Carbon capture and storage (CCS) has been considered as a practical way in sequestering the huge anthropogenic CO2 amount with a reasonable cost until a more pragmatic solution appears. The CCS can work as a bridge before fulfilling the no-CO2 era of the future by applying to large-scale CO2 emitting facilities. But CCS appears to lose some passion by the lack of progress in technical developments and in commercial success stories other than EOR. This is the time to go back to basics, starting from finding a solution in small steps. The CCS technology desperately needs far newer ideas and breakthroughs that can overcome earlier attempts through improving, modifying, and switching the known principles. This book tries to give some insight into developing an urgently needed technical breakthrough through the recent advances in CCS research, in addition to the available small steps like soil carbon sequestration. This book provides the fundamental and practical information for researchers and graduate students who want to review the current technical status and to bring in new ideas to the conventional CCS technologies. ‘Homegardens’ are integrated tree–crop–animal production systems, often established on small parcels of land surrounding homesteads, and primarily found in tropical environments. This multi-authored volume contains peer-reviewed chapters from the world’s leading researchers and professionals in this topic. It summarizes the current state of knowledge on homegarden systems, with a view to using this knowledge as a basis for improving both homegardens and other similar multistrata agroforestry systems.

With carbon farming, agriculture ceases to be part of the climate problem and becomes a critical part of the solution Agriculture is rightly blamed as a major culprit of our climate crisis. But in this groundbreaking new book, Eric Toensmeier argues that agriculture—specifically, the subset of practices known as “carbon farming”—can, and should, be a linchpin of a global climate solutions platform. Carbon farming is a suite of agricultural practices and crops that sequester carbon in the soil and in aboveground biomass. Combined with a massive reduction in fossil fuel emissions—and in concert with adaptation strategies to our changing environment—carbon farming has the potential to bring us back from the brink of disaster and return our atmosphere to the “magic number” of 350 parts per million of carbon dioxide. Toensmeier’s book is the first to bring together these powerful strategies in one place, including in-depth analysis of the available research and, where research is lacking, a discussion of what it will take to get us there. Carbon farming can take many forms. The simplest practices involve modifications to annual crop production. Although many of these modifications have relatively low sequestration potential, they are widely applicable and easily adopted, and thus have excellent potential to mitigate climate change if practiced on a global scale. Likewise, grazing systems such as silvopasture are easily replicable, don’t require significant changes to human diet, and—given the amount of agricultural land worldwide that is devoted to pasture—can be important strategies in the carbon farming arsenal. But by far, agroforestry practices and perennial crops present the best opportunities for sequestration. While many of these systems are challenging to establish and manage, and would require us to change our diets to new and largely unfamiliar perennial crops, they also offer huge potential that has been almost entirely ignored by climate crusaders. Many of these carbon farming practices are already implemented globally on a scale of millions of hectares. These are not minor or marginal efforts, but win-win solutions that provide food, fodder, and feedstocks while fostering community self-reliance, creating jobs, protecting biodiversity, and repairing degraded land—all while sequestering carbon, reducing emissions, and ultimately contributing to a climate that will remain amenable to human civilization. Just as importantly to a livable future, these crops and practices can contribute to broader social goals such as women’s empowerment, food sovereignty, and climate justice. The Carbon Farming Solution does not present a prescription for how cropland should be used and is not, first and foremost, a how-to manual, although following up on references in a given section will frequently provide such information. Instead, The Carbon Farming Solution is—at its root—a toolkit. It is the most complete collection of climate-friendly crops and practices currently available. With this toolkit, farmers, communities, and governments large and small, can successfully launch carbon farming projects with the most appropriate crops and practices to their climate, locale, and socioeconomic needs. Toensmeier’s ultimate goal is to place carbon farming firmly in the center of the climate solutions platform, alongside clean solar and wind energy. With The Carbon Farming Solution, Toensmeier wants to change the discussion, impact policy decisions, and steer mitigation funds to the research, projects, and people around the world who envision a future where agriculture becomes the protagonist in this fraught, urgent, and unprecedented drama of our time. Citizens, farmers, and funders will be inspired to use the tools presented in this important new book to transform degraded lands around the world into productive carbon-storing landscapes.

