# Contents

1 Introduction: Soils—The Earth’s Skin .............................. 1
   1.1 Soils as Natural Bodies in Ecosystems ..................... 1
   1.2 Functions of the Soils in the Ecosphere ..................... 3
   1.3 Soils as an Open System Worth Protecting ................... 5
References ................................................................ 6

2 Inorganic Soil Components—Minerals and Rocks ................. 7
   2.1 The Rock Cycle ............................................. 7
   2.2 Minerals ..................................................... 7
      2.2.1 General ................................................. 7
      2.2.2 Silicate Structure ...................................... 9
      2.2.3 Primary (Lithogenic, Pyrogenic) Silicates ........... 10
      2.2.4 Clay Minerals ........................................... 15
      2.2.5 Clay Mineral Formation and Transformation ....... 21
      2.2.6 Oxides and Hydroxides ................................ 22
      2.2.7 Carbonates, Sulfates, Sulfides and Phosphates .... 30
   2.3 Rocks ...................................................... 30
      2.3.1 Igneous Rocks ......................................... 31
      2.3.2 Sediments and Sedimentary Rocks ................... 32
      2.3.3 Metamorphic Rocks .................................... 38
      2.3.4 Anthropogenic Substrates ............................ 39
   2.4 Weathering ................................................. 40
      2.4.1 Physical Weathering .................................... 40
      2.4.2 Chemical Weathering ................................... 41
      2.4.3 Role of the Biota ....................................... 45
      2.4.4 Weathering Stability .................................... 46
   2.5 Mineral Constituents of Soils .................................. 49
References ................................................................ 52

3 Soil Organic Matter ................................................... 55
   3.1 Origins, Distribution and Dynamics ............................ 55
   3.2 Contents and Quantities of Organic Matter in Soils ....... 56
3.3 Plant Residues and Their Transformation During Decomposition ........................................... 60
  3.3.1 Composition and Structure of Organic Residues ......................................................... 60
  3.3.2 Decomposition and Transformation Reactions in the Soil .............................................. 63
3.4 Formation of Stable Organic Matter ................................. 66
  3.4.1 Stabilization by Interactions with the Mineral Phase .................................................... 67
  3.4.2 Stabilization by Spatial Separation ................................................................................. 70
  3.4.3 Organic Matter in Functional Soil Fractions ................................................................. 71
3.5 Composition and Properties of Soil Organic Matter .............. 71
  3.5.1 Binding Forms of C, N, P and S in Soil Organic Matter .................................................. 71
  3.5.2 Properties of Soil Organic Matter .................................................................................... 73
3.6 Soil Organic Matter Dynamics ................................................... 74
  3.6.1 Turnover Rates and Turnover Time of Organic Matter in Soils .................................... 74
  3.6.2 Estimation of the Turnover Time ....................................................................................... 75
  3.6.3 C Turnover Modeling ....................................................................................................... 78
  3.6.4 Soils as a Carbon Reservoir and Source ........................................................................ 79
References ......................................................................................................................... 84

