un-common Groundwater pollutants112.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21282.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.111 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.3 Gr	oundwater pollution	09
2.4 Drinking water Availability in Sri Lanka122.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21212.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			2.3.1 Common Groundwater pollutants	10
2.1 Drinking water resources of Number 2004132.5 Earthquake and Indian ocean Tsunami, 2004132.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 21202.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			2.3.2 Un-common Groundwater pollutants	11
2.6 Degree of Tsunami affect on groundwater resources of Sri Lanka162.7 Some groundwater studies in India and Maldives after the tsunami 2004 212.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.4 Dr	inking water Availability in Sri Lanka	12
2.7 Some groundwater studies in India and Maldives after the tsunami 2004 212.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.5 Ea	rthquake and Indian ocean Tsunami, 2004	13
2.8 How salt water intrusion happens in coast242.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.6 De	egree of Tsunami affect on groundwater resources of Sri Lanka	16
2.8.1 Factors affecting to salt infiltration262.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.7 Some groundwater studies in India and Maldives after the tsunami 2		04 21
2.09 Soil salinity292.10 Soil pH322.11 Environmental parameters of Study area342.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53		2.8 Ho	ow salt water intrusion happens in coast	24
2.10 Soil pH322.11 Environmental parameters of Study area342.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 3Methodology40-53			2.8.1 Factors affecting to salt infiltration	26
2.11 Environmental parameters of Study area342.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 340-53		2.09 S	oil salinity	29
2.11.1 Geology of study area342.12: Conclusion of literature survey38Chapter 340-53		2.10 S	oil pH	32
2.12: Conclusion of literature survey 38 Chapter 3 Methodology 40-53		2.11 E	Environmental parameters of Study area	34
Chapter 3 Methodology 40-5.			2.11.1 Geology of study area	34
Methodology 40-53	,	2.12:	Conclusion of literature survey	38
	Chapt	ter 3		
3.1 Initial field visit and location identification 40	Methodology			40-53
		3.1 In	itial field visit and location identification	40
3.2 Area of investigation40		3.2 Ai	rea of investigation	40

3.3 Questionnaire survey	42
3.4 Well selection	42
3.4.1 GPS application	45
3.4.2 Data acquisition and Monitoring	45
3.5 Water sampling	46
3.5.1 Sample pretreatment and preparation	46
3.6 Water quality analysis	47
3.6.1 Electrical conductivity (EC), Total dissolved	47
Solids (TDS) and Salinity	
3.6.2 pH of water	47
3.6.3 Water soluble cations	47
3.6.4. Sulphate ion	48
3.6.5 Chloride Ions	49
3.6.6 Bicarbonate Ions	49
3.7 Soil study	50
3.7.1 Soil chemical analysis	51
3.7.2 Soil pH	52
3.7.3 Soil salinity	52
3.8 Quality control methods	52
3.9 Graphical interpretation of maps, spatial analysis and grid analysis	53
3.10 Secondary data collection	53
Chapter 04	
The Groundwater usage pattern in coastal strip of Matara	54-58
District after the 2004 Asian Tsunami	
4.1 Dug well maintenance	54
4.2 Impact made by tsunami on water use pattern from the dug wells	55
4.3 Well maintenance	56
4.4 Summary	57
Chapter 05	
Groundwater regime in coastal belt of Matara district	59-83
5.1 Temporal changes of groundwater level	59
5.2 Spatial distribution of groundwater regime	60
5.2.1 Groundwater distribution pattern in Goviyapana area (M1)	60
5.2.2 Groundwater distribution pattern in Kapparathota area (M2)	64

4:

1

5.2.3 Groundwater distribution pattern in Pelana area (M3)	68
5.2.4 Groundwater distribution pattern in Bandaramulla area (M4)	72
5.2.5 Groundwater distribution pattern in Madihe area (M5)	75
5.2.6 Groundwater distribution pattern in	79
Thotamuna and Uyanwaththa area (M6)	
5.3 Summary	82
Chapter 06	
Dynamics of the well water salinity in southern coastal belt	84-88
6.1 Temporal changes of water salinity	84
6.2 Summary	88
Chapter 07	
Spatial variation of groundwater salinity and pH as at October, 2007	89-99
7.1 Salinity of groundwater (Electrical conductivity) in Matara coastal be	lt 89
7.2 Groundwater pH in the coastal belt of Matara district	96
7.3 Summary	99
Chapter 08	
Groundwater quality of the southern coastal strip of Matara district after	100-117
the salinity stabilization	
8.1 Cations and Anion composition of groundwater in southern	100
coastal strip	
8.1.1 Calcium ion concentration in well water	102
8.1.2 Magnesium ion concentration in well water	102
8.1.3 Sodium ion concentration in well water	103
8.1.4 Potassium ion concentration in well water	103
8.1.5 Chloride ion concentration in well water	103
8.1.6 Sulphate ion concentration in well water	106
8.1.7 Bicarbonate ion concentration in well water	106
	107
8.2. Classification of well water in southern coastal strip	107
8.2. Classification of well water in southern coastal strip based on piper diagram	107
	111
based on piper diagram	
based on piper diagram 8.3 Classification of water based on Adjusted Sodium Adsorption Ratio	111
based on piper diagram 8.3 Classification of water based on Adjusted Sodium Adsorption Ratio 8.4 Interrelationship of prominent cations and anions	111 111
based on piper diagram 8.3 Classification of water based on Adjusted Sodium Adsorption Ratio 8.4 Interrelationship of prominent cations and anions 8.5 Trace elements in well water in Tsunami belt of Matara District	111 111 113
based on piper diagram 8.3 Classification of water based on Adjusted Sodium Adsorption Ratio 8.4 Interrelationship of prominent cations and anions 8.5 Trace elements in well water in Tsunami belt of Matara District 8.5.1 Cadmium ion concentration	111 111 113 114

