Contents

Part I General Characteristics of the Hilly Region of Middle and Lower Yangtze River

1 Ecological and Environmental Characteristics in the Hilly Region of Middle and Lower Yangtze River .......................... 3
   1.1 Introduction ..................................................... 3
   1.2 Physiographic Conditions ........................................ 5
   1.3 The Vegetation Characteristics ................................. 8
      1.3.1 Distribution of Vegetation in the Middle and Lower Reaches of the Yangtze River ................. 8
      1.3.2 The Characteristics of Biodiversity in the Middle and Lower Reaches of the Yangtze River ......... 9
      1.3.3 Current Situation and Existing Problems of Biodiversity .............................................. 10
      1.3.4 Biodiversity Crisis .......................................... 12
   1.4 Soil Characteristics and Nutrient Status .................... 13
      1.4.1 Main Soil Types ............................................. 13
      1.4.2 The Soil Characteristics and Existing Problems ........ 14
   1.5 The Current Situation of Soil Erosion and Its Causes ...... 18
      1.5.1 The Current Situation of Soil Erosion ..................... 18
      1.5.2 Factors Causing Soil Erosion ............................. 19
      1.5.3 The Characteristics of Soil Erosion ..................... 24
References ........................................................................ 26

Part II Development and Application of Soil Loss Models for Soil Loss Prediction in the Shangshe Catchment, Dabie Mountains, China

2 Calculation of Water and Sediment Discharge Using an Integral Calculus Method ........................................... 31
   2.1 Introduction ....................................................... 31
   2.2 Study Area ........................................................ 32
   2.3 Materials and Methods .......................................... 33
      2.3.1 Water Runoff Observation ................................. 33
2.3.2 Precipitation Observation .................................. 36
2.3.3 Suspended Sediment Observation ............................ 36

2.4 Method to Calculate the Amount of Water and Sediment
Discharge ........................................................................ 37
2.4.1 Method to Calculate the Amount of Water Discharge .... 37
2.4.2 Method to Calculate Sediment Load ....................... 41

2.5 Comparison of Soil Loss Among Various Types
of Land Use .................................................................... 41

References ....................................................................... 46

3 Development of the GOIUG Model with a Focus
on the Influence of Land Use in the Shangshe Catchment .... 47
3.1 Introduction .............................................................. 47
3.2 The Study Area ......................................................... 49
3.3 Materials and Methods ............................................. 49
3.3.1 Water Runoff Observation and Precipitation ........... 49
3.3.2 Suspended Sediment Observation ....................... 49
3.3.3 GOIUG Model ....................................................... 51

3.4 Results and Discussion ............................................. 56
3.4.1 The Results of Calculated SISSD Graph
Compared with Observed Ones ................................. 56
3.4.2 Discussion .......................................................... 63

References ....................................................................... 64

4 GIS-Based ER-USLE Model to Predict Soil Loss
in Cultivated Land .......................................................... 65
4.1 Introduction .............................................................. 65
4.2 Materials and Methods ............................................. 66
4.2.1 Study Area .......................................................... 66
4.2.2 Field Observations at the USLE-Plot Scale
and the Micro-plot Scale ........................................... 67
4.2.3 Field Observations at the Sub-Catchment Scale .... 68
4.2.4 Precipitation Observation .................................... 68
4.2.5 Proposal for Use of ER-USLE Model
for Annual Soil Loss Prediction Based
on Single Events ......................................................... 68

4.3 Calculation of the Factors Used in the ER-USLE Model .... 70
4.3.1 $R_e$ Factor ......................................................... 70
4.3.2 $LS$ Factor ......................................................... 71
4.3.3 $LS$ Factor at the Sub-catchment Scale .............. 72
4.3.4 $K$ Factor .......................................................... 73
4.3.5 $C_1$ Factor ........................................................ 74
4.3.6 $P$ Factor .......................................................... 74
4.3.7 $P_s$ and $C_s$ Factors ........................................... 75

4.4 Results and Discussion ............................................. 76

References ....................................................................... 79
5 Development and Test of GIS-Based FUSLE Model in Sub-catchments of Chinese Fir Forest and Pine Forest in the Dabie Mountains, China