Agroforestry has come of age during the past three decades. The age-old practice of growing trees and crops and sometimes animals in interacting combinations—has been ignored in the single-commodity-oriented agricultural and forestry development paradigms—has been brought into the realm of modern land-use. Today agroforestry is well on its way to becoming a specialized science at a level similar to those of crop science and forestry science. To most land-use experts, however, agroforestry has a tropical connotation. They consider agroforestry as something that can and can only be identified with the tropics. That is a wrong perception. While it is true that the tropics, compared to the temperate regions, have a wider array of agroforestry systems and hold greater promise for potential agroforestry interventions, it is also true that agroforestry has several opportunities in the temperate regions too. Indeed, the role of agroforestry is now recognized in Europe as exemplified by this book, North America, and elsewhere in the temperate zone. Current interest in ecosystem management in industrialized countries strongly suggests that there is a need to embrace and apply agroforestry principles to help mitigate the environmental problems caused or exacerbated by commercial agricultural and forestry production enterprises.

This volume contains a solid body of the current state of knowledge on the various themes and activities in agroforestry worldwide. It is organized into three sections: the Introduction section consists of the summaries of six keynote speeches at the 2nd World Congress of Agroforestry held in Nairobi, Kenya, in 2009; that is followed by two sections of peer-reviewed thematic chapters grouped as “Global Perspectives” (seven chapters) and “Regional Perspectives” (eleven chapters), authored by professional leaders in their respective agroforestry-related fields worldwide. A total of 130 professionals from institutions in 33 countries in both developing and the industrialized temperate regions of the world contributed to the book as chapter authors and/or reviewers. Thus, the book presents a comprehensive and authoritative account of the global picture of agroforestry today. Agroforestry is the cultivation, by farmers, of trees or other woody plants with crops or pasture. Its scientific study is attracting great
interest and increasing funding because of its potential to produce sustainable agricultural systems and agroforestry is now included in most university and college courses covering land use subjects. Tropical Agroforestry is the first book that provides an analytical account of the principles, as well as the practices, of agroforestry within the context of the needs of land occupiers and, in so doing, describes the various specialist aspects that are now emerging as part of this discipline. The main objective throughout the book is to present, in a readable way, the underlying functional basis of woody/non-woody plant mixtures and to give a balanced account of how agroforestry can contribute to sustainable production from land. Understanding the biology of multipurpose trees is a key to this. This book is divided in two sections. Several chapters in the first section provide a state-of-the-art review of various carbon sinks for CO2 sequestration such as soil and oceans. Other chapters discuss the carbon sequestration achieved by storage in kerogen nanopores, CO2 miscible flooding and generation of energy efficient solvents for postcombustion CO2 capture. The chapters in the second second section focus on monitoring and tracking of CO2 migration in various types of storage sites, as well as important physical parameters relevant to sequestration. Both researchers and students should find the material useful in their work. Agroforestry in Sustainable Agricultural Systems examines the environmental and social conditions that affect the roles and performance of trees in field- and forest-based agricultural production systems. Various types of ecological settings for agroforestry are analyzed within temperate and tropical regions. The roles of soil, water, light, nutrient and pest management in mixed, annual, woody perennial and livestock systems are discussed. Important new case studies from around the world offer innovative strategies that have been used successfully in raising forests and tree products on a sustainable basis for commercial harvesting and for providing other environmental services in land conservation and watershed management. The publication was launched at the Global Symposium on Soil Organic Carbon (GSOC) held at FAO headquarters (Rome, 21-23 March 2017). It provides an overview to decision-makers and practitioners of the main scientific facts and information regarding the current knowledge and knowledge gaps on Soil Organic Carbon. It highlights how better information and good practices may be implemented to support ending hunger, adapting to and mitigating climate change and achieving overall sustainable development.

