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Sustainable Phosphorus Management

A Global Transdisciplinary Roadmap



 Springer

Sustainable Phosphorus Management A Global Transdisciplinary Roadmap

Jim Elser, Phil Haygarth



Sustainable Phosphorus Management A Global Transdisciplinary Roadmap:

Sustainable Phosphorus Management Roland W. Scholz, Amit H. Roy, Fridolin S. Brand, Deborah T. Hellums, Andrea E. Ulrich, 2014-03-12 This book describes a pathway for sustainable phosphorus management via the Global Transdisciplinary Processes for Sustainable Phosphorus Management project Global TraPs Global TraPs is a multi stakeholder forum in which scientists from a variety of disciplines join with key actors in practice to jointly identify critical questions and to articulate what new knowledge technologies and policy processes are needed to ensure that future phosphorus use is sustainable improves food security and environmental quality and provides benefits for the poor The book offers insight into economic scarcity and identifies options to improve efficiency and reduce environmental impacts of anthropogenic phosphorus flows at all stages of the supply and use chain

Phosphate Rock Dilip Kumar, Deepak Kumar, 2023-04-13 Phosphate Rock An Industry in Transition takes an interdisciplinary approach to dealing with the phosphate rock chain and its exploration extraction processing fertilizer making and storage and transportation The book treats the subject from a global perspective giving readers insights into what is happening in the emerging economies of the world and possible solutions to problems It also provides all the parameters necessary to evaluate economic viability of undertaking a mining venture taking into consideration demands of sustainable mining social responsibly environmental pollution control measures community development and precautions necessary for ensuring health and safety in the hazardous conditions of mining operations In recent years supply chain management has grown in importance as it forms tighter links in integration of key business processes from initial extraction of raw phosphate rock to end customers through different stages of process techniques The book surveys the changes in technology including many game changing innovations that could transform mining Presents a purposive classification of resources status of global phosphate rock reserves and their life indices Covers mining conditions and possibilities of improvement in methods of exploration and environmental impact Includes economic considerations for resource assessment mining quality control and supply problems

Phosphorus, Food, and Our Future Karl A. Wyant, Jessica E. Corman, Jim J. Elser, 2013-06-14 Phosphorus is essential to all life A critical component of fertilizers Phosphorus currently has no known substitute in agriculture Without it crops cannot grow With too much of it waterways are polluted Across the globe social political and economic pressures are influencing the biogeochemical cycle of phosphorus A better understanding of this non renewable resource and its impacts on the environment is critical to conserving our global supply and increasing agricultural productivity Most of the phosphorus focused discussion within the academic community is highly fragmented Phosphorus Food and Our Future will bring together the necessary multi disciplinary perspectives to build a cohesive knowledge base of phosphorus sustainability The book is a direct continuation of processes associated with the first international conference on sustainable phosphorus held in the United States the Frontiers in Life Sciences Sustainable Phosphorus Summit though it is not a book of conference proceedings rather the book is part of an integrated coordinated

process that builds on the momentum of the Summit The first chapter will introduce the biological and chemical necessity of phosphorus The subsequent ten chapters will explore different facets of phosphorus sustainability and the role of policy on future global phosphorus supplies The final chapter will synthesize all of the emerging views contained in the book drawing out the leading dilemmas and opportunities for phosphorus sustainability

Soil and Fertilizers Rattan Lal, 2020-05-06

Soil and Fertilizers Managing the Environmental Footprint presents strategies to improve soil health by reducing the rate of fertilizer input while maintaining high agronomic yields It is estimated that fertilizer use supported nearly half of global births in 2008 In a context of potential food insecurity exacerbated by population growth and climate change the importance of fertilizers in sustaining the agronomic production is clear However excessive use of chemical fertilizers poses serious risks both to the environment and to human health Highlighting a tenfold increase in global fertilizer consumption between 2002 and 2016 the book explains the effects on the quality of soil water air and biota from overuse of chemical fertilizers Written by an interdisciplinary author team this book presents methods for enhancing the efficiency of fertilizer use and outlines agricultural practices that can reduce the environmental footprint Features Includes a thorough literature review on the agronomic and environmental impact of fertilizer from degradation of ecosystems to the eutrophication of drinking water Devotes specific chapters to enhancing the use efficiency and effectiveness of the fertilizers through improved formulations time and mode of application and the use of precision farming technology Reveals geographic variation in fertilizer consumption volume by presenting case studies for specific countries and regions including India and Africa Discusses the pros and cons of organic vs chemical fertilizers innovative technologies including nuclear energy and the U N s Sustainable Development Goals Part of the Advances in Soil Sciences series this solutions focused volume will appeal to soil scientists environmental scientists and agricultural engineers

