

Table of contents

1. INTRODUCTION	7
2. DEFINITION AND CONCEPTS OF AGROFORESTRY	8
2.1. The role of Agroforestry	8
3. THE HISTORY OF AGROFORESTRY	11
4. AGROFORESTRY SPECIES: THE MULTIPURPOSE TREES	12
4.1. Multipurpose trees (MPTs)	12
4.1.1. Fodder trees	13
4.1.2. Fuelwood trees	13
4.1.3. Fruit trees	13
4.1.4. Other underexploited woody perennials	13
4.1.5. Improvement of MPTs: the ideotype concept	14
4.2. Herbaceous species	16
5. CLASSIFICATION OF AGROFORESTRY SYSTEMS	18
5.1. Structural classification of systems	19
5.1.1. Based on the nature of components	19
5.1.2. Based on the arrangement of components	20
5.2. Classification based on function of systems	20
5.3. Ecological classification	21
5.4. Classification based on socioeconomic criteria	21
5.5. A framework for classification	22
5.6. Agroforestry systems and practices	23
6. DISTRIBUTION OF AGROFORESTRY SYSTEMS IN THE TROPICS	26
6.1. The tropical environment	26
6.2. Distribution of tropical agroforestry systems	27
6.2.1. Lowland humid and subhumid tropics	28
6.2.2. Semiarid and arid tropics	29
6.2.3. Tropical highlands	29
6.3. Agroecological spread of tropical agroforestry systems	30
7. AGROFORESTRY PRACTICES	34
7.1. Shifting cultivation	34
7.1.1. Concept of shifting cultivation	34
7.1.2. Who are the shifting cultivators?	35
7.1.3. Sustainability	36
7.1.4. Shifting cultivation as a cause of deforestation	36
7.1.5. Shifting cultivation and Imperata problem	37
7.1.6. Soil Management and shifting cultivation	38
7.1.7. Improvement of shifting cultivation	39
7.2. Improved fallow	39
7.2.1. The evolution of planted fallows	39
7.2.2. The concept of improved tree fallow	42
7.2.3. Fallow management	43
7.3. Taungya	45
7.4. Homegardens	46
7.4.1. Types of homegardens	47
7.4.2. Structure of homegardens	49
7.4.3. Food production from homegardens	51
7.5. Plantation crop combinations	52
7.5.1. Integrated land-use systems with plantation crops	53
7.5.2. Smallholder systems with coconuts: a notable example of integrated land-use	54

7.5.3. Crop combination with other plantation crops	56
7.5.4. Multistory tree gardens	58
7.6. Hedgerow intercropping	59
7.6.1. Nutrient yield	59
7.6.2. Effect on soil properties and soil conservation	60
7.6.3. Effect on crop yields	61
7.6.4. Future directions	63
7.7. Other agroforestry systems and practices	65
7.7.1. Tree fodder and silvopastoral systems	65
7.7.2. Agroforestry for fuelwood production	67
7.7.3. Intercropping under scattered or regularly planted trees	68
7.7.4. Agroforestry for reclamation or problem soils	70
7.7.5. Buffer-zone agroforestry	71
8. TEMPERATE AGROFORESTRY SYSTEMS	73
8.1. Characteristics of temperate-zone agroforestry	73
8.2. Historical perspective	74
8.3. Current temperate-zone agroforestry systems	75
8.3.1. Intercropping under hardwood species	75
8.3.2. Livestock grazing in managed plantations (silvopastoral systems)	76
8.3.3. Windbreaks	76
8.4. Agroforestry in Europe	78
8.4.1. Forest grazing	79
8.4.2. Quality timber from new silvopastoral systems	80
8.4.3. Trees in silvoarable systems	81
8.4.4. Fodder trees	87
8.4.5. Future of European agroforestry	88
9. AGROFORESTRY FOR SOIL MANAGEMENT	90
9.1. Soil fertility and land degradation	90
9.2. Agroforestry and soil erosion	92
9.3. Soil organic matter	94
9.3.1. Input of organic matter	95
9.3.2. Decomposition of organic matter	97
9.4. Nutrient cycling	97
9.4.1. Nitrogen fixation	98
9.4.2. Efficiency use	99
9.5. The general soil-agroforestry hypothesis	100
9.6. How We Know That Trees Improve Soils	103
9.7. Tree-Soil Transects	103
9.8. The albida effect	105
9.9. Processes by which Trees Improve Soils	106
9.9.1. Processes which increase additions to the soil	107
9.9.2. Processes which reduce losses from the soil	107
9.9.3. Processes which affect soil physical conditions	108
9.9.4. Processes which affect soil chemical conditions	108
9.9.5. Soil biological processes and effects	109
9.10. Adverse Effects of Trees on Soils	110
9.10.1. Allelopathy	110
9.10.2. Acidification	111
9.10.3. Removal of organic matter and nutrients in tree harvest	111
10. TREE-CROP INTERACTION	112
10.1. Main Types of Tree-Crop Interaction	112
10.1.1. Competition and complementarity: definition	113
10.1.2. Quantification of competition	114
10.1.3. Quantification of resource capture	115
10.1.4. Advantages of trees for resource capture	116

