

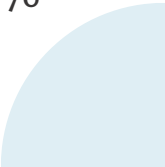


Table of Contents

1	Rainfed Agriculture	1
	Introduction	1
1.1	Basic Concept of Rainfed Agriculture	3
1.1.1	Features and Concerns with Rainfed Agriculture	3
1.1.2	Types of Rainfed Agriculture	4
1.1.3	Rainfed Agriculture issues and Prospects in India	5
1.2	Techniques for Water and Soil Conservation	18
1.2.1	Strip Cultivation	18
1.2.2	Mulching	23
1.2.3	Rotation of Crops	27
1.2.4	Contour Cultivation	29

1.2.5	Planting of Trees and Afforestation	31
2	Drought	35
	Introduction	35
2.1	Drought: Overview	37
2.1.1	Definition of Drought	39
2.1.2	Types of Drought	42
2.1.3	Causes of Drought	47
2.1.4	Effects of Drought	51
2.2	Crop Adaptation and Mitigation to Drought	55
2.2.1	Crop Adaptation	55
2.2.2	Mitigation to Drought	59
3	Water Harvesting	66
	Introduction	67
3.1	Water Harvesting and Benefits	67
3.1.1	Benefits of Water Harvesting	69
3.1.2	Significance of Water Harvesting in Agriculture in Dry Areas	73
3.2	Techniques of Water Harvesting	75
3.2.1	Rain Barrels	76
3.2.2	Dry System	79
3.2.3	Wet System	80
3.2.4	Green Roof	86
3.3	Efficient Utilization of Water through Soil and Crop Management Practices	90
3.3.1	Soil Moisture Management for Sustainable Farming System	91
3.3.2	Practices to Improve Infiltration Conserve Water and Reduce Runoff	98
3.4	Management of Crops in Rainfed Areas	121
3.4.1	Contingent Crop Planning for Aberrant Weather Conditions	123
3.4.1	Late-onset of Monsoon	123
3.4.3	Dry Spells during Crop Period	124

3.4.4	Early withdrawal of the Monsoon	126
3.4.5	Extended Monsoon	126
4	Watershed: An Introductory Approach	127
	Introduction	128
4.1	Concept of a Watershed	129
4.1.1	Watershed–Definition	130
4.1.2	Significance of Watersheds	131
4.1.3	Watershed Delineation	133
4.1.4	Objectives of Watershed Development	136
4.1.5	Development of Watersheds in India	137
4.1.6	Community Watershed Management	138
4.2	Watershed Management Approach	140
4.2.1	Watershed Planning	140
4.2.2	Data Collection	144
4.2.4	Strategy Development	147
4.2.5	Implementation	148
4.3	Watershed Characteristics and Classification	150
4.3.1	Classification of Watershed	151
4.3.2	Physical Features	155
4.3.3	Channel Features	156
4.3.4	Hydrological Features	156
4.4	Issues and Causes of Watershed Deterioration	157
4.4.1	Water Extraction	160
4.5	Watershed Analysis Data	164
4.5.1	Components of Watershed	164
4.5.2	Steps involved in Watershed Delineation	166
4.5.3	Application of Watershed Analysis	169
4.5.4	Features of Watershed	169
5	Watershed Hydrology	171
	Introduction	171
5.1	Hydrologic Cycle	172
5.1.1	Process of Hydrological Cycle	175
5.1.2	Precipitation	176



5.1.3	Rainfall Measurement	178
5.1.4	Errors in Rainfall Measurements	182
5.1.5	Frequency Analysis of Point Rainfall	183
5.1.6	Mass Curve of Rainfall	183
5.1.7	Hyetograph	184
5.1.8	Depth–Area–Duration Curves	186
5.1.9	Intensity Duration Frequency (IDF) Curves	188
5.2	Runoff of Watershed Hydrology	188
5.2.1	Factors Affecting Runoff	188
5.2.2	Measurement of Runoff	190
5.2.3	Measurement of Stage	190
5.2.4	Peak Rate of Runoff	204
5.2.5	Cook’s Method	207
5.2.6	SCS Curve Number Method	208
5.3.	Geomorphology of Watersheds	209
5.3.1	Linear Aspects	212
5.3.2	Aerial Aspects	214
5.3.3	Relief Aspect	215
5.4.	Hydrograph	216
5.4.1	Hydrograph and the Catchment’s Characteristics	216
5.4.2	Hydrograph Components	218
5.4.3	Base Flow Separation	219
5.4.4	Unit Hydrograph Theory	222
5.4.5	Limitations of Unit Hydrograph Theory	222
5.4.5.	S–Curve	224
5.4.6.	Synthetic Hydrograph	225
5.5.	Stream Gauging	226
5.5.1	Measuring Discharge using Weir	228
5.5.2	Flood Peak	229
5.5.3	Design Flood	229
5.5.3	Flood Routing	231
6	Watershed Modeling	234
	Introduction	234

6.1	Perception of Watershed Modeling	235
6.1.1	Watershed Modeling Strategy	236
6.1.2	Watershed Modeling System	239
6.2.	Modeling of Rainfall Runoff Process	244
6.2.1	Importance of Interception	247
6.2.2.	Methods to Measure Interception	249
6.2.3	Evaporation	252
6.2.4	Surface Water Flow.	253
6.2.5	Groundwater Flow	253
7	Watershed Planning and Management	257
	Introduction	258
7.1	Watershed Planning and Development	258
7.1.1	Watershed Planning Process	260
7.1.2	Data Required for Watershed Planning	263
7.1.3	Watershed Development	275
7.2	Watershed Management	290
7.2.1	Objectives for Watershed Management	292
7.2.2	Factors affecting the Watershed Management	293
7.2.3	Hydrologic Data for the Watershed Planning	293
7.2.5	Watershed Codification	301
7.2.6	Water Budgeting in a Watershed	301
7.2.7	Rainwater Conservation Technologies	305
7.3	Integrated Watershed Management	307
7.3.1	Principles for Integrated Watershed Management	308
7.3.2	Purposes of Integrated Watershed Management	310
7.3.3	New Perspective and Opportunities related with Watershed Management	314
	References	316
	Index	318