Encyclopedia of Food Security and Sustainability , 2018-11-08

The Encyclopedia of Food Security and Sustainability Three Volume Set covers the hottest topics in the science of food sustainability providing a synopsis of the path society is on to secure food for a growing population It investigates the focal issue of sustainable food production in relation to the effects of global change on food resources biodiversity and global food security This collection of methodological approaches and knowledge derived from expert authors around the world offers the research community food industry scientists and students with the knowledge to relate to and report on the novel challenges of food production and sustainability This comprehensive encyclopedia will act as a platform to show how an interdisciplinary approach and closer collaboration between the scientific and industrial communities is necessary to strengthen our existing capacity to generate and share research data Offers readers a one stop resource on the topic of food security and sustainability Contains articles split into sections based on the various dimensions of Food Security and Food Sustainability Written by academics and practitioners from various fields and regions with a farm to fork understanding Includes concise and accessible chapters providing an authoritative introduction for non specialists and readers from

undergraduate level upwards as well as up to date foundational content for those familiar with the field Soil Organic Matter and Feeding the Future Rattan Lal,2021-12-08 Soil organic matter SOM is the primary determinant of soil functionality Soil organic carbon SOC accounts for 50% of the SOM content accompanied by nitrogen phosphorus and a range of macro and micro elements As a dynamic component SOM is a source of numerous ecosystem services critical to human well being and nature conservancy Important among these goods and services generated by SOM include moderation of climate as a source or sink of atmospheric CO₂ and other greenhouse gases storage and purification of water a source of energy and habitat for biota macro meso and micro organisms a medium for plant growth cycling of elements N P S etc and generation of net primary productivity NPP The quality and quantity of NPP has direct impacts on the food and nutritional security of the growing and increasingly affluent human population Soils of agroecosystems are depleted of their SOC reserves in comparison with those of natural ecosystems The magnitude of depletion depends on land use and the type and severity of degradation Soils prone to accelerated erosion can be strongly depleted of their SOC reserves especially those in the surface layer Therefore conservation through restorative land use and adoption of recommended management practices to create a positive soil ecosystem carbon budget can increase carbon stock and soil health This volume of *Advances in Soil Sciences* aims to accomplish the following Present impacts of land use and soil management on SOC dynamics Discuss effects of SOC levels on agronomic productivity and use efficiency of inputs Detail potential of soil management on the rate and cumulative amount of carbon sequestration in relation to land use and soil crop management Deliberate the cause effect relationship between SOC content and provisioning of some ecosystem services Relate soil organic carbon stock to soil properties and processes Establish the relationship between soil organic carbon stock with land and climate Identify controls of making soil organic carbon stock as a source or sink of CO₂ Connect soil organic carbon and carbon sequestration for climate mitigation and adaptation *Nano-Biochar and Nanoparticles for Soil Health Improvement* Vishnu D. Rajput,Tatiana M. Minkina,2025-03-13 Crop loss and insufficient yield are two important issues faced by farmers A major cause of both of these issues is unhealthy soil Various technological means have been tested and used for purifying soil and making it healthy However they are expensive and often unfriendly to the environment This new book explores sustainable means of soil improvement through the promising use of nano biochar and nanoparticles for improving soil quality as well as for reducing waste The book discusses how nano biochar can improve soil quality and sustainability and explores the various types of nanoparticles and approaches for improving soil health Chapters present research on how nanoparticles and nano biochar can reduce salinity stress improve soil physiochemical properties and improve intrinsic soil characteristics **Adaptive Soil Management : From Theory to Practices** Amitava Rakshit,Purushothaman Chirakuzhyil Abhilash,Harikesh Bahadur Singh,Subhadip Ghosh,2017-03-15 The book focuses in detail on learning and adapting through partnerships between managers scientists and other stakeholders who learn together how to create and maintain sustainable resource systems As

natural areas shrink and fragment our ability to sustain economic growth and safeguard biological diversity and ecological integrity is increasingly being put to the test In attempting to meet this unprecedented challenge adaptive management is becoming a viable alternative for broader application Adaptive management is an iterative decision making process which is both operationally and conceptually simple and which incorporates users to acknowledge and account for uncertainty and sustain an operating environment that promotes its reduction through careful planning evaluation and learning until the desired results are achieved This multifaceted approach requires clearly defined management objectives to guide decisions about what actions to take and explicit assumptions about expected outcomes to compare against actual outcomes In this edited book we address the issue by pursuing a holistic and systematic approach that utilizes natural resources to reap sustainable environmental economic and social benefits for adaptive management helping to ensure that relationships between land water and plants are managed in ways that mimic nature

