
Contents

1	Introduction	1
1.1	Historical Development of Soil Survey in the Philippines	1
1.1.1	The Beginning of Soil Survey in the Philippines	1
1.1.2	From the 1930s Until the Outbreak of World War II	2
1.1.3	From After the War Until the 1950s	2
1.1.4	Soil Surveys in the 1960s	3
1.1.5	Soil Surveys in the 1970s	4
1.1.6	Soil Surveys in the 1980s	4
1.1.7	Soil Surveys in the 1990s	5
1.1.8	The First Decade of the New Millennium (2000–2010)	6
1.1.9	Prospects and Challenges for Soil Survey in the Second Decade of the New Millennium	7
1.1.10	The Future of Soil Survey in the Philippines	7
1.2	Understanding What Is Pedology	8
1.2.1	Giving the Soils a Second Look	8
1.2.2	Pedology Fundamental Concepts	9
1.2.3	The Soil Profile	12
1.2.4	The Soil Morphology: Description of Horizons	15
1.3	Factors of Soil Formation and Development	19
1.3.1	The Soils That we Classify and Map	19
1.3.2	Soils and the Geologic Parent Material	20
1.3.3	Topography as a Factor of Soil Formation	22
1.3.4	Impact of Climate and Vegetation	24
1.3.5	Anthropogenic Influences	26
1.4	The Soils and Philippine History	26
1.4.1	Aborigines and the Waves of Early Migrants	26
1.4.2	The Philippines Before the Islamization of Southeast Asia	28
1.4.3	The Coming of Islam in the Philippines	29
1.4.4	The Arrival of Spain in the Philippines	33
1.4.5	The Spanish Colonial Rule in the Philippines	35
1.4.6	The Philippine Revolution and the American Rule	37
1.4.7	The Second World War to the Present	40
1.5	The Classification and Mapping of Philippine Soils	41
1.5.1	Basic Soil Classification and Soil Mapping Concepts	41
1.5.2	Soil Classification in the Philippines	43
1.5.3	Soil Mapping at Higher Levels of Soil Classification	44
1.5.4	Soil Mapping at Lower Levels of Soil Classification	45
	References	47

2	The Soils of the Lowlands	51
2.1	The Soils of the Coastal Areas	51
2.1.1	Beach Sand and Coastal Sand Dunes	52
2.1.2	Soils of the Active Tidal Flats	52
2.1.3	Saline Soils of the Estuaries and Tidal Swamps	53
2.1.4	Soils of the Old or Former Tidal Flats	55
2.2	The Soils of the River and Lake Terraces, and Freshwater Swamps	57
2.2.1	The Major River Systems, Lakes, and Wetlands of Luzon	58
2.2.2	The Major River Systems, Lakes, and Wetlands of Visayas	59
2.2.3	The Major River Systems, Lakes, and Wetlands of Mindanao	60
2.2.4	Soils of the River Terraces, Interhill Miniplateaus, and Intermountain Valleys	61
2.2.5	Soils of the River Levees	66
2.2.6	Soils of the Lake Terraces and Lacustrine Plains	66
2.2.7	Nonsaline Soils of the Freshwater Swamps and Marshes	68
2.2.8	Organic Soils (Peatlands)	69
2.3	Soils of the Narrow and Broad Alluvial Valleys and Flood Plains	70
2.3.1	Soils of the Narrow Alluvial Flood Plains: The Poorly Drained Soils Characterized by the Presence of Redoximorphic Features	71
2.3.2	Soils of the Narrow Alluvial Flood Plains: The Well-Drained Soils	74
2.3.3	Soils of the Broad Alluvial Plains: The Poorly Drained Soils and Characterized by Presence of Redoximorphic Features	75
2.3.4	Soils of the Broad Alluvial Plains: The Well-Drained Soils	87
2.4	Soils of the Infilled and Localized Valleys, Narrow Miniplateaus, Collo-Alluvial Plains, and Fan Terraces	93
2.4.1	Infilled, Localized Valleys, and Narrow Miniplateaus: The Poorly and Moderately Drained Soils and Characterized by Presence of Redoximorphic Features	93
2.4.2	Infilled and Localized Valleys and Narrow Miniplateaus: The Well-Drained Soils	95
2.4.3	Soils of the Collo-Alluvial Plains and Fan Terraces: The Poorly Drained Soils and Characterized by Presence of Redoximorphic Features	96
2.4.4	Soils of the Collo-Alluvial Plains and Fan Terraces: The Well-Drained Soils	100
	References	104
3	The Soils of the Uplands	107
3.1	Alluvial Soils at Midstream and Upstream River Valleys	107
3.1.1	The Poorly Drained Soils, Characterized by Presence of Redoximorphic Features	108
3.1.2	The Well-Drained Soils and Characterized by Absence of Redoximorphic Features	110
3.2	Soils that Developed from Volcanic Tuff	113
3.2.1	Soils Underlain by Diliman Tuff, Poorly Drained Soils, Characterized by Presence of Redoximorphic Features	113