4 Soil Organisms and Their Habitat ........................................... 87
  4.1 Soil Organisms ...................................................................................................................... 87
    4.1.1 Microflora and Viruses in Soils ...................................................................................... 87
    4.1.2 Soil Fauna (Micro-, Meso-, Macro- and Megafauna) ................................................... 92
    4.1.3 Numbers and Biomass of Soil Organisms .................................................................... 97
    4.1.4 Soil Organisms as a Biocoenosis ................................................................................. 100
  4.2 Environmental Conditions .................................................................................................. 104
    4.2.1 The Soil as a Source of Nutrients and Energy for Soil Organisms ................................. 104
    4.2.2 Water and Atmosphere ................................................................................................. 105
    4.2.3 pH Value and Redox Potential ...................................................................................... 107
    4.2.4 Temperature .................................................................................................................. 107
  4.3 Functions of Soil Organisms .............................................................................................. 108
    4.3.1 Function of Soil Organisms in Matter Cycles ............................................................... 108
    4.3.2 Function of Soil Organisms in Redox Reactions ........................................................... 112
    4.3.3 Function of Soil Organisms in Soil Structure Stabilization ........................................... 114
  4.4 Soil Organisms as Bioindicators ......................................................................................... 115
    4.4.1 Effect of Soil Management on Soil Organisms .............................................................. 115
    4.4.2 Environmental Pollution ............................................................................................... 117
    4.4.3 Climate Change .............................................................................................................. 118
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>Methods in Soil Biology</td>
<td></td>
</tr>
<tr>
<td>4.5.1</td>
<td>Microorganisms</td>
<td></td>
</tr>
<tr>
<td>4.5.2</td>
<td>Soil Fauna</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Chemical Properties and Processes</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Soil Solution</td>
<td></td>
</tr>
<tr>
<td>5.1.1</td>
<td>Composition of Rainwater</td>
<td></td>
</tr>
<tr>
<td>5.1.2</td>
<td>Composition of the Soil Solution</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Gas Equilibria</td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Speciation and Complex Formation</td>
<td></td>
</tr>
<tr>
<td>5.3.1</td>
<td>Ionic Strength, Concentration, and Activity</td>
<td></td>
</tr>
<tr>
<td>5.3.2</td>
<td>Solution Speciation</td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Solubility and Dissolution Kinetics</td>
<td></td>
</tr>
<tr>
<td>5.4.1</td>
<td>Solubility Constant, Ion Activity Product, and Saturation Index</td>
<td></td>
</tr>
<tr>
<td>5.4.2</td>
<td>Stability Diagrams</td>
<td></td>
</tr>
<tr>
<td>5.4.3</td>
<td>Dissolution and Precipitation Kinetics</td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Sorption</td>
<td></td>
</tr>
<tr>
<td>5.5.1</td>
<td>Reactive Surfaces and Surface Charge</td>
<td></td>
</tr>
<tr>
<td>5.5.2</td>
<td>Ion Exchange</td>
<td></td>
</tr>
<tr>
<td>5.5.3</td>
<td>Surface Complexation of Cations and Anions</td>
<td></td>
</tr>
<tr>
<td>5.5.4</td>
<td>Sorption of Organic Substances on Mineral Surfaces</td>
<td></td>
</tr>
<tr>
<td>5.5.5</td>
<td>Sorption Kinetics</td>
<td></td>
</tr>
<tr>
<td>5.5.6</td>
<td>Sorption Modeling</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>Soil Reaction and pH Buffering</td>
<td></td>
</tr>
<tr>
<td>5.6.1</td>
<td>Soil Reaction</td>
<td></td>
</tr>
<tr>
<td>5.6.2</td>
<td>Soil Acidity and Base Neutralization Capacity (BNC)</td>
<td></td>
</tr>
<tr>
<td>5.6.3</td>
<td>H⁺ Sources</td>
<td></td>
</tr>
<tr>
<td>5.6.4</td>