5.1 Introduction

5.2 Study Area

5.3 Materials and Methods

5.3.1 Field Observation at the Sub-catchment Scale

5.3.2 Precipitation Observation

5.3.3 Field Observations at the USLE-Plot and Micro-plot Scales

5.3.4 FUSLE Model for Soil Loss Prediction

5.4 Factors in FUSLE Model

5.4.1 \( R_e \) Factor

5.4.2 \( L \) and \( S \) Factors

5.4.3 \( K \) Factor

5.4.4 \( C \) Factor

5.4.5 Litter Factor

5.5 Results

5.6 Application and Test of FUSLE in a Sub-catchment of Pine Forest

5.6.1 Materials and Field Observations of Runoff and Soil Loss in the Sub-catchment of Pine Forest

5.6.2 Application and Test of FUSLE in the Sub-catchment of Pine Forest

5.7 Conclusions

References

6 Spatial Variability of Soil Erodibility (\( K \) Factor) at a Catchment Scale in Nanjing, China

6.1 Introduction

6.2 Materials and Method

6.2.1 General Situation of the Studied Area

6.2.2 Soil Sampling

6.2.3 Research Methods

6.3 Results and Analysis

6.3.1 Descriptive Statistical Analysis of the \( K \) Factor

6.3.2 Semi-variance Function Analysis of the \( K \) Factor

6.3.3 Spatial Variation Features of \( K \) Factor

6.3.4 Vertical Variability Characteristics of \( K \) Factor by Different Vegetation Types

6.4 Conclusions

References

7 Application of a GIS-Based Revised FER-USLE Model in the Shangshe Catchment

7.1 Introduction

7.2 Study Area
7.3 Materials and Methods ........................................ 116
  7.3.1 Field Observations of Soil Loss at the
        Micro-plot Scale, the USLE-Plot Scale, the
        Sub-catchment Scale, and the Catchment Scale .... 116
  7.3.2 Field Observations of Litter Coverage
        and Terrace Conditions .................................. 116
  7.3.3 FER-USLE Model ....................................... 116
7.4 Calculations of Factors in FER-USLE Model .................. 117
  7.4.1 $R_e$ and $K$ Factors .................................. 117
  7.4.2 $LS$ Factor ............................................. 118
  7.4.3 $P$ Factor .............................................. 119
  7.4.4 $P_s$ and $C_s$ Factors .................................. 121
  7.4.5 $C_l$ Factor ............................................. 122
  7.4.6 Litter Factor .......................................... 122
7.5 Results .......................................................... 123
7.6 Percentage of Predicted SSD by Land Use Using
        the GOIUG and FER-USLE Models ......................... 125
7.7 Conclusions ..................................................... 126
References ............................................................ 127

8 Model of Forest Hydrology Based on Wavelet Analysis ........ 129
  8.1 Introduction ................................................. 129
  8.2 Methods ....................................................... 130
    8.2.1 Wavelet Transform ................................... 130
    8.2.2 Model of Rainfall–Runoff–Forest Coverage .......... 131
  8.3 Application of the Model of Rainfall–Runoff–Forest Coverage 132
    8.3.1 Study Basin ........................................... 132
    8.3.2 Trend Analysis Results of the Wavelet Transform ... 133
  8.4 Results of Model ............................................. 134
Reference ............................................................ 138

Part III Practices of Soil Erosion Control in Eastern China

9 Theory of Vegetation Reconstruction for Various
    Management Types with Different Site Conditions .......... 141
  9.1 Site Management Classification ............................ 141
  9.2 Characteristics of the Four Management Groups ............ 142
    9.2.1 The Vegetation Reconstruction of the Extreme
           Erosion and Degeneration Site Management Group .... 142
    9.2.2 The Regeneration and Improvement
           of Secondary Forest Management Group ............... 143
    9.2.3 The Agroforestry Management Group ................. 143
    9.2.4 Good Site Commercial Forest Management Group .. 144
  9.3 Vegetation Reconstruction Theory of Different Site
    Type Management Groups .................................... 144
9.3.1 Management Group of Extremely Eroded and Degenerate Inferior Lands ............. 144
9.3.2 Basic Theory of Vegetation Restoration and Reconstruction in Limestone Hills .......... 148
9.3.3 Agroforestry System Group .................. 149
9.3.4 Good Condition Commodity Forest Management Group ......................... 155

9.4 Closing Hillsides with Secondary Forest to Culture Forest with Least Human Interference and Regeneration Management Group ........................... 156
9.4.1 Theory of Closing the Hillside and Regenerating the Secondary Forest .......... 156
9.4.2 Comprehensive Governing Theory of Small Watershed 159