3.2.2	Soils Underlain by Macolod Corridor Tuff, Poorly Drained Characterized by Presence of Redoximorphic Features	114
3.2.3	Soils Underlain by Western Cordillera Tuff, Poorly Drained Soils and Characterized by Presence of Redoximorphic Features	117
3.2.4	Soils Underlain by Diliman Tuff, Well-Drained Soils and Do Not Exhibit Redoximorphic Features	117
3.2.5	Soils Underlain by Various Macolod Corridor Tuff, Well Drained and Do Not Exhibit Redoximorphic Features	118
3.2.6	Soils Developed from Other Tuffaceous Materials	118
3.3	Soils that Developed from Igneous Rocks	119
3.3.1	Soils Developed from Predominantly Andesite Parent Materials	119
3.3.2	Soils Developed from Predominantly Basalt Parent Materials . . .	122
3.3.3	Soils Developed from Predominantly Andesite-Basalt Parent Materials	123
3.3.4	Soils Developed from Predominantly Dioritic and Basalt Parent Materials	128
3.3.5	Soils Developed from Undifferentiated Igneous Rock Parent Material	128
3.3.6	Soils Developed from Conglomerates/Agglomerates Parent Material	129
3.4	Soils that Developed from Sedimentary Rocks	130
3.4.1	The Limestone Soils of the Philippines	130
3.4.2	Soils Developed from Shale Parent Material	135
3.4.3	Soils Underlain by Sandstone	137
3.4.4	Soils Developed from Shale-Sandstone	140
3.4.5	Soils Originating from Mix of Calcareous Materials, Shale, and Sandstone	141
3.5	Soils that Developed from Metamorphic Rocks	141
3.5.1	Soils Developed from Underlying Quartzite, Schist, Slate, and Marble	141
3.6	Soils that Developed from Mixed Parent Materials	142
3.6.1	Soils Developed from Mixed Sedimentary and Igneous Rocks	142
3.6.2	Soils from Undifferentiated Metamorphic/Igneous- Metamorphic-Shale	142
	References	147
4	The Soils of the Hills and Mountains	149
4.1	Alluvial Soils of the Plateaus	149
4.1.1	Soils of the Plateaus with Poor Drainage or Presence of Redoximorphic Features	149
4.1.2	Soils of the Plateaus with Good Drainage	150
4.2	Soils that Developed from Volcanic Tuff	150
4.2.1	Soils Underlain by Diliman Tuff, Well-Drained	150
4.2.2	Soils Underlain by Various Macolod Corridor Tuff	151
4.2.3	Soils Underlain by Southern Sierra Madre Tuff	152
4.3	Soils that Developed from Igneous Rocks	152
4.3.1	Soils Developed from Predominantly Andesite Parent Materials	152
4.3.2	Soils Developed from Predominantly Basalt Parent Materials . . .	154

4.3.3	Soils Developed from Andesite–Basalt Parent Materials	157
4.3.4	Soils Developed from Diorites	162
4.3.5	Soils Developed from Diorites and Quartz	163
4.3.6	Soils Developed from Quartz and Siliceous Rocks	164
4.3.7	Soils Developed from Conglomerate and Agglomerate Rocks (Mixed Igneous).	164
4.3.8	Soils Developed from Andesitic, Basaltic, Dacitic, or Ultrabasic Rocks	166
4.3.9	Soils Developed from Undifferentiated Igneous Bedrock, with Good Drainage	167
4.4	Soils that Developed from Sedimentary Rocks	168
4.4.1	Soils Developed from Limestone	168
4.4.2	Soils that Developed from Shale Parent Material	169
4.4.3	Soils that Developed from Shale and Other Sedimentary Materials	172
4.4.4	Soils that Developed from Sandstone Parent Material	173
4.4.5	Soils Developed from Cherts and Jaspers	175
4.4.6	Soils Developed from Mixed Metamorphic: Shale and Sandstone	176
4.5	Soils that Developed from Metamorphic Rocks	177
4.5.1	Soils Developed from Weathering of Marble	177
4.5.2	Soils Developed from Metamorphic Rocks Underlain by Weathered Shale Rock	177
4.5.3	Soils Developed from Predominantly Metamorphic Rocks	177
4.6	Soils that Developed from Mixed Parent Materials	178
4.6.1	Soils Developed from Mixed Igneous and Metamorphic Parent Materials	178
4.6.2	Soils Developed from Mixed Metamorphic and Sedimentary Parent Materials	178
4.6.3	Soils Developed from Igneous and Sedimentary Parent Materials	179
	References	185
5	Soils and the Philippine Economy	187
5.1	The Soil as the Patrimony of Our Nation and Vital Economic Resource	188
5.1.1	The Soil as Biomass Producer	188
5.1.2	The Soil as Platform for Human Activities	188
5.1.3	The Soil as an Environmental Regulator for Atmospheric, Hydrological, and Nutrient Cycles	189
5.1.4	Sustainable Economic Use of Soil Resources	190
5.2	Major Rice Soils of the Philippines	190
5.2.1	Introduction	190
5.2.2	The Ideal Soil for Growing Rice	191
5.2.3	The National Rice Production Program	192
5.2.4	Summary on Rice Areas and the Rice Program	194
5.3	Soils Grown to Other Economically Important Crops	195
5.3.1	Introduction	195
5.3.2	Economically Important Crops and the Philippine Agricultural Geography	196
5.3.3	The Ideal Corn Soils	197