8.5.4 Manganese ion concentration	115
8.5.5 Zinc ion concentration	115
8.6 Discussion	115
8.7 Summary	117
Chapter 09	
Soil salinity and soil pH of the Tsunami affected area of Matara district	118-127
after the salinity stabilization	
9.1 Soil Salinity	118
9.2 Soil pH in the Tsunami affected area of the Matara district	123
9.3 Summary	126
Chapter 10	
Conclusions	
Chapter 11	
References	

Table	Page No
1.1 Statistics of Tsunami Victims in Matara District	01
2.1 WHO standards for drinking water	05
2.2 Water quality classes	09
2.3 Water budget, Sri Lanka	12
2.4 Some important Tsunami Invents of the world history	13
2.5 Water quality changes in some selected wells, kollam, kerala	22
2.6 Electrical conductivity changes in some wells, Alappuzha, kerala	23
2.7 Approximate limits of soil salinity classes according to the USDA, 1954	31
2.8 Size limits of soil separators	32
2.9 Rating of different soil classes against soil reaction	33
2.10 Physical characteristics of soils in coastal belt of the Matara district	35
3.1 Geographical information of soil sampling points	50
4.1 Changes of water usage pattern after the Tsunami	56
5.1 Correlation matrix of ground water regime in relations to elevation	63
during dry and wet weather conditions in Goviyapana area (M1)	
5.2 Correlation matrix of ground water regime in relation to	67
elevation in Kapparathota area (M2)	
5.3 Correlation matrix of ground water regime related factors at Pelana area (M3)	71
5.4 Correlation matrix of ground water regime related factors at	75
Bandaramulla area (M4)	
5.5 Correlation matrix of ground water regime related factors at Madihe area	78
5.6 Correlation matrix of ground water regime related factors at Thotamuna and	82
Uyanwaththa area (M6)	
7.1 Physical factors of well which had high salinity	89
8.1 Chemical parameters of water – cation	100
8.2 Anion composition in groundwater in the coastal aquifer in Matara district	103
8.3 Water quality classes	107
8.4 Water quality classes in Matara coastal belt	107
8.5 Chemical composition of sea water of the Indian ocean	110
8.6 Na+, and Cl ⁻¹ ion concentrations of well water in coastal belt of Matara	110
District	
8.7 Adjusted Sodium Adsorption Ratio of the well water in coastal	111
belt of Matara District (SAR)	

List of Tables

8.8 Correlation Matrix between cation concentration and anion	112
concentration of affected wells	
8.9 Correlation Matrix between cation concentration and anion	112
concentration of non affected wells	
8.10 Dissolved trace elements in water	113
8.11 Trace elements in a seawater of Indian ocean	116
8.12 Correlations of cations of water with cations of associated soils in the area	116
9.1 Approximate limits of soil salinity classes according to the USDA, 1954	118
9.2 Soil EC (μ S/cm) distribution in the area, at different depth of soil profile	119
9.3 Soil ratings according to the USDA, 1962	123
9.4 Soil pH distribution in the area, at different depth of soil profile	124
9.5 Classification of soils according to the different soil reaction ratings	125
9.6 Correlation coefficients of soil pH at deferent depths	125