Soil Degradation and Restoration in Africa Rattan Lal, B. A. Stewart, 2019-07-09 Soil degradation is a widespread problem in Africa resulting in decreased agricultural productivity while demand for food continues to increase Degradation is caused by accelerated erosion acidification contamination depletion of soil organic matter and plant nutrients and salinization The major cause of soil degradation in Africa is uncontrolled and excessive grazing in the savanna regions followed by deforestation and the use of inappropriate and extractive farming practices Perpetual neglect of the health of soils in Africa can exacerbate the already serious problems of food and nutritional insecurity and environmental degradation Food and nutritional security of the growing population of Africa can only be achieved if degraded soils are restored and soils of agroecosystems are managed prudently and sustainably Ignoring soils and taking the fragile finite and precious soil resources for granted is the principal cause of poverty hunger and environmental degradation The downward spiral must be reversed through soil restoration measures based on translating science into action This book describes the soils of Africa processes of soil degradation extent and severity of soil degradation and the impacts of degradation processes on food and nutritional security Features Explores the extent and severity of soil degradation in Africa Analyzes the cause effect relationship between anthropogenic activities and soil degradation Reviews processes of soil degradation in Africa including erosion salinization nutrient depletion and decline of soil organic matter Addresses the effect of climate change on soil degradation in Africa Explains how soil degradation causes food and nutritional insecurity Part of the Advances in Soil Sciences series this volume is specifically devoted to the processes and factors that cause soil degradation and the challenges and potential for remediation and restoration of soil health in Africa

Special Issue: Integrating Approaches to Sustainable Phosphorus Management in Agroecosystems Thomas Nesme, 2016

Peak Phosphorus: Opportunity in the Making Andrea Emmy Ulrich, 2013

Phosphorus Management in Crop Production Nand Kumar Fageria, Zhenli He, Virupax C. Baligar, 2017-02-17 The world population is projected to reach nine billion by 2050 and in the coming years global food demand is expected to increase by 50% or more

Higher crop productivity gains in the future will have to be achieved in developing countries through better natural resources management and crop improvement. After nitrogen, phosphorus (P) has more widespread influence on both natural and agricultural ecosystems than any other essential plant element. It has been estimated that 5.7 billion hectares of land worldwide contain insufficient amounts of available P for sustainable crop production and P deficiency in crop plants is a widespread problem in various parts of the world. However, it has been estimated that worldwide minable P could last less than 40 years. For sustaining future food supplies, it is vital to enhance plant P use efficiency. To bring the latest knowledge and research advances in efficient management of P for economically viable and environmentally beneficial crop production in sustainable agriculture, *Phosphorus Management in Crop Production* contains chapters covering functions and diagnostic techniques for P requirements in crop plants, P use efficiency and interactions with other nutrients in crop plants, management of P for optimal crop production and environmental quality, and basic principles and methodology regarding P nutrition in crop plants. The majority of research data included are derived from many years of field, greenhouse, and lab work; hence the information is practical in nature and will have a significant impact on efficient management of P fertilizers to enhance P use efficiency, improve crop production, promote sustainable agriculture, and reduce P losses through eluviations, leaching, and erosion to minimize environmental degradation. A comprehensive book that combines practical and applied information, *Phosphorus Management in Crop Production* is an excellent reference for students, professors, agricultural research scientists, food scientists, agricultural extension specialists, private consultants, fertilizer companies, and government agencies that deal with agricultural and environmental issues.

Phosphorus in Agriculture: 100 % Zero Ewald Schnug, Luit J. De Kok, 2016-06-14. The title *Phosphorus in Agriculture 100 % Zero* is synonymous for make or break. And it stands up to the promise. This book sends an important message as it delivers background information, intrinsic hypotheses, validation approaches, and legal frameworks all for balanced phosphorus fertilization in agriculture. This implies firstly that the phosphorus requirement of crop is fully satisfied by applying exclusively fertilizers which contain the nutrient in completely available form. Secondly, environmental demands through eutrophication and hazardous contaminants must not be compromised. The book identifies equally knowledge gaps and deficits in the transformation and implementation of research into practice. Bottom line is that research delivers the tools for a sustainable phosphorus management while legal frameworks are insufficient.