10.1.5 Evidence for complementarity in resource capture	117
10.2. Methods for Quantifying Interactions in Mixtures.....	118
10.2.1. Land equivalent ratio.....	118
10.2.2. Tree-crop interaction (TCI) equation.....	119
10.2.3. Quantifying interaction in hedgerow intercropping	120
10.3. Below-ground interactions	121
10.3.1 Nutrient pump and safety net hypotheses.....	122
GLOSSARY	124
LIST OF ACRONYMS AND ABBREVIATIONS¹	128
REFERENCES	129

productivity due to erosion is one of the most serious threats to agricultural productivity today. What land is available is quickly degraded, and the remaining land declines in crop and livestock productivity. The erosion alone has led to the loss of approximately 50% of the world's arable land resources, and is a major cause of erosion. That is why there is renewed interest in strategies for management of agricultural lands.

It has been estimated that approximately 100 million hectares of the world's forests cut down each year is needed to replace the amount lost to agriculture due to erosion and consequent loss of soil fertility. Other agricultural lands and cropland are gradually degraded to land with very low productivity. Over 60% of the deforestation of tropical rain forests is caused by agricultural agriculture settlement. These farmers largely convert the land to agriculture by slash-and-burn. As traditional slash-and-burn (or shifting cultivation) systems, long fallow periods are no longer feasible in most parts of the world, resulting in the loss of the structure and processes of natural forest systems. These systems have a high potential to increase the productivity of farming systems and improve crop production. Agroforestry is also considered to be a promising alternative to shifting cultivation or other monocropping systems.

Farm productivity in the tropics may be increased through the adoption of agroforestry in conjunction with the domestication of native tree species. The International Centre for Tropical Agroforestry (ICRAF) is helping to improve agroforestry systems through the development of alternatives to slash-and-burn agriculture through agroforestry systems, such as multi-strata agroforestry (planting of legumes, fruit and timber trees), improved fallows (planting of legumes and fast growing trees to improve soil fertility period and improve food security) and domestication of native tree species. These diverse and potentially sustainable land uses such as agroforestry systems can, to the extent possible, build on farmers' existing experiences with agroforestry systems, pastures and livestock, and forest products. Therefore, the adoption of agroforestry through agroforestry is expected to reduce deforestation, and agroforestry is expected to be a primary forest.

Agroforestry has attracted much great attention, especially in the tropics, in many tropical lands, particularly for marginal areas. Many areas are considered to be unsuitable although too dry, too steep, or too rocky to be considered for agriculture. The practice of agroforestry, but the adoption of a new agroforestry system is expected to be