



Contents

Preface to Fifth Edition (vii)

1 Map Language

1.1	Introduction	1
1.2	Map as Model	2
1.2.1	Spatial Elements	3
1.2.2	Terminology	4
1.3	Classification of Maps	5
1.4	Map Scale	6
1.5	Spatial Referencing System	9
1.6	Map Projections	10
1.6.1	Grouping of Map Projections	13
1.7	Commonly used Map Projections and their Comparison	14
1.7.1	Mercator	14
1.7.2	Transverse Mercator	14
1.7.3	Oblique Mercator	15
1.7.4	Polyconic Projection	15
1.7.5	Lambert Conical Orthomorphic Projection	15
1.8	Grid Systems	16
1.8.1	Lambert Grid System for India	16
1.8.2	Universal Transverse Mercator (UTM) Grid	17
1.9	Computer in Map Production	18
1.10	Digital Database in a GIS	19
1.10.1	Digitiser Units Vs Real-world Coordinates	20
1.11	Linkage of GIS to Remote Sensing	21

2 Photogrammetry

2.1	Introduction	24
2.2	Brief history of Photogrammetry	25
2.3	Classification of Aerial Photographs	26
2.4	Organisation of Aerial Photography	27
2.5	Aerial Cameras	28
2.5.1	Types of Cameras	29
2.5.2	Components of Aerial Camera	29
2.5.3	Camera Magazine	30
2.5.4	Camera Body	31
2.5.5	Lens Cone Assembly	31
2.5.6	Resolution of a Lens System	31
2.5.7	Format of a Film	32
2.5.8	Photographic Bases	33
2.6	Geometry of Vertical Aerial Photograph	34
2.7	Scale of a Vertical Aerial Photograph	36
2.7.1	Scale of a Vertical Aerial Photograph Over of a Flat Terrain	36
2.7.2	Scale of Vertical Photograph Over Undulating Terrain	37
2.7.3	Other Methods for Determining Scale of Vertical Aerial Photograph ..	38
2.8	Relief Displacement	38
2.9	Stereo Photogrammetry-	40
2.9.1	Stereoscopic Depth Perception	40
2.9.2	Stereoscopic Viewing of Overlapping Aerial Photographs	41
2.9.3	Procedure for use of Stereoscopes	42
2.9.4	Steps for Stereoveiwing by Stereoscope	43
2.10	Stereoscopic Parallax	43
2.10.1	Parallax measurement - Monoscopic	45
2.10.2	Principal of Floating Mark	45
2.10.3	Stereoscopic Methods of Parallax Measurement	46
2.10.4	Determination of parallax bar constant	47
2.10.5	Parallax Equations	47
2.10.6	Elevation by Parallax Differences	50
2.11	Stereoscopic Plotting Instruments-Analogue and Analytical	51
2.11.1	Interior Orientation	51
2.11.2	Relative Orientation	52
2.11.3	Absolute Orientation	53
2.12	Aerial Photography - Planning and Execution	54

2.13	Control for Aerial Photography	55
2.13.1	Requirement of Photogrammetric Control	56
2.13.2	Methods of Providing Control on Aerial Photographs	56
2.14	Aerial Triangulation	56
2.14.1	Aerial Triangulation can be classified into two broad categories	57
2.14.2	Aerial Triangulation -Analogue Method	57
2.14.3	Independent Model Triangulation	57
2.14.4	Aerial Triangulation - Analytical Method	58
2.14.5	Collinearity or Coplanarity	58
2.14.6	Blocks of Photos (Block Adjustment)	59
2.14.7	Bundles Adjustment	60
2.15	Digital or Soft Copy Photogrammetry	60
2.15.1	Scanning of Aerial Photographs	60
2.15.2	Application of GPS in Photogrammetry	60
2.15.3	Integrated GPS Flight Management System	61
2.15.4	Aerial Triangulation using GPS Data	61
2.15.5	Storage and Data Compression in Digital Photogrammetry	61
2.15.6	DEM and DTM in Soft Copy Photogrammetry	61