Soil Phosphorus Rattan Lal, B.A. Stewart, 2016-09-19. Phosphorus is an essential plant nutrient, but global population growth has dramatically reduced the availability of phosphorus fertilizer resources. Despite this scarcity, there remain numerous problems associated with the excessive and inappropriate use of phosphorus, leading to non-point source pollution and eutrophication of natural waters. Identifying appropriate systems for managing soil phosphorus and reducing the risks of eutrophication are needed to minimize the environmental risks. This book focuses on the availability and recycling of phosphorus, regulatory and policy issues of sustainable phosphorus use, and water quality management in agroecosystems.

pertaining to phosphorus Sections are dedicated to global phosphorus reserves cycling and pathways of phosphorus phosphorus in agriculture human dimensions and policy intervention and research and development priorities Phosphorus is a finite but crucial resource and is an essential element to all life Sub optimal availability and nutrient imbalance in the root zone can adversely impact plant growth and the quality of food and feed grown on these soils However the proven reserves of phosphorus can hardly be adequate for a few centuries only Yet its misuse and mismanagement has caused severe problems of eutrophication of water and pollution of the environment Thus judicious management of soil phosphorus is essential This volume is specifically devoted to availability and recycling of phosphorus regulatory policy issues of sustainable use of phosphorus and management in agroecosystems in the context of maximizing the use efficiency and minimizing the environmental risks of water quality

Smart Strategies for Phosphorus Management and Reutilization in Agriculture Rajinder Kaur,Vagish Dwibedi,Santosh Kumar Rath,Azamal Husen,2026-03-18 Smart Strategies for Phosphorus Management and Reutilization in Agriculture gives a comprehensive exploration of the state of phosphorus in soil addressing the urgent challenge of its depletion while unveiling cutting edge technologies designed to recycle this vital resource for future sustainability The book provides deep insights into emerging biological and chemical techniques that promise sustainable management and recycling of phosphorus ensuring its availability for agricultural use as fertilizers It examines the global status of phosphorus P bridging the gap between soil P dynamics and the pressing issue of its exhaustion Chapters deliver an in depth analysis of industrial processes for P production highlighting the challenges posed by the depletion of P minerals essential for fertilizer manufacturing Readers learn innovative biological chemical and biochemical approaches for reclaiming phosphorus from waste materials transforming waste into a valuable agricultural resource This book is an essential resource for researchers microbiologists chemical engineers and a guide for those seeking to navigate the challenges of phosphorus sustainability and unlock its potential for agricultural innovation

Phosphorus, Food, and Our Future Karl A. Wyant,Jessica R. Corman,James J. Elser,2013-08-08 A complete and multidisciplinary study of phosphorus sustainability stemming from the Frontiers Life Sciences Sustainable Phosphorus Summit

Phosphorus Management for Sustainable Crop Production ICAR - Directorate of Rapeseed-Mustard Research,2020

Phosphorus Jim Elser,Phil Haygarth,2020-12-08 Phosphorus is essential to the production of our food and it also triggers algal blooms in lakes rivers and oceans when it slips through our hands An understanding of this essential resource and how we have used and misused it over the years is crucial to the sustainability of our well being on our planet In this book world authorities on phosphorus sustainability Jim Elser and Phil Haygarth explain this element s involvement in biology human health and nutrition food production ecosystem function and environmental sustainability Phosphorus chronicles the sustainability challenges phosphorus both poses and solves in various contexts The book begins with its discovery over 350 years ago moving to its basic chemistry and the essential role it plays in all living things on Earth Chapters go on to explain the rise in the usage of

phosphorus in agriculture and how the increase in the mining of rock phosphate in the mid 20th century was essential for the Green Revolution. However, phosphorus emissions from human wastes and detergents triggered widespread algal blooms in the 1960s and 1970s. While such emissions have been brought under better control with wastewater treatment, diffuse emissions from farming continue to cause water quality degradation. The authors explain how these diffuse phosphorus emissions may worsen with climate change. In ten concise chapters, Elser and Haygarth offer engaging explanations of our historical use and abuse of phosphorus, including the phosphorus sustainability movement and new efforts to sustain food benefits of limited rock reserves following the phosphate rock price shock in 2007. Highlighting new approaches for phosphorus, the two Systems Innovators turn toward the emerging set of sustainable phosphorus solutions necessary to achieve a sustainable phosphosphere and avoid phosphogeddon. The book provides an insider's take on this essential resource and why all of us need to wrestle with the wicked problems this element will cause illuminate or eliminate in years to come.

