ECONOMIC ASPECTS OF FARM ORGANIZATION ON RED RIVER CLAY

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ABSTRACT

ECONOMIC ASPECTS OF FARM ORGANIZATION

ON RED RIVER CLAY

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In this thesis the problems of farm organization on a particular soil type in Manitoba were examined. Red River Clay was the soil type used in the study.

The case study approach was used in this thesis. One farm was chosen and the problems of farm organization and income maximization on this farm were studied. The empirical tool used in the analysis was linear programming. The farm chosen was considered typical of the area and the results of the study should be applicable to other farms in the area. The results show that the return realized by the farm business can be substantially increased through improved farm organization. The results also point out that in problems of farm organization the entire farm business must be considered and not just one segment or enterprise.

In this analysis it was discovered that the inclusion of rotations which produced no hay and which did not allow any of the livestock rotations considered in the study to be included resulted in a substantial loss of return. The choice of rotations among those which produced enough hay to

allow the cattle space to be fully utilized did not have much effect on the return.

The results show that farmers who fertilize at recommended rates should receive more return than those who use no fertilizer.

The choice of livestock enterprise to be included in the final plan also has an effect on the return realized. The livestock enterprise which results in the highest return is steer calves medium grain.

In the study it was found that gains in return could be made by increasing capital as long as capital was a limiting factor. With each increase in capital available the entire farm business must be reorganized.

In the study it was assumed that a hay market existed. If this hay market was lost the results of the study show that the farmer would have to make adjustments in his farm business. If he was unable to make these adjustments he would suffer a considerable loss in return.

If the price of the "key" enterprises rises sufficiently it will make necessary an adjustment of the farm business. This was tested by raising the price of cattle purchased for the cattle finishing enterprises. This decreases the net return of these enterprises. A five percent increase in this price causes no adjustment but a ten percent increase caused all cattle finishing enterprises to be removed from the final plan.

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CHAPTER I

INTRODUCTION

During recent years many changes have occured in the conditions which face Canadian agriculture. Many of these changes have adversely affected the position of agriculture.

One very important change is the change that has occured in the relationship of prices paid by farmers to those received by farmers. In 1951, the peak of a period considered favorable to agriculture, the index of prices received by farmers exceeded the index of prices paid by farmers by 84 points. During the period 1951 to 1959 this gap narrowed until in 1956 the index of prices paid by farmers exceeded the index of prices received. This condition also prevailed in 1957, 1958 and 1959. In 1959 the index of prices paid by farmers exceeded the index of prices received by 10 points. For both indices the base period was 1935 - 39. In this situation it is essential that the farmer organize his farm business in such a way that income is maximized.

In the same period another important change which

1/ Dominion Bureau of Statistics, Index Numbers of Farm Prices of Agricultural Products, Ottawa, Canada 1951 - 60. Dominion Bureau of Statistics, Price Index Numbers of Commodities and Services Used by Farmers, Ottawa, Canada 1951 - 60.

Mordecai Ezekiel sets out three alternative methods of changing farm organization, given resources, in order to increase income. These are:[4/]

1. Improved combination of enterprises with enterprise efficiency unchanged.

2. Present combination of enterprises left unchanged with improved enterprise efficiency.

3. Improved combination of enterprises with improved enterprise efficiency.

The production economist must guide farmers in the choice between these alternatives and in the choice of specific adjustments within each alternative.

Past studies in all parts of North America have shown how changes of the first type, improved combination of enterprises, can be used to increase farm income. Of particular interest to this study are the two studies done by J.C. Gilson of the University of Manitoba.[5/] Both these studies showed that income could be improved substantially through improved enterprise combination.

4/ Mordecai Ezekiel, "Most Advantageous Organization and Practices in an Area", Social Science Research Council, Research in Farm Management, Scope and Method, New York, 1932.

5/ Gilson J.C., An Application of Linear Programming to Farm Planning, Faculty of Agriculture and Home Economics, University of Manitoba, Winnipeg, Manitoba, March, 1960. Gilson J.C., Economic Aspects of Alternative Crop Rotations and Beef Production Systems, Faculty of Agriculture and Home Economics, University of Manitoba, Winnipeg, Manitoba, May, 1960.

I. SCOPE AND OBJECTIVES

The central objective of this thesis was to study the problem of improving farm organization on a particular soil type of Manitoba - Red River Clay.

The specific objectives given below outline the particular aspects of farm organization that were studied.

Specific Objectives

1. An attempt was made in the study to determine how much grass and legume production should be carried out on Red River Clay soils. It was hypothesized that the amount of grass and legume production has a substantial effect on the income level received. Agronomists have set up certain minimum levels of grass and forage production necessary for soil conservation. In this study it is to be determined whether or not production above this level can increase income.

