

growing urbanization and recreational activity is a matter for societal choice with the onus of decision resting in the hands of government, a sombering thought.

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THE FOOD RESOURCE by John T. Pierce. Harlow and New York: Longman and Wiley, 1990.

John Pierce presents a well-reasoned and thoroughly documented analysis of the food resource for the intensely growing population of our globe. In his own words, he attempts "to develop a better understanding of the relationship between agriculture and the global environment. This is done through an examination of major physical factors, defined in resource and environmental terms, which affect the productive capabilities of the food system. Influencing these physical factors were both human/institutional constraints and natural constraints. The analysis has indicated that the failure to maintain and expand productive capacity was due as much, if not more, to institutional than natural constraints. This statement does not deny the importance and significance of natural limits to growth in the food system. Parenthetically, these limits will have more influence on food development options in the future, as societies make increased demands on the ecosystem and use up the surplus capacity now available for development." (p. 298)

The nine chapters following the opening statement deal with resources, trends in world food production, prospective studies, population pressure, water, land degradation, climate and energy, and conclude with chapter 10—sustainable food systems.

Throughout the book the environmental implications of agriculture are carefully assessed and the socio-economic and management aspects of food production are given no less attention than the physical resource base. Two examples may illustrate this. By an FAO estimate 62 percent of the total population of developing nations (41 countries) lived in the late 1960s on an average intake of less than 2200 calories. Their number declined to 48 percent (31 nations) ten years later.

An illustration of the different standards of living is the use of cereals. In the early 1980s, 87 percent of all cereals produced by developing nations, exclusive of rice, were for human consumption, as against only 29 percent in developed ones, which used 72 percent of cereals in the feeding of livestock.

Some of the many illuminative facts presented by Pierce may be quoted. Cereals are grown on about 52 percent of cultivated lands and account for about half the total per capita calorie supply. Between 1960 and 1970 more

than 850 million hectares were brought under cultivation. Between 1950 and 1980 agricultural areas expanded worldwide by 26 percent, average yield by 80 percent, total population by 126 percent. But regional and national rates may be quite different. Pierce rightly stresses the disadvantage of the "highly-weathered, leached and lateritic character of tropical soils," excepting the classic wet-rice cultivation. By contrast, he presents modern advances in biological technology which "made" crops more disease resistant, more efficient in their use of nutrients and capable of ripening earlier. The great biological success stories of the twentieth century are the adaptation/ extension of corn, wheat and other cereals to previously hostile environments (especially in higher latitudes), and the development of high-yielding variety grains capable, with the correct inputs, of producing two to three times more than traditional varieties." (p.23) However, there could have been more stress laid on the social and managerial aspects of the availability of food. The bumper crop of wheat of 1990 in the Soviet Union, a high percentage of which was not harvested due to a non-functioning harvest mechanism, is a striking recent example.

The book is amply and carefully documented, with frequent quotations from primary sources. The text is illustrated by 54 figures and 49 valuable tables. In addition there are 29 maps, 21 of them global overviews. They present the worldwide distribution of the conditions for food production and features of consumption. Special credit should be given to the map of ratio of population to arable land base (p. 99), giving a striking presentation of the population pressure in Egypt, Japan, South Korea, the Netherlands and Switzerland (!), versus North America, USSR, Argentina and Australia. Unfortunately, a number of maps could have been better presented on the technical side. The map on p. 52 lacks explanation of the shadings used. Page 45 presents the average calorie intake, giving the darkest shading to the lowest rate of intake, and the lightest to the highest rates; one would have expected a reverse application of shades. The same applies to the maps on pages 59 and 60. On the map of global desertification (p. 208) "slight" has a stronger shading than "moderate." The map on page 127 presents "irrigated land as a percentage of arable and permanent cropland 1983"; but arable land and permanent cropland are not identical. Finally, anyone conversant with the arid lands of South America will take exception to the world map of annual water deficiency and surplus regions of the world (p. 31), adapted from Falkenmark. The Nordeste of Brazil and most certainly the Atacama desert of Chile and Peru should rank with the areas of greatest water deficiency (group 4 of the map); they certainly exceed most, if not all, of Australia in this respect.

