THE MINIMUM COST COMBINATION IN AGRICULTURE
with Special Reference to Developing Countries in Tropical Areas

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Abstract: It has been made clear that the minimum cost combination in agriculture varies greatly from country to country and must change considerably from phase to phase in the course of national economic development. The criteria according to which the minimum cost combinations of the different developing countries tend to change vary greatly, depending on whether the countries in question were initially sparsely or densely populated. It also follows that in developing countries with varying economic structures the technical progress made will also vary in importance. It is easy to see from what has been said that progress in the mechanical field will be of greatest profit to thinly populated agricultural countries, while the future development of overpopulated agricultural countries will receive most benefit from progress in the field of organic sciences.

Th. Brinkmann, one of the great theorists in farm management in Germany, once said that the multitude of individual farm management problems encountered by the farmer could be divided into three basic groups:

- those concerning the selection of the most economical equipment and materials of production;

- those concerning the application of equipment and materials of production for the purpose of obtaining the highest possible yields;

- and those concerned with achieving maximum utilization of products.

This paper will be concerned with the first of these three groups of questions, i.e. the selection of the most economical equipment and materials of production in agriculture. We shall commence by making a distinction between the three classical production factors: land, labour, capital. Later we shall further distinguish between various forms of capital goods.

1. Theoretical Principles

a) The Law of Diminishing Marginal Returns

There is a relationship between the minimum cost combination and the law of diminishing marginal returns. This law states that 1): "... the increase in the gross profit in agriculture does not correspond to the increase in operating expenses, i.e. the increase in the gross profit obtained per additional unit of value invested tends to diminish continually after a certain point until it finally disappears ... For a private enterprise, where the corresponding monetary value is substituted for the gross profit and the operating expenses ..., this means that the difference between the monetary value of the input units and the monetary value of the corresponding output units will also gradually decrease and will become negative before the potential limit in yield increase has been reached. Thus it cannot possibly be profitable to strive for maximum yields, let alone increase intensity to an indefinite extent. In private enterprise the maximum permissible increase in operating costs..."

expenses is reached when marginal input is covered by marginal yield, i.e. when the last unit of value invested is covered by the last unit of profit achieved...

This law of diminishing marginal returns becomes obvious wherever an increase in input involves only one production factor, while the input of the other factors remains the same, and wherever input is increased disproportionately.

The law of diminishing marginal returns makes it possible to determine the optimum degree of intensity. We shall take the application of fertilizers to potato crops as our first example. The dotted line and curve in Fig 1 depict the relationship between input and output in the United States of America.

The last fertilizer unit per hectare is to be regarded as the marginal input, which is shown by the straight line A1. One fertilizer unit therefore costs US$ 23.72. The marginal output curve is shown by the hyperbola E1. With conditions as they are depicted here the highest permissible degree of intensity in the application of fertilizer is five fertilizer units, since at this point (P1) the marginal input and the marginal output are balanced. If the application of nitrogen fertilizers is increased beyond the point P1, financial losses will occur, since the marginal input is then no longer covered by a corresponding marginal output. If, on the other hand, fertilization is not undertaken up to the optimum limit, for instance, if two units per hectare less than the optimum amount are applied, the profit potential is not fully exhausted. The net yield, which is what is important for the farmer, is shown by the area integral between the line A1 and the curve E1. The fact that this area integral is smaller if only three fertilizer units per hectare are applied than it is if five fertilizer units per hectare are used shows that the net yield obtained is smaller if less than the optimum amount of fertilizer is used.

The graph also shows how the intensity of fertilizer application must vary if the price-cost relationship changes. Let us assume that the cost of mineral fertilizer sinks to the level shown by the line A2. The point of intersection of the marginal input line and the marginal output curve now lies at P2. This means that about 6.8 fertilizer units per hectare must now be applied for optimum results. Or let us suppose that though the cost of mineral fertilizers remains steady at the level of A1 the price of potatoes rises to the level shown by the marginal yield curve E2. This again makes the intensified use of fertilizers possible. About 6.2 fertilizer units per hectare should now be applied. This is shown by the fact that the point of intersection of the marginal input line and the marginal output curve now lies at P3. The greatest increase in the number of fertilizer units applied per hectare is necessary when the prices of agricultural products increase and those of mineral fertilizers decrease simultaneously. In this case the input-output ratio is illustrated by A2/E2 (American crop yield growth rates and 1963–64 West German prices and costs).

The point of intersection is now at P4 and optimum fertilizer application would therefore be 6.7 units per hectare. Fertilization may therefore be more intense in the Federal Republic of Germany than in the United States. We shall be going into this in more detail later.