Nitrogen Management for Maximum Efficiency and Minimum Pollution

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I. INTRODUCTION

It is clear that agriculture must evolve towards conserving nonrenewable energy resources and minimizing adverse environmental impacts. Of the essential plant nutrients which can realistically be managed, N undoubtedly has the greatest potential environmental and health impact. Further, while small relative to total U.S. energy use, N fertilizer manufacturing has the largest energy requirement for any single facet of production agriculture. The objectives of this chapter are twofold: (i) to consider the impacts of N in the environment, and (ii) to examine various management systems for conservation of N (and, hence, minimization of pollution) in agro-ecosystems. Much of the discussion will draw on principles detailed in other chapters.

II. N REQUIREMENTS FOR FOOD AND FIBER

The National Research Council (NRC, 1978) estimated yearly worldwide biological N fixation on agricultural lands at $89 \times 10^6$ tons ($10^{12}$ g) and industrial fertilizer N production at $49 \times 10^6$ tons in 1976. Atmospheric inputs from combustion and lightning would add to this total. In contrast, utilizing a daily protein-N requirement of 4-6 g/capita per day, the annual protein-N uptake requires only $6-9 \times 10^6$ tons N/year (Bolin & Arrhenius, 1977), yet malnutrition is a fact of life in many parts of the world. The disparity results from inefficient food distribution, wastage during storage, losses in the conversion of plant proteins to animal proteins, low quality proteins, and the fact that production of food calories also depends on the plant N supply (Bolin & Arrhenius, 1977). Indeed, Sukhatme (1977) presents convincing arguments that, on average, per capita protein supply exceeds needs by about 60% for almost all of the developing countries; inadequate energy intake thus becomes a major factor in protein malnutrition.