<td>pH Buffering, Soil Acidification and Acid Neutralization Capacity (ANC)</td>
<td></td>
</tr>
<tr>
<td>5.6.5</td>
<td>Liming of Acidic Soils</td>
<td></td>
</tr>
<tr>
<td>5.7</td>
<td>Redox Reactions and Redox Dynamics</td>
<td></td>
</tr>
<tr>
<td>5.7.1</td>
<td>Redox Reactions and Redox Potential</td>
<td></td>
</tr>
<tr>
<td>5.7.2</td>
<td>pe-pH Diagrams</td>
<td></td>
</tr>
<tr>
<td>5.7.3</td>
<td>Redox Reaction Kinetics</td>
<td></td>
</tr>
<tr>
<td>5.7.4</td>
<td>Redox Processes in Soils</td>
<td></td>
</tr>
<tr>
<td>5.7.5</td>
<td>Soil Redox Potential</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Physical Properties and Processes</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Texture and Packing</td>
<td></td>
</tr>
<tr>
<td>6.1.1</td>
<td>Particle Formation</td>
<td></td>
</tr>
<tr>
<td>6.1.2</td>
<td>Particle Size</td>
<td></td>
</tr>
<tr>
<td>6.1.3</td>
<td>Particle Classification</td>
<td></td>
</tr>
<tr>
<td>6.1.4</td>
<td>Particle Properties</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>6.1.5 Common Particle Distributions</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>6.1.6 Packing of the Primary Particles</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>6.1.7 Temporal Changes</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>6.1.8 Correlation Between the Solid Phase</td>
<td>189</td>
<td></td>
</tr>
<tr>
<td>and Other Soil Properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2 Interactions Between the Solid and Liquid Phases</td>
<td>189</td>
<td></td>
</tr>
<tr>
<td>6.2.1 Flocculation and Peptization</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>6.2.2 Shrinkage and Swelling</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>6.2.3 Wettability</td>
<td>199</td>
<td></td>
</tr>
<tr>
<td>6.2.4 Cohesion, Consistency and Hydraulic</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Pressure Head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3 Soil Structure</td>
<td>202</td>
<td></td>
</tr>
<tr>
<td>6.3.1 Structural Morphology</td>
<td>202</td>
<td></td>
</tr>
<tr>
<td>6.3.2 Stresses and Deformations</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>6.3.3 Soil Structural Stability</td>
<td>215</td>
<td></td>
</tr>
<tr>
<td>6.3.4 Biological, Climatic and Anthropogenic Effects on Soil Structure</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td>6.3.5 Assessment of the Soil Structure for Agricultural Purposes</td>
<td>227</td>
<td></td>
</tr>
<tr>
<td>6.4 Soil Water</td>
<td>228</td>
<td></td>
</tr>
<tr>
<td>6.4.1 Introduction—Binding Forms</td>
<td>229</td>
<td></td>
</tr>
<tr>
<td>6.4.2 Water Binding Intensity</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>6.4.3 Water Movement in the Liquid Phase</td>
<td>239</td>
<td></td>
</tr>
<tr>
<td>6.4.4 Water Movement in the Vapor Phase</td>
<td>249</td>
<td></td>
</tr>
<tr>
<td>6.4.5 Soil Water Balance</td>
<td>252</td>
<td></td>
</tr>
<tr>
<td>6.4.6 Water Balance of Landscapes</td>
<td>257</td>
<td></td>
</tr>
<tr>
<td>6.5 Soil Air</td>
<td>261</td>
<td></td>
</tr>
<tr>
<td>6.5.1 Composition and Origin of the Constituents</td>
<td>262</td>
<td></td>
</tr>
<tr>
<td>6.5.2 Transport Mechanisms</td>
<td>264</td>
<td></td>
</tr>
<tr>
<td>6.5.3 Gas Balance</td>
<td>266</td>
<td></td>
</tr>
<tr>
<td>6.6 Soil Temperature</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>6.6.1 Significance of Thermal Phenomena</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>6.6.2 Energy Gains and Losses</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>6.6.3 Thermal Properties</td>
<td>268</td>
<td></td>
</tr>
<tr>
<td>6.6.4 Heat Movement</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td>6.6.5 Heat Balance</td>
<td>271</td>
<td></td>
</tr>
<tr>
<td>6.7 Transport Processes and Translocations</td>
<td>273</td>
<td></td>
</tr>
<tr>
<td>6.7.1 Transport in Soils in the Liquid Phase</td>
<td>274</td>
<td></td>
</tr>
<tr>
<td>6.7.2 Transport in Soils in the Gaseous Phase</td>
<td>276</td>
<td></td>
</tr>
<tr>
<td>6.8 Soil Color</td>
<td>277</td>
<td></td>
</tr>
<tr>
<td>6.8.1 Color Classification</td>
<td>277</td>
<td></td>
</tr>
<tr>
<td>6.8.2 Coloring Components</td>
<td>278</td>
<td></td>
</tr>
<tr>
<td>6.8.3 Correlations Between Color and Soil Properties and Processes</td>
<td>279</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td>279</td>
<td></td>
</tr>
</tbody>
</table>