Readers interested in the semi-arid and arid parts of the world will be amply rewarded by studying chapters 6-8 dealing with water, land degradation and climate in their influence on the food resource. The importance

of interannual and other short-term fluctuations inherent in these climates is given due prominence: "the lower ... precipitation, the higher climatic variability" (p. 223) is unfortunately only too true. The author illustrates this by excellent documentation from the Sahel. Page 232 reproduces a graph of rainfall deviations in 1905–1985 from the 1931–60 mean, a striking illustration of the drought of the 1980s. Unfortunately, from the point of view of desertification, years with ample rainfall may be no less dangerous than drought years, at least as concerning developing nations. Only too frequently, a series of wet years lead to overstocking, as many pastoral people believe that the more numerous their herds are, the better. The result is overgrazing and desertification, and with the advent of the next drought "a collapse in the carrying capacity of the land." "The increasingly intensive use of dryland regions which are marginal at best for crop and livestock production is an important issue, as is poor management of water resources. Where migration was once the response to dry spells, limitations on movements and expansion of sedentary agriculture prevent this." (p. 213)

The table on p. 126 illustrates the irrigated area by continents, in million hectares for 1950–1985. Asia holds throughout the leading position in irrigated area—184 mill. ha. in 1985, being 68 percent of the world's irrigated area (vs. 41.5 percent only of the world's land area). Africa has less irrigated areas than either North America or Europe: 13 mill. ha only were irrigated in 1985—4.8 percent of the world's total (vs. 29.2 percent of the total land area). Increase of irrigated area from 1950 through 1985 was substantial, with the greatest additions in the 1960s: Asia 66–184 mill ha, North America 12–4, Europe 8–29, Africa 4–13. In this connection the author's reminder that regions with scarce water supply demand "high levels of management and technical expertise" (p. 132) is certainly appropriate, but unfortunately not always available, especially in Third World countries. Figures of no lesser significance are presented on p. 128, i.e., the percentage of food produced under irrigation to total food production: Pakistan—80 percent, China—70, India, Chile, Peru—55 each.

Some caveats are appropriate concerning certain assumptions of the author or quoted by him. Holy's projection (p. 131) of a 270 percent increase of world water use for 1967–2000 should be considered with more than reservation. It is more than doubtful whether that much unpolluted water will be available. One, furthermore, should definitely rule out withdrawal of groundwater in excess of supply (p. 132), even as a short-term solution. A more careful and conserving approach to water management should be advocated, and a stricter stand on drainage vs. irrigation as well. The iron rule is that drainage installations must be fully operative simultaneously with the beginning of irrigation. Pierce rightly states that "the introduction of irrigation radically changes the natural water-salt balance increasing the extent and risk of saline and alkaline soils." (p. 196) There is more than

ample evidence to prove this sore fact, from Peru through the Indus valley of Pakistan where land is rotated through the vicious circle of reclamation-irrigation-salinization-etc. (K. Ahmad), and even to "the Central Valley of California, the most intensively irrigated area of the United States, where areas such as the Tulare Sub-basin have no natural outlet or drainage, leading to an alarming increase in salinity" (p. 160). One can only stress the validity of the author's concluding statement: "Sustainable development over the long term is not a choice but an imperative for society." (p. 313).

This is a fitting conclusion of an excellent book on a critical subject humanity has to face.

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MARINE MINERAL RESOURCES by F.C.E. Earney. London: Rutledge, 1990.

Like many terrae incognitae, the deep sea is expected by many to contain fabulous riches, natural treasures waiting to be picked up. Finds of metallic mineral deposits in the deep ocean and petroleum reservoirs in the open seas enhanced that image, which, although bearing a minute grain of truth, is not correct. Consequent to these finds, the interest of many countries in the marine natural resources of their adjacent marine environment, as well as the high seas, had risen to a level where international ground rules were required to arbitrate existing conflicting claims and to settle expected future disputes. Earney's book on *Marine Mineral Resources* is an important contribution to the clarification of the verifiable natural resources of the deep sea and the continental margin, and the technologies of their exploitation, as well as a comprehensive review of the means set by the international community to divide these resources among sea-dwelling and land-locked nations.

Earney's book is divided into two parts, the first discusses the politics and the resources of the deep sea, and the second deals with the continental margins. The book attempts to cover comprehensively all the variable aspects of marine mineral resources, and discusses a wide and varied spectrum of topics, such as plate tectonics, the Law of the Sea, and the geology, technology and geopolitics of offshore petroleum. That comprehensiveness leads to the presentation of a considerable series of facts and interpretations, which is the significant contribution of the book.

The opening chapters are dedicated to the Law of the Sea, the history of the efforts to negotiate the legislation and the essence of that international legal Convention. Earney unfolds the need for international legislation on the exploitation of the mineral resources of the deep sea in a lucid manner. He describes the conflicting interests of the pioneer investors and the devel-