Urban Phosphorus Sustainability Geneviève Metson, 2015. Sustainable phosphorus (P) management is emerging as a pressing concern at both global and local scales because P is an essential nutrient in agriculture and an important aquatic pollutant. While there has been considerable progress in our understanding of the problems caused by human alteration of the P cycle, there remain critical knowledge gaps that hinder our ability to effectively manage this key element. For example, although we know cities are hotspots of P movement on the landscape because they concentrate P inputs (food and P outputs: food and sewage waste), we have limited knowledge about how P moves in and through cities and the role cities could play in more sustainable P management. We also do not know how important individual choices such as diet are in determining overall demand for P. In this thesis, I explore the role cities can play in improving P management through diet and urban agriculture. Throughout, I focus on how an interdisciplinary approach that incorporates the ecological, social, and technological factors that drive urban P cycling can enhance our ability to answer questions about P management in cities. I first focused on the role of human dietary choices in P demand through time, examining how changes in diets have altered demand for P resources over the past 50 years. My results indicate that the global per capita P footprint (the per person amount of mineral P required to produce food crop or animal products for consumption) increased 38% between 1961 and 2007. There is considerable variability in per capita P footprint and in the rate of change in per capita P footprint among countries, mostly associated with differences in meat consumption. In one city in a high P-consuming country, Montreal, Canada, I used substance flow analysis to quantify the P cycle in the food system and in the urban agriculture system of the city. I determined that most of the P entering Montreal accumulates in landfills and little is recycled. The majority of inputs applied to urban agriculture are from recycled sources such as compost, hinting that although urban agriculture is a quantitatively small component of the city's P cycle, it could be a catalyst towards more recycling. To assess this potential, I needed to understand not only the P cycle itself but also the social, ecological, and technological driving factors of urban P.

cycling To develop a complete set of social ecological and technological drivers I might examine in Montreal I conducted a comprehensive literature review of the drivers in urban P substance flow analyses from around the world Using a systems thinking lens I found eight categories of driving factors that should be included in an interdisciplinary analysis of urban P cycling Including these categories of driving factors will improve researchers ability to identify synergies between P management solutions and problems and other urban priorities and plans Finally I return to the Montreal case study to examine these categories of driving factors in detail I used semi structured interviews with key stakeholders participant observation and document review to identify Montreal specific driving factors that act as facilitators and barriers to increasing P recycling I found that a law on the books that encourages organic matter recycling and strong support for increasing the presence of urban agriculture in Montreal have the potential to facilitate P recycling In order to take advantage of these facilitators however it will be necessary to overcome the barriers associated with cultural inertia lack of knowledge and lack of proper infrastructure Increasing social capital as well as connecting urban agriculture and waste management objectives and increasing knowledge about composting can help overcome these barriers

Phosphorus Management in Crop Production, 2018-05 Sustainable crop production aims at maintaining high crop yield without adversely affecting ecosystems to meet the need of current as well as future generations In order to meet the increasing world population agricultural production and productivity need to parallel increased Since phosphorus P in agriculture is the second most growth limiting macronutrient after nitrogen its proper management in soil contributes significantly to sustainable crop production Despite its importance for normal plant growth and metabolism P is one of the least accessible nutrients Phosphorus is a macronutrient that plays a number of important roles in plants and is fundamental for the efficient use of nitrogen fertilizer The maximum uptake rate of phosphorus by plants occurs around flowering but its accumulation continues until maturity Adequate phosphorus results in higher grain production improved crop quality greater stalk strength increased root growth and earlier crop maturity For over one hundred years phosphorus has been applied to crops as fertilizer first as ground bone and now as some chemical reaction product of ground rock Yet for all that experience its management cannot be taken for granted Phosphorus Management in Crop Production presents in depth coverage of soil and climatic factors that affect P availability and diagnostic techniques for P requirements by different crops as well as provide up to date information on the function of P in crop plants and methods to identify P use efficient field crops practices that could enhance P use efficiency Definitive chapters cover sustainable phosphorus management in agriculture soil order and management practices control soil phosphorus fractions does balanced phosphorus fertilization sustain high herbage yields and phosphorus contents in alternately grazed and mown pastures P use efficiency and interactions with other nutrients in crop plants management of P for optimal crop production and environmental quality phosphorus cycling in Montreal s food and urban agriculture systems and basic principles and methodology regarding P nutrition in crop plants This work is a

comprehensive guide for students lecturers practitioners food scientists agricultural extension specialists private consultants
fertilizer companies and government agencies that deal with agricultural and environmental issues

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Sustainable Phosphorus Management A Global Transdisciplinary Roadmap Introduction

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