3 Remote Sensing - Basic Principles

3.1	Introduction	65
3.2	Electromagnetic Remote Sensing Process	67
3.3	Physics of Radiant Energy	69
3.3.1	Nature of Electromagnetic Radiation	71
3.3.2	Electromagnetic Spectrum	74
3.4	Energy Source and its Characteristics	76
3.5	Atmospheric Interactions with Electromagnetic Radiation	80
3.5.1	Atmospheric Properties	81
3.5.2	Absorption of Ozone	82
3.5.3	Atmospheric effects on Spectral Response Patterns	83
3.6	Energy Interactions with Earth's Surface Materials	84
3.6.1	Spectral Reflectance Curves	87
3.7	Cossine Law	94

4 Microwave Remote Sensing

4.1	Introduction	96
4.2	The Radar Principle	97
4.3	Factors affecting Microwave Measurements	99
4.3.1	Surface Roughness	100
4.3.2	Radar Scattering Mechanism	101
4.4	Radar Wavebands	102
4.5	Side Looking Airborne Radar (SLAR) systems	103
4.6	Synthetic Aperture Radar (SAR)	108
4.7	Interaction between Microwaves and Earth's surface	111
4.7.1	Speckle Noise	111
4.7.2	Backscattered Radar Intensity	111
4.8	Interpreting SAR Images	112
4.9	Geometrical Characteristics	112
4.9.1	Slope Foreshortening	113
4.9.2	Layover	114
4.9.3	Aspect	114
4.9.4	Radar Shadow	114

5 Remote Sensing Platforms and Sensors

5.1	Introduction	115
5.2	Satellite System Parameters	116
5.2.1	Instrumental Parameters	116
5.2.2	Viewing Parameters	117
5.3	Sensor Parameters	120
5.3.1	Spatial Resolution	120
5.3.2	Spectral Resolution	123
5.3.3	Radiometric Resolution	125
5.4	Imaging Sensor Systems	127
5.4.1	Multispectral Imaging Sensor Systems	128
5.4.2	Thermal Sensing Systems	130
5.4.3	Microwave Imaging Systems	132
5.4.4	Hyperspectral Imaging Systems	132
5.5	Earth Resources Satellites	133
5.5.1	Landsat Satellite Programme	133
5.5.2	SPOT Satellite Programme	134
5.5.3	Indian Remote Sensing Satellite (IRS)	134
5.5.4	AEM Satellites	144

5.6 Meteorological Satellites	144
5.6.1 NOAA Satellites	144
5.6.2 GOES Satellites	147
5.6.3 NIMBUS Satellites	147
5.6.4 Meteosat Series	147
5.6.5 Megha-Tropiques	147
5.7 Satellites Carrying Microwave Sensors	152
5.7.1 Seasat	152
5.7.2 European Remote Sensing Satellite-1	152
5.7.3 Radarsat	152
5.7.4 RISAT-1	152
5.7.5 RISAT-2	153
5.8 Ocean Series	154
5.8.1 Oceansat-1	154
5.8.2 Oceansat-2	160
5.9 Ikonos Satellite Series	161
5.10 Communication Satellites	164
5.10.1 GSAT	164
5.10.2 HAMSAT	168
5.10.3 INSAT	169
5.11 Cartosat Series	169
5.11.1 CARTOSAT-1	169
5.11.2 CARTOSAT-2	171
5.11.3 CARTOSAT-2A	172
5.11.4 CARTOSAT-2B	173
5.12 Resource SAT Series	174
5.12.1 Resourcesat – 1	174
5.12.2 RESOURCESAT-2	175
5.13 Quick Bird	176
5.14 CHANDRAYAAN-1	178
5.15 HySIS Satellite	179
5.16 Hyperion	181

6 Visual Image Interpretation

6.1	Introduction	182
6.2	Types of Pictoral Data Products	183
6.3	Image Interpretation Strategy	186
6.3.1	Levels of Interpretation Keys	187
6.4	Process of Image Interpretation	189
6.5	Interpretation of Aerial Photo	191
6.6	General Procedure for Photo Interpretation	191
6.6.1	Preliminary Stage	191
6.6.2	Detailed Examination	191
6.6.3	Interpretation Stage	191
6.6.4	Compilation Stage	192
6.7	Three Dimensional Interpretation Method	192
6.7.1	Stereoscopic Depth Perception	192
6.7.2	Stereo Scope	193
6.8	Basic Elements of Image Interpretation	195
6.9	Application of Aerial Photo Interpretation	199
6.10	Interpretation of Satellite Imagery	206
6.11	Key Elements of Visual Image Interpretation	206
6.11.1	Visual Interpretation of Topographic features based on Reflection characterstics of images is given in table 6.2 below.	208
6.11.2	Drainage Pattern and Texture	208
6.11.3	Erosion	212
6.11.4	Image Tone	213
6.11.5	Vegetation and Land Use	213
6.12	Concept of Converging Evidence	213

