Nutrient Disequilibria in Agroecosystems: Concepts and Case Studies

This book is a recent addition to the discussion on nutrient pollution deriving from human activities (primarily agricultural) in the developed North, and the sometimes large negative nutrient balances (also mainly agricultural) in the developing South. The obvious question of how this book differs from many others on nutrient cycles and nutrient budgets, is faced in the preface by the editors. The stated difference is that this book attempts to deal with the issues of scale in the study of ecosystems. That we should study ecosystems “at different spatial and temporal scales” has become a catchphrase in the research-for-development community, and is commonly agreed to be a good thing, but what does it mean in practice? This book begins to answer those questions, covering both concepts and a variety of case studies.

Before even considering the book’s content, I must quibble with the word “disequilibria” in the title, which implies to me that we must somehow achieve equilibrium (which is not equivalent to steady state) in agricultural operations. In fact, disequilibrium is the name of the game in agriculture, at least at the scale of the farm field and the cropping season. Resources gathered from outside or accumulated over a span of time are concentrated in a small area to maximize production of harvestable product, which is then removed from the field. At field scale, disequilibrium is a must for food production. Several chapter authors make a point of the near-equilibrium status of indigenous subsistence cropping systems such as shifting cultivation. This is true if we expand the system boundaries in space or time. The problem is that in most of the tropics, there is no longer either space or time for equilibrium to be re-established. Rather than dwell on the was of collapsing indigenous systems, I would rather admit the reality of disequilibrium and deal with it directly. In most of the tropics, extensification is not an option, and intensification requires disequilibrium.

Aside from that small complaint, the book competently develops principles in the first six conceptual chapters, follows with eight case studies, and closes with a summary chapter by the editors. For the book as a whole, and in the concept chapters especially, the imprint of the Netherlands is strong, with over 40% of the book’s contributors being from the Netherlands, many of these from Wageningen Agricultural University. However, the editors have succeeded (for the most part) in avoiding overlap in the topics and in the discussions, or too heavy a slant towards one research group’s philosophy.
Chapter 1 discusses nutrient cycling and nutrient budgets, and offers a brief introduction to some theoretical principles of “scaling rules” which may be appropriate to scaling-up exercises. Chapter 2 offers basics, with examples, of nutrient budgets and balances, and challenges the notion that a system in steady state is necessarily sustainable. Chapter 3 provides examples of scaling up, noting the loss of information as data are aggregated to higher levels, and thus the need for scaling down as well as scaling up; large-scale summaries complement but cannot replace small-scale intensive data collection. Error and bias in nutrient budget estimates are considered in Chapter 4, with examples ranging from laboratory to national scales. The potential of diverse technologies for soil fertility management is the topic of Chapter 5, and makes the point that both maximizing production and minimizing nutrient losses is not possible; rather we should strive to optimize the system. Finally, Chapter 6 discusses and models the unintended environmental effects of macroeconomic policy shifts, for example the removal of fertilizer subsidies mandated by structural adjustment programs.

Chapters 7 through 14 are case studies, which were deliberately chosen to represent as wide a range as possible of terrestrial, aquatic and marine, agriculture, silviculture and fisheries, temperate and tropical. In a slim 300-page volume there is a risk that by attempting to cover everything, nothing is covered thoroughly. The strategy is successful, however, in giving an overview, however brief, of some of the major nutrient flows in various ecosystems managed or exploited for their food or materials harvests.

Whether explicitly intended or not, one of the messages I got from the book was the paucity of data often available at larger scales, and the risks involved with the inevitable assumptions one must therefore make when trying to come up with estimates of nutrient balances. An estimate of negative N leaching in Mozambique obviously required some modification of the assumptions. Another study assumed high N leaching but zero K leaching, and high erosional P loss but no sedimentation; thus losses were probably underestimated for K but overestimated for P. The assumptions are not necessarily flawed, but some notion of the reliability of the estimates, or explicit discussion of assumptions, will help readers to better interpret these larger-scale nutrient loss estimates.

The book is well edited, with very few typos, and the text is generally quite readable. A small problem is that there are a few tables which disagree with each other, or with the discussion in the text. Some estimates of harvest nutrient offtake disagree by an order of magnitude with the same estimates from another table (and one positive soil balance from harvest offtake is obviously impossible). Similarly, agroforestry is said to have no effect on leaching (in one table) but is discussed in the text as a documented positive.

These editing/proofing errors are minor, however, and do not detract substantially from the book as a whole. I heartily recommend the book as a valuable contribution to the discussion of regional and global nutrient flows. I could find many more areas of agreement, and disagreement, with particular statements, with data reliability, or with assumptions, but in a scientific discussion (as in much of agriculture) disequilibrium is the name of the game. In science, equilibrium is stagnation, and this book should generate much debate and many new ideas.
Soil Erosion at Multiple Scales. Principles and Methods for Assessing Causes and Impacts
F.W.T. Penning de Vries, F. Agus, J. Kerr (Eds.); CABI Publishing, Wallingford, Oxon, UK. in association with the International Board of Soil Research and Management (IBSRAM), 1998, 390 pages, hardbound, ISBN 0 85199 290 0, $60.00

This book consists of 22 chapters based on papers presented at a workshop held in November 1997 in Bogor, Indonesia, as well as the reports of six working groups, which discussed various aspects of soil erosion during the two final days of the workshop. The objective of the workshop was to draw together the latest advances in soil erosion research, especially those related to differences in scale, recognizing that much of the research conducted on small plots cannot easily be extrapolated to the level of farms, micro-catchments and catchments, and up to regional and national scales. Moreover, with new developments in computer technology and geographic information systems (GIS), and the concomitant development of simulation models, it is now possible to analyse complex processes of soil erosion and predict the effect of rainfall, topographical features, land use and management on runoff, soil loss and nutrient losses, as well as off-site effects of sediment deposition in the landscape, in irrigation systems and reservoirs. With the increasing demand for sufficient and high-quality water in the dry season and the need to prevent floods in the rainy season, there is an increasing interest in looking beyond the direct effect of erosion on soil productivity at the farm level to the wider effects of soil erosion in the catchment and at the regional level. This book attempts to bring together the experiences of agronomists and soil scientists, who traditionally have worked at the plot and farm scale, with those of social scientists, economists and modellers who tend to work at larger scales, and to try to integrate both approaches. Such a workshop was clearly necessary to help promote a more efficient and integrative approach to resource management in uplands, especially in the Asian context.

The book starts with a description by Enders of a general framework for conducting a cost-benefit analysis for assessing soil erosion as compared with soil conservation practices. Many authors mention that numerous plot experiments have identified effective measures to control erosion, such as mulching, minimum tillage, contour hedgerows of grasses and leguminous shrub species, but that few of these practices have been adopted by farmers. Using cost-benefit analyses, economists clearly show that the costs of these practices, especially establishment and maintenance costs of hedgerows, far outweigh the benefits for the individual farmer, at least in the short term (5–10 years). While most upland farmers are poor and have a relatively short...