MASSACHUSETTS
Flower Growers ASSOCIATION
AFFILIATED WITH THE SOCIETY OF AMERICAN FLORISTS

Bulletin 99 | Franklin J. Campbell, Editor | November, 1966

Resource Earnings in Carnation Production

DR. ELMAR JARVESOO
Dept. of Agricultural and Food Economics, Univ. of Massachusetts

Knowledge of the earning power of the different resources used in a business operation is the very basis for rational management decisions in any business enterprise, carnation production included. Equipped with such knowledge the manager can avoid wasteful use of expenditures and can aim at a proper balance among various types of input items. This balance means that a dollar spent on each individual input must return to the firm approximately equal amounts of gross revenue from each input — and return more than the dollar spent.

How to Determine the Earnings of Production Expenditures

Partial budgeting is the commonly used practice to ascertain the productivity of business spending. The procedure may involve setting up formal budgets for different spending alternatives and comparing the profitability of these alternatives or, more frequently, such budgeting is just another mental weighing of one alternative spending opportunity against the others.

In developing such productivity criteria for resource use the manager usually compares the *added expenditure* with the *added revenue.* In economist's language these are referred to as *marginal costs* and *marginal revenues.* The value of marginal product, thus, means value added to the firm's gross revenue by virtue of one additional unit of input — an added square foot of bench area, an added man-month of labor, or an additional dollar spent on water, fertilizer, pesticides or on the services of a new automatic gadget. *(Note:* we are not saying added dollar spent on a new device but on its services, because such mechanical devices render services over a period of time.)

In recent years, modern mathematical methods have been used for determining the earning power of resource inputs. In greenhouse production these methods have not yet been tried or their usefulness evaluated. In the past year we have conducted such a study and the highlights of its findings will be reported below.

Characteristics of Sample Growers and Resource Categories

The study included twenty specialized carnation growers in the Boston area, ranging in size from 6,000 to nearly 50,000 square feet of productive greenhouse area. These growers furnished detailed bookkeeping data on resource inputs, i.e., operating expenses and capital costs, and on their production and earnings. A Cobb-Douglass type of production function was then fitted to the data, and was used to estimate the marginal productivities of resources used.

To keep the mathematical computations involved within manageable limits, expenditures on inputs had to be aggregated into groups. Ultimately, five categories of inputs were used for calculations. These are:

1. *Land* — Measured in terms of square feet of greenhouse bench area (some under plastic included)
2. Labor — Measured in man-months. To account for wide quality differences of labor a standardizing procedure was used to estimate the number of man-months of typical greenhouse labor. Operators' labor and the labor of unpaid family members was included on the basis of operators' estimates.
3. *Soil Additions*—Measured in dollars spent on peat moss, fertilizers, lime and other soil conditioners, and pesticides.
4. *Crop Expenses* — (General Operating Expenses) — Measured in dollars spent on such items that directly affect crop yield and the market price of blooms.
5. *Capital Cost* — Measured in dollars of rental value including depreciation and interest.

The average grower operated 20,070 square feet of greenhouse bench area and used 52.4 man-months of labor a year (including the operator and unpaid family members). He spent $827 annually for soil additions, $3519 for general operating expenses. His capital cost averaged $4332. The average gross return was $38,855 a year or a little under $2 per square foot of bench area. All averages listed are geometric means instead of arithmetic means commonly used.

Earning Power of Resources Used

The earning power, or productivity, of resource inputs used are calculated for the sample group as a whole and are summarized in the accompanying table as values of marginal productivities. The range of variation in marginal resource productivities is also indicated. This range is calculated theoretically based on the standard deviation and, if the number of observations is large enough, about two-thirds of actual cases will fall within this range. As our sample included only twenty firms, i.e., twenty observa-

MASSACHUSETTS *Flower Growers* ASSOCIATION

HAROLD P. PIERS, President — 150 Speen St., Framingham, Mass.

WILLIAM KLOSOWSKI, Vice-President — River Rd., Middleton, Mass.

EDWIN TODT, Secretary-Treasurer — 5 Kimball Rd., Westboro, Mass.

TABLE I

PRODUCTIVITY OF ONE ADDED UNIT OF RESOURCE INPUT AT GEOMETRIC MEAN LEVEL AND THE RANGE OF PRODUCTIVITY BASED ON STANDARD ERROR OF ESTIMATE

Input Categories	Unit of Input	Resource Productivity	Calculated Range of Productivity Var. Lower Limit	Upper Limit
			— dollars —	
Land (bench area)	1 square foot	0.36	0.20	— 0.52
Labor	1 man-month	244.18	192.58	— 295.78
Soil Additions	1 dollar	3.03	1.26	— 4.80
Other Crop Expenses	1 dollar	1.72	1.01	— 2.44
Capital (use cost)	1 dollar	2.53	2.14	— 2.93

Note: These average resource productivities are applicable only at or near the geometric mean values of inputs listed in the text. As the productivities change according to the input levels of resources they are different when moving away from the mean. Generally, the earning power per unit of input declines if the input level increases, and vice versa.
Of course, the productivities of the inputs vary with individual growers mainly according to the managerial ability of the operator.

tions, this two-thirds rule may not hold true.