7 Digital Image Processing

7.1	Introduction	215
7.2	Basic Character of Digital Image	215
7.3	Preprocessing	220
7.3.1	Geometric Correction Methods	220
7.3.2	Radiometric Correction Methods	223
7.3.3	Atmospheric Correction Methods	228

7.4	Image Registration	229
7.4.1	Conversion of Geographical Coordinates to Conical Orthomorphic Coordinates	230
7.4.2	Transformation of Conical Orthomorphic Coordinates to Digital Imagery Coordinates	231
7.5	Image Enhancement Techniques	233
7.5.1	Contrast Enhancement	233
7.6	Spatial Filtering Techniques	240
7.6.1	Low Pass Filters	240
7.6.2	High Pass Filters	244
7.6.3	Filtering for Edge Enhancement	245
7.7	Image Transformations	248
7.7.1	NDVI Transformation	249
7.7.2	PCA Transformation	252
7.8	Image Classification	254
7.8.1	Supervised Classification	255
7.8.2	Training Dataset	258
7.8.3	Unsupervised Classification	260
7.9	Performance analysis of IRS-bands for land use/land cover classification system using Maximum Likelihood Classifier	260
7.9.1	Classification Methodology	261
7.9.2	The Land Use and Land Cover Classification System	262
7.9.3	Data Analysis	263
7.9.4	Classification Accuracy Approach	263
7.10	Image Classification and GIS	265
7.11	Hyperspectral Image Classification	277
7.11.1	Classification of Hyperspectral Data	278
7.11.2	Spectral Angle Mapper	278
7.11.3	Artificial Neural Networks	279
7.11.4	Support Vector Machines	279
7.11.5	Ensemble Classifiers	279

8 Global Positioning System (GPS)

8.1	Introduction	283
8.2	System Design Considerations	284
8.2.1	Technological Advances	285

8.3	GPS System Eelements	286
8.3.1	The Space Segment	287
8.3.2	The Control Segment	288
8.3.3	The User Segment (The Applications)	291
8.3.4	The User Segment (Positioning Principles)	292
8.4	GPS Satellite Constellation and Signals	294
8.4.1	GPS Constellation Design	294
8.4.2	GPS Signal Components	296
8.4.3	The Civilian - Military Relationship	297
8.4.4	Why is the GPS Signal so Complicated?	299
8.4.5	GPS Satellite Ephemerides	300
8.5	GPS Measurements	301
8.5.1	The Transmitted Signal	301
8.5.2	The GPS Range Measurements	301
8.5.3	The GPS Carrier Phase Measurements	302
8.5.4	Ranging Using PRN Codes	302
8.5.5	An Observation Model of the Pseudo-Range	304
8.5.6	Coping with the Satellite Clock Bias	305
8.6	GPS Instrumentation	306
8.6.1	Antennas	308
8.6.2	Signal Processing Principles for Code-Correlating Receivers	308
8.6.3	Trends In GPS Instrumentation	310

9 Fundamentals of GIS

9.1	Introduction	312
9.2	Roots of GIS	313
9.3	Overview of Information System	315
9.4	The Four Ms	316
9.5	Contribution Disciplines	317
9.6	GIS Definitions and Terminology	319
9.6.1	Geographical Entities	320
9.6.2	Attributes	321
9.6.3	Topology	321
9.6.4	Cognitive Models	322

9.7	GIS Queries	323
9.8	GIS Architecture	323
9.8.1	Components of a GIS	324
9.8.2	GIS Work Flow	326
9.9	Theoretical Models of GIS	328
9.9.1	Functional Elements of GIS	328
9.9.2	Fundamental Operations of GIS	328
9.10	Theoretical Framework for GIS	329
9.11	GIS Categories	330
9.12	Levels/Scales of Measurement	331

10 Spatial Data Modelling

10.1	Introduction	333
10.2	Stages of GIS Data Modelling	334
10.3	Graphic Representation of Spatial Data	336
10.3.1	Raster Data Representation	338
10.3.2	Vector Data Representation	341
10.3.3	Spatial Data Models	342
10.4	Raster GIS Models	343
10.4.1	Simple Raster Arrays	345
10.4.2	Hierarchical Raster Structures	345
10.4.3	Types of Raster GIS Models	346
10.4.4	Compact Raster Data Models	350
10.5	Vector GIS Models	354
10.5.1	Spaghetti Model	355
10.5.2	Topological Models	358
10.5.3	Shape File	362
10.5.4	Compact Vector Data Models	363
10.6	Comparison of Raster and Vector Models	364