7 Soil Development and Soil Classification

7.1 Factors of Soil Formation

7.1.1 Parent Rock

7.1.2 Climate
7.1.3 Gravity and Relief ........................................... 289
7.1.4 Water ...................................................... 290
7.1.5 Fauna and Flora ........................................... 291
7.1.6 Human Activities .......................................... 292
7.1.7 Time ....................................................... 293

7.2 Processes of Soil Development ................................... 294
7.2.1 Transformations and Depletions of the Mineral Body ........... 294
7.2.2 Humus Accumulation—Development of Humus Forms .......... 297
7.2.3 Structure Formation ......................................... 300
7.2.4 Translocations ............................................. 301
7.2.5 Redoximorphosis ........................................... 306
7.2.6 Turbations .................................................. 308
7.2.7 Soil Landscape Processes .................................... 311
7.2.8 Profile Differentiation ...................................... 313

7.3 Diagnostic Criteria of Soils .................................... 316
7.3.1 Soil Horizon Designation .................................... 316
7.3.2 Diagnostic Horizons, Properties and Materials ............... 322

7.4 Soil Classification ............................................. 322
7.4.1 Soil Classification According to the WRB ....................... 323
7.4.2 Soil Classification According to the US Soil Taxonomy ........... 325

7.5 Representative Soil Units ....................................... 332
7.5.1 Leptosols (LP) ............................................. 333
7.5.2 Arenosols (AR) ............................................ 337
7.5.3 Regosols (RG) ............................................. 339
7.5.4 Cambisols (CM) and Umbrisols (UM) ......................... 339
7.5.5 Chernozems (CH), Phaeozems (PH) and Kastanozems (KS) .... 345
7.5.6 Soils with Clay Migration ................................... 348
7.5.7 Podzols (PZ) ............................................. 351
7.5.8 Stagnosols (ST) and Planosols (PL) .......................... 353
7.5.9 “Reductosols” and Reductic Technosols (TC) .................. 356
7.5.10 Vertisols (VR) ............................................ 357
7.5.11 Andosols (AN) ........................................... 359
7.5.12 Ferralsols (FR) and Plinthosols (PT) ........................ 359
7.5.13 Calcisols (CL) and Gypsisols (GY) .......................... 361
7.5.14 Durisols (DU) ............................................ 362
7.5.15 Solonchaks (SC) .......................................... 362
7.5.16 Solonetz (SN) ............................................ 364
7.5.17 Desert Soils—Soils with a Yermic Horizon and Aridic Properties ................................. 365
7.5.18 Gleysols (GL) ............................................ 367
7.5.19 Fluvisols (FL) ............................................. 370
7.5.20 Peat Soils—Histosols (HS) ................................ 376
7.5.21 Cryosols (CR) and Other Soils with Permafrost ............... 379
## Contents

7.5.22 Anthrosols (AT) .................................................. 380
7.5.23 “Zoosols” (ZO) .................................................. 382
7.6 Paleosols on Earth, and Soils on Mars and Titan .......... 384
7.6.1 Paleosols on Earth .............................................. 384
7.6.2 Soils on Mars and Titan ....................................... 385
References ................................................................. 387

### 8 Soil Geography

8.1 The Pedosphere ..................................................... 391
8.2 Paradigms of Soil Landscapes and Soil Genesis .......... 392
8.3 Soil Association Systematics and Soil Regions of Central Europe ............................................ 397
8.3.1 Soil Regions of Central Europe (Fig. 8.4) ............. 397
8.3.2 Soil Regions in Urban Industrial Areas ................. 398
8.4 Soil Zones of the World ........................................... 399
8.4.1 Ferralsols-Gleysoils-Fluvisols Soil Zones in the Inner (Humid) Tropics (Rain Forest) .......... 399
8.4.2 Acrisols-(Luvisols-Plinthosols)-Nitisols-Vertisols Soil Zones in the Outer (Seasonal) Tropics (Savannah) ...................................................... 401
8.4.3 Regosols-Calcisol-Solonchak Soil Zones in Semi-deserts ......................................................... 402
8.4.4 Arenosol-(Leptosol)-Gypsisol-Solonchak Soil Zones in (Extreme) Deserts (Fig. 8.1) ........ 403
8.4.5 Planosol-Luvisol-(Acrisol)-Cambisol Zones in the Mediterranean Region ......................... 403
8.4.6 Chernozem-Kastanozem-Solonetz Zones of the Grasslands (Steppe, Prairie, Pampa, Veld) (Fig. 8.2) ......................................................... 404
8.4.7 Cambisol-Luvisol-Gleysoys Zone of Temperate Zones (Mixed Forest and Forest Steppe) .... 405
8.4.8 Podzol-Cambisol-Histosol Zone of Boreal Forests (Taiga) ......................................................... 405
8.4.9 Leptosol-Regosol-Gleysoys-Histosol Zone of the Tundra (Polar Steppe) ......................... 406
8.4.10 Leptosol-Gelic-Regosol-Cryosol Zone of Cold Deserts ................................................................. 406
References ................................................................. 407