It was in late 2002 that the idea of preparing a collection of multi-authored chapters on different aspects of ag- st forestry as a compendium for the 1 World Congress of Agroforestry, June 2004, was tossed around. With the approval of the idea by the Congress Organizing Committee, serious efforts to make it a reality got under way in early 2003. The rigorously peer-reviewed and edited manuscripts were submitted to the publisher in December 2003. Considering the many different individuals involved in the task as authors and manuscript reviewers, we feel quite pleased that the task could be accomplished within this timeframe. We are pleased also about the contents on several counts. First of all, the tropical-temperate mix of topics is a rare feature of a publication of this nature. In spite of the scientific commonalities between tropical and temperate practices of agroforestry, the differences between them are so enormous that it is often impossible to mesh them together in one publication. Secondly, several of the chapters are on topics that have not been discussed or described much in agroforestry literature. A third feature is that of the authors, though well known in their own disciplinary areas, are somewhat new to agroforestry; the perceptions and outlooks of these scholars who are relatively unin?uenced by the past happenings in agroforestry gives a whole new dimension to agroforestry and broadensthescopoefthesubject. Finally, ratherthanjustreviewingandsummarizingpastwork,mostchapterstake the extra effort in attempting to outline the next steps. Agroforestry, the word coined in early seventies, has made its place in all the developed and the developing countries of the world and is now recognized as an important approach to ensuring food security and rebuilding resilient rural environments. India has been an all-time leader in agroforestry. The South and Southeast Asia region comprising India is often described as the cradle of agroforestry. Almost all forms of agroforestry systems exist across India in ecozones ranging from humid tropical lowlands to high-altitude and temperate biomes, and perhumid rainforest zones to parched drylands. The country ranks foremost among the community of nations not only in terms of its enormous diversity and long tradition of the practice of agroforestry, but also in fostering scientific developments in the subject. Agroforestry applies to private agricultural and forest lands and communities that also include highly erodible, flood-prone, economically marginal and environmentally sensitive lands. The typical situation is agricultural, where trees are added to create desired benefits. Agroforestry allows for the diversification of farm activities and makes better use of environmental resources. Owing to an increase in the population of human and cattle, there is increasing demand of food as well as fodder, particularly in developing countries like India. So far, there is no policy that deals with specifics in agroforestry in India. But, the Indian Council of Agricultural Research has been discussing on the scope of having a National Agroforestry Policy in appropriate platforms. However, evolving a policy requires good and reliable datasets from different corners of the country on the subject matter. This synthesis volume containing 13 chapters is an attempt to collate available information in a classified manner into different system ecologies, problems and solutions, and converging them into a policy support. Building on FAO policy advice and incorporating lessons from ongoing agricultural carbon finance projects of FAO and other organizations, this document will provide an overview of potential mitigation finance opportunities for soil carbon sequestration. The first part provides an overview of the opportunities for climate change mitigation from agricultural soil carbon sequestration. The second part is aimed primarily at carbon projects developers and decision makers at national level concerned with environmental and agriculture policies and incentives and farmers’ associations working towards rural development and poverty alleviation. Soil organic carbon (SOC), a key component of the global carbon (C) pool, plays an important role in C cycling, regulating climate, water supplies and biodiversity, and therefore in providing the ecosystem services that are essential to human well-being. Most agricultural soils in temperate regions have now lost as much as 60% of their SOC, and as much as 75% in tropical regions, due to conversion from natural ecosystems to agricultural uses and mainly due to continuous soil degradation. Sequestering C can help to offset C emissions from fossil fuel combustion and other C-emitting activities, while also enhancing soil quality and long-term agronomic productivity. However, developing effective policies for creating terrestrial C sinks is a serious challenge in tropical and subtropical soils, due to the high average annual temperatures in these regions. It can be accomplished by implementing improved land management practices that add substantial amounts of biomass to soil, cause minimal soil disturbance, conserve soil and water, improve soil structure, and enhance soil fauna activity. Continuous no-till crop production is arguably the best example. These soils need technically sound and economically feasible strategies to sustainably enhance their SOC pools. Hence, this book provides comprehensive information on SOC and its management in different land-use systems, with a focus on preserving soils...
and their ecosystem services. The only book of its kind, it offers a valuable asset for students, researchers, policymakers and other stakeholders involved in the sustainable development and management of natural resources at the global level. This college-level textbook summarizes the state of current knowledge in the rapidly expanding field of agroforestry. The book, organized into 25 chapters in six sections, reviews the developments in agroforestry during the past 15 years and describes the accomplishments in the application of biophysical (plant and soil related) and socioeconomic sciences to agroforestry. Although the major focus of the book is on the tropics, where the practice and potential of agroforestry are particularly promising, the developments in temperate zone agroforestry are also discussed. This text is recommended for students, teachers, and researchers in agroforestry, farming systems, and tropical land use.