11 GIS Data Management

11.1	Introduction	366
11.2	Data Base Management Systems	367
11.2.1	Functions of DBMS	368
11.2.2	Components of DBMS	369

11.3	GIS Data File Management	371
11.3.1	Simple List	371
11.3.2	Ordered Sequential Files	372
11.3.3	Indexed Files	372
11.3.4	Building GIS Worlds	373
11.4	Database Models	376
11.4.1	Hierarchical Database Models	376
11.4.2	Network Systems	378
11.4.3	Relational Database Models	378
11.4.4	Standard Query Language (SQL)	381
11.5	Storage of GIS Data	382
11.5.1	The Hybrid Data Model	383
11.5.2	The Integrated Data Model	383
11.6	Object Based Data Models	385
11.6.1	Entity-Relationship-Attribute Model	386
11.6.2	Location-Based Representations for Spatio-Temporal Data	387
11.6.3	Entity-Based Representations for Spatio-Temporal Data	388
11.6.4	Time-Based Representations for Spatio-Temporal Data	390
11.6.5	A Combined Approach for Spatio-Temporal Representation	391
11.7	Temporal Topology	391
11.8	Organisational Strategy of DBMS in GIS	392

12 Data Input and Editing

12.1	Introduction	394
12.2	The Data Stream	395
12.2.1	Existing Datasets	396
12.2.2	Creation of Data	398
12.3	Data Input Methods	398
12.3.1	Keyboard Entry	399
12.3.2	Manual Digitising	399
12.3.3	Scanning and Automatic Digitising	403
12.4	GPS For GIS Data Capture	404
12.4.1	Capturing Coordinate Data	405
12.4.2	Advantages of GPS	405
12.4.3	GPS Data Creation	406

12.5 Data Editing	406
12.5.1 Detecting and Correcting Errors	406
12.5.2 Data Reduction and Generalisation	409
12.5.3 Edge Matching and Rubber Sheetng	410

13 Data Quality Issues

13.1 Introduction	414
13.2 Components of Data Quality	415
13.3 Accuracy	417
13.3.1 Spatial Accuracy	418
13.3.2 Temporal Accuracy	420
13.3.3 Attribute Accuracy	420
13.3.4 Conceptual Accuracy	421
13.4 Precision and Resolution	421
13.4.1 Spatial Resolution	422
13.4.2 Temporal Resolution	422
13.4.3 Thematic Resolution	422
13.5 Consistency	423
13.6 Completeness	423
13.7 Sources of Error in GIS	424
13.8 Modelling Errors	425
13.8.1 Point Data Error Models	426
13.8.2 Line and Area Data Error Model	426
13.8.3 Models for Dot and Pixel Counting	428
13.9 Error Evaluation by Graphical Methods	428
13.9.1 Metadata Issues	429
13.9.2 Graphic Design Issues	429
13.9.3 Error Analysis Issues	429
13.9.4 User Satisfaction Issues	430

14 Data Analysis and Modelling

14.1 Introduction	431
14.2 Format Conversion	432
14.2.1 Data Structure Conversion	432

14.2.2 Conversion of Different Raster Formats	433
14.2.3 Skeletonising	436
14.3 Data Medium Conversion	437
14.3.1 Mode of Digitisation	437
14.3.2 Scan Digitising Systems	438
14.3.3 Line Array of Detectors	438
14.4 Spatial Measurement Methods	439
14.5 Reclassification	441
14.6 Buffering Techniques	442
14.7 Overlay Analysis	444
14.7.1 Vector Overlay Capabilities	446
14.7.2 Topological Overlay	447
14.7.3 Raster Overlay	449
14.8 Modelling Surfaces	451
14.8.1 DTM Generation	452
14.8.2 Triangulated Irregular Network (TIN)	453
14.8.3 DTM Manipulation	455
14.8.4 DTM Interpretation	455
14.8.5 Slope Models	456
14.8.6 DTM Visualisation	457
14.8.7 DTM Applications	458
14.9 Modelling Networks	458
14.10 GIS Output	461
14.10.1 Maps as Output	462
14.10.2 Graphical Output	464