10 Models of Reforestation for Soil Erosion Control in the Hilly Region of the Middle and Lower Reaches of the Yangtze River ........................................ 161
10.1 Introduction ..................................... 161
10.2 The Vegetation Reconstruction Model for Extremely Eroded and Degraded Red Soil Sites Under Harsh Conditions .......................... 162
10.2.1 Site Features ................................... 162
10.2.2 Guiding Ideologies for Management .................................. 162
10.2.3 Key Techniques .................................. 163
10.2.4 Application of Models ........................... 165
10.3 The Stereoscopic Management Model for the Reservoir Area in the Hilly Red Soil Region ......................... 166
10.3.1 Elements of the Design ........................ 167
10.3.2 Stereoscopic Management Model .................. 169
10.4 The Vegetation Restoration Model for Harsh Limestone Areas .................. 171
10.4.1 The Features of the Harsh Limestone Areas .......................... 171
10.4.2 The Guiding Ideology for Management .................................. 171
10.4.3 Key Techniques .................................. 171
10.4.4 Application of Models ........................... 175
10.5 Vegetation Restoration Models in the Abandoned Mining Areas ................. 178
10.5.1 Site Features ................................... 178
10.5.2 Guiding Ideology for Management .................................. 179
10.5.3 Key Techniques .................................. 179
10.6 The Agroforestry Management Models ........................................ 181
10.6.1 The Agroforestry Management Models in Low Hilly Areas ................. 181
10.6.2 Forest–Herb Management Model .................................. 186
10.6.3 Tree–Tea (Camellia sinensis) Compound Model ........................ 189
10.6.4 The Forest–Amaranth–Stockbreeding Composite Management Model with Grain Amaranth as the Linkage ............... 194
10.6.5 The Composite Management Model of Forest–Agriculture (Amaranth)–Stockbreeding in Limestone Mountainous Regions ............ 200

10.7 Management Models of Commercial Forests with Good Site Features .................. 204
10.7.1 Management Model of Commercial Forests .......... 204
10.7.2 High-Efficiency Intensive Culture of Dual-Purpose Bamboo Forest with Shoot and Timber Orientation ............... 209
10.7.3 High-Efficiency Intensive Culture of High-Quality Oil Tea (Camellia oleifera) Forest .... 211

11 Effect of Afforestation on Soil and Water Conservation .......... 213
11.1 The Amount of Soil Erosion in Different Types of Lands .... 213
11.2 Loss of Soil Nutrient Elements in Different Types of Reforestations ................... 218
11.3 The Effect of Reforestation on Plant Biodiversity .......... 223
11.4 Improvement Effect of Reforestation on Micrometeorology ... 228
11.4.1 The Improvement Effect of Rehabilitated Forest Ecosystem on Micrometeorology .... 228
11.4.2 The Improvement Effect of the Circulation System of Forestry–Agriculture–Husbandry on Micrometeorology ............ 232
11.4.3 Improving the Effect of Composite Management System of Tea–Forest on Micrometeorology ............... 235
11.4.4 The Effect of Stereoplanting Pattern in Orchards on Micrometeorology ............... 238

Reference ........................................ 241

12 A Study on Plant Roots and Soil Anti-scourability in the Shangshe Catchment, Dabie Mountains of Anhui Province, China .......... 243
12.1 Introduction .................................. 243
12.2 Research Methods ............................ 245
12.2.1 Choice of Different Types of Plants and an Investigation on Soil and Roots .... 245
12.2.2 Measurement of Soil Anti-scourability .......... 245
12.3 Results and Analysis .......................... 246
12.3.1 Distribution Characteristics of the Root Profiles of Different Types of Plants .......... 246
12.3.2 Plant Roots and Soil Anti-scourability .......... 248
12.3.3  Analysis of the Correlation Between Soil Anti-scourability Enhancement Value and Plant Roots . 250
12.3.4  Comprehensive Analysis of Soil Stability Function of Root System .......................... 250
12.4 Conclusions .......................................................................................................................... 252
References .................................................................................................................................. 254

13 Social and Economic Benefits of Forest Reconstruction  ........................................ 257
13.1 Introduction .......................................................................................................................... 257
13.2 Economic Benefits of Forestry–Agriculture Composite Management System ........................ 258
13.2.1 Economic Benefits of Forestry–Amaranth–Stockbreeding Composite System .......... 258
13.3 Economic Benefits of the Forest–Tea Composite System ........................................ 263
13.3.1 Economic Benefits of Persimmon (*Diospyros kaki*)–Tea Composite System ........ 265
13.3.2 Economic Benefits of Slash Pine (*Pinus elliottii*)–Tea Composite System .............. 267
13.3.3 Economic Benefits of Tea Gardens with Composite Management ......................... 268
13.4 Economic Benefits of the Forest–Grain Composite System ........................................ 268
13.5 Economic Benefits of the Forest–Medicine Composite System ....................................... 268
13.6 Economic Benefits of the Forest–Fruit Composite Management Model ....................... 273
13.7 Comprehensive Evaluation of the Economic Benefits of Major Composite Management Models . . . 274

Index ............................................................................................................................................. 277
Theory and Practice of Soil Loss Control in Eastern China
Zhang, Y.; DeAngelis, D.L.; Zhuang, J.Y.
2011, XIX, 281 p., Hardcover
ISBN: 978-1-4419-9678-7