### 9 Soil-Plant Relations

9.1 Rootability and Rooting Zone .................................... 409
9.1.1 Root System of Plants and Rootability .................. 409
9.1.2 Potential Rooting Zone ........................................ 410
9.2 Water Supply to Plants ............................................ 410
9.2.1 Plant-Available Water ........................................ 411
9.2.2 Water Transport in the Soil–Plant–Atmosphere Continuum ......................................................... 414
9.2.3 Water Consumption and Plant Yields .................... 417
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3 Soil Air and Oxygen Supply to Plant Roots</td>
<td>419</td>
</tr>
<tr>
<td>9.3.1 Soil Air Budget</td>
<td>419</td>
</tr>
<tr>
<td>9.3.2 Oxygen Supply to Plant Roots</td>
<td>420</td>
</tr>
<tr>
<td>9.4 Soil Thermal Budget, Soil Temperature and Plant Growth</td>
<td>421</td>
</tr>
<tr>
<td>9.5 Plant Nutrient Supply</td>
<td>422</td>
</tr>
<tr>
<td>9.5.1 Nutrient Contents, Binding Forms and Budgets</td>
<td>423</td>
</tr>
<tr>
<td>9.5.2 Nutrient Availability and Nutrient Supply in Soils</td>
<td>426</td>
</tr>
<tr>
<td>9.5.3 Nutrient Fertilization</td>
<td>431</td>
</tr>
<tr>
<td>9.6 Essential Nutrient Elements</td>
<td>433</td>
</tr>
<tr>
<td>9.6.1 Nitrogen</td>
<td>433</td>
</tr>
<tr>
<td>9.6.2 Phosphorus</td>
<td>444</td>
</tr>
<tr>
<td>9.6.3 Sulfur</td>
<td>454</td>
</tr>
<tr>
<td>9.6.4 Potassium</td>
<td>457</td>
</tr>
<tr>
<td>9.6.5 Calcium</td>
<td>461</td>
</tr>
<tr>
<td>9.6.6 Magnesium</td>
<td>462</td>
</tr>
<tr>
<td>9.6.7 Sodium</td>
<td>464</td>
</tr>
<tr>
<td>9.7 Micronutrient Elements</td>
<td>464</td>
</tr>
<tr>
<td>9.7.1 Manganese</td>
<td>465</td>
</tr>
<tr>
<td>9.7.2 Iron</td>
<td>468</td>
</tr>
<tr>
<td>9.7.3 Copper</td>
<td>470</td>
</tr>
<tr>
<td>9.7.4 Zinc</td>
<td>472</td>
</tr>
<tr>
<td>9.7.5 Boron</td>
<td>474</td>
</tr>
<tr>
<td>9.7.6 Molybdenum</td>
<td>476</td>
</tr>
<tr>
<td>9.7.7 Chlorine</td>
<td>477</td>
</tr>
<tr>
<td>9.8 Beneficial Elements</td>
<td>478</td>
</tr>
<tr>
<td>9.8.1 Silicium</td>
<td>478</td>
</tr>
<tr>
<td>9.8.2 Cobalt</td>
<td>479</td>
</tr>
<tr>
<td>9.8.3 Selenium</td>
<td>480</td>
</tr>
<tr>
<td>References</td>
<td>481</td>
</tr>
<tr>
<td>10 Threats to the Soil Functions</td>
<td>485</td>
</tr>
<tr>
<td>10.1 Threats to the Soil Functions Through Chemical Contaminations</td>
<td>486</td>
</tr>
<tr>
<td>10.1.1 Entry Paths of Pollutants in Soils</td>
<td>487</td>
</tr>
<tr>
<td>10.2 Inorganic Substances</td>
<td>488</td>
</tr>
<tr>
<td>10.2.1 Sulfur Dioxide and Nitrogen Compounds—Forest Decline</td>
<td>488</td>
</tr>
<tr>
<td>10.2.2 Fluorine</td>
<td>493</td>
</tr>
<tr>
<td>10.2.3 Cyanides</td>
<td>494</td>
</tr>
<tr>
<td>10.2.4 Heavy Metals</td>
<td>496</td>
</tr>
<tr>
<td>10.2.5 Salts</td>
<td>509</td>
</tr>
<tr>
<td>10.2.6 Radionuclides</td>
<td>510</td>
</tr>
<tr>
<td>10.3 Organic Pollutants</td>
<td>517</td>
</tr>
<tr>
<td>10.3.1 Classification, Use, Inputs and Contents in Soils</td>
<td>517</td>
</tr>
<tr>
<td>10.3.2 Processes at the Soil Surface</td>
<td>523</td>
</tr>
</tbody>
</table>
10.3.3 Fixation in the Soil ........................................ 524
10.3.4 Decomposition and Translocation .................. 528
10.3.5 Uptake by and Effects on Organisms. ............ 530
10.4 Farmyard and Secondary Raw Material Fertilizers,
   Dredged Material ........................................ 533
10.5 Toxicological/Ecotoxicological Evaluation of Chemical
   Soil Pollution ............................................. 536
10.5.1 Values for the Soil—Human Path .................... 538
10.5.2 Values for the Soil—Crop Plant Path .............. 540
10.5.3 Soil Values for the Soil—Groundwater Path...... 541
10.5.4 Biological Evaluation of Soil
   and Soil Material ..................................... 542
10.6 Remediation of Chemical Contaminations .......... 543
10.7 Threats to Soil Functions Through
   Non-chemical Contaminations ......................... 546
10.7.1 Soil Erosion .......................................... 546
10.7.2 Mechanical Soil Deformation ....................... 553
References ..................................................... 558