- New York Times bestseller
- The 100 most substantive solutions to reverse global warming, based on meticulous research by leading scientists and policymakers around the world “At this point in time, the Drawdown book is exactly what is needed; a credible, conservative solution-by-solution narrative that we can do it. Reading it is an effective inoculation against the widespread perception of doom that humanity cannot and will not solve the climate crisis. Reported-by-effects include increased determination and a sense of grounded hope.”—Per Espen Stoknes, Author. What We Think About When We Try Not To Think About Global Warming “There’s been no real way for ordinary people to get an understanding of what they can do and what impact it can have. There remains no single, comprehensive, reliable compendium of carbon-reduction solutions across sectors. At least until now. . . . The public is hungry for this kind of practical wisdom.”—David Roberts, Vox “This is the ideal environmental sciences textbook—only it is too interesting and inspiring to be called a textbook.”—Peter Kareiva, Director of the Institute of the Environment and Sustainability, UCLA In the face of widespread fear and apathy, an international coalition of researchers, professionals, and scientists have come together to offer a set of realistic and bold solutions to climate change. One hundred techniques and practices are described here—some are well known; some you may have never heard of. They range from clean energy to educating girls in lower-income countries to land use practices that pull carbon out of the air. The solutions exist, are economically viable, and communities throughout the world are currently enacting them with skill and determination. If deployed collectively on a global scale over the next thirty years, they represent a credible path forward, not just to slow the earth’s warming but to reach drawdown, that point in time when greenhouse gases in the atmosphere peak and begin to decline. These measures promise cascading benefits to human health, security, prosperity, and well-being—giving us every reason to see this planetary crisis as an opportunity to create a just and livable world.

Over the past decade the potential of agroforestry systems to sequester carbon and their role in providing ecosystem services has become the forefront of research as a result of global climate change. Agroforestry, that unambiguously integrates trees into land use systems, has traditionally contributed to global climate change adaptation. Hence, the promotion of Agroforestry is vitally vital to reinforce the resiliency of the country to future global climate change. Agroforestry and Climate Change provides a wide-ranging coverage of comprehensive information on emerging eco-friendly technology and its prospective role in contesting climate change through agroforestry. The book starts with highlights three ways agroforestry can be part of a climate change response: adapt to increased risks and uncertainties, facilitate an energy transition, and restoring landscape multifunctionality to allow current human resource appropriation to become sustainable, fitting sustainable development goals within planetary boundaries. Next, this book covers a study that presents how to use local agroecological knowledge in climate change adaptation. Further, this book presents a literature review to shed light on the social, environmental and economic benefits and challenges of using agroforestry systems for the purposes of conservation and restoration. The book also focuses on - carbon revenue in the profitability of agroforestry relative to monocultures; carbon sequestration potential of agroforestry systems in India; estimating carbon storage in windbreak trees on U.S. agricultural lands; agroforestry practices and carbon sequestration cost estimates among forest land dependent households in Nigeria; and reducing subsistence farmers’ vulnerability to climate change: evaluating the potential contributions of agroforestry in western Kenya. Additionally, the book reviews the literature and discusses the adverse impacts of climate change on agriculture and forestry, the effects of adapting agroforestry on climate changes, and important policies for promoting agroforestry adaptation. Climate change may significantly reduce the productivity of farms globally. Potential impact of climate change on farm productivity is a significant concern given that agriculture represents the primary livelihood strategy for most rural poor in tropical developing countries. In the last, therefore, this book presents contribution of agroforestry to climate change mitigation and livelihoods in developing countries.