2. The second objective is to determine whether or not the recommendations made by agronomists for fertilizer use on Red River Clay can be defended economically. It is hypothesized that a higher net income can be realized by farmers who fertilize at the recommended rates than by those who use no fertilizer.

3. In the study an attempt will be made to determine which type of beef cattle production is best suited to Red

farm income can be increased through improved farm organization. In addition a great deal of work has been done by agronomists on Red River Clay soils. As a result there is more data available on yields, fertilizer responses and possible rotations than for other soil types of Manitoba.

II METHOD

Since this study involves farm organization, linear programming is the empirical tool which will be used. Linear programming is a tool which allows the selection of optimum production plans given assumptions about enterprises to be considered and resources available. This is exactly what will be attempted in the study and thus linear programming is well suited for use in this study. The results that are determined are completely applicable only to the farm that is used in the study. The results can however be used on farms which closely resemble the farm used in enterprises considered and resources available.

CHAPTER II

THEORETICAL BACKGROUND

I. LINEAR PROGRAMMING AND THE BUDGET APPROACH

Linear programming and the comparative budget approach, which has been used in agricultural economics for many years, have much in common. A budget is a detailed production plan for a firm for some future period. Every firm has at its disposal a certain complement of resources which may be used in the production plan. These resources are fixed in that it is assumed that the amount available cannot be increased during the period under discussion. Variable resources will also be used in the production plan but the quantity available can be increased to any required amount during the period under discussion. Finally there is present a certain number of enterprises, any of which could be carried out using only those types of fixed resources available.

A production plan for a future period consisting of a combination of these given enterprizes which uses no more of the fixed resources than are available is called a budget. A budget or production plan might consist of only one enterprise or a number of enterprises. The budget might use the entire quantity available of one resource and none of

another or it might use the total amount of each resource available. It can be seen that there will be for any firm a number of possible production plans or budgets.

Using the comparative budget approach a number of possible production plans or budgets are drawn up and for each plan the receipts, expenses and thus the profits are calculated. Then the production plan or budget which yields the most profit is chosen as the one which should be used by the firm.

One disadvantage of the comparative budget approach is that as the number of fixed resources and enterprises considered increases, the number of possible budgets increases more than proportionately. The research worker soon finds that it is impossible to consider all possible budgets. It is then necessary to decide which production plans, of all those possible, should be considered. This can only be decided by the subjective judgement of the research worker. If this is the case there always remains the possibility that there is a production plan that has not been considered that is superior to all those that have been considered.

Linear programming is a systematic, mathematical technique which is used to find exactly the same results as are determined using the budget approach. In linear programming the same fixed resources and the same enterprises that were used in the budget approach are again utilized.

Using linear programming the number of possible production plans is not limited as it is in the budget approach. The technique allows all possible enterprise combinations to be considered simultaneously. It thus assures that the plan which returns the maximum profit is the plan selected.

The use of linear programming also reduces the amount of computation involved. This can be even further reduced through the use of the electronic computer. The electronic computer can be used for linear programming but not for the ordinary budget approach.

II. HISTORICAL DEVELOPMENT OF LINEAR PROGRAMMING

Linear programming was first developed in 1947 for the solution of managerial problems confronting the United States Air Force.[1/] It was used on such problems as that of determining how a maximum amount of goods could be transported with a limited number of pilots, aircraft and air fields. Economists soon became interested in the adoption of linear programming to economic problems.[2/] The first application of linear programming to the problems of agricultural economics

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1/ Robert Dorfman, Application of Linear Programming to the Theory of the Firm (Berkley and Los Angeles, The University of California Press, 1951), Pg. 4.

2/ Ibid., Pg. 5.

consisted of the selection of the most profitable crop rotation.[3] In 1951 linear programming was first used to find a minimum cost livestock ration that also satisfied certain minimum nutrient levels.[4] In 1954 the technique was used to select optimum combinations of livestock enterprises.[5] Finally in 1955 linear programming was used to select the complete optimum farm plan including both livestock enterprises and crop rotations.[6] In the study being discussed here linear programming will be used to select a complete farm plan.

Developments in the technique also allow optimum plans to be selected at various levels of a resource restriction. In this case the optimum plan selected at one quantity level of the resource and then a new optimum plan is selected at another quantity level.[7] Techniques have also been developed

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[3] Clifford Hildreth and Stanley Reiter, "On the Choice of a Crop Rotation Plan", in T.C. Koopmans, editor, Activity Analysis of Production and Allocation (New York, John Wiley and Sons Inc., 1951), Pg. 177 ff.

[4] Fredrick Waugh, "The Minimum Cost Dairy Feed", Journal of Farm Economics August, 1951, Pg. 281 ff.

[5] E.R. Swanson, and K. Fox, "The Selection of Livestock Enterprizes by Activity Analysis", Journal of Farm Economics February, 1954, Pg. 78 ff.