11 Land Evaluation and Soil Protection ...................... 561
11.1 Principles of Soil Evaluation/Assessment .............. 562
11.2 Evaluation for Taxing and Agricultural Use ......... 564
   11.2.1 Soil Evaluation—German Soil Taxation
         Framework ............................................ 565
   11.2.2 Soil Evaluation—Grassland Taxation
         Framework ............................................ 567
   11.2.3 Assessment for Special Crops ..................... 567
11.3 Assessment for Forest Use ............................. 568
11.4 Evaluation for Societal Requirements Without Use
   of the Primary Production ............................. 573
11.5 Common International Soil Evaluation Methods ...... 575
   11.5.1 Storie Index Rating (SIR) ......................... 575
   11.5.2 Fertility Capability Classification (FCC) ....... 575
   11.5.3 Land Capability Classification (LCC) .......... 576
   11.5.4 Land Suitability Classification (LSC) ........... 577
   11.5.5 Agro-Ecological Zones ............................ 578
   11.5.6 Soil Quality Assessment .......................... 578
11.6 Soil Information Systems ................................. 579
11.7 Soil Protection ........................................... 581
   11.7.1 Reasons for Soil Protection ...................... 581
   11.7.2 Protection of the Natural Body ................. 581
   11.7.3 Soil Functions and Potentials .................... 582
   11.7.4 German Federal Soil Protection Act ............ 582
References ..................................................... 584

Appendix ....................................................... 587

Index .......................................................... 593
Scheffer/Schachtschabel Soil Science
2016, XVIII, 618 p. 255 illus., 218 illus. in color., Hardcover
ISBN: 978-3-642-30941-0