CONTENTS

INTRODUCTION

Review of Literature ii
Identification of the research problem and selection of the study area viii
Importance of the Study ix
Objectives of the study ix
Hypotheses ix
Study Area x
Data sets and Methodology xi
Scheme of Presentation xiii
Limitations of this study xv
References xvi

CHAPTER 1
GEOGRAPHICAL SETTING OF CHHATTISGARH PLAIN 1-37

1.1. PHYSICAL SETTINGS 1
1.1.1. Location and Extension 1
1.1.2. Physiography 5
1.1.3. Geology 8
1.1.4 Drainage Pattern 14
1.1.5. Climate 15
1.1.5.1 Temperature 15
1.1.5.2 Rainfall 18
1.1.5.3 Seasons 18
1.1.6. Soil 19
1.1.7. Natural Vegetation 21
1.2. CULTURAL AND SOCIO-ECONOMIC SETTING 23
1.2.1. Administrative set up 23
1.2.2. Population Distribution 24
1.2.3. Population Density 25
1.2.4. Growth Rate 27
1.2.5. Sex Ratio 29
1.2.6. Literacy 30
1.2.7. Livelihood pattern and Occupational Structure 31
1.2.8. Transport 35
1.3 FINDINGS 35
REFERENCES 37

### CHAPTER 2

**ANALYSIS OF CLIMATES IN CHHATTISGARH PLAIN** 38-73

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 INTRODUCTION</td>
<td>38</td>
</tr>
<tr>
<td>2.2 CONCEPTUAL FRAMEWORK</td>
<td>39</td>
</tr>
<tr>
<td>2.3 DATA SETS AND METHODOLOGY</td>
<td>40</td>
</tr>
<tr>
<td>2.4 CLIMATIC WATER BALANCES OF CHHATTISGARH PLAIN</td>
<td>44</td>
</tr>
<tr>
<td>2.5 NATURE AND DISTRIBUTION OF WATER BALANCE ELEMENTS</td>
<td>50</td>
</tr>
<tr>
<td>2.5.1. Potential Evapotranspiration (PE)</td>
<td>52</td>
</tr>
<tr>
<td>2.5.2. Actual Evapotranspiration (AE)</td>
<td>54</td>
</tr>
<tr>
<td>2.5.3. Water Deficit (WD)</td>
<td>55</td>
</tr>
<tr>
<td>2.5.4. Water Surplus (WS)</td>
<td>57</td>
</tr>
<tr>
<td>2.5.5. Distribution Pattern of Water Balance Elements in Varied Temperature Situations</td>
<td>59</td>
</tr>
<tr>
<td>2.6 ANALYSIS OF CLIMATES</td>
<td>59</td>
</tr>
<tr>
<td>2.6.1. Thronthwaite’s Climatic Classification</td>
<td>60</td>
</tr>
<tr>
<td>2.6.1.1 Thermal Regime</td>
<td>60</td>
</tr>
<tr>
<td>2.6.1.2 Moisture Regime</td>
<td>64</td>
</tr>
<tr>
<td>2.7 CLIMATE CHANGE VS VARIATION IN THE EXISTING CLIMATE TYPE</td>
<td>67</td>
</tr>
<tr>
<td>2.7.1. Change in the Thermal Regime Climates</td>
<td>67</td>
</tr>
<tr>
<td>2.7.2. Change in the Moisture Regime Climates</td>
<td>67</td>
</tr>
<tr>
<td>2.8 CONCLUSION</td>
<td>70</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>71</td>
</tr>
</tbody>
</table>
CHAPTER 3

