Chapter 10

Energy of Phosphate Fertilizer Applications and Food Energy Returns

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I. INTRODUCTION

"It is the business of agriculture to collect and store solar energy as food energy in plant and animal products" (Commission on Agricultural Production Efficiency, 1975). In this definition, we find the real basis for assessing the efficiency of agriculture—or of the inputs it uses. Solar energy is the only form of energy directly converted to food energy by plants. Other forms of energy inputs used in farming are not directly converted to biological energy. They merely change the efficiency with which the solar energy is collected and stored. Thus, many of the commonly used measures of efficiency, such as return of food energy per unit of fossil energy input, should not be used. In fact, many food crops are cultivated by the human race for their protein, mineral, or vitamin content and not for their biological energy content. We define "efficiency" in this discussion to be the ratio of biological energy content of the harvested crop parts to the incident photosynthetically active solar energy, expressed as a percentage.

We propose to show that fertilizer use, at proper rates, is a highly energy-efficient practice in food production. However, economics presently constrains the amount of fertilizer use to levels below those required for highest solar energy conversion efficiency. Greater food production directly implies more intensive agriculture—that is, greater input energy as well as greater biological energy output. The cost of inputs may be based on the energy contained in them or added in manufacture. However, the price of the agricultural produce when also based on energy content will, in most cases, rise to a degree that severe economic dislocation will be the result.

It has been estimated that U.S. agriculture uses between 2.5 and 3.0% of the total national energy budget (Council for Agricultural Science and Technology, 1973). We think it important that a distinction be made be-