5.3.4	The Ideal Coconut Soils	197
5.3.5	The Ideal Sugarcane Soils	198
5.3.6	Best Soil and Water Management Practices for the Growing of Upland Crops	199
5.4	Problem Soils of the Philippines	202
5.4.1	Introduction.	202
5.4.2	Definition and Extent of Problem Soils in the Philippines.	203
5.4.3	Soils with Steep Slopes	203
5.4.4	The Poorly Drained Soils	205
5.4.5	The Coarse-Textured Soils	206
5.4.6	The Heavy Cracking Clay Soils.	207
5.4.7	Low Fertility Acid Soils	207
5.4.8	The Saline-Sodic Soils	209
5.4.9	The Acid Sulfate Soils	210
5.4.10	Peat Lands	211
5.4.11	Mine Tailings	212
5.4.12	Summary of Problem Soils in the Philippines	214
5.5	Maximizing Economic Benefits from Soils Through Land Evaluation . . .	216
5.5.1	Introduction.	216
5.5.2	Principles of Land Evaluation	217
5.5.3	Basic Land Evaluation Concepts	217
5.5.4	Developing the Diagnostic Criteria.	220
5.5.5	The Land Evaluation Process	222
5.5.6	Sample Application of Land Evaluation: Updating the Strategic Agriculture and Fisheries Development Zones as the Agricultural Component of the Updated Comprehensive Land Use Plan	223
5.6	The Soil as National Asset: Soil Valuation and Accounting	237
5.6.1	The Soil as an Economic and Environmental Asset	237
5.6.2	Physical Inventory of Soil and Land Resources as National Patrimony	238
5.6.3	Part 1: Soil Resources Inventory Research Agenda	238
5.6.4	Part 2: Land Resources Inventory Research Agenda.	239
5.6.5	Monetary Valuation of Soil and Land Resources	240
5.6.6	Changes in Stock Inventory.	241
5.6.7	Summary and Conclusion	242
5.7	Land Degradation Assessment	242
5.7.1	The Philippine Commitment to UNCCD.	243
5.7.2	The Philippine LADA Project	243
5.7.3	Basic Land Degradation Concepts	243
5.7.4	The Philippine Land Use System.	244
5.7.5	Comparing GLC2000 Against GC2009.	246
5.7.6	The Agricultural Lands.	251
5.7.7	The Forest Lands	253
5.7.8	Mangrove Forest	254
5.7.9	Wetlands.	256
5.7.10	Initial Conclusions from the LADA Study	259
5.8	Sustainable Economic Use of Soil Resources	260
5.8.1	Sustainable Farming Philosophy Hinged on Nutrient Recycling.	260
5.8.2	Translating Agricultural Production Philosophies into Policy Advocacies	262

5.8.3	The Battle Against Flood: An Ignored Lesson from Social Studies Classes	263
5.8.4	A Sample Political Platform Hinged on Sustainable Agricultural Philosophy	265
	References	268
6	Soil Issues and Challenges	273
6.1	Quingua Series and a Flood-Free Home	273
6.2	A Plush Subdivision in a Heavy Cracking Clay Soil	274
6.3	Soil Carbon Sequestration and a Look at Organic Soils	276
6.4	A Loophole in the Agribusiness Enterprise Development Planning	278
6.5	A Second Look at a Typical Rice Soil: Are There Still Researchable Areas?.	280
6.6	A Lost Step in Soil Renewal Cycle in the Quest for Economic Progress	282
6.7	Crop Production Sustainability for Intensively Used Soils.	284
6.8	Improving Productivity of Acid Uplands and Hillylands.	286
6.9	Soil Pollution Coming from Organic Fertilizers?	288
6.10	Soil Ecology and the Watershed as Unit of Rural Planning.	289
6.11	Soils and Global Competitiveness of Our Industrial Crops	292
6.12	Prawns that Just Grew to Shrimp Size	295
6.13	Last Words: Today's Battle Cry is No Longer Food Security but Food Sovereignty	296
6.13.1	Food Security	296
6.13.2	Food Sovereignty.	296
6.13.3	Food Sovereignty and the National Food Production Policy	297
6.13.4	Food Sovereignty: The Simple Case of a Woman Rice Farmer in Visayas	298
6.13.5	Food Sovereignty: The Sample Cases of Diversified Farmers in Visayas and Mindanao	300
6.13.6	Summary and Conclusion	301
	References	301
	Authors' Biography.	305
	Soil Series Maps of the Philippines	309
	Appendix A: Major Rice Soils of the Philippines	313
	Appendix B: Major Soils Grown to Economically Important Crops	321
	Glossary	333
	Index	343

The Soils of the Philippines

Carating, R.B.; Galanta, R.G.; Bacatio, C.D.

2014, XXII, 346 p. 226 illus., 219 illus. in color.,

Hardcover

ISBN: 978-94-017-8681-2