ASSESSMENT OF CLIMATE CHANGE IN CHHATTISGARH PLAIN

3.1 INTRODUCTION 74
3.2 DATA SETS AND METHODOLOGY 75
3.3 TREND ANALYSIS OF TEMPERATURE AND RAINFALL 77
3.3.1 Trends in Mean Annual Temperature 78
3.3.2 Rainfall Trends 83
3.3.2.1 Trends in Annual Rainfall 83
3.3.2.2 Trends in South-West Monsoon Rainfall 85
3.3.2.3 Trends in Post Monsoon Rainfall 87
3.3.2.4 Mann-Kendall test for temperature and rainfall trend analysis 89
3.4 CLIMATIC SHIFTS ANALYSIS 91
3.5 DROUGHT ANALYSIS 94
3.5.1 Droughts in Chhattisgarh Plain 96
3.5.1.1 Categorization of Droughts 96
3.5.1.2 Decennial Frequency of Droughts 98
3.5.1.3 Drought Proneness in Chhattisgarh Plain 101
3.6 AGRO CLIMATIC ANALYSIS 103
3.6.1 Moisture Potentiality Status 104
3.6.2 Agro climatic Regionalization 107
3.7 GLOBAL WARMING VS CROP SUITABILITY 109
3.8 CONCLUSION 111
REFERENCES 113

CHAPTER 4

AGRICULTURAL SCENARIO OF CHHATTISGARH PLAIN

4.1 INTRODUCTION 118
4.2 CONCEPTUAL FRAMEWORK 119
4.3 DATA SETS AND METHODOLOGY 120
4.4 AGRICULTURAL LAND USE 121
4.4.1 Net Sown Area 121
CHAPTER 5
IMPACT OF CLIMATE CHANGE ON AGRICULTURE  181-200

5.1 INTRODUCTION  181
5.2 CONCEPTUAL FRAMEWORK  182
5.3 DATA AND METHODOLOGY  183
5.4 IMPACT ON AGRICULTURAL AREA  184
5.4.1 Variability in Rainfall: Response of Net Sown Area and Total Cropped Area  184
5.4.2 Variability in annual rainfall Vs. crop hectare age  185
CHAPTER 6
SOCIO ECONOMIC IMPACTS OF CLIMATE CHANGE

6.1 INTRODUCTION

6.2 CONCEPTUAL FRAMEWORK

6.3 CLIMATE CHANGE IMPACTS ON FOOD SECURITY

6.4 HEALTH IMPACT: MALNUTRITION, DISEASES RELATED TO CLIMATE CHANGE

6.4.1 Climate Change increases the risk of health through different pathways

6.4.2 Climate Change and effect of extreme heat on health

6.4.3 Climate change leading to natural disasters and its effect on health

6.4.4 Climate change and its effect on diseases

6.5 CLIMATE CHANGE AND WATER SCARCITY

6.6 CLIMATE CHANGE AND POVERTY

6.7 INVOLUNTARY DISPLACEMENT, MIGRATION

6.7.1 Human Mobility and Migration due to rainfall variability in Chhattisgarh plain region

6.8 CONCLUSION

REFERENCES
CHAPTER 7

AGRICULTURAL ADAPTATION STRATEGIES TO THE IMPACTS OF CLIMATE CHANGE IN CHHATTISGARH PLAIN 222-233

7.1 INTRODUCTION 222

7.2 AGRICULTURAL ADAPTATION STRATEGIES TO THE IMPACTS OF CLIMATE CHANGE 223

7.2.1 Crop adaptation strategies 223

7.2.1.1 Planting of drought resistant varieties of crops 223

7.2.1.2 Crop diversification 223

7.2.1.3 Change in cropping pattern and calendar of planting 224

7.2.1.4 Mixed cropping 224

7.2.2 Improved irrigation efficiency 225

7.2.3 Adopting soil conservation measures that conserve soil moisture 225

7.2.4 Planting of trees (afforestation) and agro forestry 226

7.2.5 Other adaptation strategies 226

7.2.5.1 Interaction among technology, decision making and climatic impacts 226

7.2.5.2 Labour migration 227

7.2.5.3 Income diversification 227

7.2.6 Government response measure 228

7.3 CONCLUSION AND RECOMMENDATIONS 228

REFERENCES 230

SUMMARY AND CONCLUSION 234-245

BIBLIOGRAPHY 246-265

PUBLISHED PAPER