List of Figures

Figure	Page No
1.1 Agro ecological zones of Sri Lanka	02
2.1 Piper diagram for classification of water with basis of chemical composition	08
2.2 26th December 2004 Tsunami amplitudes	15
2.3 Salinity increments of some tsunami affected wells in coast of Sri Lanka	18
2.4 Salinity changes of water in the east cost of Sri Lanka	19
2.5 Typical groundwater regime at bending river mouth of	25
sandwich area (before tsunami)	
2.6 Typical groundwater regime at bending river mouth of	25
sandwich area (after tsunami)	
2.7 Typical groundwater regime in coast before tsunami;	25
Flat or undulate earth surface	
2.08 Typical groundwater regime in coast during tsunami	25
2.09 Tsunami flood creates saltwater intrusion (after tsunami)	26
2.10 Soil types distribution of the area	34
3.1 Study area; coastal belt of Matara district	41
3.2 Wells selected for the study in different segments of coastal	44
belt (M1 to M6) of Matara district	
3.3 Monitoring of water level	45
3.4 Water sampling transects	46
3.5 Calibration curve for SO_4^{-2}	48
3.6 Soil Sampling points	50
4.1 Locations distribution of interviewers	54
4.2 Distance (m) from the sea to interviewers house	54
4.3 Aprons damaged by the Tsunami	55
4.4 Present status of apron	55
4.5 Screening method of well opening	57
4.6 Water lifting method	57
5.1 Temporal changes of groundwater level (average) during the study period	59
5.2 Spatial distribution of groundwater level (Average for 33 months)	60
5.3 Earth surface contours in Goviyapana area	61
5.4 Groundwater level contour map in Goviyapana area (M1) in dry season	62
5.5 Groundwater level contour map in Goviyapana area (M1) in rainy season	62

5.6 Spatial distribution of groundwater regime at Goviyapana area	63
(M1) in northern part of Matara district	
5.7 Hydraulic gradient of Govoyapana area (M1)	64
5.8 Earth surface contours in Kapparatota	64
5.9 Groundwater level contour map in Kapparathota area (M2) in rainy season	65
5.10 Groundwater level contour map in Kapparathota area (M2) in dry season	65
5.11 Spatial distribution of groundwater regime at Kapparathota area (M2)	66
5.12 Hydraulic gradient at Kapparathota area (M2)	67
5.13 Earth surface contours in Pelana area	68
5.14 Groundwater level contour map in Pelana area (M3) in dry season	69
5.15 Groundwater level contour map in Pelana area (M3) in rainy season	69
5.16 Spatial distribution of groundwater regime at Pelana area (M3)	70
5.17 Hydraulic gradient at Pelana area (M3)	71
5.18 Earth surface contours in Bandaramulla area	72
5.19 Groundwater level contour map in Bandaramulla area (M4) in rainy season	73
5.20 Groundwater level contour map in Bandaramulla area (M4) in dry season	73
5.21 Spatial distribution of groundwater regime at Banadramulla area (M4)	74
5.22 Hydraulic gradient at Bandaramulla area (M4)	74
5.23 Earth surface contours in Madihe area	75
5.24 Groundwater level contour map in Madihe area (M5) in rainy season	76
5.25 Groundwater level contour map in Madihe area (M5) in dry season	76
5.26 Distribution of groundwater regime at Madihe area (M5)	77
5.27 Hydraulic gradient at Madihe area (M5)	77
5.28 Earth surface contours in Thotamuna and Uyanwathta	79
5.29 Groundwater level contour map in Thotamuna and Uyanwaththa	80
area (M6) in rainy season	
5.30 Groundwater level contour map in Thotamuna and Uyanwaththa	80
area (M6) in dry season	
5.31 Spatial distribution of groundwater regime at Thotamuna	81
and Uyanwaththa area (M6)	
5.32 Hydraulic gradient at Thotamuna and Uyanwaththa area (M6)	81
6.1 Average value of EC for different EC ranges	85
6.2 Electrical conductivity changing with time	85
6.3 Electrical conductivity changing pattern in the area	86
6.4 Bimodal pattern of EC changes with effect of rainfall	87
VIII	

Ņ

÷.

7.1 M1- Electrical conductivity map of Goviyapana area	90
7.2 M2- Electrical conductivity map of Kapparathota area	91
7.3 M4- Electrical conductivity map of Pelana area	92
7.4 M4- Electrical conductivity map of Bandaramulla area	93
7.5 M5- Electrical conductivity map of Madihe area	94
7.6 M5- Electrical conductivity map of Thotamuna and Uyanwaththa area	95
7.7 pH distribution map in Goviyapana area (M1) season	96
7.8 M2- pH distribution map of Kapparathota area	96
7.9 M3- pH distribution map of Pelana area	97
7.10 M4- pH distribution map of Bandaramulla area	97
7.11 M5- pH distribution map of Madihe area	98
7.12 M6- pH distribution map of Thotamuna Uyanwaththa area	98
8.1 Average of cations concentrations of water in affected wells and	102
non affected wells	
8.2 Mean value of anions in affected wells and non affected wells	105
8.3 Piper diagram for well water classes in affected area	108
8.4 Piper diagram for well water classes in non affected area	108
8.5 Cation changing pattern with the distance from sea	109
8.6 Anion changing pattern of well water in coastal belt of Matara district	109
8.7 Distribution of wells which exceeds WHO drinking water limits	117
9.1 Depth distribution pattern of soil salinity in different locations	120
of the coastal strip in Matara district	
9.2 soil salinity and groundwater salinity in different locations of	121
the coastal strip in Matara district	
9.3 Variation of correlation coefficient values between salinity of groundwater	122
and salinity of soils at different depths	×
9.4 Soil pH changers with the distance from sea	. 126