Productivity of Land

Productivity of Land averaged $.36 per square foot of bench area showing a range of $.20 to $.52.

These figures have to be interpreted as follows: one square foot of bench area added at mean level of this input (20,070 square foot), and keeping all other inputs unchanged, will add $.36 to the total gross revenue annually. To evaluate the profitability of this move we have to know the annual cost of the added one square foot of bench area. Land cost is the annual rent of growing space including in our case the depreciation, interest on capital, insurance and taxes on greenhouse structures. Based on the present greenhouse and bench construction costs we have calculated the annual cost per square foot of bench area as $.38 which is very close to its productivity. However, in considering the aggregation of resources it was found that two input items — fuel and cuttings — were so closely correlated to bench area that they had to be considered as part of the cost of the factor, Land. Fuel and cuttings combined added $.37 to the annual cost of Land, bringing the total cost to $.75, or well beyond the corresponding level of annual earnings.

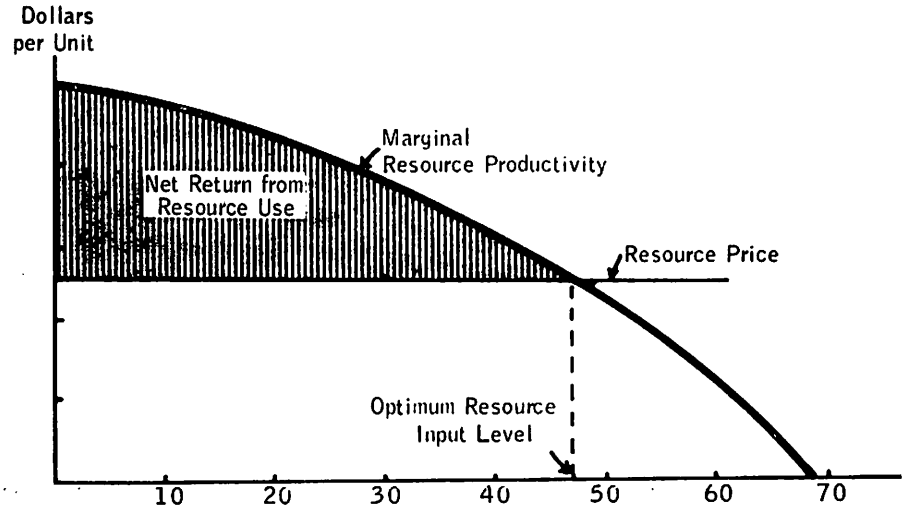
The implication is that adding greenhouse area alone without concurrently increasing other inputs is not profitable. To express the idea differently: lowering the intensity of operation pattern is not profitable under Massachusetts conditions. In fact, just the reverse is true.

Productivity of Labor

The man-month used in carnation growing earned $244.18, ranging from $192.58 to $295.78. The cost of one man-month of typical quality greenhouse labor was calculated to be $241.20. This cost is based on a $1.25 hourly wage rate and 180 hours worked a month, plus Social Security and Workmen's Insurance cost to the firm—making a total cost of $1.34 an hour.

The meaning of this finding is that, on an average, the last dollar spent on hired labor just about returned the dollar in increased revenue. The level where marginal productivity of labor would equal its price is at 53 man-months of labor in the average size operation, compared with 52.4 man-months actually used. This indicates that labor in our carnation ranges is used practically at the point of maximum returns. Additional labor at $1.34

THEORETICAL MODEL FOR TREATMENT OF MARGINAL RESOURCE PRODUCTIVITY



Resource Input Level in Hypothetical Units

The model assumes diminishing marginal productivity as more of the resource is used. At any specific resource input level its marginal productivity (i.e., return per last unit of input) is shown by the vertical distance between the base and the Marginal Resource Productivity curve. The vertical distance between the resource productivity and resource price is the net return per unit of input. The area between these two lines designates total net return from that resource input.

an hour would produce less than its cost, depressing the net income.

While a more labor-intensive operation cannot be recommended in general, this average situation does not preclude the possibility that in particular situations increased use of labor would pay.

Among the twenty cooperating growers the marginal labor productivities varied from $166 to $398 per man-month (or $.92 to $2.20 an hour). Four growers showed $300 or more returns from the last man-month of labor used and additional labor at going greenhouse wage rates would likely increase the gross revenue over additional cost. In some cases it may be desirable to cut back labor use for maximum net revenue.

