CONTENTS

Chapter		Title	Page
		Certificate	**ii**
		Abstract	**iii**
		Declaration	**vi**
		Acknowledgements	**viii**
		List of Tables	**xiv**
		List of Figures	**xvi**
		List of Abbreviations	**xix**
1		**INTRODUCTION**	**1**
	1.1	Research questions	6
	1.2	Aim	6
	1.3	Objectives	6
	1.4	The scope of the study	6
	1.5	Limitations	7
	1.6	Organization of the thesis	8
2		**REVIEW OF LITERATURE**	**9**
	2.1	Shrimp culture development	9
		2.1.1 Shrimp culture development in India	10
	2.2	Impacts of shrimp culture	11
		2.2.1 Positive impacts	11
		2.2.2 Negative impacts	12
		2.2.2.1 Conversion agricultural land	13
		2.2.2.2 Deforestation	14
		2.2.2.3 Unscientific use of chemicals and drugs	15
		2.2.2.4 Water and soil quality deterioration	15
		2.2.2.5 Socio-economic impacts	16
		2.2.2.6 Food security	17
		2.2.3 Impact asessment	18
	2.3	Sustainable development	19
	2.4	Remote Sensing and GIS	21
		2.4.1 Remote Sensing	22
		2.4.1.1 Satellite data	22

2.4.1.2 Image interpretation 24
2.4.2 Geographic Information System (GIS) 26
2.5 Remote Sensing and GIS application on shrimp farming 26
2.6 Remote Sensing and GIS studies on Environmental Impact Assessments 27
2.7 Remote Sensing and GIS based site selection of aquaculture 27
2.8 Guideline for sustainable shrimp farming in India 29

3 LOCATION AND BASELINE INFORMATION 31
3.1 Description of the study area 31
3.2 Location and extent of the study area 31
3.3 Physical & socio-economic status 31
3.3.1 Geomorphology 33
3.3.2 Relief and topography 33
3.3.3 Soil characteristics 33
3.3.4 Climate 34
3.3.5 Drainage 35
3.3.6 Natural vegetation 36
3.3.7 Agriculture 36
3.3.8 Education & economy 36
3.3.9 Transportation 37
3.4 History of shrimp culture in the study area 37
3.4.1 Shrimp culture production statistics 38
3.5 Farm size distribution and culture management practices 39

4 DATA AND METHODOLOGY 41
4.1 Land use and Land cover classification and change detection 41
4.1.1 Satellite data 41
4.1.2 Collection and study of collateral data 43
4.1.3 Ground Control Point (GCP) collection 43
4.1.4 Geometric correction 43
4.1.5 On-screen visual interpretation 44
4.1.6 Ground Truth (GT) verification 46

4.1.7 Mouza, Gram Panchayet (GP), Block level Land use and Land cover classification 46
4.1.8 Change Detection Matrix (CDM) 46
4.1.9 Information extract from change detection map 47
4.1.10 Land ude and Land cover change prediction and Markov chain 47
4.2 Environmental impact study and assessment 48
4.2.1 Baseline study 48
4.2.2 Scoping and identification of key impacts 49
4.2.2.1 Soil and water sampling and analysis 49
4.2.2.2 Questionnaire Checklist 51
4.2.2.3 Cost Return Analysis 51
4.2.2.4 Leopold Matrix 51
4.3 Identification and prioritization of potential sites for shrimp culture 52
4.3.1 Establishment of a structural hierarchy 52
4.3.2 Pair wise comparisons of criteria 53
4.3.3 Estimation of weights 53
4.4 Software programs and tools used 53
4.4.1 Handheld GPS receiver 54
4.4.2 Digital conductivity meter 54
4.4.3 Digital pH meter 54
4.4.4 Soil pH tester 55
4.4.5 Hand held refractometer 55
4.4.6 Water pH meter 55
4.4.7 Software used for GIS analysis 55

5 LAND USE AND LAND COVER CHANGE DETECTION 61

5.1 Introduction 61
5.2 Materials and methods 66
5.2.1 Satellite data 66
5.2.2 Comparison of Land use and Land cover classification and change detection matrix 66
5.2.3 Land use and Landcover change prediction using Markov Chain 68

5.2.3.1 Markov Chain model validation 69
5.3 Results 69
5.3.1 Land use and Land cover classification 69
5.3.2 Land use and Land cover change detection 76
5.3.3 Growth pattern of shrimp farming 82
5.3.4 Shrimp farming at Gram Panchayat level 84
5.3.5 Plot-wise Land use and Land cover change detection 86
5.3.6 Land use and Land cover change prediction using Markov Chain 90
5.4 Summary 93

6 ENVIRONMENTAL IMPACTS 95

6.1 Introduction 95
6.2 Materials and Methods 98
6.2.1 Soil and water sample collection and analysis 98
6.2.2 Cost-return analysis 99
6.2.3 Checklist for identification of key impacts 100
6.2.4 Leopold Matrix for assessment of impact magnitude 100
6.3 Results 103
6.3.1 Impacts on physical environment 103
6.3.1.1 Changes recognized on waterbodies 103
6.3.1.2 Soil quality degradation 105
6.3.1.3 Water quality deterioration 109
6.3.1.4 Loss of vegetation cover 110
6.3.1.5 Air pollution 112
6.3.1.6 Embankment erosion 114
6.3.2 Impacts on economic environment 116
6.3.2.1 Economic return of the shrimp production 116
6.3.2.2 Employment generation 119
6.3.2.3 Loss of rice production 120
6.3.3 Impacts on social environment 123
6.3.3.1 Impacts on health and education 123
6.3.3.2 Deterioration of moral value 124
6.3.3.3 Alcohol addiction 124

6.3.3.4 Impacts of social crime 125
6.3.4 Assessment of the impacts of shrimp farming based on Leopold Matrix 127
6.4 Summary 129

7 IDENTIFICATION OF POTENTIAL SITES FOR SHRIMP CULTURE 130

7.1 Introduction 130
7.2 Materials and methods 132
7.2.1 Data sources 136
7.2.2 Determination of weights for factors 137
7.3 Results 146
7.4 Summary 149

8 DISCUSSION 150

8.1 Development and Affects 150
8.2 Sustainable Aquaculture 152
8.2.1 Site selection 152
8.2.2 Design 153
8.2.3 Scale and extent 153
8.2.4 Management 153
8.2.5 Technology and research 154
8.2.6 Proper Planning 154
8.3 Recommendation 155

9 SUMMARY AND CONCLUSIONS 157

BIBLIOGRAPHY 161
APPENDICES 178
CURRICULUM VITAE 191