15 Integration of Remote Sensing and GIS

15.1 Introduction	466
15.2 Remote Sensing and GIS Synergy	467
15.3 Raster Data for GIS	468
15.4 Vector Data for GIS	469
15.5 Need for Integration	470
15.6 Facilities for Integration	471
15.7 General View on Applications	471
15.8 Software Scenario	473

16 Urban and Municipal Applications

16.1	Introduction	482
16.2	The Role of Satellite Imagery and other Data Sets	483
16.3	The Indicator Function of Urban Land Uses	484
16.4	Appropriate Methodologies	486
	16.4.1 Rapid Land-Use Assessment	487
	16.4.2 Rapid Land Information System Development.....	487
	16.4.3 GIS as an Emerging Tool	488
16.5	An Analysis System	489
	16.5.1 Dynamic Urban Land-Use	490
	16.5.2 Semi-Dynamic Land-Use	490
	16.5.3 Passive Land-Use	490
16.6	Land use/Land cover System in India	491
16.7	Case Study of Hyderabad City	494
	16.7.1 Growth and Development of Hyderabad	498
	16.7.2 Division of Planning Zones	500
16.8	Methodology	501
	16.8.1 Data Source and Collection	502
	16.8.2 Data Processing	503
	16.8.3 Geocoding and Georeferencing	505
	16.8.4 Digital Image Enhancement of LISS III Data	505
16.9	Land Use/Land Cover Map Generation	505
	16.9.1 Image Interpretation Process	506
16.10	Production of GIS Output	506
16.11	Area Statistics	507

17 Forest Resources Management

17.1	Introduction	510
17.2	Geomatics in Forestry	511
17.3	Forest Cover Mapping and Change Detection	513
17.4	Forest Inventory (Stock Mapping)	516
17.5	Dynamics of Forest Ecosystem and Forest Canopy	517
	17.5.1 Leaf Reflectance	517
	17.5.2 Leaf Area Index (LAI)	518

17.5.3	Effect of Canopy cover	518
17.5.4	Effect of Leaf Location and Orientation	518
17.5.5	Effect of Illumination and viewing geometry	519
17.5.6	Forest Stand Measurements	519
17.5.7	Stand Measurements using Aerial Photographs	519
17.5.8	Stand Measurements using Satellite Remote Sensing	520
17.6	Forest Damage Assessment	520
17.6.1	Disease and Insect Damage	521
17.6.2	Pollution Damage	521
17.7	Parameters of Forest Inventory	522
17.8	Development of Working Plan	523
17.9	Forest Management Information System (FMIS)	524
17.10	Forest Fire Forecasting and Risk Area Mapping	525
17.10.1	Forest Fire Model	526
17.10.2	Fire Behaviour Prediction Model	526
17.10.3	Fire Group	527
17.11	Bio-Diversity Characterization	528
17.11.1	Scientific Rationale	528
17.11.2	Landscape Ecology	529
17.11.3	Remote Sensing and Landscape Ecology	529
17.11.4	Landscape Ecology and GIS	530
17.12	Wildlife Habitat Mapping	531

18 Watershed Management

18.1	Introduction	532
18.1.1	Concept of Sustainability	535
18.2	Philosophy and Concept of Watershed	536
18.2.1	Classification of Watersheds	537
18.3	Technology Vectors and Social Dynamics	539
18.4	Role of Remote Sensing and GIS	540
18.5	GIS Database for Watershed Management	543
18.5.1	Suggested Developmental Plans	544
18.5.2	Technical Inputs	544

18.6	General Objectives of Watershed Management Program	544
18.6.1	Operational Objectives	545
18.7	Research Approach	546
18.8	Model Watershed	547
18.8.1	Objectives of Model Study	547
18.8.2	Method used in Model Study	549
18.9	Land Use and Land Cover	550
18.10	Slope Analysis.....	551
18.11	Soil Mapping	553
18.11.1	Soil Mapping Procedure	553
18.11.2	Soils of the Area	554
18.11.3	Suitability for Sustainable Agriculture	554
18.12	Hydrogeomorphological Mapping	556
18.13	Groundwater Prospects Map	558
18.14	Drainage Mapping	558
18.15	Action Plan Generation	559

