

TABLE OF CONTENTS

Title	Page No.
<i>Certificate</i>	<i>i</i>
<i>Declaration</i>	<i>ii</i>
<i>Acknowledgments</i>	<i>iii</i>
<i>Table of Contents</i>	<i>v</i>
<i>List of Tables</i>	<i>viii</i>
<i>List of Figures</i>	<i>ix</i>
<i>List of Abbreviations</i>	<i>xiii</i>
Chapter 1: Introduction	1
1.1 Background	1
1.1.1 Global Temperature: Critical Trends	2
1.1.2 Global Rainfall Patterns: Alarming Changes	4
1.2 Climate of India: Modulating Factors IOD and ENSO	7
1.2.1 Impacts of Concurrent Phases of IOD and ENSO	9
1.2.2 Impact and Intensification of Extreme Weather Events	9
1.3 Climate Risks and Extremes in Gujarat	11
1.4 Study Area	12
1.5 Objectives of the Study	12
1.6 Data Source and Methodological Approach	13
1.6.1 Database	13
1.6.2 Methodological Approach	14
1.7 Significance of the Study	17
1.8 Thesis Organisation	18
Chapter 2: Profile of the Study Area	21
2.1 Introduction	21
2.2 Location and Extent	21
2.3 Historical Evolution	23
2.4 Physiographic Divisions	25
2.4.1 Central Gujarat	26
2.4.2 Kutch	26
2.4.3 North Gujarat	26
2.4.4 Saurashtra	27
2.4.5 South Gujarat	27
2.5 Climate	28
2.6 Vegetation	32
2.7 Geomorphology	35
2.8 Rivers	36

2.9 Population Characteristics	37
2.9.1 Population Growth	37
2.9.2 Population Density	38
2.9.3 Sex Ratio	39
2.9.4 Literacy Rate	40
2.9.5 Urban Demographics	41
2.9.6 Distribution of Population by Age Groups	43
2.10 Socio-Economic Profile	43
2.10.1 Income and Employment	43
2.10.2 Industrial Development	44
2.10.3 Healthcare	45
2.10.4 Life Expectancy at Birth	46
2.10.5 Workforce	47
Chapter 3: Literature Review	49
3.1 Global Climate Dynamics: Temperature and Rainfall Trends	50
3.2 Climate Profile of India: Influences and Associated Impacts	55
3.3 Climate Profile of Gujarat: Exploring Distinct Regions	58
3.4 Assessing Trends and Weather Extremes	61
3.4.1 Trend Assessment	61
3.4.2 Extreme Events	64
3.4.2.1 Heatwaves	64
3.4.2.2 Drought	65
3.4.2.3 Floods	66
3.4.2.4 Cyclone	67
3.5 Time Series Forecasting Models	67
3.6 Conclusion	71
Chapter 4: Temperature, Rainfall, and PCI Trends of Gujarat: A Spatio-Temporal Analysis	72
4.1 Introduction	72
4.2 Methodology	74
4.2.1 Precipitation Concentration Index (PCI)	75
4.2.2 Criteria for Rainfall Distribution and Intensity Assessment	75
4.2.3 Criteria for Defining Heat and Cold Waves	77
4.2.4 Criteria for Categorizing IOD and ENSO Phases	78
4.3 Results and Discussion	79
4.3.1 Variability of Rainy Days in Gujarat	86
4.3.2 Distribution of Annual Rainfall Anomalies	88
4.3.3 Rainfall Intensity Analysis in Gujarat	89
4.3.4 Precipitation Concentration Index (PCI)	90
4.3.5 Analysis of Extreme Heat and Cold Events	93
4.3.6 Regional Climate Variability Influenced by Global Phenomena	95
4.4 Conclusion	102

Chapter 5: Assessing Spatio-Temporal Trends of Rainfall and Temperature in Gujarat's Physiographic Regions	104
5.1 Introduction	104
5.2 Methodology	106
5.2.1 Mann-Kendall Test	107
5.2.2 Sen's Slope	108
5.2.3 Innovative Trend Analysis (ITA)	109
5.3 Results and Discussion	110
5.3.1 Comparative Assessment of Seasonal Trends	110
5.3.2 Assessment of Monthly Rainfall Trends	115
5.3.3 Assessment of Monthly T_{\min} Trends	118
5.3.4 Assessment of Monthly T_{\max} Trends	121
5.3.5 Trends in Temperature and Rainfall Extremes	125
5.3.5.1 Extreme Heat Events	125
5.3.5.2 Extreme Cold Events	126
5.3.6 Trends in Rainy Days and Intense Rainfall Events	128
5.4 Conclusion	132
Chapter 6: Forecasting Variables Using ARIMA: Comparative Analysis of Inter-Regional Changes in Gujarat	134
6.1 Introduction	134
6.2 Methodology	135
6.2.1 Augmented Dickey-Fuller Test	136
6.2.2 Autoregressive Integrated Moving Average Model	137
6.2.3 Potential Evapotranspiration (PET)	139
6.3 Results and Discussion	139
6.3.1 Best-Fit Model Selection and Forecast Trends	144
6.3.2 Assessment of Hydrological Excess and Deficit	155
6.4 Conclusion	159
Chapter 7: Conclusion	162
7.1 Summary of Key Findings	162
7.2 Study Limitations	166
7.3 Future Research Directions	166
7.4 Suggestions	168
References	170
List of Publications	202