The Interrelationships of Agronomy and Economics in Research and Recommendations to Farmers

Earl O. Heady and W. D. Shrader

AGRONOMISTS, more than any other group of biological scientists in Land Grant Colleges, have been interested in the farm management or production economics aspects of soil practices and land use patterns. This interest of agronomists gave rise to work in farm management and agricultural economics. While early farm management and agronomic work was closely integrated, perhaps because farm management was originally located in agronomy departments, and continued cooperative work has taken place, increased accomplishments in agriculture might be attained through intensification of this cooperation, both in research and education. The tardiness with which many farmers adopt new agronomic practices can be explained partly by the failure of agronomy research and education to incorporate the concepts of production economics into its procedures. Also, use of the concepts from production economics provide the basis for selecting the most desirable land use pattern and in integrating cropping programs with livestock programs. Finally, these concepts from production economics may be used effectively in soil classification, particularly where it is to serve as the basis of farmer or national decisions. In this paper we discuss two simple concepts from production economics in their relationship to research procedures and extension recommendations. One of these is the input-output or production function concept; the other is the substitution or production possibility concept.

The Input-Output or Production Function Concept

The input-output or production function concept, which refers to the output of product relative to the input of material or resource such as seed, fertilizer or increments of inputs, is characteristic of nearly every phase of agronomic production. It is found in fertilizer applications, rates of planting and amounts of labor spent in seed bed preparation or cultivations. The subject of response curves has been the subject of numerous papers, especially as it applies to fertilizer. Mitscherlich in 1909 (5) incorporated the notion in his "Law of diminishing soil yield." It was developed by Mitscherlich, Boguslawski, and Gutman (6) to the "Effect law of the growth factors" in which each growth factor is considered to follow a definite response curve. Wilcox (10) states that the slope of the response curve is the same for a given growth factor irrespective of soil conditions. He also believes that the maximum yield resulting from any growth factor need be determined only once. This extreme view has been refuted by DeVries, 1939 (5) and Russell, 1932 (9). It is now recognized that the shape of the response curve for a given growth factor is the same only if the conditions under which the particular growth factor is being measured are the same.

Most workers in agronomic research recognize the importance of the concept of diminishing returns for building up response curves are very often on an "all or nothing" basis. Hesitancy on the part of farmers in adopting recommended practices where the input-output concept is not incorporated into research designs is quite understandable. The production function concept is, of course, used in scattered rate studies. Perhaps it has not been used more because, unlike fertilizer, it is usually this: Is there a response? This is an important problem in fertility studies and explains many of the procedures used in selections and design of procedures. This paper is aimed at underestimating the importance of research. Instead, it is directed towards illustrating how farmers can be helped in technology transfer. This is the single goal of farmers, four units of fertilizer would be used if corn yield is 50 bushels in the absence of fertilizer, 59, 65, 68 and 69 with the first, second, third and fourth fertilizer increments the shape of the response curve for a given growth factor.

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Better use could be made of many types of research if the input-output relationship were recognized in research designs and recommendations. An input-output relationship can be obtained in the simple manner of figure 1 where output (quantity of fertilizer, seed, labor or other production elements) is graphed on the vertical axis while input (quantity of fertilizer, seed, labor or other production elements) is graphed on the horizontal axis. Over the relevant range of applications, the input-output curve or production function curve (convex) in a manner denoting diminishing marginal productivity i.e. each additional (one) unit of fertilizer adds a smaller increment (or marginal quantity) to yield than the previous unit. The agronomic principles can be illustrated with a fertilizer example (although the same principle applies to seeds of different kinds, or other materials used to increase per acre yields). Suppose that the fertilizer is applied to corn in increments of 40-pound units. The first 40-pound unit adds, above the yield which would be for the absence of fertilizer, 9 bushels to total yield; the second adds 6 bushels, the third adds 3 bushels, and the fourth adds 1 bushel if corn yield is 50 bushels in the absence of fertilization, it will be 59, 65, 68 and 69 bushels.