[6] G.A. Peterson, "Selection of Maximum Profit Combination of Livestock Enterprises and Crop Rotations", Journal of Farm Economics August, 1955, Pg. 546 ff.

[7] E.O. Heady and W. Candler, Linear Programming Methods (Ames, Iowa State College Press, 1958), Pg. 232 ff.

which allow the optimum to be selected for different price levels.[8] Both these techniques will be used in the present study.

III. BASIC CONCEPTS OF LINEAR PROGRAMMING

There are three concepts which are basic to an understanding of linear programming and for which definitions must be given - resources, products and production processes.

Resource

Dorfman defines a resource as :[9]

> We may think of all the physical and intangible things used by the firm as being grouped into classes in such a way that it is a matter of indifference to the firm or any firm which member of a class it obtains for use in its productive work, such a class we shall call a resource, a factor or an input.

A brief example should help to clarify this concept. Labour is often considered by laymen and in some work by economists to be one resource. In agriculture, labour available at different seasons of the year is not identical. It is not a matter of indifference to a farmer whether he receives an additional hundred hours either in January or

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[8] Ibid., Pg. 265 ff.

[9] Robert Dorfman, Application of Linear Programming to the Theory of the Firm (Berkley and Los Angeles, The University of California Press, 1951), Pg. 13.

August, therefore labour must be classified into groups in such a way that as far as the farmer is concerned one hour of labour in a particular group is identical with any other member.

Product

A product is defined in exactly the same way as a resource except that the products rather than being used in productive effort are the result of productive effort. Products are also classified into groups such that the individual or firm desiring a member is indifferent as to which member is received.[10/]

Productive Process:

Dorfman defines productive process as a "physical event or series of events in which men participate purposefully in order to transform some resources into products".[11/] Two processes are classified as two instances of the same process if they use the same resources in the same proportions and produce the same products in the same proportions.

To clarify this definition Dorfman expresses the relationship mathematically borrowing a notational

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10/ Ibid., Pg. 13.

11/ Ibid., Pg. 14.

procedure from chemistry:[12/]

$$E_i: a_{i1}F_1 + a_{i2}F_2 + \cdots + a_{im}F_m \longrightarrow b_{i1}C_1 + b_{i2}C_2 + \cdots + b_{in}C_n.$$

Where E_i is a productive process, using m resources and producing n products. $F_1, F_2, \ldots, F_m$ represent unit levels of these resources and $C_1, C_2, \ldots, C_n$ unit levels of the products, $a_{i1}, a_{i2}, \ldots, a_{im}$ represent the quantities of each of the factors used by the process E_i, while $b_{i1}, b_{i2}, \ldots, b_{in}$ represent the quantities of each of the outputs produced by E_i.

A second productive process using the same m resources and producing the same n outputs could be represented:

$$E_j: a_{j1}F_1 + a_{j2}F_2 + \cdots + a_{jm}F_m \longrightarrow b_{j1}C_1 + b_{j2}C_2 + \cdots + b_{jn}C_n.$$

Then if:

$$\frac{a_{i1}}{a_{j1}} = \frac{a_{i2}}{a_{j2}} = \cdots = \frac{a_{im}}{a_{jm}} = \frac{b_{i1}}{b_{j1}} = \frac{b_{i2}}{b_{j2}} = \cdots = \frac{b_{in}}{b_{jn}}$$

the two processes E_i and E_j are two instances of the same process.

To further clarify this concept suppose that there are two fluid milk enterprises using exactly the same resources except that in one enterprise the cows are fed a high grain - low forage ration and in the other the cows are fed a low grain - high forage ration.

[12/] Ibid., Pg. 14.

Then: E_1: AF_1 + 10,000 H + 3,200 G $\longrightarrow$ 11,000M

and E_2: AF_1 + 15,000 H + 2,500 G $\longrightarrow$ 10,500M

Where E_1 is the enterprise using the low forage - high grain ration and E_2 is the enterprise using the high forage - low grain ration. In both expressions A represents the amount of all the other resources used. The unit level of these resources is represented by F_1. H represents the unit level of forage, G the unit level of grain and M the unit level of milk production.

Ignoring the other resources, process E_1 uses 10,000 pounds of forage, 3,200 pounds of grain and produces 11,000 pounds of milk. Process E_2 uses 15,000 pounds of forage, 2,500 pounds of grain and produces 10,500 pounds of milk. Commonly these enterprises might be considered identical but since they do not use the resources in the same proportion and do not produce the output in the same proportion they are not instances of the same process. That is :

$$\frac{A}{A} \neq \frac{10,000}{15,000} \neq \frac{3,200}{2,500} \neq \frac{11,000}{10,500}$$

Now that these three fundamental definitions have been set up the assumptions on which linear programming is based can be presented.