The analysis also gave an additional proof to the known fact that the marginal productivity of labor in carnation production is relatively low compared with industrial and other wages for full-time skilled help. If the productivity is low, higher wages cannot be paid. This graphically shows the plight of all flower growers who have to compete for hired labor with other types of employment. Raising labor productivity in greenhouse flower production, therefore, is one of the most urgent tasks of the growers.

Productivity of Soil Additions

The productivity of the last dollar spent on Soil Additions at the $827 average expenditure level was $3.03. This indicates that using money for buying fertilizers, lime, soil conditioners and pesticides was very profitable as every dollar spent increased the gross return by three times as much. Although the productivity of this input showed considerable variation among cooperating growers, in no case did it drop below the cost of one dollar. The lowest returns in individual firms were $1.41 and $1.63, and the two highest returns were $7.43 and $5.29 per dollar spent. If the marginal productivity is high, more of the resource should be used to maximize total net returns.

The high earning power of expenditures on Soil Additions is an interesting observation. Because of the smallness of these expenditures it is generally assumed that these inputs are being used at their optimum level where added dollar would approximately return one dollar gross revenue. It is evidently not so. Further cultural experiments with a wider range of treatments are needed to ascertain if the findings of this study can be generalized. The calculations do not specifically show which components of the aggregate input category Soil Additions was most profitable. Pesticides may show high productivity if they save a crop. Growers data indicated a range of 1.2 to 9.0 cents for fertilizers used per square foot. The low figures may well point an underuse of this admittedly productive input.

Productivity of General Operating Expenses (Crop Expenses)

These expenses averaged $3519 per grower and the last dollar spent returned an average of $1.72 in gross revenue. The productivity range among growers was from $.87 to $2.42. In one firm the return was less than the cost, in all other operations the last dollar spent returned more than a dollar.

Since this input category is composed of a number of different input items it is not possible to identify immediately just which expenditure was the most productive. Machinery, electricity and water are directly connected with crop productivity while telephone, packaging materials, freight and advertising are connected with marketing activities and will eventually affect the price received for the product. It can be guessed that expenditures on mechanization are productive and that optimum level has not been reached.

Once the general productivity situation is determined, budgeting and specific considerations must show just which expenditures to increase.

Productivity of Capital

Capital cost averaged $4331 per grower and the last dollar added to this input category returned an average of $2.53 in gross revenue. The productivity per dollar expended ranged from $1.84 to $4.97.

The magnitude of the marginal productivity of this input category suggests that more intensive use of capital may contribute significantly to the overall profitability in carnation production. Building new greenhouses with available automatic devices for labor saving has frequently proven profitable because older structures often are not suitable for mechanization or other labor saving methods. In new, well-mechanized greenhouses one full-time worker can operate fully twice as much greenhouse bench area as in older ranges. Greenhouse mechanization and automation in general show high productivity of capital.

To sum up the findings of resource productivity analysis it can be said that the opportunities for Massachusetts carnation growers seem to lie in more capital intensive operations. Adding labor generally did not increase net returns. Neither was there any indication that adding growing area without concurrent increase of other inputs would improve growers' position. However, increasing the size of business with all other inputs in proportion beyond the average of about 20,000 square feet of bench area would increase net returns. Adding one percent to all five resource categories would cost $364 but would increase the gross revenue $396. This outcome could be improved more by changing the proportions of inputs — using relatively more soil additions, capital inputs and to some degree general operating expenses.

LIMITATIONS OF FINDINGS

The most important limitation of this study derives from the impossibility of accounting for that intangible factor of production — the management. It cannot be quantified or directly measured and, consequently, cannot be included in the mathematical production function. Leaving management out as an input factor results in its contribution being distributed over the other inputs, thus overestimating their actual earning power. Without capable management these resources would earn less than theoretically calculated.

Management and the environmental factors of each operation define a specific production function

— and the earning power of resources — for each individual firm. The aggregate production function for the sample group of firms is a "hybrid" that does not reflect faithfully the productivities of resources in individual firms.

Further limitations result from the fact that growers' bookkeeping records were not uniform or complete. Also, only one-year records were used, and that may not represent the typical long-range situation of the firm. Finally, the sample of 20 growers is rather small and may include unrecognized bias. All these considerations limit the direct application of the findings in individual firms.

Use of the Findings

The findings of this study can be used in several ways. They have re-emphasized the urgent need for improved labor productivity in the industry as a whole. Industry leaders should direct more attention to problems of greenhouse mechanization and introducing other labor saving devices in greenhouse operations.

The production function defined

for the industry can be used—with competent help and necessary judgment—to analyze individual growers business operations. By evaluating the resource productivities for the particular firm such an analysis points out needed adjustments.

*Summary of a forthcoming Massachusetts Experiment Station Bulletin where the methodology and findings are discussed in more detail.