Agroforestry systems are believed to provide a number of ecosystem services; however, until recently evidence in the agroforestry literature supporting these perceived benefits has been lacking. This volume brings together a series of papers from around the globe to address recent findings on the ecosystem services and environmental benefits provided by agroforestry. Specifically, this volume examines four major ecosystem services and environmental benefits: (1) carbon sequestration, (2) biodiversity conservation, (3) soil enrichment and (4) air and water quality. Past and present evidence clearly indicates that agroforestry, as part of a multifunctional working landscape, can be a viable land-use option that, in addition to alleviating poverty, offers a number of ecosystem services and environmental benefits. This realization should help promote agroforestry and its role as an integral part of a multifunctional working landscape the world over. The book should be particularly useful to students, professionals, researchers and policy makers involved in natural resource management, agroforestry, biodiversity conservation, and environmental management. Reprinted from Agroforestry Systems, Volume 76, No. 1 (2009)


Forests grow and their biomass increases; they absorb carbon from the atmosphere and store it in plant tissue. Understanding the biomass of forest vegetation is essential for determining the storage of carbon in the dominant tree component and computing carbon cycling at a regional as well as global level. This book consisting of five chapters will give a comprehensive understanding of biomass production vis-à-vis carbon storage in relation to litter and nutrient dynamics of the forest by analyzing the mode and magnitude of biomass production and carbon storage as a function of various silvicultural factors. This book discusses different strategies that can be adopted by agriculture and industry to enhance CO2 sequestration and reduce the impacts of global warming and climate change. Written by researchers from different fields, chapters cover such topics as the management of agricultural systems with the implementation of agronomic practices that can reduce greenhouse gas emissions and increase soil carbon stocks, the technology of adsorption on activated carbon from low-cost raw material, and the effective methods of carbon capture and storage, among others. This volume is a useful reference for the general public, undergraduate and graduate students, and researchers who aim to deepen their knowledge of those topics.
To achieve goals for climate and economic growth, "negative emissions technologies" (NETs) that remove and sequester carbon dioxide from the air will need to play a significant role in mitigating climate change. Unlike carbon capture and storage technologies that remove carbon dioxide emissions directly from large point sources such as coal power plants, NETs remove carbon dioxide directly from the atmosphere or enhance natural carbon sinks. Storing the carbon dioxide from NETs has the same impact on the atmosphere and climate as simultaneously preventing an equal amount of carbon dioxide from being emitted. Recent analyses found that deploying NETs may be less expensive and less disruptive than reducing some emissions, such as a substantial portion of agricultural and land-use emissions and some transportation emissions. In 2015, the National Academies published Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration, which described and initially assessed NETs and sequestration technologies. This report acknowledged the relative paucity of research on NETs and recommended development of a research agenda that covers all aspects of NETs from fundamental science to full-scale deployment. To address this need, Negative Emissions Technologies and Reliable Sequestration: A Research Agenda assesses the benefits, risks, and "sustainable scale potential" for NETs and sequestration. This report also defines the essential components of a research and development program, including its estimated costs and potential impact.

This document attempts to present the current state of knowledge on agroforestry parkland systems. These systems, which for many local populations are very important for food security, income generation and environmental protection, are found primarily in the semi-arid and sub-humid zones of West Africa. The document provides a thorough description of their distribution and diversity and discusses different ways of classifying them. It also presents data on current trends in parkland development and assesses determining factors. The document then provides an in-depth analysis of biophysical tree-soil-crop interactions and the factors regulating them, and describes various improved parkland management techniques. It goes on to examine the strength and limitations of institutional arrangements as well as the constraints imposed by Sahelian forest policies on the sustainable management of parklands. The production, use and marketing of parkland products is reviewed with an emphasis on their contribution to food security, local and national income as well as social values. Overall costs and benefits of the practice of parkland agroforestry are evaluated. In conclusion, the document identifies crucial research needs and promising avenues for promoting sustainable management of parkland systems.