19 Natural Disaster Management : Landslides

19.1	Introduction	560
19.2	Major Types of Landslides	561
19.3	Common Features of Landslides	562
19.4	Causes of Landslides and Related Phenomena	563
19.5	Landslide Analysis	564
19.5.1	Slope Stability	564
19.5.2	Forces on Slopes	564
19.5.3	Role of Earth Material	564
19.5.4	Role of Slope and Topography	565
19.5.5	Role of Climate and Vegetation	565
19.5.6	Role of Water	565
19.5.7	Role of Time	565
19.6	Human Causes of Landslides	566
19.6.1	Highway Construction	566
19.6.2	Hillside Development	566

19.6.3 Dams and Reservoirs	566
19.6.4 Mining	567
19.7 Remote Sensing for Landslide Mapping	567
19.8 Landslide Analysis in Geographic Information Systems	568
19.9 Hazard mapping of landslides	570
19.9.1 Infiltration and Drainage Model :	571
19.9.2 Stability Model	571
19.10 Case Study : Kohima Area	572
19.10.1 Objective of the study	573
19.10.2 Slope Analysis	574
19.10.3 Drainage and its Density	574
19.10.4 Land use/Land cover Analysis	574
19.10.5 Land Use Change Analysis	577
19.10.6 Results of the GIS Analysis System	577

20 Creation of Information System: A Case Study

20.1 Objectives	578
20.2 Methodology	579
20.2.1 Work Flow	579
20.3 Data Used	582
20.3.1 Details and Limitations of the Data Used	582
20.4 The Study Area	582
20.5 Basic Themes	584
20.5.1 Base Map	584
20.5.2 Transportation Map	584
20.5.3 Village Map	585
20.5.4 Physiography Map	586
20.5.5 Land Use / Land Cover Map	586
20.5.6 Agriculture	588
20.5.7 Wasteland	589
20.6 Water Resources	590
20.6.1 Drainage	590
20.6.2 Ground Water Resources	591
20.6.3 Ground Water Prospects in the Study Area	591

20.7	Ground Water Prospects Map	591
20.7.1	Pediplain Shallow Weathered in Granitic Gneiss Landscape	592
20.7.2	Valley Fill Shallow in Granitic Gneiss Landscape	592
20.7.3	Pediment in Granitic Gneiss Landscape	592
20.7.4	Pediment-inselberg Complex in Granitic Gneiss Landscape	592
20.7.5	Inselberg in Granitic Gneiss Landscape	592
20.7.6	Residual Hill in Granitic Gneiss Landscape	593
20.7.7	Denudational Hill in Granitic Gneiss Landscape	593
20.7.8	Dyke Ridge in Dolerite Landscape	593
20.8	Socio Economic Conditions	593
20.8.1	Population	593
20.8.2	Details of Village Wise Farmers Categories	593
20.8.3	Transportation	595
20.8.4	Livestock	596
20.8.5	Education Facilities	596

21 Siting Selection of Wastewater Treatment Plant

21.1	Introduction	598
21.2	Data Processing for Siting	599
21.3	The Site Selection Criteria for WWTP	600
21.4	Case Study; Textile Industry	601
21.4.1	Description of the Study Area	602
21.4.2	Textile Industry in Chirala	603
21.4.3	Effluent from Textile Industry	603
21.4.4	Environmental Impacts Due to Textile Industry	603
21.5	RS and GIS in Site Selection for CETP	604
21.6	Methodology	605
21.7	Thematic Maps	606
21.7.1	Transportation Network Map	606
21.7.2	Drainage Network Map	606
21.7.3	Slope Map and Aspect Map	608
21.7.4	Land Use/Land Cover Map	609
21.8	Criteria for Site Suitability Analysis	609
21.8.1	Site Suitability Map	610

22 Lake Ecosystem

22.1	Introduction	613
22.2	Types of Lakes	614
22.3	Lake Pollution	615
	22.3.1 Lake Encroachments	615
22.4	Lake Studies using RS and GIS	616
22.5	Case Study: Ameenpur Lake	618
	22.5.1 Research Methodology	621
	22.5.2 Satellite Data Used	624
	22.5.3 Processing of Satellite Data	627
	22.5.4 Pre-processing and Image Classification	628
	22.5.5 Land Use/Land Cover Change Zetition	628
	22.5.6 Scrubland	633
	22.5.7 Water Bodies	634
22.7	Summary	638
	 References	 639
	Subject Index	655