- the success of erosion control programs will depend on the importance society places on these problems and the practical introduction of theoretical work.

In the Humid Tropics

- bare fallow causes the greatest erosion problems
- nitrogen and phosphorous losses in eroded soil is comparable to normal application rates of maintenance fertilizer for corn
- erosion effects depend upon crop grown, inputs, soil weathering, and water transmission properties
- policy must consider erosion causes and costs (both on- and off-site) and socio-economic and policy issues
- wise planning will merge technical guides with expert systems and establish effective development projects in erosion-susceptible areas so that site characteristics are matched with conservation-effective and sustainable land uses which emphasize land husbandry rather than structures
- coordinating boards, including all stakeholders, are needed for successful, integrated partnerships.

Chapters 11 and 12 address technical aspects of soil erosion and agricultural productivity on a global scale. Trends in population growth, agricultural intensification, and limitations to production among developing and developed countries are presented in a context so that future opportunities for growing enough food in different regions of the world can be projected. A variety of vegetative and mechanical approaches to controlling soil erosion are summarized and clearly presented in Fig. 11.2. Current technical information on water and wind erosion, and factors limiting agricultural productivity are also provided.

The last chapter focuses on vetiver grass, a fairly new alternative for erosion control. The advantages and disadvantages of this approach in conservation efforts are discussed with specific emphasis on climate and topography considerations. In light of the relative newness of these techniques, many experiences, precautions, and early data are presented to assist the conservationist in their future directions.

As I finish reading this book I am left with the conclusion that it is time for the world to face up to soil erosion if we intend to ensure an adequate food supply for all people. We have much of the technical knowledge needed to eliminate soil erosion and can obtain additional information in a fairly judicious manner. We have a fairly good understanding of the social, economic, and policy factors influencing agricultural practices which impact soil erosion. What we do not have is a commitment and action by policy-makers to develop new policy and promote education that will ensure the quality and productivity of our soil resources for future generations. *World Soil Erosion and Conservation* is a beginning toward that end.

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Duckweed Aquaculture: A new Aquatic Farming System for Developing Countries. 1993. Paul Skillicorn, William Spira and William Journey. The International Bank for Reconstruction and Development/The World Bank, Washington, DC. 76+pp. $6.95.

This small book is based primarily on the results of a single, nonreplicated study conducted by a private, American company in Mirzapur, Bangladesh. It is supplemented with background information and data from a few other sources, but the Mirzapur study provides the vast majority of information presented.

The book comprises six "sections" (which this reviewer would call chapters). Section 1 consists of a short but informative review of the biology of the duckweeds. The authors include all four genera of the Family *Lemnaceae* under the common name "duckweed." The four genera are *Lemna, Spirodela, Wolffia*, and *Wolfiella.*

Section 2 is entitled "Duckweed Farming" and presents agronomic issues pertaining to the production of duckweed under cultivation. Some of the topics discussed are suitable areas for establishing culture plots, water management, nutrient sources, nutrient levels, protection from the wind, harvesting, and similar considerations.

Section 3 is a lengthy chapter devoted almost entirely to reporting results from the Mirzapur study, which consisted of field trials in which duckweed was grown in production ponds and fed to fish in two other ponds. One fish pond contained a polyculture of several kinds of carp, and the other contained only the Nile tilapia, *Oreochromis niloticus.* While the results are interesting, the reader must keep in mind that these were unreplicated trials with a number of

uncontrolled variables such as poachers sneaking in at night and selectively netting large numbers of fish.

Section 4 is devoted to economic issues regarding duckweed-fed fish farming, and although it is only eight pages long, it contains what appears to be a complete economic analysis of a duckweed-fed fish farming operation. This is, in my opinion, the best written chapter in the book and provides the most complete, in-depth coverage of its subject matter.

Section 5 deals with the use of duckweed to treat wastewater and provide useful biomass at the same time. This chapter is also based on the field trials at Mirzapur, but includes results and ideas from a number of other studies as well. It comes closer to being a manual for use by people in developing countries than any of the other chapters.

The last section (6) is entitled "Alternative Uses for Duckweed, Constraints and Future Research." It is a short review of some of the questions that need to be answered and some of the problems that need to be solved in order to make duckweed aquaculture a widespread, economically rewarding activity. The book ends with two economic investment scenarios and a selected bibliography.

As I read the book, I found myself wondering what audience could benefit from it. The foreword says it was intended for established fish farmers who want to experiment with duckweed as fish food, staffs of agricultural extension services, scientists who want to establish pilot operations with duckweed, staffs of donor agencies considering funding duckweed research, and wastewater specialists who may wish to promote wastewater treatment plants based on the use of duckweed in conjunction with fish culture. In my opinion, the only class of potential users listed above who could benefit greatly from the book would be staffs of donor agencies that may be considering the funding of duckweed research. The book would give such people a general background on the subject and acquaint them with the types of research that might be useful. It is certainly not a scientific treatise, and it lacks sufficient detail to be a "cook book" manual for people wanting to set up their own facilities for either a fish-feeding operation or a duckweed-based wastewater treatment plant.

The writing style is repetitious, with the same statements being made over and over again, within individual chapters as well as in different chapters. There are numerous other minor writing deficiencies. Three examples are:

1. Figure 2 presents the composition of duckweed from three different sources, but fails to say if the duckweed from all three sources belonged to the same genera. It also fails to say whether the percentages shown are on a wet weight or dry weight basis.
2. A discussion on page 24 refers to high densities of phytoplankton *which respire at night* and high densities of fish *which respire at all times* (italics are the reviewer's). Obviously, phytoplankton and fish both respire at all times.
3. The writing is anthropomorphic in many places. On pages 53 and 61, for example, the authors talk about starved plants *searching* for growth nutrients (again, the italics are the reviewer's).

There are 25 figures in the book, consisting of graphs, diagrams, and sketchy line drawings. The graphs and diagrams are nicely presented although the captions are frequently incomplete. The line drawings are attractive and add to the esthetic appeal of the book, but they add nothing to the reader's understanding of the subject matter. For example, Figure 14 shows six species of Chinese and Indian Carp, but it could never be used by anyone to identify an unknown fish.

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