ABSTRACT: In recent years, carbon (C) sequestration potential of agroforestry systems has attracted attention, especially following Kyoto Protocol's recognition of agroforestry as an option for mitigating greenhouse gases. Although the possible benefits of agroforestry in carbon (C) sequestration have been conceptually discussed, field measurements to validate these concepts have not been undertaken to any significant extent. In addition to the traditional agroforestry systems, improved practices and technologies are now being expanded into the dry regions such as the West African Sahel for perceived benefits such as arresting desertification, reducing water and wind erosion hazards, and improving biodiversity. Thus, it is imperative to investigate C sequestration potential of agroforestry practices in these regions. My research hypothesizes that the tree-based systems will retain more C in the systems both above- and below-ground than tree-less land-use systems. By joining the C credit market, the landowners could sell the C sequestered in their agroforestry systems. This research consisted of three components. The first examined C (biomass + soil) stored in five target land-use systems: two traditional parkland systems involving Faidherbia albida and Vitellaria paradoxa trees as the dominant species, two improved agroforestry systems (live.
Online Library Carbon Sequestration Potential Of Agroforestry Systems Opportunities And Challenges Advances In Agroforestry

Organic animal production has increased rapidly in recent years to keep up with the increasing consumer demand for organic meats. There are many guidelines and restrictions on what should go into the feedstuffs of organically farmed animals, from which difficulties arise when trying to ensure a well-balanced, nutritious diet without the use of any supplements. The book has been completely updated and revised to address how to formulate organic diets in situations where there is a declining supply of organic feed, as well as the feasibility of utilizing novel feedstuffs and their acceptability by consumers of organic meat products. Including the experiences of producers in relation to appropriate breeds and production systems for forage-based organic production, this book is an important read for researchers and students of organic food animal production, veterinary sciences and food; as well as food industry personnel and organic farmers.

Agroforestry is recognized as a sustainable land-use management in the tropics, as it provides environmental-friendly ecosystems; it also provides people with their every day need for food and cash. Since the recognition of agroforestry as a science, curricula have been developed for agroforestry programs for undergraduate and graduate trainings in Universities. Therefore, there is an urgent need to develop and make available educational material. This textbook strives to provide up-to-date information on tropical agroforestry to serve as educational material in the tropical context. The authoritative textbook of Nair (1993) on agroforestry was published 18 years ago, and before the advent of tree domestication, an important agroforestry practice today. In addition, many other research activities, such as carbon sequestration and integrated pest management, have been included in the agroforestry agenda. This book is an important read for researchers and students of organic food animal production, veterinary sciences and food; as well as food industry personnel and organic farmers.

This new volume addresses the burning issues of the impact of climate change, the alteration of environmental quality, and subsequent mitigation and adaptation strategies through various agroecosystem practices, primarily in agroforestry. The book discusses in depth the impact of climate change on forests and other agroecosystems. It presents new research on mitigation strategies, looking at carbon sequestration in agricultural soils, environmental greening, natural resource management, and livelihood security. It provides a thorough analysis of the potential of various modern, improved, and scientific farming practices, such as climate-smart agriculture and agroforestry systems for climate change mitigation and adaptation. The book also examines the invasion of major fungal diseases in forests and agricultural crops due to climatic fluctuations and goes on to look at water and waste management practices.

Carbon Inventory Methods Handbook fills the need for a handbook that provides guidelines and methods required for carbon inventory. It provides detailed step-by-step information on sampling procedures, field and laboratory measurements, application of remote sensing and GIS techniques, modeling, and calculation procedures along with sources of data for carbon inventory. The book is driven by a growing need for ‘carbon inventory’ for land use sections such as forests. Much attention has been given to above ground biomass and its potential as a carbon sink, but in a mature forest ecosystem 40 to 60 percent of the stored carbon is below ground. As increasing numbers of forests are managed in a wide diversity of climates and soils, the importance of forest soils as a potential carbon sink grows. The Potenti